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MYCOTAXON

Greetings from the new Editor-in-Chief

In 1974, Professors Richard P. Korf, as Managing & English Language Editor, and Grégoire L. Hennebert, as Book Review & French Language Editor, introduced a new mycological taxonomic journal to the world. After thirty years, *Mycotaxon* has received international acclaim for its outstanding success in expediting publication of new fungal species while fostering open communication between mycological contributors and expert reviewers. As a satisfied 21-year subscriber and occasional contributor, it is with a mix of pride and trepidation that I assume the editorial duties of the founders and their succeeding Editors-in-chief, Dr. Jean Boise Cargill (1991-1998) and Dr. Pavel Lizon (1998-2003).

From the beginning, all agreed that this most recent transition should be "as seamless as possible." And so it should appear, at least to the subscriber. The journal retains the same name, its cascade of different-hued covers, and a comforting "book" heft and shape that scores of library shelves have been designed to accommodate. The journal will still appear quarterly and still focuses on fungal taxonomy and nomenclature.

Nonetheless, now is the best time to implement changes long desired by the Editorial Board. One innovation is our decision to "web-ify" regional checklists, thereby making them available to more users and providing data that is easily searched by user and more easily updated by author. Dr. Ahmet Asan of Turkey and Dr. Larry Grand and Caroline Vernia of North Carolina — who publish short summaries in *Mycotaxon* 89(1) — become the first to "publish" their complete checklists on what we hope will become one of www.mycotaxon.com's most heavily used webpages.

In an era when most scientific documents are created on the computer, there is little sense in continuing to publish exclusively from print-ready hard copy. The move away from typewriter technology now enables anyone with access to a word-processing program to submit professional appearing manuscripts. But with so many font choices and styles available, there was a need to restrict font choices so as to produce a more pleasingly uniform appearance for our journal. Hence our extensive author guideline revisions published in *Mycotaxon* 88: 515-526, 2003.

Unfortunately, we did not realize until three weeks before press time that our "new" guidelines still offer too many choices for a uniform first page format. Please note our **newest** Author, Address, Abstract, and Key words requirements:

- **AUTHORS**—Times/Times New Roman, 10-point font, boldface, Large & Small Capital, centered on page;
- *Address information*—Times/Times New Roman, 9-point font, italics, centered on page, with the Email address on the 1st line alone [***without*** a preceding label such as "email:"], Institution/Street Address on the 2nd line, and City/Code/Country information on the bottom line;

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- **Abstract & Key Words headers—**Arial/Helvetica 8-point font, boldface, followed by a similarly formatted m-dash. These headers should stand on the first line of each paragraph, followed by text formatted in Times/Times New Roman, 8-point plain or italic (not bold) font.

Regarding presubmission reviews — *Mycotaxon* now requests that authors submit complete manuscripts for pre-review in fully formatted digital text (via email attachment) BEFORE sending files with embedded graphics, hard copy, and final submission materials.

Regarding final submission — we ask that you submit a digital document file with formatted text but containing NO graphics in your final submission. A second file with graphics inserted (particularly line drawings, which are considered text) is encouraged, but be certain to label that file with a name indicating that it has photos embedded. Remember you must **also** send separate digital graphics files in properly scaled TIFF format for the press to insert into the final publication. Separate digital text and graphics files under 4 mb (<4,000 kb) may be sent to the Editor-in-chief as email attachments and/or with final hard copy in the final submission packet. Electronic files sent by regular mail should be on CD-R (**preferred**), Macintosh zip (next favored), or PC floppy (least favored) discs.

Regarding hard copy — Yes, *Mycotaxon* still accepts exclusively hard-copy submissions! (After all, our purpose is to encourage taxonomy, not keyboarding.) Just be aware that using "snail" mail takes longer — particularly when changes are needed before publication.

As deadlines are wont to do, my first press deadline arrived too soon. We (i.e., I) thought that this first effort could easily be printed almost entirely from author-submitted digital files. Unfortunately, "we" were wrong. Volume 89(1) is thus an amalgam of [i] photographed author-submitted hard copy, [ii] photographed pages printed by the Editor from author digital files, and – possibly – [iii] digital files printed directly by Sheridan Press from the editorial CDs. The authors, who remained remarkably patient and receptive to over-enthusiastic changes from a novice editor, have served as most agreeable guinea-pigs ["conejillos de indias" according to one good-humored correspondent]. Such cordial authors and subscribers deserve the best. I can only hope to serve fungal taxonomy and taxonomists as well as the editors of *Mycotaxon's* first three decades.

LORELEI L. NORVELL
Mycotaxon *Editor-in-Chief*
February 29, 2004

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Crepidotus from Mexico: New records and type studies

VICTOR M. BANDALA & LETICIA MONTOYA
bandala@ecologia.edu.mx montoya@ecologia.edu.mx
División de Sistemática, Instituto de Ecología
P.O. Box 63, Xalapa, Veracruz 91000, Mexico

Abstract—*Crepidotus albidus, C. calolepis, C. croceitinctus, C. latifolius* (var. *latifolius* and var. *praelatifolius*), and *C. palmarum* are reported from montane broad-leaved forests of the Sierra Madre Oriental of eastern Mexico. *Crepidotus calolepis* and *C. palmarum* have also been collected in a tropical forest south of the Gulf of Mexico, with *C. calolepis* found at additional sites in the country. New data resulting from reexamination of five type collections as well as observations made in fresh material support the taxonomic interpretation of *C. calolepis* var. *heterocystis, C. calolepioides* and *C. molliformis* as synonyms of *C. calolepis*, and *C. latisporus* var. *veraecrucis* to be conspecific with *C. palmarum. Crepidotus praelatifolius* is supported as a variety of *C. latifolius*. Observations made on samples of some members of the Stirps *Mollis sensu* Singer are discussed. Descriptions, illustrations, and discussions are provided for all taxa.

Keywords—Agaricales, taxonomy, wood inhabiting fungi

Introduction

Although information is available for many representatives of *Crepidotus* (Hesler 1975; Hesler and Smith 1965; Kühner and Romagnesi 1953; Lonati 2000; Pilát 1948, 1949, 1950; Singer 1947, 1973, 1988), it is clear that at present few species are completely documented and consequently better understood taxonomically (Bandala et al. 1999; Bandala and Montoya 2000a & b; Bigelow 1980; Horak 1964; 1977; Horak and Desjardin 2004; Lonati 2000; Krisai-Greilhuber et al. 2002; Luther and Redhead 1981; Nordstein 1990; Ortega and Buendia 1989; Pegler and Young 1972; Pereira 1990; Redhead 1984; Senn-Irlet 1995; Senn-Irlet and De Meijer 1998; Senn-Irlet and Krieglsteiner 1996; Stangl et al. 1991). Perhaps due to relatively simple basidiomes (small, sessile, rarely colored), few macroscopic features have been evaluated which in fact provide reliable taxonomic information into the genus. The taxonomy of *Crepidotus* is practically supported by the information revealed by microscopic morphology. It is also true that after diagnosis not all the taxa have been restudied and documented with new collections or, in many cases, our knowledge of the species depends solely on specimens gathered in the geographic area sampled. The information available in the literature is often limited, and as suggested by Horak and Desjardin (2004), in several cases it represents weak and confusing data for the interpretation of species. Then, there is the possibility that variation of single uncorrelated characters could have been taxonomically overestimated, or, contrarily, that the population has been split mainly when superficially different specimens occurring in separate regions were compared.

During the last three years, simultaneously with our reexamination of herbaria samples (type collections included), we have collected new specimens in Eastern Mexico. The variability shown by Mexican specimens is well represented in different previously described species. Some other materials, however, exhibit a similar macro and microscopic pattern of variation which have been found in collections dealt with in current literature under different taxa. Confronted with the variation seen among the collections and in an effort to determine them, we have firstly been forced to elaborate a morphological species concept in order to help create a reproducible and predictive classification. For the present paper we selected information obtained from new collections of five species previously known in the country. These are reported from several new localities in Mexico which document a greater range of extension. Type studies of *C. calolepis* var. *heterocystis* Singer, *C. calolepioides* Murrill, *C. latifolius* var. *veraecrucis* Singer, *C. molliformis* Singer and *C. praelatifolius* Murrill complemented the information and are also discussed.

Methods employed in the microscopic study of specimens were those previously cited in Bandala et al. (1999) and Bandala and Montoya (2000b), although notation *RM* is now used for designation of the range of mean values of basidiospore length and width in *n* collections, or in the case of a single collection to *n* spores measured (usually 30-35). Color described for basidiomes was compared and coded according to the color chart of Kornerup and Wanscher (1978) (alphanumeric color ranges in brackets). The species are presented alphabetically. Herbaria are abbreviated according to Holmgren et al. (1990).

Taxonomy

A. DESCRIPTIONS AND NOTES OF NEW RECORDS

1. *Creidotus albidus* Ellis & Everh. **Figure 1**

Crepidotus albidus Ellis & Everh., Proc. Acad. Nat. Sc. Phil. p. 322, 1894.
Synonym: *C. citri* Pat., Bull. Soc. Myc. Fr. 18: 172, 1902; *C. levisporus* Singer, Beih. Nova Hedwigia 44: 479, 1973; *C. sublevisporus* Singer, in Singer & Digilio, Lilloa 25: 410, 1951; *C. yungicola* Singer, Beih. Nova Hedwigia 44: 480, 1973.

Most relevant data obtained in collections studied are: **pileus** (0.5-) 2-10 mm broad, white, finely tomentose hairy, semicircular, somewhat reniform by the presence of an incision in the rear portion, convex to plane, more or less campanulate or ungulated in young stages, margin striate to weakly sulcate, in some slightly crenulate. **Lamellae** whitish or white with pinkish shades, brownish with edge. **Basidiospores** 6.4-7.2 x 4.8-5.6 μm, *RM* = 6.7-6.8 x 5.1-5.3 μm, *Q* = 1.29-1.33, broadly ellipsoid, smooth, brown to yellowish-brown, thick-walled (up to 0.5 μm thick). **Cheilocystidia** (12-) 14-29 x 2-5 (-6) μm, narrowly lageniform to subcylindric, markedly flexuous and contorted, apex 1.6-2.4 μm wide, hyaline, clampless, often certain kind of incrustations-like granules are scattered among these elements. **Clamp Connections** often present in the base of hymenial elements. For more macro- and microscopic details see Bandala and Montoya (2000a) and Krisai-Greilhuber et al. (2002).

Habitat. Subgregarious, on rotten branches, on of them apparently of *Quercus*, in a mesophytic forest.

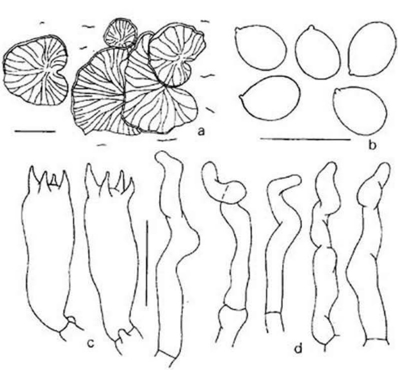

Fig. 1. *Crepidotus albidus*. a: basidiomes; b: basidiospores; c: basidia; d: cheilocystidia (Bandala 3705) (scale bar = 10 μm, except a = 5 mm).

SPECIMENS EXAMINED. **MEXICO**. **PUEBLA**: **Chiconcuautla Co.**, San Cristóbal Xochipehuala, 3-IX-2002, *Bandala 3705, 3707* (XAL).

Remarks. The combination provided by smooth basidiospores, clamps, ungelatinized tissues, and narrowly-lageniform, contorted cheilocystidia, clearly distinguish *C. albidus*. This combination of morphocharacters made it possible to interpret its conspecificity with some South American and Mexican taxa (see synonymy above). After a comparative study between North and South American type collections, Bandala and Montoya (2000a) provided a discussion of the taxonomy of this species, which was recorded from a mesophytic forest near Xalapa, Veracruz (Gulf of Mexico area). For the inventory of *Crepidotus* in Mexico we now add the above records from N Puebla. *Crepidotus albidus* presents in Mexico a scattered but more or less continuous distribution throughout the Sierra Madre Oriental and southwards along the east coast, either in broad-leaved forests (mesophytic and tropical) or reaching mixed associations of *Pinus-Quercus* in the Cofre de Perote Volcano in the central region of Veracruz. Further within the interior of the country the species is known to occur in *Pinus-Quercus* associations from the Nevado de Toluca Volcano (Central Mexico) (Krisai-Greilhuber et al. 2002). The samples known at present reveal that *C. albidus* is a commonly encountered agaric inhabiting woody substrates, having a fragmented distribution along the American continent.

2. *Crepidotus calolepis* (Fr.) P. Karst. **Figures 2-4, 10a-b, e-g. Plate 1a-c**

Crepidotus calolepis (Fr.) P. Karst., Bidr. Känn. Finl. Nat. Folk 32: 414,1879.
Basionym: *Agaricus calolepis* Fr., Öfvers. K. Vetensk.-Akad. Förh. 30 (5): 5, 1873.
Synonym: *C. mollis var. calolepis* (Fr.) Pilát, Act. Mus. Nat. Prag. 2B: 74, 1940; *C. mollis subsp. calolepis* (Fr.) Nordstein, Synopsis Fungorum 2: 67, 1990; *C. calolepis var. heterocystis* Singer, Beih. Nova Hedwigia 44: 469, 1973; *C. calolepioides* Murrill, Mycologia 5: 30, 1913; *C. molliformis* Singer, Beih. Nova Hedwigia 44: 441, 1973. For more synonyms see Singer (1973).

Pileus 6-60 (-65) mm wide, when young almost circular to somewhat rounded flabelliform, some more or less reniform, later semicircular, flabelliform or rounded flabelliform, often with an incision at the rear portion, then somewhat reniform, convex, soon plane-convex to applanate, white, yellowish-white or pale yellowish (3A2-4A2), covered with brown, brown-orange or reddish-brown fibrils which vary in size, density and in the pattern of their distribution on pileus surface, then near glabrous, tomentose-fibrillose, densely fibrillose, appressedly fibrillose-scaly or minutely scaly, to the naked eye the pigmented fibrils and the pale ground surface produce a pale yellowish (3A2-4A2), pale yellowish-orange (more or less 4A3-5B3), yellowish-brown, dark yellowish-orange or reddish-brown pileus color (5C6, 5C7-5D6, 5E6-6C7), in those fine fibrillose elements most part of the disc is whitish and pale brown-orange towards the rear portion where the fibrils are relatively abundant, hygrophanous or strongly hygrophanous, this latter more evident when surface is scarcely covered with brown fibrils and pileus is very wet, then in overal appearance whitish to white-grayish with cottony aspect in some areas, not or weakly viscid to the touch; margin initially incurved, faintly striate. **Lamellae** white, whitish, later pale yellowish-brown, greyish-brown to orange-brown, adnate or somewhat sinuate to shortly decurrent, broad or moderately broad, subventricose to ventricose, close to subdistant, with concolorous or pale, smooth to finely fimbriate edges. **Stipe** absent, the pileus is laterally attached, with a narrow or moderately wide point of attachment, often with a short, smooth or minutely tomentose-fibrillose, lateral, somewhat swollen, appressed protuberance (seen from the hymenophore). **Context** white or whitish, pale brownish in old specimens, thin to moderately thick towards center of pileus, fleshy, somewhat elastic. **Odor** none. **Taste** mild.

Basidiospores 7-11 x (5-) 5.5-7 (-7.5) μm, *RM* = 7.9-9.8 x 5.5-6.6 μm, *Q* = 1.31-1.51, ellipsoid, more or less amygdaliform in side view, often weakly tapering towards the apex, some bearing a mucron-like apex or with a faint suprahilar depression, smooth (even under SEM), thick-walled (<1 μm wide), dark yellowish to light or dark yellowish-brown, brown-yellow in mass. **Basidia** 20-30 (-35) x 8-10 μm, tetrasporic, clavate, hyaline, clampless. **Pleurocystidia** none. **Cheilocystidia** (21-) 23-90 (-110) x (3-) 4-10 (-11) μm, narrowly lageniform or sublageniform, often subcylindric or narrowly subutriform, some more or less subclaviform, straight, moderately straight or somewhat flexuous, often slightly curved above, some sinuous, occasionally bearing a thin and moderately long base, rarely with constrictions towards the apex, this latter (2.5-) 3-9 (-10) μm wide, abundant, projected beyond hymenium level, commonly arising below hymenial level but also from the hymenium, forming a dense, often refringent layer on lamella edge, which varies in degree of gelatinization even in the lamellae edges of a same specimen, hyaline, thin-walled, clampless. **Pileipellis** a cutis with cylindric to somewhat ventricose, radially oriented, septate, brownish, yellow-orange, brown-yellow, brown-orange or reddish-brown hyphae (5-) 7-15 (-20) μm wide, coarsely or finely incrusted, with inter or intraparietal incrusting brown pigment, incrustations often producing discontinuous lines more or less transversely or spirally oriented, hyphae forming an interrupted layer, compactly or somewhat loosely arranged, variable in width and markedly pigmented, terminal hyphae undifferentiated, often in prostrated groups or moderately erect, then with a trichodermoid appearance, forming the fibrils or scales of pileus surface, only faintly gelatinized but not as a refringent stratum. **Pileus trama** (in tangential section) differentiated in two layers, one beneath pileipellis, gelatinized, often clearly refringent, commonly wide but variable in width and then sometimes very reduced, composed by more or less filamentous to cylindric, somewhat loosely and radially arranged, thin-walled, colorless hyphae 2-5 (-7) μm wide, just downwards a moderately compact, somewhat interwoven stratum is distinctive where hyphae are cylindric or short and bifurcate forming a puzzle-like structure, hyphae up to 20 μm wide, hyaline, thin-walled, variably gelatinized but not refringent. **Hymenophoral trama** with a mediostratum, subregular to irregular, composed of colorless, thin-walled hyphae 5-15 (-20) μm wide, with gelatinized, commonly refringent laterostrata (subhymenium), these latter varying in the degree of gelatinization, then sometimes are poorly differentiated, weakly divergent in arrangement. **Clamp Connections** absent.

Habitat. Subgregarious, sometimes scattered or solitary, on rotten trunks, rotten branches or decaying wood, some of them of *Pinus* and *Quercus*, fructifying in tropical, mesophytic and conifer forests or mixed associations of *Pinus-Quercus*.

SPECIMENS EXAMINED. **MEXICO**.— **CHIHUAHUA**: **Bocoyna Co.**, 10 km NW of Bocoyna, Mesa del Oso, 1-VIII-1992, *Moreno IV-3* (FCME 5668). Km 82 road Creel-Guachochi Laja, 30-VIII-1980, *Pérez-Silva et al. s.n.* (MEXU 16298).— **GUANAJUATO**: **Guanajuato Co.**, Sierra de Santa Rosa, Cañada de Llano Largo, 1-VII-1995, *Hernández-Muñoz 607* (FCME 7440). Km 9-11 road Monte de San Nicolás-Santa Rosa de Lima, 29-IX-1995, *Pellicer y Villarruel 408* (FCME 7327).— **JALISCO**: **Ciudad Guzmán Co.**, Nevado de Colima slopes, road Las Víboras, El Floripondio, 11-VII-1992, *López 39* (IBUG as *C. mollis*; XAL).**Tala Co.**, SE La Primavera, Instituto de Madera, Celulosa y Papel, 22-VI-1990, *Guzmán-Dávalos 5140* (IBUG as *C. mollis*; XAL).— **MICHOACÁN**: **Cd. Hidalgo Co.**, Loz Azufres, Cañada de Agua Azul, 26-VII-1987, *Bulnes s.n.* (FCME 14190).— **MORELOS**: NW Tepoztlán, 27-VI-1969, *Singer M8239*; *M8256* (F, both as *C. calolepis* var. *heterocystis*); *M8203* (F as *C. fraxinicola*). Km 4 road La Pera-Oaxtepec, 3-VII-1976, *Pérez-Silva s.n.* (MEXU 10870).— **PUEBLA**: **Zihuateutla Co.**, Lagunillas, 9-VIII-2001, *Bandala 3410* (XAL).— **VERACRUZ**: 7 km S Montepio, Estación Biológica de Los Tuxtlas, 19-VI-1969, *Singer M 8029* (F, **Holotype** of *C. calolepis* var. *heterocystis*). Xalapa, Cerro Macuiltepetl, 13-VI-1995, *Bandala 2751*; km 2.5 old road Xalapa-Coatepec, Jardín Botánico Fco. J. Clavijero, 3-VI-1991, *Tapia 577*. Xalapa, Los Berros Park, 5-VI-1986, *Anell 365* (all at XAL).

ADDITIONAL SPECIMENS EXAMINED. **AUSTRIA**.— NW Kahlenberg, 10-VIII-1960, *Singer C211* (MICH, as *C. ralfsii*). **SPAIN**.— **CUENCA**: Hoz de Beteta, March 1975, *Tellería & Moreno s.n.* (AH 478).— **MADRID**: Rascafría, 3-V-1996, *Bandala 2943* (XAL).— **BARCELONA**: Dos Rius, 8-XI-1981, *Tabares s.n.* (AH 2520-B). **U.S.A.**— **MICHIGAN**: **Cheybogan Co.**, Colonial Pt. Hardwoods, Burt Lake, 29-VIII-1957, *Smith 57691* (MICH).— **NEW YORK**: Ithaca, 22-VI-1903, *Kauffmann 66261* (MICH); **Thompkins Co.**, Lloyd-Cornell Reserve, Slaterville, 27-VII-1957, *Shaffer 249* (MICH).— **OHIO**: Lane, Aug. 1919, *Beardslee 19072* (MICH).

Remarks. The presence of pigmented fibrils on the pileus surface, among other characters (size of the basidiospores, pileus color) has been used to distinguish *C. calolepis* (Cooke1884-1886; Jahn 1966; Murrill 1917; Pegler 1977; Senn-Irlet 1995; Singer 1973; Watling and Gregory 1989). In the literature the species is often reduced to an infraspecific taxon of *C. mollis* (Schaeff.: Fr.) Staude. Singer (1973), however, clearly recognized the fibrillose or scaly forms related to *C. calolepis*, as separating from the group of species around *C. mollis*, arguing (p. 451) '... I believe we should take Fries' diagnosis at its face value. This is necessary also because it was Fries himself who later distinguished *A. calolepis* —referring to *Agaricus calolepis*— precisely because of the 'beautiful squamules' it shows whereas *A. mollis* does not...'. In a concept combining macro- and microscopic features, Senn-Irlet (1995) came to the same conclusion recognizing two species. In the publication by Singer (1973) gelatinized forms represented by *C. mollis* (Subsect. *Defibulatini* Singer) were cited from different localities in Mexico. Three samples (included above) of *C. calolepis* (identified as var. *heterocystis*) were recorded from the States of Morelos (Central Mexico) and Veracruz (Eastern Mexico). Three additional collections gathered near Mexico City were recently reported by Krisai-Greilhuber et al. (2002). These and present records reveal, therefore, a wide distribution of *C. calolepis* in this country, inhabiting woody substrates either in coniferous forests or in broad-leaved forests.

Among the fresh and herbaria samples studied we noted a wide variation in some macro- (number of pigmented fibrils covering the pileus) and microscopic characters (degree of gelatinization of the context and hymenophoral trama), which deserve to be commented. We agree with Hesler and Smith (1965) in that the pigmented fibrils of the pileus surface can be variable in abundance between one collection and another. Even among the elements of a single sample, the frequency and number of fibrils is variable, hence the pileus surface can appear almost glabrous, fibrillose or finely fibrillose-squamose, being white-yellowish, ochraceous or brownish-orange in overall appearance. This variation seems to depend on the pileus development, also on the particular variation of the specimen sampled, as well as on the weather conditions. As observed also by Krisai-Greilhuber et al. (2002), in wet specimens which often have hygrophanous, whitish to whitish-greyish pileus, to the naked eye the surface is apparently glabrous and then recalls that of members of *C. mollis*. This was also annotated in Singer's (1973) description. Sometimes the fibrils are more abundant and conspicuous forming minute scales, but in other elements the fibrils are fine or reduced to the rear portion of the pileus, or they are scattered towards the margin. When present, however, the fibrils consistently have a characteristic microscopic aspect observable under oil lens: the pileipellis hyphae are decidedly pigmented (brownish-orange, yellowish-brown) and minutely or coarsely incrusted. Pigmented hyphae producing a fibrillose or scaly, colored pileus surface like in members of *C. calolepis* are also found in species of other groups of *Crepidotus* [e.g. *C. crocophyllus* (Berk.) Sacc., *C. rainierensis* Hesler & A.H. Sm.]. This would suggest that the character is maintained in different lineages within the genus and its presence or absence could be interpreted as being of taxonomic significance when distinguishing *C. calolepis* from close relatives. However, among the examined samples we failed to recognize a consistent qualitative or quantitative distinction to support an infraspecific segregation based solely on this feature. Thus, without any other correlated character, this limits us to relate our specimens to any of the varieties considered by Singer (1973).

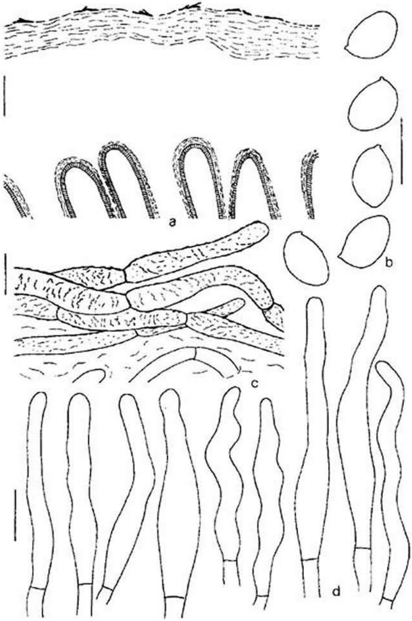

Fig. 2. *Crepidotus calolepis*. a: tangential section of pileus and hymenophore; b: basidiospores; c: pileipellis; d: cheilocystidia (Singer 8203) (scale bar = 10 μm, except a = 168 μm; c = 15 μm).

When introducing a distinction between the members with gelatinized tissues, Singer (1973) made reference to a topographical variation of gelatinized layers, these latter seen in mounted sections of pileus and hymenophore. For an evaluation of such a characteristic all samples gathered by Singer in Mexico and placed in his subsect. *Defibulatini* were examined, as well as selected type collections of species placed by Singer in this latter taxon [e.g. *Crepidotus brasiliensis* Rick, *C. calolepioides*, *C. epigloeus* Singer, *C. fraxinicola* Murrill, *C. tuxtlae* Singer, *C. molliformis*, *C. uber* (Berk. & M.A. Curt.) Sacc., *C. variisporus* Singer, *C. xanthophaeus* Singer] (Bandala 2000; Bandala and Montoya 2000a, 2002). We excluded *Crepidotus levisporus* and allied taxa (= *C. albidus*) which have smooth basidiospores but present clamps and ungelatinized tissues, therefore, they were considered to belong to another taxonomic group (Bandala and Montoya 2000a). In the resulting group of species of subsect. *Defibulatini s.* Singer that include *C. calolepis* and *C. mollis*, we found that the specimens do not have clamps, they bear smooth basidiospores, and invariably present gelatinized tissues and diverticulate hyphae (recalling puzzle-like elements), these latter scattered in the context and hymenophoral trama. Senn-Irlet (1995), Senn-Irlet and De Meijer (1998), and Krisai-Greilhuber *et al.* (2002) indeed described similar features in European and American specimens of species of this group that they studied.

Collections of members of subsect. *Defibulatini s.* Singer selected for study present a certain degree of gelatinization among the tissues, including the cortical layer of pileus. That characteristic is better evaluated since gelatinized, often refringent strata, either in the context or in the hymenophoral trama, are evident in tangential sections (cf. fig. 2a). Such strata presumably were those that Singer (1973) referred to. In the hymenophore the strata are reduced to the subhymenium, i.e. the hymenophoral trama exhibits two refringent, gelatinized laterostrata, and thus the lamella edge commonly presents a relative abundance of gelatine (where the cheilocystidia are immersed). Among lamellae the gelatinized layer of the subhymenium often reaches the lower portion of pileus context, hence appearing as one more stratum of pileus context. However, the most distinctive gelatinized stratum (often refringent) of the pileus context is situated towards the upper portion, just below the pileipellis hyphae. The hyphae of this gelatinized layer are somewhat loosely arranged and more or less periclinally oriented. Except for *C. brasiliensis*, *C. epigloeus*, *C. tuxtlae*, *C. uber* and *C. xanthophaeus* (not treated here) that exhibit only the gelatinized, refringent hymenophore laterostrata, in the context of the specimens examined no more than the upper gelatinized stratum can be recognized. These gelatinized, refringent strata, however, can be variable in width and better developed from one specimen to another, even within a same collection. In some specimens the gelatinized stratum of the context can be notably wide, and then the rest of the context appears reduced, whereas in the hymenophore the laterostrata can be thin and more conspicuous towards the lamella edge. Or on the contrary, the laterostrata can be somewhat wide along the lamella, and the gelatinized layer in the context can be reduced (evidently the specimens of the latter species cited show such variation in the hymenophore). This variation can even be related to the basidiome development, context thickness or to the effect of prevailing weather conditions when the specimens were sampled, and perhaps in some cases also to the process of conservation (drying). Studies on ontogeny are still required for a better understanding of the extent of the morphologic variation of each taxa. Since in the group of specimens examined of *Crepidotus calolepis*

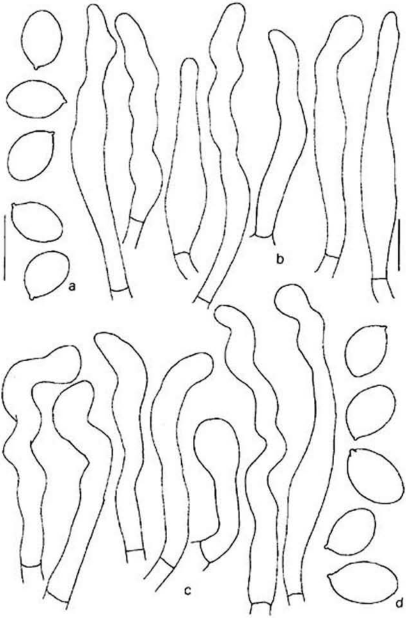

Fig. 3. *Crepidotus calolepis*. a: basidiospores; b: cheilocystidia (Singer 8029); c: cheilocystidia; d: basidiospores (Singer 8256) (scale bar = 10 μm).

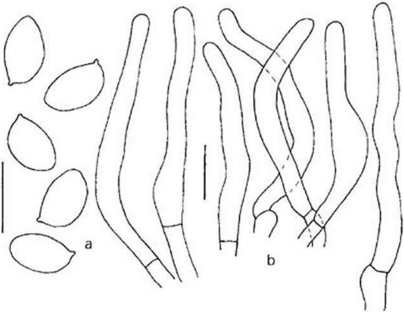

Fig. 4. *Crepidotus calolepis*. a: basidiospores; b: cheilocystidia (Singer 8239) (scale bar = 10 μm).

such variation does not distinguish single collections, we interpreted the differences in the degree of development of gelatinized layers as part of the morphologic variation expected to occur among members of a population. For the taxonomic treatment of the material studied, it was better to evaluate the presence or absence of gelatinized layers than the degree of gelatinization, an opinion also shared by Nordstein (1990) and Senn-Irlet (1995).

The presence of both the fibrils and the gelatinized layers mentioned above are found not only in collections of *Crepidotus calolepis* according to reports in the literature (Cooke1884-1886; Jahn 1966; Murrill 1917; Pegler 1977; Senn-Irlet 1995; Singer 1973; Watling and Gregory 1989), but also in the type specimens of *C. molliformis* from Mexico (Singer 1973) and *C. calolepioides* from Jamaica (Murrill 1913), two species segregated from *C. calolepis* according to Singer (1973). The microscopic data obtained from the type reexamination of these two samples are summarized and discussed below (fig. 10 a-b & e-g). The specimens supporting these species and those of *C. calolepis* var. *heterocystis* also described from Mexico, are interpreted here as belonging to a single taxon. In our opinion the taxonomic distinction of var. *heterocystis* can not be justified since the microscopic variation shown by the specimens is included in the range of the species variation as here interpreted. We have found the shape of cheilocystidia to be consistent among the collections examined. Along a single gill edge some cheilocystidia having the same shape pattern can be variably flexuous, straight, moderately curved or even with constrictions. Nordstein (1990) has observed a similar variation in European specimens treated as *C. calolepis*. The three collections considered by Singer as var. *heterocystis* (included above) exhibit differences with regard to these structures: whilst in collection *8256* flexuous elements are more or less common on the lamella edge (fig. 3c), in coll. *8029* (holotype) they are less frequent (fig. 3b), and in coll. *8239* they are practically absent (fig. 4b). The limitations inherent in the study of these herbarium samples prevent us from developing an objective evaluation of the frequency of the flexuous forms. As such cheilocystidia, as described by Singer (1973), are not unique to separate single collections, we could not justify using the degree of distortion of the shape of these structures as a reliable taxonomic distinguishing feature. For the time being, we interpret the materials of var. *heterocystis* as showing part of the cheilocystidia variation of *C. calolepis*.

Taxa from subsect. *Defibulatini s.* Singer (*Crepidotus levisporus* and allied taxa excluded) mentioned above make this group of species consistent. This in part supports several authors' concept of an isolated infrageneric taxon (Hesler and Smith 1965; Nordstein 1990; Pilát 1948; Senn-Irlet 1995; Singer 1947, 1973, 1986; Watling and Gregory 1989). The taxonomic interpretation of it could be resolved through the proposal of Subg. *Crepidotus* s. str. Senn-Irlet (1995). Furthermore, phylogenetic analysis based on molecular data (at least with specimens related to this group currently sequenced by some authors) suggests natural affinities among the taxa placed here (Aime and Miller 2002; Aime et al. 2002; Senn-Irlet and Hofstetter 1996). With regard to *C. calolepis* and *C. mollis*, the strikingly pigmented, incrusted hyphae present on the pileipellis of the specimens of the former, are not found in collections of *C. mollis*, as it is currently circumscribed (Senn-Irlet 1995; Singer 1973). The wider basidiospores in *C. calolepis*, in combination with the characteristics (macro- and microscopic) of the pileus surface are useful to separate it from *C. mollis*. We agree with Senn-Irlet (in litt.) that mating studies will provide additional information to support a robust species concept between both taxa.

3. *Crepidotus croceitinctus* Peck **Figure 5**

Crepidotus croceitinctus Peck, Ann. Rep. N.Y. Stat. Mus. 39: 72, 1886.
Synonym: *C. subcroceitinctus* Hesler & A.H.Sm., North American Species of *Crepidotus*: 139, 1965.

Most relevant data obtained in collection studied are: **pileus** 13-23 mm wide, cream-yellow to yellow (4A4-5), with scattered, whitish fibrillose tomentum, then some areas of the disc paler, semicircular to more or less rounded flabelliform, convex, margin slightly striate, with a moderate abundance of whitish mycelium at the base. **Lamellae** concolorous to somewhat darker, edges fimbriate. **Basidiospores** 6.4-8 x (4.8-) 5.6-7.2 μm, $RM = 7 \times 6.2$ μm, $Q = 1.15$, broadly ellipsoid, at times somewhat subglobose, verrucose to coarsely verrucose, yellowish-brown, thick-walled (up to 0.5 μm thick). **Cheilocystidia** 20-40 x 3-6 μm, with apex (3-) 5-8 (-9) μm wide, narrowly clavate to clavate, commonly contorted, flexuous, with short outgrowths or with a knobbed apex, hyaline, clampled, thin-walled. **Pileipellis** a cutis composed of more or less compactly arranged hyphae, with scattered, prostrate to erect terminal hyphae, which are more abundant in certain areas, then almost in a gradual transition between a cutis and a trichoderm, towards the rear portion the layer is somewhat loosely disposed with a variable presence of terminal

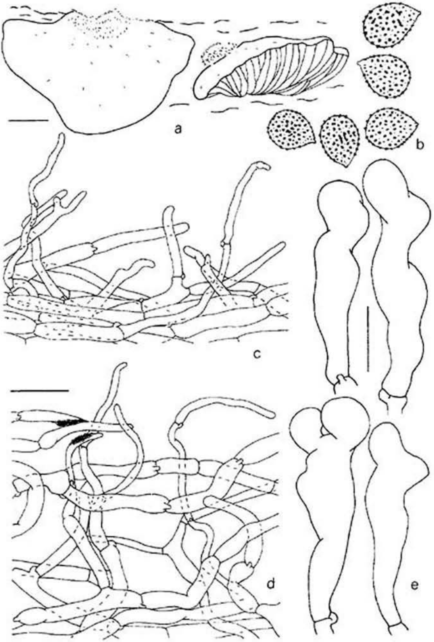

Fig. 5. *Crepidotus croceitinctus*. a: basidiomes; b: basidiospores; c: pileipellis (near middle portion of pileus); d: pileipellis (towards the rear portion of pileus); e: cheilocystidia (Bandala 3706) (scale bar = 10 μm, except a = 5 mm; c-d = 25 μm).

hyphae, all hyphae are yellowish to pale yellowish-orange, some segments more pigmented or even obscurely incrusted, a certain kind of incrusted, yellowish-brown material is evident in some parts. **Clamp Connections** in all tissues. For more macro- and microscopic details see Bandala and Montoya (2000b).

Habitat. Subgregarious, on rotten trunk, in a mesophytic forest.

> **SPECIMENS EXAMINED.** MEXICO. PUEBLA: Chiconcuautla Co., San Cristóbal Xochipehuala, 3-IX-2002, *Bandala 3706* (XAL).

Remarks. This new finding of the species from N Puebla records its most northern occurrence at present known in Mexico. As described from New York (USA), *C. croceitinctus* nowadays shows a fragmented distribution along the American Continent (Peck 1886; Hesler and Smith 1965; Singer 1953,1973; Pereira 1990; Senn-Irlet and De Meijer 1998; Bandala and Montoya 2000b).

4. *Crepidotus latifolius* group

Among the species of *Crepidotus* having baculate basidiospores, *C. latifolius* and *C. praelatifolius* are macroscopically distinctive because both produce small (often densely gregarious) basidiomes in combination with a hymenophore with very broad lamellae. These latter are somewhat spaced and consistently broad. The width of the lamellae is out of proportion in relation to the context width and also to the pileus length, hence commonly extending beyond pileus margin and producing a rather exposed hymenophore. The basidiomes appearance is then somewhat asymmetrical (figs. 6a, d & g; 7a). The examined specimens representing this group share the variation of most characters of taxonomic importance (basidiome color, both basidiospore size and ornamentation, pileipellis structure). The morphologic distinction that we found between *C. latifolius* and *C. praelatifolius* is based on the cheilocystidia shape. Considering that the distinction between both is only based on a single character, we follow the arguments of Kuyper (1988) and Noordeloos (1987) with regard to an infraspecific interpretation, and recognize two varieties: the var. *latifolius*, characterized by apically rounded or more or less capitate cheilocystidia, and the var. *praelatifolius*, distinguished by the narrowly-lageniform (tapering upwards) cheilocystidia. For a discussion on *C. latifolius* var. *veraecrucis* see below (fig. 10c-d). Its type specimen was found to be an intermediate form of *C. palmarum*, therefore, the var. *veraecrucis* is considered a later synonym.

4a. *Crepidotus latifolius* Peck var. *latifolius* — Figures 6-7, Plate 1d-g

Basionym: *Crepidotus latifolius* Peck, Bull. Torr. Bot. Club 26: 66, 1899.

Pileus 2-10 (-13) mm wide, semicircular or more or less flabelliform, some at first moderately ungulate, convex to plano-convex, finally applanate, laterally or almost dorsally attached, often with a knob-like point of attachment and then somewhat campanulate, hygrophanous, whitish or somewhat white-grayish, at times pale white-yellowish, pale brownish with age, glabrous to weakly tomentose-fibrillose, commonly minutely fibrillose to rather villose towards the rear portion by the abundance of basal mycelium, margin straight, smooth or slightly striate, often with age exhibits certain process of deterioration being somewhat irregular and then reducing the pileus surface and exposing part of the lamellae. **Lamellae** adnate to narrowly adnate, broad to very broad, 2-5 (-6) mm wide, ventricose, often projecting beyond the margin of the pileus, whitish to whitish-yellow, gradually pale pinkish-brown to brownish, brown or somewhat reddish-brown in advanced stages of development, edges whitish, fimbriate to moderately fimbriate, subdistant to distant, converging to a lateral point, with lamellulae of different length. **Stipe** absent. **Context** whitish, very thin (< 0.5 mm wide), then the pileus is somewhat submembranous. **Odor** none. **Taste** not distinctive.

Basidiospores 5.5-7.5 (-8) x (4.5-) 5-6.5 (-7) μm, *RM* = 5.9-6.4 x 5.2-6.1 μm, *Q* = 1.06-1.14, subglobose, slightly attenuated towards the hilar appendix, then with a weak suprahilar depression, at times somewhat broadly subellipsoid, spinose to finely verrucose seen under light microscope, baculate when observed under SEM, with more or less homogeneous, short, conical-truncate protuberances; thick-walled (up to 0.5 ?m wide), yellowish to pale yellowish-brown, ornamentation darker, brownish-orange in mass. **Basidia** 25-35 x 7-8 (-9) μm, tetrasporic, clavate to clavate-ventricose, hyaline, clamped. **Pleurocystidia** none. **Cheilocystidia** (20-) 22-60 x (3-) 4-9 (-10) μm, more or less narrowly utriform, with a subcapitate or capitate apex 7-12 (-14) μm wide, often clavate-capitate or subcylindric-capitate, abundant, projecting beyond the hymenium level, forming a moderately dense layer along lamella edge, hyaline, thin-walled, clamped. **Pileipellis** a cutis of more or less interwoven, thin-walled, cylindric, colorless hyphae 4-9 μm wide, terminal hyphae scattered, prostrate to semierect, rarely erect, they are more frequent towards the rear portion where the hyphae are moderately more loosely arranged, then forming an irregular transition between a cutis and a trichoderm, in this zone the terminal hyphae are somewhat more erect and intricate depending apparently on the abundance of superficial tomentum, terminal elements cylindric to clavate or sublageniform, some tapering towards the tip, straight to moderately flexuous, hyaline, at times with minute yellowish incrustations (but not forming a pigmented layer), thin-walled, ungelatinized. **Pileus trama** with hyaline, more or less compactly interwoven, cylindric to ventricose, thin-walled hyphae up to 12 (-14) μm wide, in mounted sections sometimes the loosely arranged upper portion of the pileus contrasting with the more compact disposition of the pileus trama hyphae. **Hymenophoral trama** subregular to irregular, hyphae similar to the context; subhymenium poorly differentiated, with short-subglobose hyphae. **Clamp Connections** present in all tissues.

Habitat. Densely gregarious to gregarious, rarely scattered, sometimes with a more or less imbricate aspect, on decaying trunks or stumps, in mesophytic forest.

SPECIMENS EXAMINED. MEXICO.— OAXACA: Sierra Mazateca, near Huautla de Jimenez, Rancho del Cura, 7-VII-1969, *Singer M8284* (F).— VERACRUZ: Parque Ecológico Fco. J. Clavijero, 22-V-1990, *Montoya 1746*; 26-VI-1992, *Bandala 2081*; 12-V-2001, *Bandala 3300, 3304* (all at XAL).

ADDITIONAL SPECIMENS EXAMINED. USA. — OHIO: Cuyahuga Co.,Cleveland, 4-VI-1944, leg. Walters 5, *Smith 66263* (MICH, as *C. latifolius*).— TENNESSEE: Knoxville, Baring Woods, 6-VII-1939, *Hesler s.n.* (TENN 12270, as *C. latifolius*).

Remarks. The distinctive small basidiomes with very broad lamellae is what macroscopically characterizes *C. latifolius* and its varieties. The basidiospores and cheilocystidia can also be useful to separate them from *C. applanatus* (Pers.) Kumm.

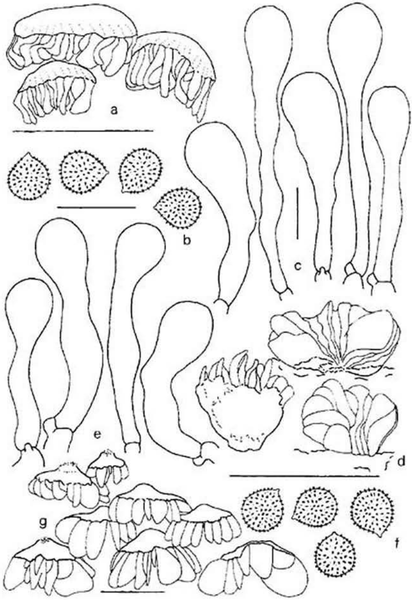

Fig. 6. *Crepidotus latifolius* var. *latifolius*. a: basidiomes; b: basidiospores; c: cheilocystidia (Smith 66263); d: basidiomes; e: cheilocystidia; f: basidiospores (Singer 8284); g: basidiomes (Bandala 3304) (scale bar = 10 μm, except a = 3 mm; e & g = 5 mm).

and relatives. Such microscopic characters show constant differences between the collections examined but require careful observation. In the samples of the group *C. latifolius* examined most basidiospores show a different form, characterized by being rounded but attenuated towards the hilar appendix, thus appearing less globose than those of *C. applanatus*. The basidiospores in the collections of both varieties (*latifolius* and *praelatifolius*) seen as a population are somewhat smaller (slender) in comparison with those of *C. applanatus*, but based solely on this character (basidiospore size), one single collection of that group could hardly be separated from the small-spored specimens of *C. applanatus*. In members of this latter species the basidiospores are spherical, but in terms of mean values of *Q* (length/width ratio) the differences are minimal: 1.00-1.12 (Senn-Irlet 1995) or 1.00-1.10 (Nordstein 1990; Bandala 2000) in *C. applanatus* versus 1.06-1.14 in the 'group' *C. latifolius*. In the collections belonging to *C. applanatus* var. *applanatus s. str.* Senn-Irlet (1995), the cheilocystidia are more rarely utriform, but consistently clavate to narrowly-clavate or somewhat cylindric. The lamellae edges of specimens of *Crepidotus latifolius* var. *latifolius*, however, could also bear clavate forms mixed with utriform cheilocystidia. See below *Crepidotus latifolius* var. *praelatifolius* for differences compared with *C. applanatus* var. *subglobiger* Singer *s. str.* Senn-Irlet (1995).

About 24 American taxa of *Crepidotus*, including *C. latifolius* (and its vars.) constitute the core of species related to *C. applanatus* within sect. *Sphaerula* Hesler & A.H. Sm. (or subsecc. *Porpophorini* Singer) (Hesler and Smith 1965; Singer 1973, 1986). In most cases minor macroscopic differences, which indeed show a certain overlapping, have been considered as supporting their taxonomic segregation. With regard to the hymenophore, however, there is a distinctive morphologic pattern which makes the group of specimens representing *C. latifolius* different macroscopically (figs. 6a, d & g; 7a). According to descriptions in the literature (Singer 1947, 1973; Hesler and Smith 1965) specimens of the core of species of sect. *Sphaerula* exhibit a rather continuous variation in the dimensions of the basidiome (including the relation pileus-lamellae together), which often complicates the taxonomic treatment of the samples based solely on their macroscopic appearance. Comparing such information with that recorded during our study of fresh materials, and that obtained after an examination of several type or authentic collections of members of this group related to Mexican taxa (Bandala 2000), the data revealed that in the species that embrace relatively small specimens (e.g. *Crepidotus applanatus*, *C. avellaneus* Hesler & A.H. Sm., *C. conchatus* Hesler & A.H. Sm., *C. cuneiformis* Pat., *C. subapplanatus* Hesler & A.H. Sm., *C. truncatus* Petch, among others), even the lamellae could be moderately broad. However, the hymenophore is comparatively proportional with regard to the pileus length and context width, the basidiomes being thus almost entirely proportional in overall appearance. Outside the core of species around *C. applanatus* a similar pattern of hymenophore could be found among the basidiomes of species producing small basidiomes, e.g. *C. cesatii* (Rab.) Sacc., *C. epibryus* (Fr.: Fr.) Quél., *C. palmarum* or *C. variabilis* (Pers.: Fr.) P. Kumm. The relation between lamellae and both pileus length and context width should be more accurately analyzed when comparing the samples macroscopically, because this could avoid misidentifications.

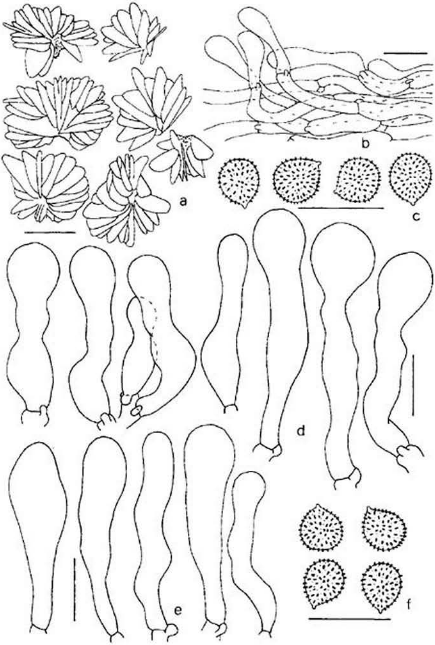

Fig. 7. *Crepidotus latifolius* var. *latifolius*. a: basidiomes (Bandala 3300); b: pileipellis; c: basidiospores; d: cheilocystidia (Montoya 1746); e: cheilocystidia; f: basidiospores (Lloyd 49964) (scale bar = 10 μm, except a = 5 mm; b = 15 μm).

In this regard we are not completely convinced by the proposal of lectotypification of *Crepidotus latifolius* (var. *latifolius*) with the collection *Lloyd 49964* (U.S.A. Ohio: near Cincinnati, dated 1902, BPI). In the diagnosis Peck (1899) described *C. latifolius* with '... pileus very thin, submembranous, ... 3-6 mm broad, ... white, lamellae very broad, suborbicular, 5-6 times as wide as the thickness of the flesh ... extending beyond the margin of the pileus...'. These features are in fact found in the different collections from the U.S.A. and Mexico included above. In the protologue Peck (1899) indicated '... Ohio, Lloyd...' referring to the type, however, we did not find it at Ch. Peck's Herbarium (NYS), it was not apparently conserved. This was already pointed out by Singer (1947) who suggested considering Peck's taxon invalid. Hesler and Smith (1965) found at BPI the cited collection *Lloyd 49964*, and selected it as the lectotype of *C. latifolius* (var. *latifolius*) a selection later accepted by Singer (1973) too. We have examined the mentioned material of Lloyd, which is composed of several elements but not in optimum conditions. This sample does not have notes of the macroscopic features when fresh, and its present state of preservation limits the complete macroscopic interpretation of the species as described by Peck. Although most basidiomes are broken, in overall appearance the elements resemble small forms of members of sect. *Sphaerula* around *Crepidotus applanatus*. Furthermore, the gill edge when available could hardly be revived, hence our microscopic evaluation of it was based on a very reduced number of cheilocystidia (fig. 7e-f). In a note accompanying the sample L.R. Hesler underlined a similar fact. Most relevant microscopic observations that we made on *Lloyd 49964* are the following:

Basidiospores 5.5-6.5 x (4.5-) 5-6 (-6.5) μm, *RM* = 5.9 x 5.4 μm, *Q* = 1.10, subglobose, commonly constricted towards apiculus, minutely warted to punctate, distinctly baculate under SEM (plate 1g), yellowish to pale yellowish. **Basidia** tetrasporic, clavate, hyaline, clamped. **Pleurocystidia** absent. **Cheilocystidia** 35-42 x 5-7 μm, with apex 7-10 (-13) μm, clavate to subcylindric, hyaline, rare, almost inconspicuous (due to the difficulties in reviving the edge of lamellae), clamped. **Pileipellis** a cutis of prostrate, interwoven hyphae 3-7 μm wide, hyaline to pale yellowish (not pigmented), with some erect or moderately erect, undifferentiated terminal elements, then such areas more or less in transition between a cutis and a trichoderm, pellis poorly differentiated from the context hyphae, which are more compactly arranged, hyaline to pale yellowish, 5-15 μm wide, thin walled, clamped. **Hymenophoral trama** regular to irregular, hyphae 5-10 μm wide, hyaline, clamped. These data are similar to those included by Hesler in his note: '...basidiospores 4.5-6 x 4.5-6 μm, globose to subovoid, punctate, brown; cheilocystidia 32-43 x 7-8 μm, clavate-subcapitate, few; cuticle a cutis, with more or less erect, slender, colorless hyphae which are scattered or numerous at times approaching a trichodermium; clamp connections present on the epicuticular hyphae...'. This latter information, however, differs from that described by Hesler and Smith (1965 p. 54), which suggests that they provided a composite description based on Lloyd's material as well as on the macro- and micromorphologic information from the additional collections (above included) that they interpreted as *Crepidotus latifolius*. Although Singer (1973) compared *Lloyd 49964* with his samples, data in his description clearly indicate that it was based solely on the two collections that he considered from Mexico and Bolivia.

The collections examined from the U.S.A. and that of Singer from Mexico (Oaxaca) share with our collections from Veracruz the same morphologic pattern (figs. 6-7). The former correspond to the materials studied by Hesler and Smith (1965) and Singer (1973), respectively, all treated as *Crepidotus latifolius* (var. *latifolius*). These specimens are well preserved and differ from *Lloyd 49964* by their distinctive small-sized, more or less densely gregarious basidiomes, with thin flesh and very broad lamellae, even in their dry condition (as depicted in fig. 6a & d). The microscopic description provided above is based on the collections mentioned, including the Mexican material. These present a similar variation in the basidiospore characteristics (size, shape, ornamentation) and exhibit similar cheilocystidia, though new Mexican collections were the ones that allowed us to carry out a more complete study of these latter structures (figs. 6-7). Since the group of species around *Crepidotus applanatus* may possess moderately small basidiomes, being macroscopically similar superficially, and microscopically exhibiting similar ranges of size and shape of both cheilocystidia and basidiospores, we should be cautious about considering the collection *Lloyd 49964* as a lectotype for *C. latifolius* (var. *latifolius*). This latter collection perhaps represents a small form of *C. applanatus*. With the available information we do not have enough evidence to interpret the elements of this collection as members of *C. latifolius*. We agree with Hesler, Smith and Singer that the samples (included above) from Cleveland, Knoxville (USA) and Oaxaca (Mexico) that they studied support the concept of *C. latifolius* as circumscribed by Peck, which embraces the variation of our collections from Veracruz. However, to fulfill the nomenclatural rules, in our opinion, it would be desirable to review Peck's (or Lloyd´s) herbarium in order to look for the existence of another specimen (still unidentified) or even a topotypical specimen before adopting that lectotype.

4b. *Crepidotus latifolius* var. *praelatifolius* Figure 8a-e. Plate 1h

Crepidotus latifolius var. *praelatifolius* (Murrill) Singer, Beih. Nova Hedwigia 44: 359, 1973.
Basionym: *C. praelatifolius* Murrill, Bull. Torr. Bot. Club 67: 230, 1940.

Pileus 1-3 mm wide, more or less semicircular, at times somewhat flabelliform, some at first moderately ungulate, convex to plane, laterally or almost dorsally attached, hygrophanous, whitish or somewhat white-grayish, some white-yellowish, pale brownish with age, tomentose-fibrillose to glabrescent, more fibrillose towards the rear portion by the abundance of basal mycelium; margin smooth or slightly striate; surface often showing certain process of deterioration, being somewhat irregular and then reducing the pileus area, exposing part of the lamellae. In the holotype the lamellae are practically held by a very small fragment of pileus. **Lamellae** adnate to narrowly adnate, broad to very broad 2-5 (-6) mm wide, ventricose, often projecting beyond the margin of the pileus, whitish, whitish-yellow to brown-yellowish or brownish, edges whitish, moderately fimbriate, subdistant to distant, converging to a lateral point, with lamellulae of different length. **Stipe** absent. **Context** whitish, very thin (< 0.5 mm wide), then the pileus is somewhat submembranous. **Odor** none. **Taste** not distinctive.

Basidiospores 5.5-6.5 x 5-6 (-6.5) μm, RM = 6.1-6.2 x 5.5-5.8 μm, Q = 1.07-1.14, subglobose, slightly attenuated towards the hilar appendix, then with a weak suprahilar depression, at times somewhat broadly subellipsoid, spinose to finely verrucose seen under light microscope, baculate when observed under SEM, with more or less homogeneous, short, conical-truncate protuberances; thick-walled (up to 0.5 µm wide), yellowish to pale yellowish-brown, ornamentation darker, brownish-orange in mass. **Basidia** 15-25 x 6-8 µm, tetrasporic, clavate to cylindric-clavate, hyaline, clamped. **Pleurocystidia** none. **Cheilocystidia** 23-65 (-70) x (3.5-) 5-9 (-10) µm, narrowly lageniform, tapering upwards (not acute), apex 2.5-6 (-7) µm wide, at times subcylindric or somewhat narrowly subutriform and with a moderately rounded tip, straight or slightly flexuous, projecting beyond the hymenium level, more or less abundant but somewhat scattered along the lamella edge, hyaline, thin-walled, clamped. **Pileipellis** a cutis of more or less interwoven, thin-walled, cylindric, colorless hyphae 3-7 (-9) µm wide, terminal hyphae scattered, prostrate to semierect, towards the rear portion the hyphae are more loosely arranged then forming an irregular transition between a cutis and a trichoderm, in this zone the hyphae are somewhat more erect and intricate depending apparently on the abundance of superficial tomentum, terminal elements cylindric to clavate, hyaline, thin-walled, ungelatinized. **Pileus trama** thin, with hyaline, more or less compactly interwoven, cylindric to ventricose, thin-walled hyphae 3-15 µm wide, in mounted sections sometimes the loosely arranged upper portion of the pileus contrasts with the more compact disposition of the context hyphae. **Hymenophoral trama** subregular to subirregular, hyphae 4-10 µm wide, similar to context; subhymenium poorly differentiated, with short-subglobose hyphae. **Clamp Connections** present in all tissues.

Habitat. Gregarious, sometimes with a more or less imbricate aspect, on a decaying trunk, in mesophytic forest.

SPECIMENS EXAMINED. MEXICO.— **VERACRUZ**: km 2.5 old road Xalapa-Coatepec, near Instituto de Ecología, 24-V-1995, *Bandala 2736* (XAL).

ADDITIONAL SPECIMENS EXAMINED. U.S.A.— **FLORIDA**: Gainsville, 8-IX-1938, *Rhoads s.n.* (Holotype, FLAS; Isotype MICH). ***Crepidotus applanatus* var. *subglobiger*.** **SPAIN**. — **MADRID**: Rascafría, 19.XI.1975, *Rollán s.n.* (AH 473).— **SEGOVIA**: Boca del Amo, 13.XI.1978, leg. *Soc. Mic. Castellana* (AH 5171).

Remarks. Minor differences in the size of both pileus and lamellae have been the basis for the taxonomic separation between *C. praelatifolius* and *C. latifolius* (Hesler and Smith 1965; Murrill 1940; Pilát 1950; Singer 1947, 1949). We found among the samples of this group examined that the macroscopic variation overlaps, as does that exhibited by the basidiospores (size, shape, ornamentation). Except for the narrowly-lageniform cheilocystidia (fig. 8b & e), our examination of the samples did not reveal any other morphocharacter that could offer reliable taxonomic differences to segregate Murrill's taxon. We share Singer's (1973) opinion and consider that on the basis of this single distinctive character *C. praelatifolius* should be recognized as a variety of *C. latifolius*. The reduction of the pileus surface, that leaves a great part of the lamellae exposed as shown by the holotype, is occasionally found among the elements of var. *latifolius*. This characteristic is apparently indicative of differences between collections of both varieties. However, before considering it to be of taxonomic value, an evaluation during the developement of the basidiomes is still required.

Comparatively speaking, microscopically the var. *latifolius* is superficially similar to *C. applanatus* var. *applanatus* (see above), as *C. latifolius* var. *praelatifolius* is with regard to *C. applanatus* var. *subglobiger s. str.* Senn-Irlet (1995). In this latter case, the combi-

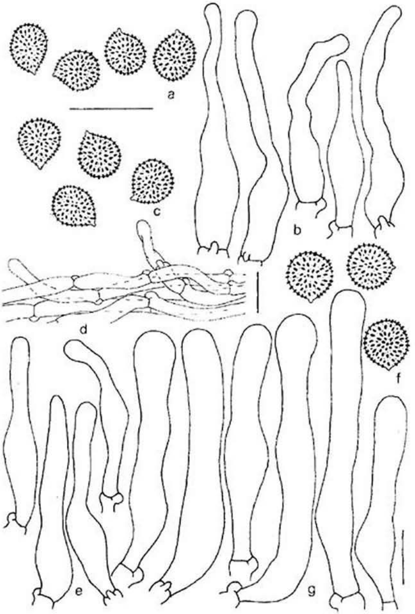

Fig. 8. a-e: *Crepidotus latifolius* var. *praelatifolius*, a: basidiospores; b: cheilocystidia (Rhoads s.n.); c: basidiospores; d: pileipellis; e: cheilocystidia (Bandala 2736). f-g: *Crepidotus applanatus* var. *subglobiger*, f: basidiospores; g: cheilocystidia (AH 5171) (scale bar = 10 μm, except d = 15 μm).

nation of gregarious, small, very broad-lamellate basidiomes also distinguish the var. *praelatifolius* from var. *subglobiger*. At microscopic level, apart from the basidiospore characteristics discussed above (see *C. latifolius* var. *latifolius*), specimens of both varieties can be distinguished by the cheilocystidia. These varieties show a similar pattern of cheilocystidia shape (lageniform), but when compared these structures are clearly different in size and overall appearance. Descriptive data provided by Seen-Irlet (1995) about the cheilocystidia of *C. applanatus* var. *subglobiger* ['... (20-) 30-75 (-90) x 5-10 μm, cylindrical, narrowly lageniform or narrowly utriform, mixed with some flexuous, angled or forked ones, rarely some subcapitate...'] are useful when comparing it with var. *applanatus*, and suggest differences with var. *praelatifolius*. Our examination of two of the collections of *C. applanatus* var. *subglobiger* treated by that author (*AH 473*; *AH 5171*), revealed cheilocystidia (28-) 32-75 (-80) x 6-11 (-12) μm, with apex (4-) 5-9 (-10) μm wide (fig. 8f-g). This indicates therefore, that the var. *praelatifolius* can be recognized by its smaller and slender cheilocystidia, showing a more narrowly lageniform pattern than those of var. *subglobiger*.

5. *Crepidotus palmarum* Singer **Figures 9-10c-d. Plate 1i-l**

Crepidotus palmarum Singer, in Singer & Digilio, Lilloa 25: 406, 1951.
Synonym: *C. luridus* Singer var. *luridus*, *Beih. Nova Hedwigia* 44: 479, 1973; *C. luridus* var. *minor* Singer, *Beih. Nova Hedwigia* 44: 479, 1973; *C. luridus* var. *oaxacae* Singer, *Beih. Nova Hedwigia* 44: 479, 1973; *C. latifolius* var. *veraecrucis* Singer, *Beih. Nova Hedwigia* 44: 360, 1973.

For descriptive details see Bandala and Montoya (2000b). Specimens studied have **basidiospores** (4.8-) 5.6-8 x 4.8-6.5 (-7) μm, *RM* = 5.8-6.9 x 5.1-5.8 μm, *Q* = 1.13-1.19, broadly ellipsoid, verrucose with moderately coarse verrucae. **Cheilocystidia** 20-50 x 4-8 μm, clavate to narrowly clavate or somewhat narrowly utriform, with a rounded, capitate or subcapitate apex (6-) 7-13 (-14) μm, abundant, hyaline, clamped. **Clamp Connections** present in all tissues.

Habitat. Subgregarious, on rotten branches, in mesophytic and tropical forests.

> **SPECIMENS EXAMINED. MEXICO. PUEBLA: Chiconcuautla Co.**, San Cristóbal Xochipehuala, 3-IX-2002, *Bandala 3707-A* (XAL). **VERACRUZ:** 7 km S of Montepio, Estación Biológica de Los Tuxtlas, 20-VI-1969, *Singer M 8038* (F, as *C. cuneiformis*).

Remarks. The combination of moderately small, white basidiomes, broadly ellipsoid, verrucose basidiospores, clavate-capitate cheilocystidia, and clamped hyphae distinguish this species (Bandala and Montoya 2000b). This same combination of features was found in the specimen *Singer M 8038* (fig. 9d-f), consequently we considered it as representing a member of *C. palmarum*. Singer (1973) placed this collection under *C. cuneiformis* Pat. This latter species is recognized, however, because its basidiomes produce globose or spherical, punctate to spinose basidiospores (baculate seen under SEM) as observed in the type specimen (Guadaloupe: *Duss 31*, Herb. Patouilliard 405, FH) and as noted also by Hesler and Smith (1965) and Pegler (1983). Furthermore, the collection *Singer M 8761* holotype of *C. latifolius* var. *veraecrucis* (discussed below) can be assigned to *C. palmarum*. The noticeable verrucose, subglobose to broadly ellipsoid basidiospores exhibited by this latter specimen clearly excluded it taxonomically from the group of *C. latifolius* previously mentioned.

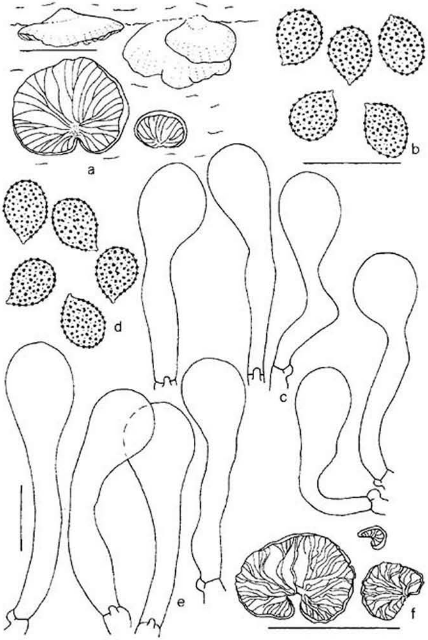

Fig. 9. *Crepidotus palmarum.* a: basidiomes; b: basidiospores; c: cheilocystidia (Bandala 3707-A); d: basidiospores; e: cheilocystidia; f: basidiomes (Singer 8038) (scale bar = 10 μm, except a & f = 5 mm).

In addition to previous records of *C. palmarum* from Morelos, Oaxaca and Veracruz (Singer 1973; Bandala and Montoya 2000b), the present report of the species from N Puebla as well as that of Krisai-Greilhuber *et al.* (2002) from Nayarit, show that *C. palmarum* is distributed throughout the country from coast to coast, almost following the line of the neovolcanic axis and towards the south of Mexico.

B. TYPE STUDIES

6. Crepidotus calolepioides **Figure 10a-b. Plate 1c**

Crepidotus calolepioides Murrill, Mycologia 5: 30, 1913.

HOLOTYPE: JAMAICA.Cinchona, Dec. 25- Jan. 8, 1908-1909, on a small dead branch of a deciduous shrub, *Murrill 556* (NY).

Basidiospores 7.5-10 x 5.5-7 μm, *RM* = 8.9 x 6.3 μm, *Q* = 1.43, ellipsoid, somewhat amygdaliform in side view, some weakly tapering towards the apex, smooth, thick-walled (up to 0.5 μm thick), dark to light brown-yellowish. **Basidia** tetrasporic, clavate, hyaline, clampless. **Pleurocystidia** none. **Cheilocystidia** not observed. **Pileipellis** a cutis of radially oriented, septate hyphae 5-15 μm wide, these are brown-orange to brownish colored, with a coarse or fine, inter or intraparietal incrusting brown pigment, forming an interrupted layer, variable in width, and which constitutes the scales on pileus surface, the terminal hyphae undifferentiated, often in groups, somewhat erect and then with a trichodermoid appearance. **Pileus trama** with a refringent, distinctive gelatinized layer underneath pileipellis, composed by more or less filamentous to cylindric, somewhat loosely and radially arranged, thin-walled, colorless hyphae 2-5 (-7) μm wide, downwards the hyphae are moderately compact, hyaline and tend to form a puzzle-like structure. **Hymenophoral trama** with poorly differentiated, gelatinized laterostrata. **Clamp connections** absent.

Remarks. The type consists of a fragmented basidiome and it is not possible to make a complete microscopic analysis of the gill edge. Although in a water color painting accompanying the material the pigmented fibrils or scales on pileus surface were not depicted, the notes on the fresh material describe the cap with '... minute fulvous conical setae ...'. Murrill (1913) described *C. calolepioides* with pileus surface decorated with minute, fulvous, conic elevations and emphasized that it resembles '... *C. calolepis*, but with minute conic elevations instead of tomentose-scaly ...'. Some authors listed *C. calolepioides* as a synonym of *C. calolepis* (Hesler and Smith 1965; Nordstein 1990; Senn-Irlet 1995), and the distinctive macro and microscopic morphocharacters of its type specimen suggest indeed that it shows the morphologic variation found in that species (see above). Therefore, we support the synonymy between *C. calolepiodes* and *C. calolepis*.

7. Crepidotus latifolius var. *veraecrucis* **Figure 10c-d. Plate 1k-l**

Crepidotus latifolius var. *veraecrucis* Singer, Beih. Nova Hedwigia 44: 360, 1973.

HOLOTYPE: MEXICO.VERACRUZ: 3 km S of Montepio, 30-VII-1969, *Singer M 8761* (F).

Basidiospores 6-7.5 (-8) x 4.5-6.5 μm, *RM* = 6.8 x 5.6 μm, *Q* = 1.21, broadly ellipsoid to subglobose, with a weak suprahilar depression, somewhat drop-shaped in frontal

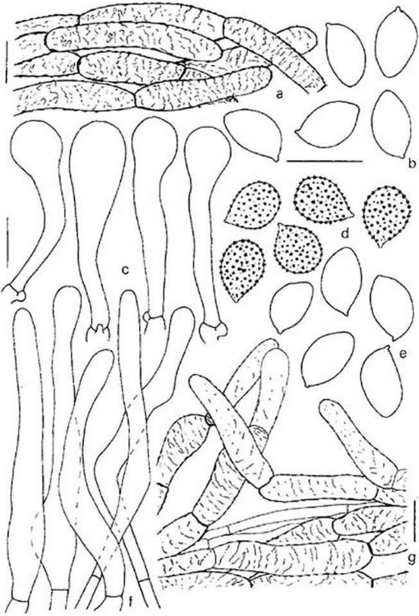

Fig. 10. a-b: *Crepidotus calolepioides*, a: pileipellis; b: basidiospores (Murrill 556); c-d: *Crepidotus latifolius* var. *veraecrucis*, c: cheilocystidia; d: basidiospores (Singer 8761); e-g: *Crepidotus molliformis*, e: basidiospores; f: cheilocystidia; g: pileipellis (Singer 8262) (scale bar = 10 μm, except a & g = 15 μm).

view, verrucose to finely verrucose, sometimes interconnected forming coarse, short lines, pale yellowish to yellowish with brownish orange ornamentation, moderately thick-walled (up to 0.5 µm wide); the verrucae seen under SEM are rounded or more or less conical, the wall bearing also small verruculae. **Basidia** 18-25 x 7-12 µm, tetrasporic, some bisporic, clavate, hyaline, clamped. **Cheilocystidia**: the gill edge hardly can be revived with KOH, it is difficult to recover it, hence our observations were made on a limited number of these structures: 20-40 x (3-) 4-6 (-8) µm, clavate or narrowly-clavate, with a more or less capitate or rounded apex 8-12 mm wide, some subcylindical elements are also present, hyaline, thin-walled, clamped. **Pileipellis**: the present state of preservation of the sample limits the complete study of the pileipellis. **Clamp connections** present.

Remarks. This variety described by Singer (1973) from Mexico was said to be macroscopically similar to the typical variety, but separated by '... somewhat pigmented pileus, variable cheilocystidia and very variable spores...'. We found that the basidiospores exhibited by the holotype have a different morphologic pattern (broadly ellipsoid, verrucose) that clearly indicates that this material belongs to a different taxon. Macroscopically the collection resembles specimens of *C. palmarum*. Based on the macroscopic data provided by Singer (1973), in combination with the basidiospores and cheilocystidia observed in the holotype, we concluded that specimen *Singer M 8761* corresponds to an intermediate form of *C. palmarum* (see above).

8. Crepidotus molliformis **Figure 10e-g. Plate 1b**

Crepidotus molliformis Singer, Beih. Nova Hedwigia 44: 441, 1973.

> HOLOTYPE. MEXICO. MORELOS: NW Tepoztlán, 1-VII-1969, ad trunci corticem arboris dicotyledoneae probabiliter *Quercus*, Singer *M8262* (F).

Basidiospores 8-9.5 (-10) x 5.5-6.5 µm, *RM* = 8.7 x 5.9 µm, *Q* = 1.47, ellipsoid to somewhat amygdaliform in side view, smooth, thick-walled (up to 0.5 µm wide), brown-yellowish to ochraceous. **Basidia** (18-) 20-27 (-30) x 8-10 µm, tetrasporic, clavate, hyaline, clampless. **Pleurocystidia** none. **Cheilocystidia** 25-78 x 4-8 (-9) µm, lageniform to narrowly lageniform, with apex 4-7 µm wide, some moderately cylindric, hyaline, clampless, abundant, immersed in a gelatinized matter, then forming a more or less refringent layer on lamella edge, often arising below hymenium from more or less loosely arranged, filamentous, commonly bifurcate, hyaline hyphae 2-5 (-8) µm wide. **Pileipellis** a cutis of radially oriented, septate, yellowish-brown to pale brown hyphae 5-15 (-20) µm wide, not or slightly gelatinized, forming an interrupted layer, variable in width and which constitutes the scales of pileus surface, coarsely or finely incrusted, with inter or intraparietal incrusting brown pigment, sometimes the incrustations forming lines in a more or less transversal arrangement, terminal hyphae undifferentiated, often in groups, somewhat erect and then with a trichodermoid appearance. **Pileus trama** with the upper portion, below the pileipellis, as a wide refringent, gelatinized layer composed of more or less filamentous to cylindric, somewhat loosely and radially arranged, thin-walled, colorless hyphae 2-7 (-9) µm wide, downwards the tissue is more compactly arranged, with cylindric or short-bifurcate hyphae 4-15 (-20) µm wide, hyaline, tending to form a puzzle-like structure. **Hymenophoral trama** with poorly differentiated, gelatinized laterostrata, which are more differentiated towards the lamella edge; mediostratum with cylindric and puzzle-like hyphae. **Clamp connections** absent.

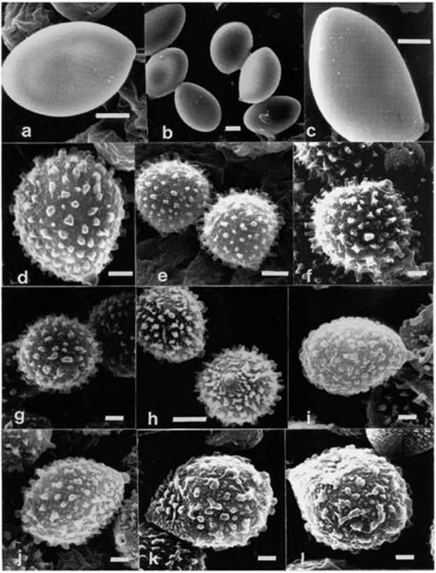

Plate 1. *Crepidotus* basidiospores (SEM): a-c: *Crepidotus calolepis* (a: Singer 8029, holotype of *C. calolepis* var. *heterocystis*; b: Singer 8262, holotype of *C. molliformis*; c: Murrill 556, holotype of *C. calolepioides*); d-g: *C. latifolius* var. *latifolius* (d: Smith 66263; e-f: Singer 8384; g: Lloyd 49964); h: *C. latifolius* var. *praelatifolius* (Rhoads s.n.); i-l: *C. palmarum* (i-j: Singer 8038; k-l: Singer 8761, holotype of *C. latifolius* var. *veraecrucis*) (scale bar = 1 μm, except a-c & e, h = 2 μm).

Remarks. In spite of the fact that the type specimen of *C. molliformis* clearly exhibits refringent, gelatinized layers in both pileus and hymenophoral trama, Singer (1973) excluded it from his '*stirps Mollis*' without making any comment on it. Although this author found *C. molliformis* to be '... macroscopically glabrous at maturity...' he emphasized its resemblance to *C. fulvotomentosus* Peck with regard to pileus surface. Peck´s taxon is accepted as a synonym of *C. calolepis* (Singer 1947, 1973; Hesler and Smith 1965; Nordstein 1990; Seen-Irlet 1995) and the degree of fibrillosity recorded for the specimen *Singer M 8262* is interpreted here as part of the individual variation. A taxonomic segregation between *C. molliformis* and *C. calolepis* would be weakly justified based on a transitional state of pileal characteristics. Microscopic features described above strongly relate Singer's specimen to the group of examined collections of *C. calolepis* (see above). Thus, macro- and microscopic characters are consistent enough to interpret the specimen *Singer 8262* as conspecific with this latter taxon.

The same collection, *Singer M 8262*, was used by Singer (1973 p. 445) under *C. sublevisporus* from Morelos, Mexico. This latter is treated as a synonym of *C. albidus* (Bandala and Montoya 2000a), and none of Singer's collections of this species from Morelos currently studied by us agree with the date provided by him (1-VII-1969). That mention was probably due to a printing error.

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New and interesting species of *Russula* from the southeastern United States 1. *Russula billsii*

STEVEN L. MILLER
fungi@uwyo.edu
Botany Department, University of Wyoming
Laramie, Wyoming 82071 USA

Abstract—*Russula billsii* is proposed and described as a new species. This species is closely related to *R. burlinghamiae* and *R. ballouii* from the southeastern United States and *R. viscida* and *R. ochroleuca* from Europe. Information is provided on the ecology, morphology, and anatomy and comparisons are made with related taxa.

Key words—biodiversity, ectomycorrhiza, basidiomycete taxonomy, Russulaceae

Introduction

Species in the genus *Russula* are conspicuous and important mushroom elements in most forest ecosystems. Their ectomycorrhizal habit and importance as a source of food for insects and larger animals has been well documented (Bills, Holtzman & Miller 1986, Villeneuve, Grandtner & Fortin 1989, 1991, Gardes & Bruns 1996, Fogel 1975, Fogel & Trappe 1978). Despite the importance of these fungi, in-depth studies directed explicitly at the Russulaceae mycoflora of many parts of North America are notably lacking. This is especially true for the southeastern United States where no monographic works have been published since the extensive studies of *Russula* from the southern Appalachians by Bills et al. (Bills & Miller 1984, Bills 1984, 1985, 1986, 1989).

The purpose of this paper is to describe one particularly interesting species of *Russula* from the mountains of West Virginia. It is hoped that this paper will rejuvenate studies of the Russulaceae in this important biogeographic region, and that others will make similar taxonomic contributions in the near future.

Materials and Methods

Methods of collection, terminology used, and classification were generally those of Miller, Aime & Henkel (2002). Basidiospore size and shape were determined from optical sections in side view with the apiculus clearly evident and excluding the ornamentation. Color names and descriptions were taken from the Methuen Handbook of Colour (Kornerup & Wanscher 1981); the designations 4A5 refer to Page 4, row A, and color block 5. Spore print colors were compared with the "Code des Couleures de Sporées chez les Russules" found in (Romagnesi 1967). Herbarium names are abbreviated according to Holmgren, Holmgren & Barnett (1990). Dried specimens were examined with standard microchemical reagents useful in the genus.

Taxonomic Description

Russula billsii S.L. Mill. FIGURES **1–2, 3–10**

Aspectu R. ballouii similis, sed illo pileo fusco-rubro granulis, flocculis et pubescentia armeniacis differt. Holotypus hic designatus: West Virginia, Tucker County, Dolly Sods Wilderness Area, 24 August 1984, col. Gerald Bills GB840 (RMS).

Etymology: Latinized (*billsii*), in honor of Dr. Gerald F. Bills who made a significant contribution to our knowledge of the *Russula* flora of the southern Appalachians.

Pileus 2.2–6.5 (9) cm broad, hemispheric young, then broadly convex to plano-depressed; margin incurved young then plane, finally uplifted, not striate to obscurely striate young, in age obscurely sulcate-striate; cuticle separable 1/3 to 3/4 to disc; surface dry to moist, tacky when moist, not viscid, dull, minutely velutinous to scurfy, with fine aereolate scales that form as granular cuticular fragments toward the margin during pileus expansion, disc smooth with canescent bloom to heavily scurfy, bloom pale greyish yellow, scales and granules bright orange yellow, 4A5–5A6, with cuticle beneath scales dark vinaceous grey 9E5 at disc, shoulders bright red or dark red 9A6–8, 9B6–79C7–8 to reddish brown 9D5–7, greyish red 9C4–6 toward margin fading to light red 9B4–5 at margin of older specimens often with small pale yellow flecks or streaks; trama firm to turgid, up to 4 mm thick at midradius, white with pinkish zone immediately beneath the cuticle, unchanging when cut; odor mild; taste acrid.

Lamellae adnate to slightly notched, close to crowded, forked commonly near stipe and occasionally elsewhere, frequently anastomosing especially in age, lamellulae present at various ranks, often associated with anastomosis, brittle, up to 5 mm broad at midradius, subacute in front, pale yellowish white young then as dark as Romagnesi IIB–C; edges even.

Stipe 3.5–6 cm tall, 1–1.6 cm wide at midpoint, equal or enlarged somewhat at apex or base or constricted midway; surface dry, dull, covered with fine pruinae or aereolate scales, scales aggregated below into distinct bands as a result of outer cuticle fragmentation during stipe expansion, with faint longitudinal rugulose pattern beneath the scales; white to cream white at first, then pale yellow brown, ochraceous-buff near 4–5B5, pale cream or with faint pinkish tint just below the lamellae, scurfy material white at first, discoloring ochraceous-buff where handled; trama stuffed when young, core spongy in age, white, unchanging or discoloring pale brownish-buff when injured.

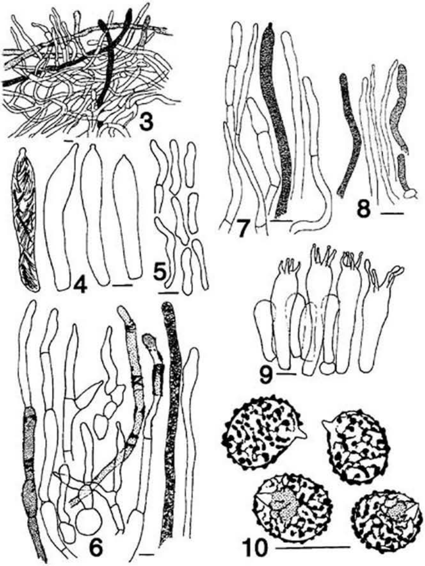
Figs. 1–2. *Russula billsii* (*GB 840*), x 0.5. 2. *Russula billsii* (*GB 840*), x 1.0. The arrow at "s" denotes the scales formed by stretching of the stipe cuticle during expansion of the stipe (photo by Gerald Bills).

Chemical reactions: (stipe trama): formalin-faintly pink, SV-pale pinkish violet, $FeSO_4$- pale pink, phenol-gray maroon, aniline (lamellae)-yellow, to yellowish orange, finally orange with surrounding gray zone after 1 h.

Basidiospores pale yellowish white (Romagnesi IIB–C) in mass, 8–9.6 x 6.4–8 μm, obovate to broadly obovate; ornamentation amyloid, 0.2–1 μm high, consisting of prominent, cylindrical to conical verrucae, short ridges and fine particles, verrucae often aggregated into short catenulate ridges, verrucae and ridges interconnected by low connectives, forming a partial to nearly complete reticulum; suprahilar area often depressed, ornamented with an aggregation of fine amyloid particles or low diffuse patches, sometimes bordered by a line of fine particles, or with fine radiating lines; hilar appendix non-amyloid, conspicuous. **Basidia** 40–52 x 8.8–11.2 μm, clavate to broadly clavate, hyaline to pale yellow in KOH, 4 sterigmate. **Hymenial cystidia** as pleuromacrocystidia and cheilomacrocystidia, 72–110 x 9.6–11.2 μm, cylindrical, narrowly clavate, lanceolate or subventricose, usually with an acute or mucronate apex, occasionally with an amorphous exudation at the apex, grayish brown in SV, hyaline to pale yellow in KOH with crystalline contents, arising from trama, projecting up to 20 μm beyond the basidia, very abundant; **marginal cells** abundant, small, basidiomorphous to often irregularly constricted or swollen or more or less sinuous. **Subhymenium** pseudoparenchymatous, 3–4 cells thick, cells 5–10 μm in diam. **Lamellar trama** composed of sphaerocytes, connective hyphae and laticiferous hyphae and enterocystidia; sphaerocytes 15–30 μm in diam, connective hyphae cylindrical 4–5 μm in diam, laticifers with pale yellow refractive contents in KOH, 5–6 μm in diam, occasionally terminating in enterocystidia with rounded terminus and finely granular contents.

Pileipellis two-layered, not gelatinous; epicutis a trichoderm consisting of erect, tangled hyphae and scattered dermatocystidia frequently aggregated into fascicles or with free ends embedded or agglutinated into a crust-like layer by a yellow to reddish brown incrusting material; epicuticular hyphae septate, branched, 3–5.5 μm in diam, with blunt, undifferentiated ends, hyaline, yellow to reddish brown in KOH or with reddish brown incrustations; incrusting material insoluble in KOH, and ethanol, dark blue orthochromatic in Cresyl Blue and losing color rapidly but remaining heavily incrusted in Basic Fuschin and dilute HCl; dermatocystidia cylindrical to narrowly clavate, with rounded or slightly attenuated apices, 0–2-septate, 25–105 x 3.5–8μm, contents slightly refractive, hyaline to pale yellow in KOH, pale grayish brown in SV, originating from laticiferous system; subcutis composed of interwoven, branched and unbranched hyphae and intermixed laticiferous hyphae; subcuticular hyphae septate, branched, 2–7.5 μm in diam, hyaline in KOH; laticiferous hyphae flexuous, 5–9.5 μm in diam, with yellow refractive contents in KOH, grayish brown in SV. Pileus trama composed of sphaerocytes, connective hyphae and laticiferous hyphae; laticiferous hyphae abundant, 4–10 μm in diam, pale yellow refractive contents in KOH, grayish brown in SV.

Stipe cuticle at the apex composed of erect, suberect or interwoven hyphae and gloeopleurous elements similar to the pileipellis; hyphae septate, branched or unbranched, hyaline or yellow to reddish brown in KOH, 3–9 μm in diam, often incrusted, with hyphal ends often fused into a crust-like layer or filled with dark



Figs. 3–10. Microscopic spore and pellis features of *Russula billsii (GB 840)*. Scale bars = 10 μm. 3. Pileipellis of erect, tangled hyphae and scattered dermatocystidia covered with encrusted often agglutinized hyphae. 4. Pleuromacrocystidia and cheilomacrocystidia. Crystals in cystidium at left are indicative of sulfovanillin staining. 5. Marginal cells. 6. Elements of suprapellis. Note uniformly granular contents of gloeopleurous hyphae, and incrusted hyphae from scurfy or floccose layer of pileus. 7. Caulocystidia and gloeopleurous elements of stipe apex. The three elements mounted in KOH on the right are gloeopleurous hyphae filled with uniformly granular material. 8. Caulocystidia and gloeopleurous elements of scales at the stipe base. The two elements at left are gloeopleurous hyphae mounted in KOH and are filled with uniformly granular material. The two hyphae at right mounted in KOH are filled with uniformly dark yellow brown resinous material. 9. Basidioles and 4-sterigmate basidia. 10. Basidiospores with depressed suprahilar area and low verrucae and connectives, forming a partial to nearly complete reticulum.

yellow brown material similar to pileus cuticle; crust-like layer continuous on young stipe, separating into scales as the stipe expands; elements of the stipe base similar but narrower, hyphae 2–5 μm in diam gloeopleurous elements up to 5 μm diam. Stipe trama consisting of an outer and inner cortex; outer cortex pseudoparenchymatous with abundant laticifers; laticifers 4.5–8.5 μm in diam, with yellow refractive contents in KOH, grayish purple in SV; inner cortex composed of nests of sphaerocytes surrounded by connective hyphae and laticifers.
Clamp connections absent in all tissues.
Habit, habitat, and distribution — Gregarious on soil, in forests dominated by *Tilia heterophylla* L., *Betula lenta* L., *Tsuga canadensis* (L.) Carr, *Betula alleghaniensis* Britton, *Rhododendron maximum* L. Known only from West Virginia; fruiting August to September.

> **MATERIAL EXAMINED—USA. West Virginia: Tucker Co.** G. Bills 840, Red Creek, Dolly Sods Wilderness Area, 2 August 1984 (**Holotype** RMS). **Tucker Co.** G. Bills 839, Dolly Sods Wilderness Area, 2 August 1984 (RMS). **Randolph Co.** C. Ovrebo and N. S. Weber, 2 August 1985 (RMS). **Barbour Co.** Donna Mitchell WV97-9, Laural Mt., 6 September 1997 (RMS).

Discussion

The fine scales, granules and abundant yellow-orange floccules and pubescence on the pileus, the ornamented stipe with basal aereolate scales and basidiospores with verrucae and ridges interconnected by low connectives and forming a partial to nearly complete reticulum indicates a close relationship with *R. ballouii* Peck also found in the southeastern United States (Bills & Miller 1984). These characters also suggest a relationship with *R. viscida* Kudrna from Europe, which has a granulose pileus especially at the disk, but lacks the yellow orange floccules, although a yellow base may be present on the stipe (Kibby 2000, Galli 1966). Kibby (2000) stated that the only species that *R. viscida* could be confused with in Great Britain is *R. atropurpurea* (Kromb.) Britzelm. except that *R. atropurpurea* lacks the yellowish-brown crustose base.

Bills & Miller (1984) followed Singer (1975) in placing *R. ballouii* in subsection Fistulosinae R.Heim because of the strikingly ornamented stipe and the scales and granulose nature of the pileus. They also indicated a close affinity between *R. ballouii* and *R. burlinghamiae* Singer (=*R. insignis* Burl., *non* Quél.) which has recently been recollected and identified from both Costa Rica and the southeastern United States (R. Halling, pers. comm.), and which also has a strongly ornamented pileus and stipe. *Russula billsii* and *R. burlinghamiae* both possess the aereolate to granulose pileus and stipe ornamentation as well as the yellow pubescence on the pileus and often the stipe.

In a molecular analysis of representatives of all infrageneric groups from Europe, Miller & Buyck (2002) found support for a previously undocumented relationship between *R. ochroleuca* (Pers.) Fr., *R. atropurpurea*, and *R. viscida*. These fungi were not related to members of the subsection Fistulosinae. Features of the pileus cuticle and basidiospore ornamentation in *R. billsii*, *R. ballouii* and *R. burlinghamiae* from the southeastern and eastern United States show a great deal of similarity to these European taxa. Sequence data (not shown) for the group also indicates a close relationship between these European and North American taxa. This suggests that stipe and pileus ornamentation, while useful characters for identification of several species in this group, are not unifying characters at the infrageneric level.

The placement of *R. billsii* and related species in an infrageneric classification scheme is somewhat difficult at the present time. *Russula atropurpurea*, *R. ochroleuca* and *R. viscida* have each been placed in separate subgenera, sections or subsections by previous experts on European *Russula* taxonomy (Romagnesi 1967, Singer 1986, Sarnari 1998). Peck (1913) did not explicitly place *R. ballouii* in a specific infrageneric group at the time of his original description. Burlingham (1915) placed her *R. insignis* (=*R. burlinghamiae* Singer) and *R. ballouii* together in section Insignes along with several other species because they possessed a yellowish stipe "adorned, at least below, with deeper yellow granules or squamules." She found no relationship with either *R. atropurpurea*, which she placed in section Atropurpureae, or *R. ochroleuca*, which she placed in the section Ochroleucae. Because not all species related to *R. billsii* share the features of ornamented pileus or stipe or the yellow floccules or pubescence, and several additional related neotropical and temperate species are in need of critical examination, it is perhaps best to hold off on the creation and formal validation of a new section or subsection at this time.

Acknowledgements

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Suttoniella arnaudii sp. nov. (Coelomycetes) on dead leaves of *Buxus sempervirens*

PILAR HOYO & ANTONIO GÓMEZ-BOLEA
agomez@ub.edu
Dep. Biologia Vegetal (Botànica), Fac. Biologia, Universitat de Barcelona
Avda. Diagonal, 645. E-08028 Barcelona. Spain

Abstract–A new species *Suttoniella arnaudii* (Coelomycetes) is recorded from Catalonia, in northeastern Spain, on dead leaves of *Buxus sempervirens*. This is the first report of the genus *Suttoniella* in Europe. *S. arnaudii* is characterized by large pycnidia and conidiogenous cells, and short secondary arms of the conidia. A key to *Suttoniella* species is provided.

Key words – taxonomy, saprotrophic fungi, triradiate conidia

Introduction

Since 1994 the first author (PH) has been studying the fungi that grow on *Buxus sempervirens* L. in Catalonia (Muntañola-Cvetković et al. 2001). We have found, on fallen leaves of this plant, a fungus which resembles that drawn by Arnaud (1954). It was identified as *Blennoria buxi* Fr. Arnaud gave no description of the fungus, but indicated that it was found on *Buxus* from Montpellier (France). Sutton (1972) rectified the identification of *B. buxi* by Arnaud (1954) and concluded that it belonged to the genus *Suttoniella* Ahmad. Sutton tried to inspect Arnaud's material, but it was not found in the Arnaud herbarium. In any case, Sutton (op. cit.) commented that, of the two species of *Suttoniella* described until then, Arnaud's material came closer to *S. eriobotryae* (Ahmad) Ahmad because of the size of the conidia. However, in *S. eriobotryae* the arms of the conidia are tapered towards the apices, whereas in Arnaud's drawings they are cylindrical and obtuse at the apices (Sutton, op. cit.).

On the basis of Arnaud's drawing and our collections, we propose a new species of *Suttoniella*, and a key to species of *Suttoniella*.

Materials and Methods

Eighty-eight sites in Catalonia (Spain) have been prospected since October 1994, in all seasons of the year. Dead leaves were inspected immediately for fungal structures, or air-dried for further study. Air-dried samples were incubated in moist chambers for 1-9 days before examination. The specimens were examined with a binocular dissecting microscope (Olympus SZH10) and a Leitz Diaplan microscope with DIC (differential interference contrast) optical systems. Hand-cut sections of the material were mounted in water or in lactophenol-fuchsin. All measurements were made in water. The 95% confidence intervals were derived from 30 conidia and 10 conidiogenous cells measured to determine the range of variation in size of these cells, with the extremes given in parenthesis. Voucher specimens are kept at BCN-Myc. (Barcelona Herbarium).

Taxonomy

Suttoniella arnaudii Hoyo & Gómez-Bolea, **sp. nov.** (Fig. 1 and 2)
Etym.: the species is named after Gabriel Arnaud (1882-1957), a French mycologist who was the first author to observe it.

> *Pycnidia amphigena, sejuncta, ovalis vel polygonalis (triangularia, tetrangularia, pentangularia), coriacea, anthracinea, initialiter subepidermalia, postea erumpentia, usque ad 3000 µm diam., fissura transversale vel triradiata, tetraradiata, pentaradiata dehiscentia. Stratum basale pycnidii 47-52 µm altum, hialinum vel pallide brunneum cellulis pseudoparenchymatis efformatum et strato hypharum verticalium superatum, cujus cellulae ultimae conidiogenae. Tectum pycnidii cellulis parvis brunneis pseudoparenchymatis, parietibus crassis compositum. Cellulae conidiogenae hyalinae, oblongus, polyblasticae, 17-23 x 9-12.5 µm. Conidia blastica, solitaria, ramosa, duobus brachiis primariis cellula basale junctis et quatuor brachiis secundariis binatim brachiis primariis insitis, compositus. Cellula basali hyalina, non-septata, laevia, furcata, 5.9-6.3 x 1.8-2 µm. Brachii primaria hyalina, non-septata, laevia, cylindrica, (15-)17-20 x 2.5-3.5 µm. Brachia secundaria divergentia, hyalina, non-septata, laevia, cylindrica, ad extremitatem rotundata, 15-20 x 2.5-3.2 µm, primariis constrictione angusta nexa. Brachia primaria cum brachiis secundariis ad maturitatem a cellula basali separata.*

Holotype: Spain: Catalonia: Barcelona: 2 Km from Olesa de Bonesvalls on the road to Vallirana, alt. 350 m, U.T.M.: 31TDF0579, on leaf litter of *B. sempervirens*, 7 June 2003, *J. A. Ramírez* and *P. Hoyo*, (BCN-Myc. HOYO-322).

Pycnidia amphigenous, isolated, oval or polygonal (triangular, tetrangular, pentangular), coriaceous, glossy black, initially subepidermal, later erumpent, up to 3000 µm in diameter, dehiscing by transverse fissure or a triradiate, tetraradiate or pentaradiate fissure. *Basal stratum* of pycnidium 47-52 µm high, hyaline to pale brown, pseudoparenchymatous cells surmounted by a layer of vertical hyphae, with ultimate cells conidiogenous. *Roof of pycnidium* composed of small, brown, thick-walled pseudoparenchymatous cells. *Conidiogenous cells* hyaline, oblong, polyblastic with 1-5 apertures, 17-23 x 9-12.5 µm. *Conidia* blastic, solitary, branched, composed of two primary arms linked to a common basal cell and four secondary arms, two per each primary arm. Basal cell hyaline, non-septate, smooth, forked, 5.9-6.3 x 1.8-2 µm. Primary arms hyaline, non-septate, smooth, cylindrical, (15-)

17-20 x 2.5-3.5 µm. Secondary arms divergent, hyaline, non-septate, smooth, cylindrical, rounded at the distal end, 15-20 x 2.5-3.2 µm, connected by a narrow constriction to the primary arm. Primary arms along with their respective secondary arms getting detached from the basal cell at maturity.

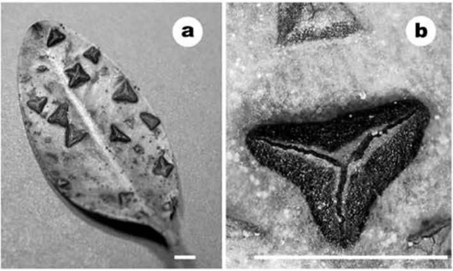

Fig. 1. *Suttoniella arnaudii* (Holotype BCN-Myc. HOYO-322). a.- Pycnidia on a *B. sempervirens* leaf. b.- Detail of a pycnidium. Scale Bars = 1,7 mm.

Ecology and distribution: *S. arnaudii* has been found at 8 localities in Catalonia (Spain) and from Montpellier (France) (Arnaud 1954). It grows on fallen leaves of *B. sempervirens*, at altitudes between 350 – 800 m. We found *S. arnaudii* only where *B. sempervirens* grows in the mediterranean region of Catalonia. *Suttoniella arnaudii* occurs together with *Microthyrium macrosporum* (Sacc.) Höhnel and, more rarely, with *Blennoria buxi*, *Botryosphaeria* sp., *Chaetopsina* cf. *fulva* Rambelli, *Dothiorella candollei* (Berk. & Br.) Petrak, *Gibberella buxi* (Fuckel) Winter and its anamorph *Fusarium lateritium* (Nees) emend. Snyder et Hansen var. *buxi* Booth, *Gyrothrix circinata* (Berk. & Curt.) Hughes, *Marasmius buxi* Fr. in Quél., *Pseudonectria coronata* (Juel) Lowen and its anamorph *Sesquicillium buxi* (J. C. Schmidt) W. Gams, and *Pyrenochaeta ilicis* M. Wilson. Well sporulated conidiomata were found from March to June. Material collected between December and February formed conidia after 1-9 days of incubation in a moist chamber. However, material collected between September and November, and submitted to the same treatment, did not form conidia.

ADDITIONAL SPECIMENS EXAMINED – SPAIN. CATALONIA: **Anoia**, Castellolí, in the Bruc tunnel, 31TCG9405, alt. 600 m, 5 May 2003, *R. Quadrada*, (BCN-Myc. Hoyo-288). **Mediona**, Obaga de Rofes, 31TCF8294, alt. 670 m, 30 November 2002, *P. Hoyo* (BCN-Myc. Hoyo-208). **Bages**, Balsareny, 31TDG0635, alt.

400 m, 3 May 2003, *P. Hoyo* and *J.A. Ramírez* (BCN-Myc. Hoyo-287). **Berguedà**, Borredà, Cobert de Puigcercós, 31TDG2165, alt. 800 m, 19 October 2002, *P. Hoyo*, (BCN-Myc. Hoyo-192). Ibidem. *P. Hoyo*, *A. Longán* and *E. Llop*, 28 February 2003 (BCN-Myc. Hoyo-259, 260, 262 and 266). **Osona**, Orís, 31TDG3459, alt. 575 m, 28 September 2002, *P. Hoyo* (BCN-Myc. Hoyo-183). Ibidem. *E. Llop*, *P. Hoyo* and *A. Longán*, 28 February 2003 (BCN-Myc. Hoyo-267, 268 and 286). Ibidem. *J.A. Ramírez* and *P.Hoyo*, 31 May 2003 (BCN-Myc. Hoyo-321). **Osona**, Seva, 13,5 Km road to Viladrau, 31TDG4332, alt. 740 m, 9 March 2003, *P. Hoyo* (BCN-Myc. Hoyo-323).- Ibidem. *P. Hoyo*, 26 April 2003 (BCN-Myc. Hoyo-318). **Osona**, 3 Km to Sora, 31TDG3263, alt. 720 m, 31 May 2003, *P.Hoyo* and *J.A. Ramírez* (BCN-Myc. Hoyo-320).

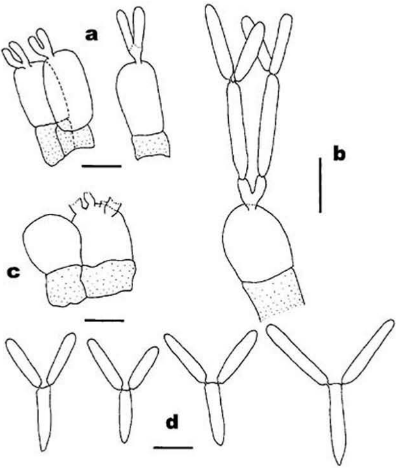

Fig. 2. *Suttoniella arnaudii* (Holotype BCN-Myc. HOYO-322). a-b.- Stages in the development of conidia. c.- Conidiogenous cells. d.- Conidia. (Scale Bars = 10 µm).

Discussion

Pseuderiospora Petrak was the genus proposed for the new species *P. gaubae* (Petrak 1959). Ahmad (1960a) pointed out that the generic name *Pseuderiospora* Petrak is a later homonym of *Pseuderiospora* Keissler published in Anzeiger Akad. Wiss Wien nr. 11, p. 75, and consequently he proposed the new name *Suttonia*, in honour of B.C. Sutton. The same author changed the generic name *Suttonia* to *Suttoniella*, because his original name was already occupied by *Suttonia* A. Rich., 1832 (Myrsinaceae) (Ahmad 1960b). Consequently, the species typus must be named *Suttoniella gaubae* (Petrak) Ahmad. The key features of the genus *Suttoniella* are the gross pycnidia, the poliblastic conidiogenous cells and the armed conidia. Subramanian & Sudha (1979) were the first authors to describe correctly the conidial ontogeny of *Suttoniella* species. They are formed by three parts: a) basal cell bifurcated distally and with a truncate base; b) two primary arms distally supported by the basal cell, one in each bifurcation, and c) four divergent secondary arms, two on each primary arm. The hitherto known species of the genus *Suttoniella* are: *S. gaubae*, *S. eriobotryae* and *S. ixorae* Subram. & Sudha. *S. gaubae* was originally described from Kangaroo Island (South Australia) on *Alyxia buxifolia* R. Br. (Petrak 1959). *S. eriobotryae* was originally described from Choa Saidan Shah (West Pakistan) on fallen leaves of *Eriobotrya japonica* (Thunb.) Lindl (Ahmad 1960a). *S. ixorae* was originally described from Tambaram, Madras (India) on leaf litter of *Ixora parviflora* Vahl. (Subramanian & Sudha 1979).

S. arnaudii differs from the remaining *Suttoniella* species in having has larger pycnidia and conidiogenous cells, and shorter secondary arms of the conidia. Comparative main features are summarised in Table 1 and a key to identify *Suttoniella* species is given below. In *S. arnaudii* the basal cell of conidia is ephemeral, and it leaves two dispersion units in a Y-shape. The time of maturation of the conidia is very short. In a moist chamber, no basal cells can be observed after 7 h and only the dispersion units are visible.

Key to Suttoniella species

1 Pycnidia more than 1500 µm wide. Conidia with primary arms (15-)17-20 x 2.5-3.5 µm and secondary arms 15-20 µm long................***S. arnaudii***

1' Pycnidia up to 1500 µm wide, conidial arms otherwise..2

2 Primary arms 4.5-5 µm wide...***S. eriobotryae***

2' Primary arms up to 3.5 µm wide...3

3 Secondary arms (26-)32-43(-50) µm long..***S. gaubae***

3' Secondary arms 20-27 µm long...***S. ixorae***

Table1. Comparative main features extracted from the protologues.

	S. gaubae (Petrak 1959)	*S. eriobotryae* (Ahmad 1960a)	*S. ixorae* (Subramanian & Sudha 1979)	*S. arnaudii*
Pycnidia	(300-)500-800 (-1000) µm, orbicular to elliptic, dehiscing by irregular fissures spreading from the centre	625-875 µm, elliptic	900-1200 µm, triangular, oblong to round, dehiscing by a transverse slit or a triradiate fissure	Up to 3000 µm, oval or polygonal, dehiscing by irregular fissures (1-)3 (-5) spreading from the centre
Basal stratum	(12-)15 (-20) µm	50-100 µm	—	47-52 µm
Conidiogenous cells	—	5-10 x 5-15 µm	14-18.5 x 7.8-8 µm, hyaline at first, later brown, cylindrical, polyblastic	17-23 x 9-12.5 µm, hyaline, oblong, polyblastic
Conidia: Primary arms	(12-)15(-20) x 2.5-3.5 µm	13.5-25 x 4.5-5 µm	18.7-24.5 x 2.6-3.3 µm, cylindrical	(15-) 17-20 x 2.5-3.5 µm, cylindrical
Conidia: Secondary arms	(26-)32-43 (-50) x 2.5-3.5 µm	20-30 x 4.5 µm	19.9-27 x 2.4-3 µm, cylindrical, rounded at the distal end	15-20 x 2.5-3.2 µm, cylindrical, rounded at the distal end
Substrate / Distribution	Leaves of *Alyxia buxifolia*. Australia	Leaves of *Eriobotrya japonica*. Pakistan	Leaf litter of *Ixora parviflora*. India	Dead leaves of *Buxus sempervirens*. Spain

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Lactarius subgenus *Piperites*: a new species and a new name

LETICIA MONTOYA & VICTOR M. BANDALA
montoya@ecologia.edu.mx bandala@ecologia.edu.mx
División de Sistemática, Instituto de Ecología
P.O. Box 63, Xalapa, Veracruz 91000, Mexico

Abstract—Two members of *Lactarius* subgenus *Piperites* were studied. *Lactarius miniatosporus* corresponds to a new species in section *Dapetes*, found in association with *Pinus* in the central region of the Gulf area of Mexico. It is compared with its close relatives, *L. subpurpureus* from the U.S., *L. thakalorum* from Nepal and the European *L. sanguifluus*. A type study revealed that morphocharacters of the U.S. variety *Lactarius scrobiculatus* var. *pubescens* (section *Crocei* subsection *Scrobiculati*) exclude its placement under *L. scrobiculatus*. We propose a new rank and the new name, *L. smithii* for this taxon.

Keywords—*Russulales*, taxonomy, ectomycorrhizal fungi

Introduction

Most species in *Lactarius* subgenus *Piperites* (Fr.) Kauffman, section *Dapetes* Fr. and those in section *Crocei* Hesler & A.H. Sm. (subsection *Scrobiculati* Hesler & A.H. Sm.) presently known from Mexico occurs in coniferous forests. Nearly half of the described species of *Pinus* in the world occur in that country (Styles 1993). This genus can be recognized as the main element that influences the distribution of populations of these groups of *Lactarius*, affecting the presence in Mexico of several *Lactarius* species known to occur (Hesler and Smith 1979) in the U.S. and Canada. For example *Lactarius paradoxus* Beardslee & Burl. (section *Dapetes*) has been recorded from Canada (Lamoureux and Neumann 1991), and the U.S. (Beardslee & Burlingham 1940; Hesler and Smith 1979; Bessette *et al.* 1997), to Eastern Mexico and as far as the Caribbean (Montoya *et al.* 1998).

In this paper a new *Pinus* associated species of *Lactarius* is described and a new status at specific level for the North American *L. scrobiculatus* var. *pubescens* A.H. Sm. is proposed.

Materials and Methods

Macroscopic features were recorded from fresh material; colors indicated in alphanumeric designations are from Kornerup and Wanscher (1978). The methods followed for the microscopic study are those cited by Montoya and Bandala (2003). The following notations are used in the text: **RM** = range of mean values of basidiospore of length x width; **Q** = range of mean values of coef. Q (length/width ratio of spores) (based on 30 basidiospore measurements in each collection). Herbarium acronyms are according to Holmgren *et al.* (1990).

Taxonomic Description

Lactarius miniatosporus Montoya et Bandala *sp. nov.* **FIGURES 1 a-e, 2 a-b**

Pileus 40-110 mm latus, convexus, plano-convexus, demum depressus, azonatus vel subzonatus, viscidus, subroseus versus rubellus vel subroceo vinaceo pallidus, luteus decolorans; margine valde subroseo rubellus, striato, incurvato. Lamellae subdecurrentes, moderate distantes, vinaceo pallidus. Stipes 15-70 x (8-) 10-20 mm, cilindricus, sordidus subroseus vel subroseo vinaceus. Caro alba, rubescens. Sporae 6.4-8 (-8.8) x 4.8-6.4 (-7.2) μm, ellipticae, sub-reticulatae vel reticulatae, ornamentum 0.6 (-0.8) μm altis. Pleurocystidia absentia. Cheilocystidia 28-48 x 5.6-6.4 μm, sub-fusiformia. Pileipellis ixocutis, hyphis filiformis instructa. HOLOTYPUS: lectus prope MEXICO. VERACRUZ: Mpio. Xico, E Cofre Perote, Ejido Ingenio El Rosario, El Revolcadero, 3.VII.2002, Montoya 3830 (XAL).

Pileus 40-110 mm wide, convex to plano convex, centrally depressed, azonate or with diffuse and vanishing zonations, viscid, pinkish with pale reddish tinges to pale pinkish-vinaceous (7A2-B3, 8A2-B2), with dark pinkish-vinaceous stains (8C5-D5), fading to straw color or yellowish white (4A2-5A2-A3-B2-B4), then often the margin retains the vinaceous-pink or red-vinaceous color (10B8-C8-D8), and the disc remains dull yellowish-white only with pale pinkish tinges, irregularly staining blue-green (25D3-25E8); margin incurved, edge tomentous in young stages, expanded, glabrous and striate in age. **Lamellae** adnate to subdecurrent, subventricose, dichotomous towards the stipe attachment, close to moderately subdistant, 3-9 mm broad, with lamellulae of different length, pinkish-gray (7B3-B4, 8B2-B3) or vinaceous-red in mass, a single lamella more or less pale pink-vinaceous (10C5), staining blue-green (25D3-25E8) when handled; cut areas staining red-vinaceous by the latex. **Stipe** 15-70 x (8-) 10-20 mm, cylindric, smooth, dry, very rarely superficially spotted, dull pink (8A2-B3) to vinaceous-pink (7B3-8A2-C4-C5, 9B4-10B3) or at times vinaceous-red (10C-D5), whitish and subtomentose at the apex, staining blue-green (25D3-E8). **Context** whitish, staining pink (5A2, 7A2-8A2) when exposed, more evident towards the margin of both pileus and stipe, staining vinaceous-red by the latex and staining blue-green (25D3-D4-E8) in all parts. **Odor** mild or of chlorine. **Taste** mild or faintly astringent. **Latex** vinaceous-red (8C7-D7, 9E7-E8), unchanging. **Spore print** pale yellowish-brown.

Basidiospores 6.4-8 (-8.8) x 4.8-6.4 (-7.2) μm, **RM** = 7-8 x 5.5-6.4 μm, **Q** = 1.2-1.3, broadly ellipsoid, ornamented with a partial to complete reticulum, 0.6 (-0.8) μm high; under SEM the ornamentation appears as continuous interconnected ridges forming an incomplete to complete reticulum; isolated warts also present; bands with an irregular and sinuous margin. **Basidia** 49-74 x 8-9.6 μm, clavate, tetrasporic and bisporic. **Pleurocystidia** absent. **Pseudocystidia** filamentous, 4-4.8 μm wide. **Cheilocystidia** 28-48 x 5.6-6.4 μm, subfusiform, ventricose, sinuous; apex pronounced and often constricted, with refringent contents, infrequent. **Pileipellis** an ixocutis, 96-240 μm wide; hyphae 3.2-5.6 μm wide. **Context** hyphae 4.8-7.2 μm wide; laticifers 8-9.6 μm wide; sphaerocytes 28-36 μm wide. **Hymenophoral trama** hyphae 4-6.4 μm wide; laticifers 5.9-7.2 μm wide, with some sphaerocytes distributed towards the upper third of the lamellae.

Habitat — In the ground, gregarious, associated with trees of *Pinus* in pure or mixed forests of *P.nubicola* Perry, *P. pseudostrobus* Lindl. and *P. patula* Schlecht. & Cham.

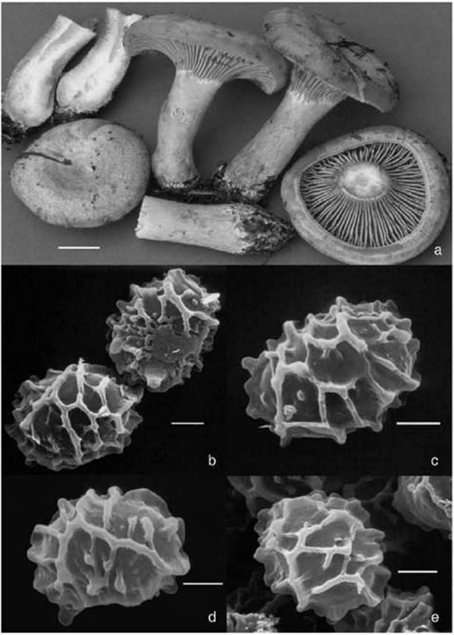

Fig. 1. ***Lactarius miniatosporus***. a: basidiomes (*Montoya 3803*). b-e: basidiospores under SEM (HOLOTYPE). (scale bar = 2 µm, except a = 15 mm).

SPECIMENS EXAMINED. **MEXICO** — **VERACRUZ: Mpio. Xico**, E Cofre Perote, Ejido Ingenio El Rosario, El Revolcadero, 7.VII.1995, *Montoya 3204*, *3205*; 11.VII.1995, *Montoya 3210*; 12.VII.1995 *Montoya 3211*; 3.VII.2002, *Montoya 3830* (HOLOTYPE). **Mpio. Xalapa**, km 2.5 old road from Xalapa

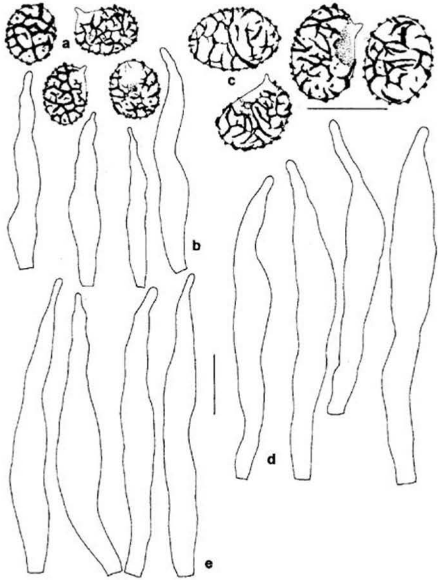

Fig. 2. ***Lactarius miniatosporus***. a: basidiospores, b: cheilocystidia (HOLOTYPE). ***L. subpurpureus***. c: basidiospores, d: pleurocystidia, e: cheilocystidia (HOLOTYPE). (scale bar = 10 µm).

to Coatepec. Botanical Garden, 26.VI.2002, *Montoya 3803*; 1.VIII.2002, *Montoya 3872*; 4.IX.2002, *Montoya 3908*; 27.IX.2002, *Montoya 3923*; 20.VI.2003 *Montoya 3990* (all in XAL).

OTHER SPECIMENS EXAMINED — ***Lactarius subpurpureus*** Peck. **UNITED STATES. N.Y.**: Sandlake & Brewerton, Oct., *Ch. Peck* (HOLOTYPE, NYS). **MICHIGAN: Marquette Co.**, Canyon Lake area, 29.VIII.1970, *Harrison 9514* (MICH). ***Lactarius sanguifluus*** var. ***violaceus*** (Barla) Basso. **SPAIN. BARCELONA**: Cantonigros Region, 15.X.1996, *Montoya 3409* (XAL). ***Lactarius thakalorum*** Bills & Cotter. **NEPAL. DHAULAGIRI**: Mustang Dist., *V. Cotter 1313* (HOLOTYPE, BPI).

Comments — The basidiospore size and absence of pleurocystidia are distinctive when comparing *Lactarius miniatosporus* with other species having basidiomes and latex with vinaceous colors. The periodical monitoring of the populations from Xalapa growing under *Pinus nubicola*, revealed that the variation of pileus color includes a typical tendency to become duller in advanced stages, with the pileus straw color or yellowish-white, and with vinaceous pigmentation only observed at the margin. It is uncommon to observe specimens with the whole pileus uniformly pinkish-vinaceous. Most collections exhibited an azonate pileus or only at times having obscure zonations. In old basidiomes the margin is often striate. These features together with the smooth stipe surface, and blue-green staining of the basidiomes represent a reliable set of macrocharacters to recognize this species in the field.

Lactarius subpurpureus is superficially similar with regard to the basidiome and latex color. Hesler and Smith (1979) reported it with darker basidiomes (dark vinaceous-red, zoned with paler colors) and deep vinaceous-red latex. These authors also recorded for *L. subpurpureus* a cream colored spore deposit. According to American specimens studied, it differs also on having consistently larger basidiospores [(9.6-) 10.4-12 x 7.2-8.8 µm, 11 x 8 µm on avg., with **Q** = 1.4 in the holotype (fig. 2 c, 3 a-b); 9.6-11.2 (-12) x 7.2-8 µm, 11 x 7 µm on avg., **Q** = 1.4 in *Harrison 9514*]. Furthermore, the presence of pleurocystidia distinguish it [44-61.6 x 6.4-8 µm in the holotype (fig. 2 d); 40.4-76.4 x 6.4-9.6 µm in *Harrison 9514*].

Another related species is *Lactarius thakalorum*. According to the protologue (Bills and Cotter 1989), and the study of the type specimen, we conclude that it is distinct from the Mexican taxon by its closer lamellae, presence of pleurocystidia (40-55 x 4-10 µm) and larger basidiospores (8-9.6 x 6.4-7.2 µm, 9 x 7 µm on avg., **Q** = 1.3).

The European *Lactarius sanguifluus* (var. *sanguifluus* and var. *violaceus*) presents another combination of characters, although it is superficially similar to *L. miniatosporus*. The more constantly zonate pileus and scrobiculate stipe, together with pleurocystidia in the European taxon distinguish it. Furthermore, var. *violaceus* has basidiospores 7.2-9.6 x 6.4-8 µm, 9 x 7 µm on avg. (in *Montoya 3409*) or 8-10 x 6.5-7 µm (Basso 1999); and in var. *sanguifluus* they are 7.9-9.5 x 6.3-8 µm, 8-8.8 x 7.1-7.4 µm on avg. (Heilmann-Clausen et al. 1998) or 7.2-9 (-10) x 6-7 µm (Basso 1999).

Lactarius smithii Montoya et Bandala ***nom. nov.*** **FIGURES 3 c-d, 4 a-c**

Basionym: *Lactarius scrobiculatus* var. *pubescens* A.H. Sm., *Brittonia 12*: 323 (1960).
HOLOTYPE: **UNITED STATES. MICHIGAN: Luce Co.**, Taquahmenon Falls State Park, 7.IX.1951 *A.H. Smith 38436* (MICH).

The sharp differences found between the type specimen and *Lactarius scrobiculatus* (Scop.: Fr.) Fr. justify the segregation of the American taxon as an isolated species. For macro- and microscopical details see Hesler and Smith (1960, 1979). Microscopic description below is based on the re-examination of the holotype:

Basidiospores 6.4-8 x 4.4-5.2 (-5.6) µm, 7 x 5 µm on avg; **Q** =1.5; ellipsoid, with the hilar appendix more or less obliquely disposed; ornamentation 0.6 (-0.8) µm high, forming a nearly complete reticulum, with a moderately fine mesh net; under SEM the reticulum is formed of continuous bands, these with a more or less regular margin or somewhat undulate at fused areas, at times with free extremes. **Basidia** 48-60 x 5.6-8 µm, subclavate, tetrasporic

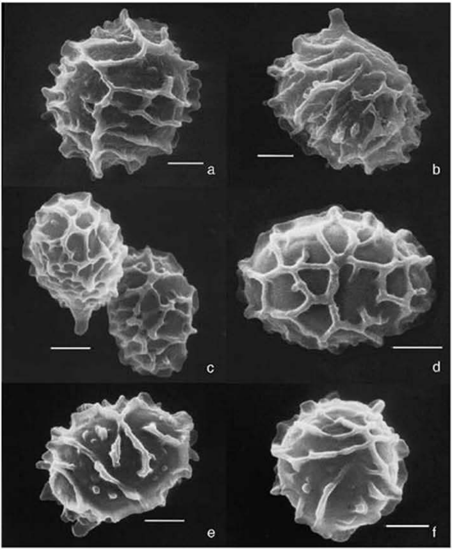

Fig. 3. Basidiospores under SEM. a-b: ***Lactarius subpurpureus*** (HOLOTYPE). c-d: ***L. smithii*** (*A.H. Smith 38436*). e-f: ***L. scrobiculatus*** (*C-27337*) (scale bar = 2 µm).

and bisporic. **Pleurocystidia** 38-48 x 5.2-5.6 µm, fusiform, scarce to absent. **Gill edge** with subcylindric to subclavate sterile elements, sinuous, 9.6-20.8 x 3.2-5.2 µm, sometimes capitate 24-28 x 7.2-10.4 µm. **Pseudocystidia** 3-6.5 µm wide, subcylindric, with refringent contents. **Pileipellis** an ixocutis; hyphae 1.6-4 µm wide, loosely arranged, forming a stratum 200-290 µm deep. **Context** hyphae 4-5.6 µm wide; laticifer hyphae 6.4-9.6 µm wide; sphaerocytes 6.4-32 µm wide. **Hymenophoral trama** hyphae 3.2-6.4 µm wide; laticifer hyphae 4-7 µm wide.

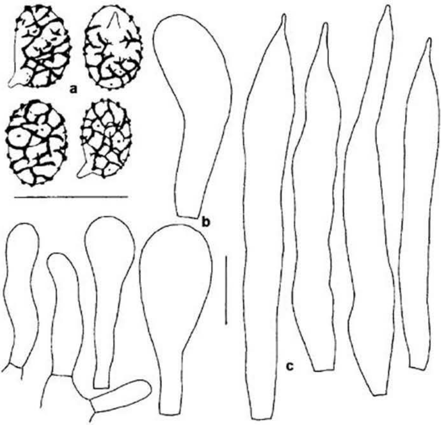

Fig.4. ***Lactarius smithii*** (*A.H. Smith 38436*). a: basidiospores. b: pleurocystidia. c: marginal cells of lamellae (scale bar = 10 µm).

Habitat — Solitary, under *Pinus* (Hesler and Smith 1960, 1979).

OTHER SPECIMENS EXAMINED — ***Lactarius scrobiculatus*** (var. ***scrobiculatus***). **SWEDEN**. MEDELPAD: Borgsjö par., Julasen, 22.VIII.1995, *Vesterholt & Elborne, JV95-305, C-27337* (C).

Comments — The following set of features, observed in *A.H. Smith 38436*, supports (as suggested by Kytovuori 1984) its segregation from *Lactarius scrobiculatus*: *a*) ellipsoid basidiospores [6.4-8 x 4.4-5.2 (-5.6) µm, 7 x 5 µm on avg., **Q** = 1.5]; *b*) these with ornamentation composed of a well defined reticulum (figs. 3 c-d, 4 a), and *c*) the glabrous pileus surface, finely fibrillose only towards the margin (Hesler and Smith 1960, 1979). *Lactarius scrobiculatus* presents *a*) basidiospores with a more constantly subglobose form [7.2-8.8 x 5.6-6.5 µm, 8 x 6 µm on avg., **Q** = 1.25, in the specimen *C-27337*; **Q** = 1.19-1.32, or **Q** = 1.23-1.38 according to Heilmann-Claussen et al. (1998) and Kytovuori (1984) respectively]; *b*) basidiospores irregularly cristulate (figs. 3 e-f) as observed in the specimen *C-27337* and based on the information by Kytovuori (1984) and Heilmann-Clausen et al. (1998), and *c*) the pileus surface finely squamulose

(Heilmann-Clausen et al. 1998). Another apparent difference between both taxa is the stipe surface, which is smooth and glabrous, only superficially spotted in the American taxon, as seen in the holotype (cf. Hesler and Smith 1960, 1979). The European taxon has a scrobiculate stipe, with unequal depressed spots on a pruinose background, and even a ring of coarse, rusty-brown hairs at the base of the scrobiculae (Kytovuori 1984). Based on all these distinctive features, we conclude that the specimen *A.H. Smith 38436* represents an independent species. As the epithet *pubescens* is preoccupied at specific rank, the new name *Lactarius smithii* is proposed.

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Taxonomic studies on Ustilaginomycetes - 24

Kálmán Vánky

vanky.k@cityinfonetz.de
Herbarium Ustilaginales Vánky (HUV)
Gabriel-Biel-Str. 5, D-72076 Tübingen, Germany

Abstract — A new genus, *Ahmadiago*, and sixteen new species of smut fungi are described: *Entorrhiza citriformis*, *E. globoidea*, *Entyloma guizotiae*, *Microbotryum paucireticulatum*, *Sporisorium arundinellae-pumilae*, *S. blakeanum*, *S. euclastae*, *Tilletia acroceratis*, *T. imbecillis*, *T. kenyana*, *T. lyei*, *Tranzscheliella laevispora*, *Urocystis aurea*, *Ur. circaeasteri*, *Ustilago cynodonticola* and *U. duranii*. New names are: *Sporisorium arundinellae-nepalensis*, *S. leersiae-hexandrae*, *S. perforatum* and *S. shivasii*. The name *Tilletia oplismeni-cristati* is validated. New combinations proposed: *Ahmadiago euphorbiae*, *Jamesdicksonia eleocharidis*, *J. melinidis*, *Macalpinomyces neglectus*, *Sporisorium africanum*, *S. andropogonis-tectorum*, *S. arundinellae*, *S. furcatum*, *S. ischaemi*, *S. ischaemi-anthephoroides*, *S. ischaemicola*, *S. ischaemi-rugosi*, *S. mnesitheae*, *S. stuhlmanii*, *S. styppeiochloae*, *Thecaphora thlaspeos*, *Tilletia patagonica*, *Tranzscheliella amplexa*, *Tr. serena*, *Ustanciosporium eleocharidis*. Synonyms: *Tothiella* is considered to be *Thecaphora*. Nineteen species are placed in synonymy. Lectotype is designated for *Ustilago ugandensis* var. *macrospora*.

Key words — smut fungi, taxonomy

A new species of *Urocystis* on *Circaeaster* (Ranunculaceae)

Thirty-three known *Urocystis* species infect members of the Ranunculaceae. These occur on the genera: *Aconitum* (1), *Actaea* and *Cimicifuga* (1), *Adonis* (1), *Anemone* (5), *Aquilegia* (1), *Barneoudia* (1), *Callianthemum* (1), *Ceratocephalus* (1), *Clematis* (1), *Delphinium* (1), *Eranthis* (1), *Helleborus* (1), *Hepatica* (1), *Isopyrum* (1), *Pulsatilla* (2), *Ranunculus* (10), *Thalictrum* (1), *Trautvetteria* (1), and *Trollius* (1).

Recently, a *Urocystis* sp. was sent to me from the Harvard University Herbaria (FH), collected in China on *Circaeaster agrestis*, a tiny, annual plant. *Circaeaster* is a peculiar, unispecific genus in the Ranunculaceae, with primitive characters. Some authorities even recognise a separate family for it, Circaeasteraceae. Its parasite turned out to be a new species:

Urocystis circaeasteri Vánky, sp. nov.

Typus in matrice *Circaeaster agrestis* Maxim., China, Sichuan Province, Luhuo Xian, N. urbe Luhuo, via versus urbem Sêrtar, 31°39'36" N, 100°42'46" E, alt. cca. 3500 m.s.m., 1.IX.1997, leg. D.E. Boufford, M.J. Donoghue et R.H. Ree 27774A, comm. D.H. Pfister et E.W. Wood. Holotypus in HMAS, isotypi in FH et in Herbario Ustil. Vánky, HUV 20222!

Sori in pedunculi floralibus conspicue tumefactis, plerumque omnes eiusdem inflorescentiae inficientes, 1–1,5 x 2–2,5 mm, obovoidei vel ellipsoidales, in apice eorum cum residuis organorum floralium, primo membrana tenui, molybdea, e planta nutrienti orta obtecti, qua irregulariter rupta massam atrobrunneam, pulveream glomerulorum sporarum ostendentes. Rarius sori etiam in foliis sicut pustulae parvae, irregulares, elongatae vel ramificatae evoluti. *Glomeruli sporarum* globosi, subglobosi, ellipsoidales usque parum irregulares, 15–28 x 20–33 µm, flavido- usque pallide rufobrunnei, e sporis (0–)1–2(–3) compositi (0 = 0,5%, 1 = 88,5%, 2 = 9,5%, 3 = 1,5%), strato plerumque incompleto cellularum sterilium circumdati, cum exceptione sine cellulis sterilibus. *Sporae* globosae, ovoideae, ellipsoidales, raro latere uno deplanatae, 12–16 x 15–20(–21,5) µm, flavido- usque pallide rufo-brunneae; pariete aequali, 0,5–1 µm crasso, valde leniter, dense punctato-verruculoso. *Cellulae steriles* subglobosae, ovoideae, ellipsoidales, elongatae, saepe latere contacto parum deplanato, magnitudine variae, 4–8 x 5–12(–16) µm, pallide flavidobrunneae; pariete aequali vel inaequali, 0,5–1,5(–2,5) µm crasso, levi.

Sori (Fig. 1) in considerably swollen floral pedicels, usually infecting all in the inflorescence, obovoid or ellipsoidal, 1–1.5 x 2–2.5 mm, with remnants of floral organs on their tip, first covered by a thin, lead coloured membrane of host origin which ruptures irregularly, disclosing the dark brown, powdery mass of spore balls. Rarely, sori also on the leaves as small, irregular, elongated or ramifying pustules. *Spore balls* (Figs. 2, 3) globose, subglobose, ellipsoidal to slightly irregular, 15–28 x 20–33 µm, yellowish- to pale reddish-brown, composed of (0–)1–2(–3) spores (0 = 0.5%, 1 = 88.5%, 2 = 9.5%, 3 = 1.5%), surrounded by a usually incompletelayer of sterile cells, exceptionally sterile cells are lacking. *Spores* (Figs. 2, 3) globose, ovoid, ellipsoidal, rarely with a flattened side, 12–16 x 15–20(–21.5) µm, yellowish- to pale reddish-brown; wall even, 0.5–1 µm thick, very finely, densely punctate-verruculose. *Sterile cells* (Figs. 2, 3) subglobose, ovoid, ellipsoidal, elongated, often with a somewhat flattened contact side, variable in size, 4–8 x 5–12(–16) µm, pale yellowish-brown; wall even or uneven, 0.5–1.5 (–2.5) µm thick, smooth.

On Ranunculaceae (Circaeasteraceae): *Circaeaster agrestis* Maxim.; E. Asia (China). Known only from the type collection.

A new species of *Entyloma* on *Guizotia* (Asteraceae)

Guizotia Cass. is a genus of 10 species in tropical Africa. It belongs to the subfamily Asteroideae, tribe Heliantheae, subtribe Coreopsidinae. *Guizotia abyssinica* (L. fil.) Cass. (*G. oleifera* DC.) is cultivated in Africa and East India as an oil plant (Niger oil; Melchior, H. (ed.), Engler's Syllabus etc., 2:490, 1964). A smut fungus on the leaves of *G. abyssinica* has been collected in Ethiopia and preserved in IMI, under the collective name of *Entyloma compositarum* Farlow. On the genera of the subtribe Coreopsidinae

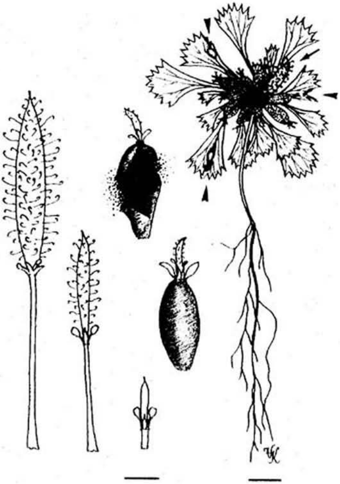

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Fig. 1. Sori of *Urocystis circaeasteri* in swollen floral pedicels and on some leaves (arrow heads) of *Circaeaster agrestis* (type). Habit (one fruit escaped infection, arrow), two sori (in the middle) and three healthy fruits of different ages (to the left).

Bars = 3 mm for habit, and 1 mm for detail drawings.

eight *Entyloma* species are known: *Bidens*, with 240 spp. has 4 *Entyloma* (comp. Vánky, 2003b:6), *Dahlia*, 15 spp./2 *Entyloma*, *Coreopsis*, 120/1, *Cosmos*, 29/1, *Guizotia*, 10/0, *Synderella* 2/0. The smut on *Guizotia* is described as:

Entyloma guizotiae Vánky, **sp. nov.**

Typus in matrice *Guizotia abyssinica* (L. fil.) Cass., Ethiopia, 1970, leg. M.K. Hingotani. Holotypus in IMI 153450, isotypus in HUV 17476!

Sori in foliis sicut maculae rotundae vel angulares, 0,5–3 mm diametro vel propter confluentiam earum majores, primo flavae, serius pallide vel atrius brunneae. *Sporae* globosae, subglobosae, ellipsoidales usque parum irregulares, nonnunquam latere uno deplanatae, 8–12 x 8–13 µm, subhyalinae; pariete aequali, 1(–1,5) µm crasso, levi; contentu granuloso. *Anamorpha* non visa.

Sori (Fig. 8) in the leaves as rounded or angular spots, 0.5–3 mm in diameter or larger by confluence, first yellow, later pale to dark brown. *Spores* (Figs. 4, 5) globose, subglobose, ellipsoidal to slightly irregular, sometimes with a flattened side, 8–12 x 8–13 µm, subhyaline; wall even, 1(–1.5) µm thick, smooth, content granular. *Anamorph* not seen.

On Asteraceae (subfamily Asteroideae): *Guizotia abyssinica* (L. fil.) Cass.; NE. Africa (Ethiopia). Known only from the type collection.

A new species of *Ustilago* on *Cynodon* (Poaceae)

Shivas & Vánky (2001) revised the smut fungi of *Cynodon*, and recognised six species: **1.** ***Sporisorium cynodontis*** (L. Ling) R.G. Shivas & Vánky, **2.** ***S. normanense*** R.G. Shivas & Vánky, **3.** ***Tilletia cynodontis*** Vánky, **4.** ***Ustilago cynodontis*** (Henn.) Henn., **5.** ***U. hitchcockiana*** Zundel, and **6.** ***U. paraguariensis*** Speg. Recently, a different species was discovered in South Africa:

Ustilago cynodonticola Vánky, R.G. Shivas & A. Witt, **sp. nov.**

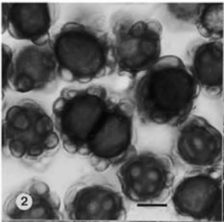
Typus in matrice *Cynodon dactylon* (L.) Pers., South Africa, KwaZulu-Natal Prov., cca. 30 km N.E. oppid. Newcastle, 27°35'25" S, 30°02'37" E, alt. cca. 1270 m.s.m., 23.XII.2002, leg. R.G. Shivas, A. Witt & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 20150; isotypi in PREM 57600, BRIP 39698 et in Vánky, Ust. exs. no. 1190. Paratypi: *Cynodon bradleyi* Stent, S. Africa, Transvaal, Ermelo, 26°32' S, 29°59' E, 2.III.1927, leg. M. Henrici, PREM 21111, HUV 20269; *Cynodon dactylon*, S. Africa, Cape Prov., Somerset-East, 1877, leg. P. MacOwan, HUV 3577, isoparatypi in Thümen, Mycoth. univ. no. 1418 (sicut *Ustilago carbo*); North-Western Prov., Pretoria, Botanical Garden, 25°44'17" S, 28°16'33" E, alt. cca. 1375 m.s.m., 7.XII.2002, leg. R.G. Shivas & K. Vánky, BRIP 39697, HUV 20151, PREM 57601; *Cynodon incompletus* Nees, S. Africa, Eastern Cape Prov., cca. 30 km S. oppid. Alice, Doubledrift Nature Reserve, 32°59'32" S, 25°50'18" E, alt. cca. 540 m.s.m., 15.XII.2002, leg. R.G. Shivas, A. Witt & K. Vánky, BRIP 39700, HUV 20153, PREM 57602.

Figs. 2, 3. Spore balls, spores and sterile cells of *Urocystis circaeasteri* on *Circaeaster agrestis*, in LM and in SEM (type).

Figs. 4, 5. Spores of *Entyloma guizotiae* on *Guizotia abyssinica*, in LM and in SEM (type).

Figs. 6, 7. Spores of *Ustilago cynodonticola* on *Cynodon dactylon*, in LM and in SEM (type).

Bars = 10 µm.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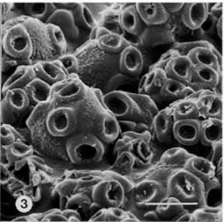
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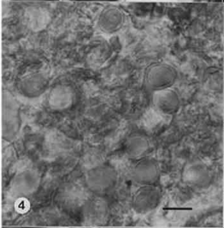
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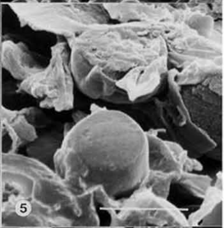
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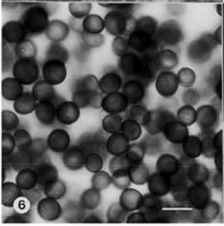
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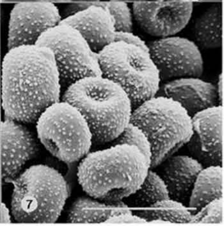
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Sori in apice surculorum sterilium, folia suprema congesta, praecipue partem basalem eorum requirentes, saepe apicem foliorum intactum relinquentes, tumefacti, distaliter attenuati, 1,5–4 x 10–35 mm, primo virides, serius atrocinerei, epidermide inter nervos in nonnullos particulos discesso obtecti, massam sporarum nigrobrunneam, semiagglutinatam usque pulveream ostendentes. *Sporae* globosae, subglobosae, ovoideae vel ellipsoidales, 6–8,5 x 6,5–9,5 µm, flavidobrunneae; pariete aequali, 0,5–0,7 µm crasso, leniter, moderate dense punctato-verruculoso; imago obliqua sporarum levis.

Sori (Fig. 9) on the top of sterile shoots, comprising the uppermost, congested leaves, especially their basal parts, swollen, narrowing distally, often with intact tips of the leaves, 1.5–4 x 10–35 mm, first green, later dark grey, covered by the epidermis which ruptures in several places between the veins, disclosing the blackish-brown, semi-agglutinated to powdery mass of spores. *Spores* (Figs. 6, 7) globose, subglobose, ovoid or ellipsoidal, 6–8.5 x 6.5–9.5 µm, yellowish-brown; wall even, 0.5–0.7 µm thick, finely, moderately densely punctate-verruculose, spore profile smooth.

On *Cynodon dactylon* (L.) Pers., *C. bradleyi* Stent, and *C. incompletus* Nees; S. Africa. Not rare.

Ustilago cynodonticola differs from the common *U. cynodontis*, in which the sori destroy the inflorescence, and the spores are slightly smaller (5.5–8 x 6–8(–8.5) µm) and smooth, as seen in LM. *U. cynodonticola* differs also from the South American *U. paraguariensis*, in which the sori are in the distal, shortened internodes of the stem, the spores are somewhat larger (7–9.5 x 7–11 µm) and sparsely verrucose.

The smut fungi on *Oplismenus* (Poaceae)

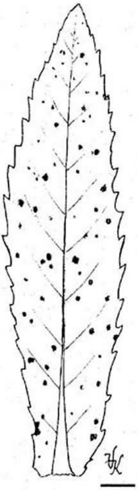
Oplismenus P. Beauv., with five very closely related species, in the tropics and subtropics, belongs to the subfamily Panicoideae, tribe Paniceae, subtribe Setariinae (Clayton & Renvoize, 1986:271). The following four smut fungi are known on *Oplismenus*, including a new species.

1. *Tilletia imbecillis* Vánky, sp. nov.

Typus in matrice *Oplismenus imbecillis* (R. Br.) Roem. & Schult., Australia, Queensland, McPherson Range, National Park, 5.VI.1947, leg. R.F. Langdon (sub *T. vittata*). Holotypus in BRIP 7831, isotypus in HUV 18649!

Sori in ovariis sparsis, hypertrophicis, elongate cylindrici, saepe parum inclinati, 1–1,5 x 10–25 mm, membrana hispida, origine matricali, venis parallelis, cooperti, in maturitate, membrana obtegenti longitudinaliter rupta massam atrobrunneam, pulveream sporarum, cellulis sterilibus intermixtam ostendentes. *Sporae* subglobosae, ovoideae, ellipsoidales usque elongatae, raro irregulares, 16–21 x 16–23 µm, elongatae earum usque 26–30 µm longae, flavae usque flavidobrunneae; pariete aequali, 1,5–2 µm crasso, verrucis 1–1,5 µm altis, in superficie sporae irregulariter sparsis, non in greges coacervatis inclusis. Apices verrucarum in visu optica mediano deplanati. *Cellulae steriles* subglobosae, ellipsoidales usque parum irregulares, saepe collapsae, 13–23 x 14–25 µm, pallide flavae; pariete 0,5–1,5 µm crasso, levi usque aspero.

Sori (Fig. 16) in scattered, hypertrophied ovaries, long cylindrical, often slightly bent, 1–1.5 x 10–25 mm, covered by a hispid membrane of host origin with parallel veins. At maturity the covering membrane ruptures



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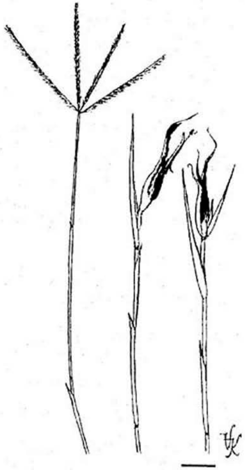

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Fig. 8. Sori of *Entyloma guizotiae* as small spots on a leaf of *Guizotia abyssinica* (type).
Fig. 9. Sori of *Ustilago cynodonticola* on *Cynodon dactylon* (type). Two infected shoots and a healthy inflorescence. Bars = 1 cm.

longitudinally disclosing the dark brown, powdery mass of spores intermixed with sterile cells. *Spores* (Figs. 10, 11) subglobose, ovoid, ellipsoidal to elongated, rarely irregular, 16–21 x 16–23 µm, elongate spores up to 26–30 µm long, yellow to yellowish-brown; wall even, 1.5–2 µm thick, including the 1–1.5 µm high warts which are irregularly scattered on the spore surface without grouping into clusters. In optical median view the tips of the warts are flattened. *Sterile cells* subglobose, ellipsoidal to slightly irregular, often collapsed, 13–23 x 14–25 µm, pale yellow; wall 0.5–1.5 µm thick, smooth to rough.

On *Oplismenus imbecillis* (R. Br.) Roem. & Schult. (*O. hirtellus* (L.) P. Beauv. subsp. *imbecillis* (R. Br.) U. Scholz; *O. undulatifolius* (Ard.) Roem. & Schult. var. *imbecillis* (R. Br.) Hackel); Australia. Known only from the type collection.

The larger, often ellipsoidal spores and the spore surface ornamentation differentiate this species from the other two *Tilletia* species on *Oplismenus*.

2. *Tilletia oplismeni-cristati* Patouillard & Hariot ex Vánky

"*Tilletia oplismeni-cristati* Pat. and Har., sp. nov." in Durán & Fischer, 1961:87. Invalidly published, no type indicated (ICBN 37.1). — Typus in matrice *Oplismenus burmannii* (Retz.) P. Beauv., Mexico, cca. 1 km E. Hotel Villa Blanca, Capilla de Taxte, off Hwy 40, 24.X.1976, leg. R. Durán & P.M. Gray. Holotypus in HUV 14046!, isotypus in WSP 68372. Paratypus: ibidem, 10.X.1978, R. Durán et P.M. Gray, HUV 14047!, isoparatypus in WSP 68614.

Sori in ovariis sparsis, late fusiformes, 0,7–1,5 x 2–5 mm, membrana hispida, origine matricali cooperti, qua longitudinaliter rupta massam nigrobrunneam, pulveream, cellulis sterilibus intermixtam ostendentes. *Sporae* globosae usque subglobosae, 17,5–21,5 x 18–21,5 µm, flavido- usque nigrobrunneae; pariete gregibus verrucarum 1,5–2,5 µm altarum, in visu opticali mediano apicibus deplanatis instructo. Greges e 10–30 verrucis formati aspectum pigmentationis inaequalis superficiei sporarum efficientes. *Cellulae steriles* globosae, ovoideae usque parum irregulares, magnitudine variae, 7–19 x 8–21 µm, subhyalinae usque fumose tincto flavae; pariete 1–1,5 µm crasso, levi. *Germinatio sporarum* basidiis aseptatis, apicaliter basidiosporas aciculares, multas, polyspermales, non conjugantes producentibus (Durán et Fischer, 1961, p. 161, tab. 86, D, F).

Sori in scattered ovaries, broadly fusiform, 0.7–1.5 x 2–5 mm, covered by a hispid membrane of host origin which ruptures longitudinally disclosing the blackish-brown, powdery mass of spores intermixed with sterile cells. *Spores* (Figs. 12, 13) globose to subglobose, 17.5–21.5 x 18–21.5 µm, yellowish- to dark brown; wall provided with clusters of verrucae, 1.5–2.5 µm high, in optical median view with flattened tips. The clusters, formed of 10–30 verrucae, give the spore surface the appearance of being unevenly pigmented. *Sterile cells* (Figs. 12, 13) globose, ovoid to slightly irregular, variable in size, 7–19 x 8–21 µm, subhyaline to smoky tinted yellow; wall 1–1.5 µm thick, smooth. *Spore germination* results in aseptate basidia producing apically numerous, acicular, multinucleate basidiospores which do not fuse (Durán & Fischer, 1961:161, Pl. 86, D, F).

On *Oplismenus burmannii* (Retz.) P. Beauv. (*O. humboldtianus* Nees), *Oplismenus* sp.; C. Africa (Malawi), N. America (Mexico), C. America (Costa Rica, Guatemala), West Indies (Guadeloupe).

The spores of *Tilletia oplismeni-cristati* on *Oplismenus* sp. from Malawi (IMI 50425) are somewhat smaller (15.5–19 x 16.5–20 µm) than those of the type, but the spore ornamentation, i.e. warts arranged in clusters, typical for this species, is present.

3. ***Tilletia vittata*** (Berk.) Mundkur, 1940:312.

Ustilago vittata Berkeley, 1853:148. — *Neovossia vittata* (Berk.) Shetty & Safeeulla, 1980(1981):399. — Type on "Oplismenoid grass" (= *Oplismenus compositus* (L.) P. Beauv., teste C.E. Hubbard), India, Bihar, Parasnath, alt. 4000 ft, before 1854, coll. Hooker, K.

Tilletia panici Mundkur, 1940:317. — Type on *Panicum* sp., India, W. Bengal, Calcutta, I.1928, K. Bagchee, HCIO 7807; isotypes IMI, HUV 16375! (syn. by Ling, 1949a:123, confirmed).

Tilletia vittata (Berk.) Mundkur var. *burmannii* Mishra, 1957:260. — Type on *Oplismenus burmannii* (Retz.) P. Beauv., India, Bihar, Netarhat, alt. 3500 ft, J.N. Mishra, HCIO?; isotypes IMI 68168, HUV 17470! (syn. by Durán & Fischer, 1961:117, confirmed).

Sori in scattered, hypertrophied ovaries, cylindrical, usually slightly bent, 1–2 x 3–15(–20) mm, covered by a hispid membrane of host origin with parallel veins. At maturity the membrane ruptures longitudinally, sometimes in several places, disclosing the black, powdery mass of spores intermixed with sterile cells. *Spores* (Figs. 14, 15) globose to subglobose, 14–19 x 15–20 µm, yellowish- or dark reddish-brown to subopaque; wall 1.5–2 µm thick provided with rather densely, somewhat irregularly situated, 1–1.5 µm high warts which may form short, irregular chains but not agglomerated in clusters, in optical median view with subacute, acute or flattened tips. *Sterile cells* (Figs. 14, 15) subglobose, ovoid to slightly irregular, variable in size, 9–17 x 9–19 µm, pale olivaceous-brown; wall 1–2.5 µm thick, smooth, indistinctly or finely verruculose.

On *Oplismenus burmannii* (Retz.) P. Beauv., *O. compositus* (L.) P. Beauv., *O. hirtellus* (L.) P. Beauv., *O. setarius* (Lam.) Roem. & Schult., *O. undulatifolius* (Ard.) P. Beauv., *Panicum* sp.; Africa (Guinea, Uganda), Asia (India), N. America (Mexico).

4. ***Ustilago oplismeni*** Viennot-Bourgin, 1959:9.

Type on *Oplismenus humboldtianus* Nees (= *O. burmannii* (Retz.) Beauv.), Guinea (French), near Roka, I.1957, G. Viennot-Bourgin.

Sori in the spikelets, hidden by the glumes, blackish-brown, powdery. *Spores* globose, 3–5.5 x 3–5.5 µm, olivaceous-brown; wall thin, irregularly ornamented with 1–1.5 µm high, irregular tubercles.

On *Oplismenus burmannii* (Retz.) Beauv. (*O. humboldtinanus* Nees); Africa (Guinea). Known only from the type locality.

Unfortunately, the type specimen seems to be lost. It is neither in the Herb. Viennot-Bourgin in PC, nor in the general mycological herbarium of PC (Dr. J. Mouchacca, pers. comm.). The rather poor description is taken from the original. I suspect that this fungus is an *Ustilaginoidea* (anamorphic Ascomycetes).

Key to the smut fungi (*Tilletia*) on *Oplismenus*

1. Sori in the spikelets, spores 3–5.5 µm long................**[*Ustilago oplismeni*]**
– Sori in hypertrophied ovaries, spores larger..2
2. Spores subglobose to long ellipsoidal, 16–23(–30) µm long .***T. imbecillis***
– Spores globose to subglobose, smaller...3
3. Spores 18–21.5 µm long, yellowish- to dark brown;
warts 1.5–2.5 µm long, arranged in clusters................***T. oplismeni-cristati***
– Spores 15–20 µm long, dark brown to subopaque;
warts 1–1.5 µm long, not arranged in clusters ....***T. vittata***

A new species of *Tilletia* on *Brachypodium* (Poaceae)

Five *Tilletia* species are known on *Brachypodium:* **1. *T. brachypodii*** Mundkur, type on *B. sylvaticum,* India, **2. *T. brachypodii-mexicani*** Vánky, type on *B. mexicanum,* Venezuela, **3. *T. brachypodii-ramosi*** Zogg, type on *B. ramosum,* France, **4. *T. colombiana*** Vánky, type on *B. mexicanum,* Colombia, and **5. *T. olida*** (Riess) J. Schröt., type on *B. pinnatum,* Germany. Of these, 1, 2 and 4 have sori in the ovaries, 3 and 5 in the leaves. A different, ovaricolous smut was discovered in the phanerogam collection of MHU, Kampala, Uganda, and also obtained from Prof. K.A. Lye.

Tilletia lyei Vánky, sp. nov.

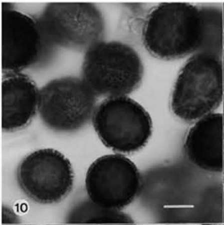
Typus in matrice *Brachypodium flexum* Nees, Kenya, Kitale Distr., Mt. Elgon, "2–3 km below the parking place on the northern Mt. Elgon Road, in edge of road in forest", 01°22' N, 22°39' E, alt. cca. 3000 m.s.m., 19.I.1969, leg. K.A. Lye 1508. Holotypus in HUV 19980!, isotypi in Herb. K.A. Lye et in MHU.

Sori in ovariis nonnullis, tumefactis inflorescentiae eiusdem, cylindrici, apice acuto, 0,5–1,5 x 4–7 mm, pericarpio brunneo cooperti, quo maturitate longitudinaliter rupto massam nigram pulveream sporarum cellulis sterilibus mixtam ostendentes. *Sporae* globosae, subglobosae, ellipsoidales, 14,5–18,5 x 16–20 µm, fumose tincto flavidobrunneae; pariete aequali, 1–1,5 µm crasso, dense verrucoso; verrucae in visu opticali mediano 0,5–1 µm altae, obtusae; imago obliqua sporarum undulata. *Cellulae steriles* subglobosae, ellipsoidales, irregulares, saepe collapsae, 17–30 µm longae, subhyalinae; pariete 3–4 µm crasso, levi usque punctato-verrucoso.

Figs. 10, 11. Spores of *Tilletia imbecillis* on *Oplismenus imbecillis*, in LM and in SEM (type).

Figs. 12, 13. Spores and sterile cells of *Tilletia oplismeni-cristati* on *Oplismenus burmannii*, in LM and in SEM (type).

Figs. 14, 15. Spores and sterile cells of *Tilletia vittata* on *Oplismenus compositus*, in LM and in SEM (India, Uttar Pradesh, Garwal Himalaya Mts., 33 km N. of Rudraprayag, 15.IX.1992, T. & K. Vánky, HUV 15692). Bars = 10 µm.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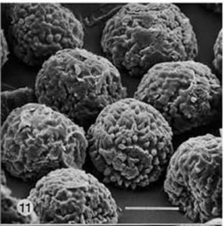
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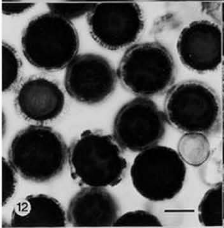
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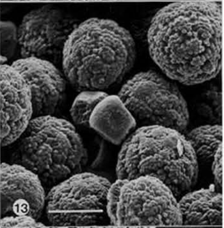
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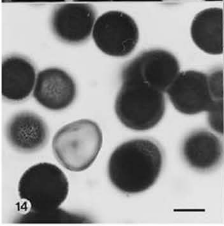
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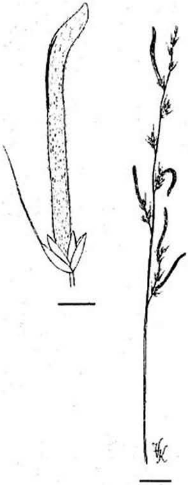

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Fig. 16. Sori of *Tilletia imbecillis* in hypertrophied ovaries of *Oplismenus imbecillis* (type). Habit, and enlarged a sorus.

Fig. 17. Sori of *Tilletia lyei* in swollen ovaries of *Brachypodium flexum* (type). Habit, and enlarged two sori. Bars = 1 cm for habit, and 3 mm for detail drawings.

Sori (Fig. 17) in some swollen ovaries of an inflorescence, cylindrical with acute tip, 0.5–1.5 x 4–7 mm, covered by the brown pericarp which ruptures longitudinally at maturity disclosing the black, powdery mass of spores mixed with sterile cells. *Spores* (Figs. 20, 21) globose, subglobose, ellipsoidal, 14.5–18.5 x 16–20 µm, smoky tinted yellowish-brown; wall even, 1–1.5 µm thick, densely verruculose; warts in optical median view 0.5–1 µm high, blunt, spore profile wavy. *Sterile cells* (Figs. 20, 21) subglobose, ellipsoidal, irregular, often collapsed, 17–30 µm long, subhyaline; wall 3–4 µm thick, smooth to punctate-verruculose.

On *Brachypodium flexum* Nees; Africa (Kenya). Known only from the type locality.

Tilletia lyei differs from other *Tilletia* species of *Brachypodium* especially by the low, blunt ornamentation of the spores.

Etymology: This species is named in honour of Prof. Kåre Arnstein Lye (Ås-NLH, Norway), an exceptional, helpful person and friend, world-authority on Cyperaceae, outstanding specialist of the flora of Scandinavia and Tropical Africa in general, and that of Uganda in particular, who also collected this smut fungus.

Key to the *Tilletia* species of *Brachypodium*

1\. Sori in leaves as long striae. Spores reticulate 2
– Sori in swollen ovaries. Spores otherwise ornamented 3
2\. Muri 0.5–1(–1.5) µm high, truncate .... ***T. olida***
– Muri 1–1.5(–2.5) µm high, pointed .... ***T. brachypodii-ramosi***
3\. Spores coarsely tuberculate, surrounded by a thick sheath .. ***T. brachypodii***
– Spores verrucose, sheath apparently lacking 4
4\. Spores chocolate-brown to opaque, 17.5–24(–26) µm long, warts 1–2.5 µm long .... ***T. brachypodii-mexicani***
– Spores paler, smaller, up to 20 µm long, warts shorter 5
5\. Warts 1–1.5(–2) µm high, pointed .... ***T. colombiana***
– Warts 0.5–1 µm high, blunt .... ***T. lyei***

Two new species of *Entorrhiza*

Ten species of *Entorrhiza* are known, all forming galls on the roots of Cyperaceae (*Carex, Cyperus, Eleocharis, Scirpus,* including *Isolepis*) and Juncaceae (*Juncus*). Of the ten species, four have spores ornamented by ridges. Two additional species of this group are:

Entorrhiza citriformis Vánky & McKenzie, **sp. nov.**

Typus in matrice *Scirpus reticularis* (Col.) Edgar (*Isolepis reticularis* Col.; det. K.A. Ford, CHR), New Zealand, South Island, 23 km N.W. oppid. Wanaka, Diamond Lake, 44°38'54" S, 168°57'45" E, alt. cca. 330 m.s.m., 5.II.1998, leg. E.H.C. McKenzie, C. & K. Vánky. Holotypus in PDD 70949, isotypus in Herbario Ustil. Vánky, HUV 19051!

Entorrhiza citriformis ab *E. fineraniae* Vánky (Mycotaxon 43:419, 1992; typus in matrice *Scirpus cernuus* Vahl, New Zealand), imprimis sporis citriformibus, latioribus distincta, magnitudine 17–23 x 23–29 µm, cristis pluribus (22–30 in circumscriptione aequatoriali sporae) instructis. Magnitudo sporarum *E. fineraniae* 12–16 x 15–25(–30) µm, conspectu secundum axem longitudinalem sporae cristis 14–20(–24) in circumscriptione aequatoriali sporae apparentibus.

Sori (Fig. 18) on the roots as light to dark brown, guttiform, fusiform, cylindrical, elongated, often slightly bent, not branching galls, 1–2.5 x 2–15 mm, filled by pale brown, agglutinated, intracellular spore masses. *Spores* (Figs. 22, 23) lemon-shaped, with a papilla on one end, and a short appendage on the opposite side (the remnant of the sporogenous hypha), 17–23 x 23–29 µm (including ornamentation), pale to dark lemon-yellow; wall more or less even, 4–5 µm thick, surface provided with coarse ridges situated parallel to the long axis of the spore, in lateral view 9–12 ridges are visible; looking from the longitudinal axis of the spore, 22–30 ridges appear on the equatorial circumference of a spore.

On Cyperaceae: *Scirpus reticularis* (Col.) Edgar (*Isolepis reticularis* Col.); New Zealand. Known only from the type collection.

Entorrhiza citriformis differs from *E. fineraniae* Vánky, especially by the lemon-shaped, much wider spores, provided with more ridges. In *E. fineraniae* the spores are 12–16 µm wide, ornamented with 14–20(–24) ridges.

Entorrhiza globoidea Vánky, **sp. nov.**

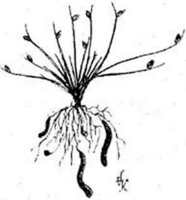
Typus in matrice *Scirpus fluitans* L., Australia, Western Australia, cca. 12 km W. oppid. Moora, 30°36'37" S, 115°51'29" E, alt. cca. 310 m.s.m., 11.IX.1999, leg. C. & K. Vánky. Holotypus in BRIP 39623, isotypus in Herbario Ustil. Vánky, HUV 19052!

Entorrhiza globoidea ab *E. fineraniae* Vánky (Mycotaxon 43:419, 1992; typus in matrice *Scirpus cernuus* Vahl, New Zealand) imprimis sporis globoideis, valde latioribus, 17–21.5(–24) x 17–24(–25) µm, cristis pluribus (20–27) in circumscriptione aequatoriali sporae instructis distincta. Sporae *E. fineraniae* 12–16 x 15–25(–30) µm, conspectu secundum axem longitudinalem sporae cristis 14–20(–24) in circumscriptione aequatoriali sporae apparentibus.

Sori (Fig. 19) on the roots as light to dark brown, globoid, ovoid, pyriform or elongated galls, when dried 1–3 x 1–6 mm, filled by pale brown, agglutinated, intracellular spore masses. *Spores* (Figs. 24, 25) globose or subglobose, rarely broadly ellipsoidal, with a papilla on one end, and a short appendage on the opposite side, 17–21.5(–24) x 17–24(–25) µm, pale yellow to lemon-yellow; wall even, 2.5–4 µm thick, surface provided with coarse ridges situated parallel to the pedicel-papilla axis of the spore, in lateral view 7–12 ridges are visible; looking from the "longitudinal" axis of the spore, 20–27 ridges appear on the equatorial circumference of a spore.

On Cyperaceae: *Scirpus fluitans* L. (*Isolepis fluitans* (L.) R. Br.), Australia. Known only from the type collection.

Entorrhiza globoidea differs from *E. fineraniae* Vánky, especially by the globoid, much wider spores, provided with more ridges. In *E. fineraniae* the spores are 12–16 µm wide, ornamented with 14–20(–24) ridges. *Entorrhiza globoidea* differs from *E. citriformis* especially by the globoid, shorter spores.



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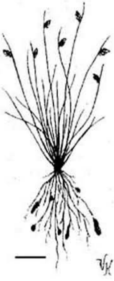

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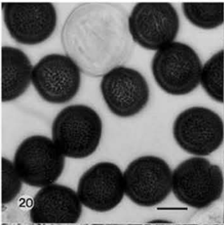
Fig. 18. Sori of *Entorrhiza citriformis* on the roots of *Scirpus reticularis*, forming galls (type).
Fig. 19. Sori of *Entorrhiza globoidea* on the roots of *Scirpus fluitans*, forming galls (type).
Bars = 1 cm.

Key to the *Entorrhiza* species with ridged spore wall

1. Ridges parallel to the long axis of the spores..2
– Ridges obliquely oriented 5
2. Spores 9–12 x 12–20 µm, with 12–16 ridges; wall c. 1 µm thick.***E. parvula***
– Spores larger, with more ridges; wall thicker...3
3. Spores 12–16 µm wide, with 14–20(–24) ridges ....***E. fineraniae***
– Spores 17–23(–25) µm wide, with more ridges 4
4. Spores globoid, 17–24(–25) µm long, with 20–27 ridges.........***E. globoidea***
– Spores lemon-shaped, 23–29 µm long, with 22–30 ridges ....***E. citriformis***
5. Spores subglobose to ellipsoidal, 11–16 µm wide, with
7–11 ridges...***E. scirpicola***
– Spores elongate-ellipsoidal or lemon-shaped, 9–12 µm wide,
with 10–14 ridges...***E. raunkiaeriana***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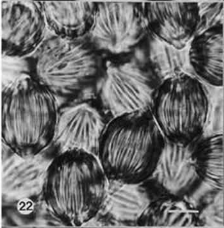
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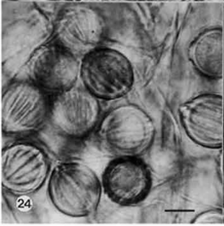
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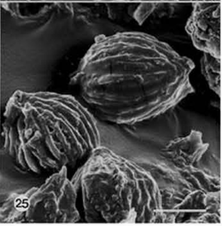
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A second smut fungus on *Acroceras* (Poaceae)

The first smut fungus described on *Acroceras* Stapf, a genus of 19 species, was *Ustilago acroceratis* Vánky, recorded on *Acroceras macrum* from Zimbabwe, Harare (Vánky, 2001:293). A *Tilletia* species, collected on the same host, at the same place, is a new species:

Tilletia acroceratis Vánky, **sp. nov.**

Typus in matrice *Acroceras macrum* Stapf, Zimbabwe, Harare, 27.III.1941, leg. A. Rattray (as aff. *Tilletia heterospora*). Holotypus in PREM 33750 (ex "Myc. Herb. S. Rhodesia 5282"), isotypus in Herbario Ustil. Vánky, HUV 20270!

Sori in nonnullis ovariis inflorescentiae eiusdem, inter involucris floralibus patentibus apparentes, ovoidei, 3–5 mm longi, primum membrana brunnea pericarpii cooperti, qua irregulariter rupta massa atrobrunnea, pulverea sporarum cellularumque sterilium dispersa. *Sporae* globosae, subglobosae, raro ovoideae vel late ellipsoidales, magnitudine variae, 17–22,5 x 17–25 µm, flavidobrunneae usque atro-chocolatobrunneae, verrucis dense distributis, verrucis dense distributis, 1,5–2,5 µm altis, polyangularibus, apice deplanatis, in visu superficiali sicut areae polyangulares, atriores apparentibus, per diametrum sporae 7–10. *Cellulae steriles* globosae, subglobosae, ovoideae usque parum irregulares, magnitudine nimis variae (globosae vel subglobosae earum 9–50 µm), hyalinae usque parum flavidobrunneae; pariete 1–4(–8) µm crasso, levi, verrucoso vel atypice ornato. Forma intermediae fere omnes a cellulis hyalinis, levibus usque ad sporas atras, typice ornatas evolutae.

Sori in some ovaries of an inflorescence, appearing between the spreading floral envelopes, ovoid, 3–5 mm long, first covered by a brown membrane of the pericarp which ruptures irregularly and the dark brown, powdery mass of spores and sterile cells are dispersed. *Spores* (Figs. 27, 28) globose, subglobose, rarely ovoid or broadly ellipsoidal, variable in size, 17–22.5 x 17–25 µm, yellowish-brown to dark chocolate-brown, provided with densely situated, 1.5–2.5 µm high, polyangular warts with flattened top, in surface view appearing as darker, polyangular areas, 7–10 per spore diameter. *Sterile cells* (Figs. 27, 28) globose, subglobose, ovoid to slightly irregular, extremely variable in size (globose or subglobose cells 9–50 µm in diameter), hyaline to pale yellowish-brown; wall 1–4(–8) µm thick, smooth, verrucose or with atypical ornamentation. There are almost all intermediate forms from hyaline, smooth cells to dark, typically ornamented spores.

On *Acroceras macrum* Stapf; Africa (Zimbabwe). Known only from the type collection.

Figs. 20, 21. Spores and sterile cells of *Tilletia lyei* on *Brachypodium flexum*, in LM and in SEM (type).

Figs. 22, 23. Spores of *Entorrhiza citriformis* on *Scirpus reticularis*, in LM and in SEM (type).

Figs. 24, 25. Spores of *Entorrhiza globoidea* on *Scirpus fluitans*, in LM and in SEM (type).

Bars = 10 µm.

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Fig. 26. Sori of *Sporisorium euclastae* on *Euclasta condylotricha* (type). Habit, and enlarged five sori of different developmental stages. To the left an inflorescence with a few sori of *S. ischaemoides*. Habit. Bars = 1 cm.

Two smut fungi on *Euclasta* (Poaceae)

Euclasta Franch., in the subfamily Panicoideae, tribe Andropogoneae, subtribe Sorghinae, is a small genus of two species in India, tropical Africa and tropical America (Clayton & Renvoize, 1986:344). No smut fungus has been reported on it. Samples of *Euclasta condylotricha*, infected by two smut fungi have been collected recently in Zambia. One forms sori in the spikelets, the other destroys the raceme pairs. The first turned out to be identical with *Sporisorium ischaemoides* (Henn.) Vánky, the second one is a new species:

Sporisorium euclastae Vánky & C. Vánky, **sp. nov.**

Typus in matrice *Euclasta condylotricha* (Steud.) Stapf (det. M. Namaganda, MHU), Zambia, Southern Prov., 70 km S.W. urbe Lusaka, 15°55'29"S, 28°10'0"E, alt. cca. 1060 m.s.m., 16.IV.2001, leg. C., T. et K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 19931! Isotypi in BPI, IMI et MHU.

Sori omia paria racemorum eiusdem inflorescentiae destruentes, longe cylindrici, 0,5–2 x 10–25 mm, peridio crasso, brunneo cooperti, quo longitudinaliter rupto massa atrobrunnea, semiagglutinata usque pulverea sporarum et catervae cellularum sterilium dispersae, sed columella 10–50 mm longa, flagelliformis, centralis, fortuito ramulo apicali, brevi instructa reliqua. *Sporae* maturae singulae, globosae, ovoideae, ellipsoidales usque subpolyedrice parum irregulares, 9–11 x 9,5–13 µm, flavidobrunneae; pariete aequali, cca. 1 µm crasso, dense echinulato, imago obliqua sporae serrulata. *Cellulae steriles* in catervis irregularibus, cellulae singulae forma magnitudine variae, subglobosae, ellipsoidales vel irregulares, lateribus deplanatis, cellulae globoideae earum diametro 5–12 µm, hyalinae; pariete aequali, cca. 0,8 µm crasso, levi, contentu homogeneo, cum 1(–2) guttula oleosa.

Sori (Fig. 26) destroying all raceme-pairs in the inflorescence, long cylindrical, 0.5–2 x 10–25 mm, covered by a thick, brown peridium which ruptures longitudinally and the dark brown, semi-agglutinated to powdery mass of spores and groups of sterile cells is scattered. A 10–50 mm long, flagelliform, central columella, sometimes with a short apical branch remains behind. *Spores* (Figs. 29, 30) when mature single, globose, ovoid, ellipsoidal to subpolyhedrally slightly irregular, 9–11 x 9.5–13 µm, yellowish-brown; wall even, c. 1 µm thick, densely echinulate, spore profile serrulate. *Sterile cells* (Fig. 29) in irregular groups, single cells variable in shape and size, subglobose, ellipsoidal or irregular, with flattened sides, globoid cells 5–12 µm in diameter, hyaline; wall even, c. 0.8 µm thick, smooth, content homogeneous, with 1(–2) oil droplets.

On *Euclasta condylotricha* (Steud.) Stapf; C. Africa (Zambia). Known only from the type collection.

Sporisorium ischaemoides (Henn.) Vánky is known in C. and S. Africa in the spikelets of different *Hyparrhenia* species (subtribe Anthistiriinae). Its occurrence on *Euclasta condylotricha* (subtribe Sorghinae) is unexpected. For description, illustration and discussion of host plant spectrum of this species see Vánky, 2003a:188-190.

A new species of *Sporisorium* on *Schizachyrium* (Poaceae)

I revised the smut fungi of *Schizachyrium* Nees, and recognised five *Sporisorium* species (Vánky, 2003b:36-43). Checking herbarium material, an additional new species was discovered:

Sporisorium blakeanum Vánky, **sp. nov.**

Typus in matrice *Schizachyrium fragile* (R. Br.) A. Camus, Australia, Queensland, N. urbe Hughenden, Poison Creek, 10.IV.1935, leg. S.T. Blake 8528. Holotypus in BRIP 7804!, isotypi in BPI 179806, IMI 43217! et in HUV 19964!

Sori racemos destruentes, fusiformes, 0,5–1,5 x 15–25 mm, spatheolo tubuliformi perfecte obtecti et peridio etiam satis crasso, flavidobrunneo, fissuris multis brevioribus vel longioribus praedito cooperti. Peridium, propter auctum continuum sori in tubo spatheoli relative brevi, rete complicatum, irregulare, cum foraminibus multis irregularibus instructam evadens. Intus in spatheolo et peridio irregulariter aperto, massa nigra, granulosopulverea glomerulorum sporarum et columella longa, centralis, filiformis, plerumque torta convenienetes. *Glomeruli sporarum* satis regulares, globosi, subglobosi, ovoidei, ellipsoidales, raro parum irregulares, (40–)50–70(–90) x 50–90(–100) µm, rubrobrunnei, e paucis decem sporarum pressu valido separabilium compositi. *Sporae* dimorphae. Sporae externae rotundae usque subpolyedrice irregulares, 11–18,5 x 15–20(–21,5) µm, mediocriter rubrobrunneae, cum maculis nonnullis magis, conspicuis, irregularibus, flavidobrunneis, propter parietem irregulariter incrassatum, usque ad 0,5–2(–2,5) µm crassum in angulis maxime incrassatum; superficies libera cellularum externarum pariete cca. 1,5 µm crasso spinis incluis 0,5–0,8 µm altis, obtusis, in visu superficiali sicut verrucae irregulares, sparse usque modice dense dispositae apparentibus; imago obliqua sporarum leniter serrulata. Sporae internae rotundae, subpolyedrice irregulares, sporis externis magnitudine obiter aequales, subhyalinae vel flavidobrunneo tinctae; pariete aequali, tenui, 0.3–0.5 µm, levi. *Cellulae steriles* nullae.

Sori (Fig. 33) destroying the racemes, fusiform, 0.5–1.5 x 15–25 mm, completely hidden by the tubuliform spatheole and also covered by a rather thick, yellowish-brown peridium, on which numerous, shorter or longer fissures appear. Due to the continued growth of the sorus within a relatively short tube of spatheole, the peridium becomes a crinkled, irregular net with numerous, irregular openings. Inside the spatheole and the irregularly opened peridium, there is a black, granular-powdery mass of spore balls and a long, central, filiform, usually twisted columella. *Spore balls* (Figs. 31, 32) rather regular, globose, subglobose, ovoid, ellipsoidal, rarely slightly irregular, (40–)50–70(–90) x 50–90(–100) µm, reddish-brown, composed of a few tens of spores which separate by hard pressure. *Spores* (Figs. 31, 32) dimorphic. Outer spores rounded to subpolyhedrally irregular, 11–18.5 x

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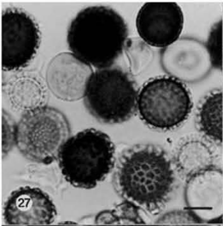
Figs. 27, 28. Spores and sterile cells of *Tilletia acroceratis* on *Acroceras macrum*, in LM and in SEM (type).

Figs. 29, 30. Spores and sterile cells of *Sporisorium euclastae* on *Euclasta condylotricha*, in LM and in SEM (type).

Figs. 31, 32. Spore balls and spores of *Sporisorium blakeanum* on *Schizachyrium fragile*, in LM and in SEM (type). In the SEM picture, the smooth spore wall of the contact sides of the outer spores, and of the inner spores is evident, where one spore is missing from the spore ball. Bars = 10 µm.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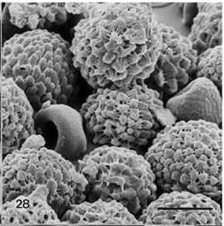
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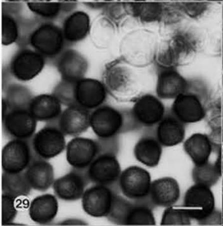
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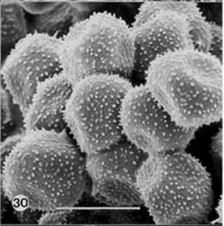
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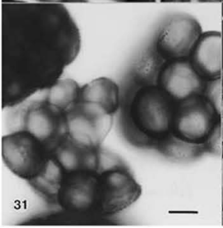
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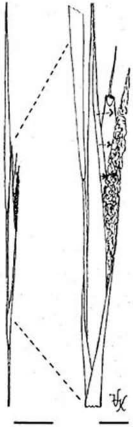

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Fig. 33. A sorus of *Sporisorium blakeanum* in the inflorescence of *Schizachyrium fragile* (type), hidden by the tubuliform spatheole, and covered by a thick, crinkled peridium with irregular openings. To the left, the spatheole is opened (habit). To the right, the sorus is somewhat lifted out from the spatheole to show the typical peridium (enlarged).Bars = 1 cm for habit, and 3 mm for the detail drawing.

15–20(–21.5) µm, medium reddish-brown, with several, large, evident, irregular, yellowish-brown spots, due to the irregularly thickened wall, which may be 0.5–2(–2.5) µm thick, thickest at the angles; free surface of the outer spores c. 1.5 µm thick, including the 0.5–0.8 µm high, blunt spines, which in surface view appear as sparsely to moderately densely situated, irregular warts, spore profile finely serrulate. Inner spores rounded, subpolyhedrally irregular, about the size of the outer spores, subhyaline or yellowish-brown tinted; wall even, thin, 0.3–0.5 µm, smooth. No *sterile cells*.

On *Schizachyrium fragile* (R. Br.) A. Camus; Australia. Known only from the type collection

Sporisorium blakeanum is closest to *S. zambianum* Vánky (type on *Schizachyrium exile* (Hochst.) Pilger, Zambia), from which it differs in the structure of the peridium, and especially in the shape and size of spore balls and spores, as well as the thickness and ornamentation of the spore walls. The spore balls in *S. zambianum* are of variable shape and measure 30–50 x 40–60 µm. The spores are more angular, measure 9–15 x 10.5–17 µm, the free surface of the outer spores is prominently echinulate, provided with 1–2 µm high spines; inner spores are light brown, finely, sparsely punctate-verrucose.

Etymology: This species is named in honour of the outstanding Australian botanist, Stanley T. Blake (1911–1973), with main interest in the Poaceae, an enthusiastic collector not only of healthy plants but also diseased ones, among them also this smut fungus.

A new *Ustilago* species on *Andropogon* (Poaceae)

Zundel (1930) revised the smut fungi of *Andropogon* and recognised 76 species. Since 1930, the classification of both the grasses and the smut fungi has changed considerably. Many "*Andropogon*" species in Zundel's paper do not belong to this genus any more, and many smut fungi do not belong to the genus under which they were treated by Zundel. Surprisingly few *Ustilago* species occur on *Andropogon*. However, a very typical one was found in Herb. WSP, under the name of *Ustilago dieteliana* Henn., which turned out to be a new species:

Ustilago duranii Vánky, **sp. nov.**

Typus in matrice *Andropogon semiberbis* (Nees) Kunth, Mexico, Chihuahua State, Creel, Monte Gallegos (Padre Gallegos) supra pag. Urique, cca. 27°38' N, 107°50' W, 12.X.1969, R. Durán (sub *U. dieteliana*), WSP 58571!

Sori in foliis supremis 1–2 surculorum sterilium, telas inter venas foliorum destruentes et earum vicem massa nigra, semiagglutinata usque pulverea sporarum implentes. Sori protrudentes a vagina folii postremi intacti, 2–3 mm lati, 6–8 cm longi, primum epidermide obtecti, quo discesso massam sporarum patefacientes, qua dissipata telas vasculares sicut filamenta longa, plerumque torta relinquentes. Apiculi foliorum affectorum tantum intacti manentes. *Sporae* globosae, subglobosae, ovoideae, ellipsoidales, 10,5–13,5 x 11–15(–16) µm, mediocriter atroflavidobrunneae; pariete aequali vel parum inaequali, 1–2,5 µm crasso, verrucis dense distributis, satis altis, confluentibus, lineas irregulares et reticulos tenues incompletos vel completos formantibus; imago obliqua sporarum grosse undulata usque denticulata.

Sori (Fig. 34) in the uppermost 1–2 leaves of sterile shoots, destroying and replacing the tissues between the leaf-veins with a black, semiagglutinated to powdery mass of spores. Sori protruding from the last healthy leaf-sheath, 2–3 mm wide, 6–8 cm long, first covered by the epidermis which flakes away, liberating the spore masses which are scattered, leaving behind fascicles of vascular tissues as long, often curled filaments. Only the 1–2 cm long tip of infected leaves remains intact. *Spores* (Fig. 36, 37) globose, subglobose, ovoid, ellipsoidal, 10.5–13.5 x 11–15(–16) µm, medium dark yellowish-brown; wall even or slightly uneven, 1–2.5 µm thick, provided with densely situated, rather high, confluent warts forming irregular rows and a fine, incomplete or complete reticulum; spore profile roughly wavy to denticulate.

On *Andropogon semiberbis* (Nees) Kunth; North America (Mexico). Known only from the type collection.

Ustilago duranii resembles *U. dieteliana* Henn. (type on *Tripsacum dactyloides* (L.) L.). However, in *U. dieteliana* the spores are 9.5–13(–14) µm long, the spore wall is 1–1.5 µm thick, provided with finer warts which often fuse in small groups or short, irregular rows, without forming meshes.

Etymology: This fungus is named in honour of Dr. Ruben Durán, outstanding North American ustilaginologist, author of numerous papers and the books The Genus *Tilletia* (1961) and Ustilaginales of Mexico (1987). He was also a keen collector of smut fungi and, among others, collected this species.

A new species of *Microbotryum* (Microbotryales)

Seven, morphologically different *Microbotryum* species have been recognised on members of Polygonaceae, Sect. Persicaria, (comp. Vánky & Oberwinkler, 1994, and see the key in Vánky, 1998a:55). All these species have reticulate spores and sori in the flowers. From the comprehensive infection studies of Liro (1924:188-240), a strict host specificity is evident, not only for these, but also for several, morphologically more or less identical smuts of Polygonaceae (comp. also Ciferri, 1931:36-42). It seems that these smuts represent a complex in which they are on different levels of speciation. For example, there are host specific smuts which hardly can be differentiated by spore morphology from *Microbotryum reticulatum* (Liro) R. Bauer & Oberw. (type on *Polygonum lapathifolium* L., Finland), e.g. *Ustilago ravida* Liro (type on *P. senegalense* Meisner, Rwanda), or *U. controversa* Cif. (type on *P. pennsylvanicum* L., U.S.A.). Other species are morphologically different, e.g. *M. radians* (Vánky & Oberw.) Vánky (type on *P. careyi* Olney, U.S.A), *M. prostratum* (Vánky & Oberw.) Vánky (type on *P. prostratum* R. Br., Australia), *M. tenuisporum* (Cif.) Vánky (type on *P. acre* H. B. & K., Argentina), and others. A further smut, close to, but different from *M. reticulatum* is:

Microbotryum paucireticulatum Vánky, **sp. nov.**

Typus in matrice *Polygonum orientale* L., India, Lakhipur, Cachar, 3.III.1942, S. Choudhury. Holotypus in Herbario Ustil. Vánky, HUV 17349!, isotypus in HCIO (sicut *Ustilago utriculosa*).

Sori in omnibus floribus inflorescentiae eiusdem, tumefacti, deformati, perianthio cooperti, massa brunneoviolacea, pulverea sporarum repleti. *Sporae* globosae, subglobosae usque late ellipsoidales vel ovoideae, raro elongatae, 10,5–13,5 x 11–14,5(–16) µm, violaceotinctae pallide rubrobrunneae; pariete 1,5–2 µm crasso, aspere reticulato, maculae 2–4 per diametrum sporae, maculae polygonales, (2,5–)3–5(–5,5) µm latae, muri earum cca. 1 µm alti, in visu opticali mediano acuti vel subacuti; in SEM interstitium leve, in medio verrucis nonnullis.

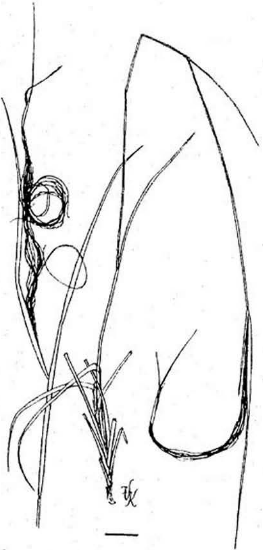

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Fig. 34. Sori of *Ustilago duranii* in the uppermost leaves of two sterile shoots of *Andropogon semiberbis* (type).

Fig. 35. Sori of *Microbotryum paucireticulatum* in the flowers of *Polygonum orientale* (type).

Bars = 1 cm.

Sori (Fig. 35) in all flowers of an inflorescence, swollen, deformed, covered by the perianths, filled with a brownish-violet, powdery spore mass. *Spores* (Fig. 38, 39) globose, subglobose to broadly ellipsoidal or ovoid, rarely elongate, 10.5–13.5 x 11–14.5(–16) µm, violet-tinted light reddish-brown; wall 1.5–2 µm thick, coarsely reticulate, 2–4 meshes per spore diameter, meshes polygonal, (2.5–)3–5(–5.5) µm wide, muri c. 1 µm high, thin, in optical median view acute or subacute; in SEM interspaces smooth with a few small warts in their centre.

On Polygonaceae (Sect. Persicaria): *Polygonum orientale* L.; S. Asia (India). Known only from the type locality.

Microbotryum paucireticulatum is closest to *M. reticulatum*, from which it differs in having somewhat larger spores, larger and fewer meshes per spore diameter and lower muri. The spores of the latter species measure 9–12 x 9–15 µm, are provided with (2–)3–4 meshes per spore diameter, meshes 2–4 µm wide, the muri are 1–1.5 µm high, and the interspaces are coarsely verrucose.

A new species of *Tilletia* on *Eragrostis* (Poaceae)

Three *Tilletia* species are recognised on *Eragrostis*: **1. *T. baldratii*** Montemart., **2. *T. eragrostidis*** G.P. Clinton & Ricker, and **3. *T. transvaalensis*** Zundel. On *Eragrostiella* two *Tilletia* species are known: **1. *T. eragrostiellae*** Vánky, C. Vánky & N.D. Sharma, and **2. *T. poonensis*** Thirum. & Pavgi. A different smut fungus was discovered in IMI:

Tilletia kenyana Vánky, **sp. nov.**

Typus in matrice *Eragrostis caespitosa* Chiov., Kenya, Makueni, alt. 3500 ft, 16.I.1960, leg. A. Bogdan. Holotypus in IMI 80374!, isotypus in HUV 18141!

Sori ovariis nonnullis vel omnibus spiculorum nonnullorum inflorescentiae eiusdem, ellipsoidales, 0,3–0,5 x 0,8–1 mm, involucris floralibus plus-minus ob-tecti, primo pericarpio obtecti, quo mature irregulariter rupto massam sporarum cellularumque sterilium pallide brunneam, semiagglutinatam ostendentes. *Sporae* globosae, subglobosae, late ellipsoidales, 13–16 x 13–19 µm, pallide flavae usque pallide flavidobrunneae, in diametro sporae verrucis 4–7, subpyramidali-bus, 1,5–2,5(–3) µm altis, obtusis, in visu superficiali conspicuis; imago obliqua sporae propter vaginam hyalinam undulata. *Cellulae steriles* subglobosae, ellipsoidales vel parum irregulares, magnitudine variae, 8–24 x 9–25 µm, hyalinae usque colore flavidobrunneo tinctae; pariete 0,5–1,5 µm crasso, levi.

Sori (Fig. 48) in some or all ovaries of a few spikelets of an inflorescence, ellipsoidal, 0.3–0.5 x 0.8–1 mm, more or less hidden by the floral envelopes, first covered by the pericarp which ruptures irregularly at maturity disclosing the pale brown, semi-agglutinated mass of spores and sterile cells. *Spores* (Figs. 40, 41) globose, subglobose, broadly ellipsoidal, 13–16 x 13–19 µm, pale yellow to pale yellowish-brown, provided with 1.5–2.5(–3) µm high, blunt, subpyramidal warts, 4–7 per spore diameter, seen in surface view, spore profile wavy due to a hyaline sheath. *Sterile cells* (Figs. 40, 41) subglobose, ellipsoidal or slightly irregular, variable in size, 8–24 x 9–25 µm, hyaline to yellowish-brown tinted; wall 0.5–1.5 µm thick, smooth.

On *Eragrostis caespitosa* Chiov.; Kenya. Known only from the type locality.

Two additional smut fungi are present in the type collection: *T. eragrostidis* and *Macalpinomyces spermophorus*.

Key to the *Tilletia* species of *Eragrostis* and *Eragrostiella*

1. Spores reticulate .... ***T. baldratii***
- Spores provided with pointed, subacute or truncate, pyramidal warts 2
2. Spores 40–60(–65) µm, warts 4–8(–9) µm high .... ***T. eragrostiellae***
- Spores smaller, warts lower 3
3. Spores 28–40 µm long, warts 2.5–5.5 µm high .... ***T. eragrostidis***
- Spores smaller, warts lower 4
4. Spores 18–28 µm long 5
- Spores 13–19 µm long, warts 1.5–2.5(–3) µm high.................. ***T. kenyana***
5. Spores with 2.5–4 µm high, pointed, pyramidal warts..... ***T. transvaalensis***
- Spores with (1.5–)2–2.5 µm high, truncate, pyramidal warts . ***T. poonensis***

A third species of *Urocystis* on *Hypoxis* (Amaryllidaceae)

Two *Urocystis* species are known on *Hypoxis*: ***U. hypoxis*** Thaxter (1893:278), type on *H. erecta* L. (= *H. hirsuta* (L.) Coville), USA. It is characterised by spore balls measuring 20–45 x 25–60 µm, composed of (1–)3–10(–15) spores. ***U. thaxteri*** Vánky (2001:270), type on *H. acuminata* Baker, *H. costata* Baker, *H. galpinii* Baker, and *H. rigidula* Baker, South Africa, with spore balls measuring 30–50 x 35–70(–80) µm, composed of (3–)5–25(or more?) spores. A different species is:

Urocystis aurea Vánky, **sp. nov.**

Typus in matrice *Hypoxis aurea* Lour., India, Maharashtra State, pr. urbem Poona, Lonawala, 7.VIII.1955, leg. S.D. Patil. Holotypus in Herbario Ustil. Vánky, HUV 15599.

Sori in capsulis, vicem seminum massa atrobrunnea, pulverea glomerulorum sporarum implentes. Rarius sori in pedicellis floralibus intumescentias fusiformes producentes. *Glomeruli sporarum* globosi, ovoidei, ellipsoidales usque parum irregulares, 20–32 x 20–40 µm, e sporis 1–6(–8) compositi et strato cellularum sterilium perfecte obtecti. *Sporae* subglobosae, ellipsoidales, elongatae usque subpolyedrice irregulares, 8–12 x 9,5–16 µm, rubrobrunneae. *Cellulae steriles* et forma et magnitudine variae, 6,5–16 µm longae, pallide flavidobrunneae, propter tenuitatem parietis liberi (cca. 0.5 µm), specimina earum aetate superiora collapsae, parietibus contactis crassioribus, cca. 1 µm, levibus.

Sori in the capsules, replacing the seeds with a dark brown, powdery mass of spore balls. More rarely sori on the floral pedicels producing fusiform swellings. *Spore balls* (Fig. 42) globose, ovoid, ellipsoidal to slightly irregular, 20–32 x 20–40 µm, composed of 1–6(–8) spores (1 = 16%, 2 = 33.5%, 3 = 29%, 4 = 16%, 5 = 3.5%, 6 = 1.5%, 7 = 0%, 8 = 0.5%) and a completely investing layer of sterile cells. *Spores* (Fig. 42) subglobose, ellipsoidal, elongated to subpolyhedrally irregular, 8–12 x 9.5–16 µm, reddish-brown. *Sterile cells* (Fig. 42) variable in shape and size, 6.5–16 µm long, pale yellowish-brown, collapsed in old specimens; wall of the free, outer side thin, c. 0.5 µm, the contact walls are c. 1 µm thick, smooth. *Spore germination* results in short holobasidia apically producing 4–8 ellipsoidal basidiospores which fuse in pairs (Gandhe, 1998).

On Amaryllidaceae (Hypoxidaceae): *Hypoxis aurea* Lour.; Asia (India).

It is not unusual that several *Urocystis* species may occur on a certain host plant genus in the Amaryllidaceae. On species of *Ixiolirion* there are two *Urocystis* species known: *U. ixioliri* Zaprom. and *U. nevodovskyi* Schwarzman, both in Asia.

A new species of *Tranzscheliella* on *Sporobolus* (Poaceae)

Twelve species of *Tranzscheliella* are known, producing superficial, naked sori on the stems, more rarely also on axes and branches of the inflorescence of Poaceae. An additional species is:

Tranzscheliella laevispora Vánky, **sp. nov.**

Typus in matrice *Sporobolus agrostoides* Chiov., Kenya, Thomson's Fall Schoob, alt. cca. 7500 ft, 28.VII.1950, R.W. Bamey. Holotypus in Herbario Ustil. Vánky, HUV 15444!

Sori in superficie telarum plantae nutrientis (vaginae foliorum?), strias nigrobrunneas, pulvereas, confluentes, usque 10 cm longas vel longiores formantes. *Sporae* globosae, subglobosae, ellipsoidales, saepe latere uno deplanatae et tunc semiglobosae vel cupulatae, cca. 3 µm latae, in visu superficiali 4–5,5 x 4,5–6,5 µm, rubrobrunneae; pariete cca. 0,4 µm crasso, latere uno parum tenuiore, levi.

Sori on the surface of host tissues (leaf sheath?), forming blackish-brown, powdery, confluent striae, up to 10 cm long or longer. *Spores* (Fig. 46, 47) globose, subglobose, ellipsoidal, often flattened on one side and then hemiglobose or cup-shaped, c. 3 µm wide, in surface view 4–5.5 x 4.5–6.5 µm, reddish-brown; wall c. 0.4 µm thick, somewhat thinner on one side, smooth.

On *Sporobolus agrostoides* Chiov.; E. Africa (Kenya). Known only from the type collection.

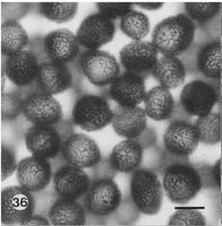
Tranzscheliella laevispora differs from *T. hypodytes* and related species, especially in having smooth spores and hemispherical or cup-shaped spores as seen in SEM.

On the fragmentary material at hand, the place of the sori could not be established with certainty, and the host plant identity could not be verified.

Figs. 36, 37. Spores of *Ustilago duranii* on *Andropogon semiberbis*, in LM and in SEM (type).

Figs. 38, 39. Spores of *Microbotryum paucireticulatum* on *Polygonum orientale*, in LM and in SEM (type).

Figs. 40, 41. Spores and sterile cells of *Tilletia kenyana* on *Eragrostis caespitosa*, in LM and in SEM (type). Bars = 10 µm.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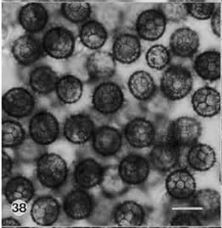
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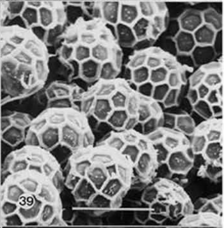
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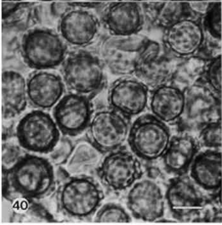
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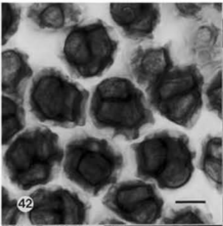
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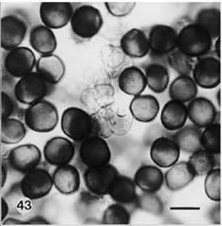
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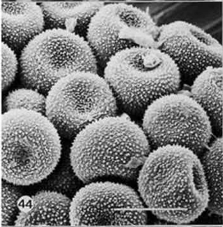
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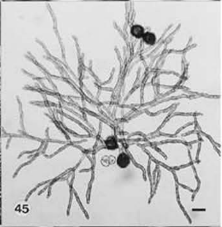
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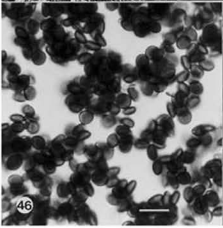
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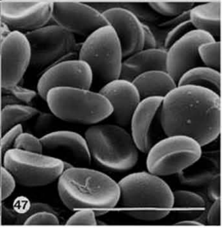
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The smut fungi of *Urochloa*, compared with those of *Brachiaria*, *Eriochloa* and *Yakirra* (Poaceae)

Urochloa P. Beauv., with 12 species in the Old World tropics, mainly in Africa, belongs to the subfamily Panicoideae, tribe Paniceae, subtribe Setariinae (Clayton & Renvoize, 1986:284). It is closely related to *Brachiaria* (c. 100 spp.), *Eriochloa* (c. 30 spp.) and *Yakirra* (6 spp.). On ***Brachiaria*** gradually I recognised ten smut fungi (Vánky, 1997b:138-141, 2000a:173-175, 2002a:377, Vánky & Shivas, 2003:246-249): **1. *Eballistra brachiariae*** (Viégas) R. Bauer, Begerow, A. Nagler & Oberw., **2. *Macalpinomyces brachiariae*** Vánky, C. Vánky & R.G. Shivas, **3. *M. ordensis*** (R.G. Shivas & Vánky) R.G. Shivas & Vánky, **4. *M. tanakae*** (S. Ito) Vánky, **5. *Sporisorium cryptum*** (McAlpine) Vánky, **6. *S. ovarium*** (Griffiths) Vánky, **7. *S. serratum*** (L. Ling) Vánky (= *S. africanum*), **8. *Tilletia brachiariae*** (Pavgi & Thirum.) Vánky, **9. *T. mauritiana*** Vánky, and **10. *Ustilago operta*** Syd., P. Syd. & Butler. On ***Eriochloa*** three smut fungi are known: **1. *Sporisorium eriochloae*** Vánky, **2. *S. mixtum*** (Massee) Vánky, and **3. *Tilletia brachiariae*** (Pavgi & Thirum.) Vánky. On ***Yakirra*** only one smut fungus is known: ***Sporisorium cryptum*** (McAlpine) Vánky. On ***Urochloa*** seven smut fungi have been reported. These were studied, compared to each other and to the smut fungi on *Brachiaria*, *Eriochloa* and *Yakirra*. It turned out that *Melanotaenium urochloae* M.S. Patil is a synonym of *Eballistra brachiariae*, *Sphacelotheca serrata* L. Ling is *Sporisorium africanum* (Syd. & P. Syd.) Vánky. *Ustilago verecunda* Syd., and *U. urochloana* Zundel are synonyms of *Sporisorium ovarium*. On *Urochloa* four smut fungi could be recognised:

1. *Eballistra brachiariae* (Viégas) R. Bauer, Begerow, A. Nagler & Oberw., 2001:423.

Melanotaenium brachiariae Viégas, 1944:748. — Type on *Brachiaria plantaginea* (Link) Hitchc., Brazil, Est. de São Paulo, Mogí-Mirim, Faz. Emílio Spina, 27.II.1941, A.P. Viégas, IACM; isotypes HCIO 11662!, HUV 15410!

Tolyposporella brachiariae Mundkur & Thirumalachar, 1946:5. — Type on *Brachiaria distachya* (L.) Haines, India, Bangalore, Karnataka,

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Fig. 42. Spores of *Urocystis aurea* on *Hypoxis aurea*, in LM (type).

Figs. 43, 44. Spores and sterile cells of *Sporisorium arundinellae-pumilae* on *Arundinella pumila*, in LM and in SEM (type).

Fig. 45. Spore germination of *Sporisorium arundinellae-pumilae* (on WA, in 5 days, at room temp.; stained with cotton-blue; type).

Figs. 46, 47. Spores of *Tranzscheliella laevispora* on *Sporobolus agrostoides*, in LM and in SEM (type). Bars = 10 µm.

14.II.1942, M.J. Thirumalachar, HCIO 10339-103341! (as "14.XII.1942"). (syn. by Vánky, 1997b:139).

Melanotaenium echinochloae M.S. Patil, 1992:180. — Type on "*Echinochloa* sp." (= misnamed *Brachiaria distachya* (L.) Haines, teste K. Vánky), India, Maharashtra State, Kolhapur, Shivaji University Campus, 8.X.1978, M.S. Patil, HCIO 30109; isotype HUV 15494! (syn. by Vánky, 1997b:139).

Melanotaenium urochloae M.S. Patil, 1992:180. — Type on *Urochloa trichopus* (Hochst.) Stapf (= misnamed *U. panicoides* P. Beauv., teste K. Vánky), India, Maharashtra State, Kolhapur, 19.XII.1979, A.R. Kulkarni, HCIO 30110; isotype HUV 17509! (syn. nov.).

For description see Vánky, 1997b:139.

On *Brachiaria distachya* (L.) Stapf, *B. piligera* (F. Muell. ex Benth) Hughes (*Urochloa piligera* (F. Muell. ex Benth) R. Webster), *B. plantaginea* (Link) Hitchc., *Urochloa panicoides* P. Beauv., *U. trichopus* (Hochst.) Stapf; S. Asia (India), Africa (Zimbabwe), Australia, South America (Brazil).

2. *Macalpinomyces pretoriensis* (Pole-Evans) Vánky, 2003b:57.

Ustilago pretoriensis Pole-Evans, in H. & P. Sydow, Ann. Mycol. 12:263, 1914. — *Sphacelotheca pretoriensis* (Pole-Evans) Zundel, 1938:301. — *Sporisorium pretoriense* (Pole-Evans) Vánky, 1998c:9, nom. herb. — Type on *Panicum helopus* Trin. var. *glabrescens* (K. Schum.) Stapf (*Urochloa panicoides* P. Beauv.), South Africa, Transvaal, Pretoria, 20.III.1914, A.O.D. Mogg, PREM 7408; isotype HUV 18004!

For its description see Vánky, 2003b:57.

On *Panicum maximum* Jacq., *Urochloa brachyurus* (Hack.) Stapf, *U. panicoides* P. Beauv. (*U. helopus* (Trin.) Stapf; *Panicum helopus* Trin. var. *glabrescens* (K. Schum.) Stapf), *U. trichopus* (Hohst.) Stapf; Africa (Malawi, South Africa, Zambia, Zimbabwe).

3. *Sporisorium africanum* (Syd. & P. Syd.) Vánky, **comb. nov.**

Basionym: *Sorosporium africanum* H. & P. Sydow, Ann. Mycol. 7:544, 1909. — Type on *Panicum trichopodon* A. Rich. (= *Urochloa trichopus* (Hochst.) Stapf), Portuguese East Africa [Mozambique], 18.IV.1908, C.W. Howard; isotypes BPI 179411 & 179412, PREM 7631.

Sphacelotheca serrata L. Ling, 1953b:183. — *Sporisorium serratum* (L. Ling) Vánky, 1997b:140. — Type on *Brachiaria serrata* (Thunb.) Stapf, Nyasaland [Malawi], Lilongwe, IX.1950, G. Jackson, IMI 44074!; isotype HUV 17372! (syn. nov.).

For its description see Vánky, 1997b:140 (as *Sporisorium serratum*).

On *Brachiaria serrata* (Thunb.) Stapf, *Urochloa oligotricha* (Fig. & De Not.) Henrard (*U. bolbodes* (Steud.) Stapf), *U. trichopus* (Hochst.) Stapf (*Panicum trichopodon* A. Rich.); Africa (Malawi, Mozambique, S. Africa).

4. ***Sporisorium ovarium*** (Griffiths) Vánky, 1997b:138.

Sorosporium ovarium Griffiths, 1907:209. — Lectotype (designated by Zundel, 1953:68) on *Panicum caespitosum* Swartz (= *Brachiaria reptans* (L.) Gard. & C.E. Hubb.), Mexico, Hidalgo, Dublan, 9.IX.1905, D. Griffiths, BPI 180088!

Sphacelotheca diplospora (Ellis & Everh.) G.P. Clinton var. *verruculosa* G.P. Clinton, 1906:27. — Type on *Panicum* sp. (= *Brachiaria meziana* Hitchc., comp. Ling, 1953b:191), Mexico, near Mexico City, Lecheria, 5.VII.1904, C.G. Pringle, NHES; isotypes BPI 177481, HUV 16754! (syn. by Ling, 1953b:191, confirmed).

Ustilago verecunda H. Sydow, 1935:231. — *Sorosporium verecundum* (Syd.) Zundel, Bothalia 3:304, 1938. — Type on *Urochloa helopus* (Trin.) Stapf, South Africa, Transvaal, Pretoria, Wonderboom, Siding, 27.II.1931, A.O.D. Mogg, PREM 26609; isotype HUV 18208! (syn. nov.).

Sorosporium brachiariae J.C. Hopkins, 1938:109 & 126. — Type on *Brachiaria brizantha* (A. Rich.) Stapf, Rhodesia [Zimbabwe], Salisbury [Harare], 26.I.1932, J.C. Hopkins, Herb. Dept. Agricult. Southern Rhodesia no. 1860; isotypi in PREM 30370! BPI 179468! & 195141. (syn. by Ling, 1953b:191, confirmed).

Ustilago urochloana Zundel, 1943:166. — Type on *Urochloa trichopus* (Hochst.) Stapf, South Africa, Transvaal, Crocodile River, Brown's Kuil Drift, 8.VI.1921, A.O.D. Mogg, PREM 20690; isotypes BPI 168742!, HCIO, HUV 15403! (syn. nov.).

Sorosporium brachiariae-ramosae Ramakrishnan, 1952:113. — Type on *Brachiaria ramosa* Stapf, India, Tamil Nadu, Coimbatore, Pollachi, 20.VIII.1912, S. Sundararaman, HCIO 19814!; isotypes IMI 56705, HUV 17272! (syn. by Vánky, 1997b:139).

For its description see Vánky, 1997b:138.

On *Brachiaria brizantha* (A. Rich.) Stapf, *B. lata* (Schum.) C.E. Hubb., *B. meziana* Hitchc., *B. piligera* (F. Muell.) Hughes, *B. ramosa* Stapf, *B. reptans* (L.) Gard. & C.E. Hubb., *B. xantholeuca* (Hackel ex Schinz) Stapf, *Panicum maximum* Jacq., *Urochloa fasciculata* (Sw.) R. Webster, *U. mosambicensis* (Hack.) Dandy (*U. pullulans* Stapf var. *mosambicensis* Hack.), *U. panicoides* P. Beauv. (*U. helopus* (Trin.) Stapf), *U. trichopus* (Hochst.) Stapf, *Urochloa* sp.; Africa (Botswana, Cape Verde I., Malawi, South Africa, Zambia, Zimbabwe), S. Asia (India), Australia, N. & C. America (Mexico, Panama).

Key to the smut fungi of *Brachiaria, Eriochloa, Urochloa* and *Yakirra* (*M. = Macalpinomyces, S. = Sporisorium*)

1. Sori in the leaves and stems .... ***Eballistra brachiariae***
– Sori in ovaries, flowers or spikelets 2

2. Spores more than 13 µm long. Sori in ovaries 3
– Spores less than 15 µm long. Sori in ovaries, flowers or spikelets 4
3. Spores 19–24(–26) µm long .... ***Tilletia brachiariae***
– Spores 13.5–18.5 µm long .... ***Tilletia mauritiana***
4. Sori in some ovaries or flowers of an inflorescence. Sterile cells abundant between the spores 5
– Sori in all ovaries or flowers of an inflorescence. Sterile cells few or absent 8
5. Spores 8–13 µm long 6
– Spores 7–11 µm long 7
6. Sori inconspicuous, up to 2 mm long. Spores densely, evidently echinulate. Spore profile serrate .... ***M. tanakae***
– Sori hypertrophied, up to 40 mm long. Spores prominently, moderately densely echinulate. Spore profile serrulate .... ***M. pretoriensis***
7. Sori inconspicuous, up to 1 mm long. Spores densely, low verrucose-echinulate. Spore profile smooth to finely wavy .... ***M. brachiariae***
– Sori hypertrophied, up to 5 mm long. Spores sparsely, evidently echinulate. Spore profile finely, sparsely serrulate .... ***M. ordensis***
8(4). Columella and spore balls absent. Sori destroying the inner floral organs, often also the basal part of the floral envelopes...... ***Ustilago operta***
– Columella and spore balls present, at least in young sori. Sori otherwise.. 9
9. Sori 5–10 mm long. Spores expressly dimorphic. Outer spores in a ball mamillate .... ***S. eriochloae***
– Sori usually much shorter. Spores not or only slightly dimorphic, not mamillate 10
10. Spores 6.5–9 µm long; wall uneven, 0.5–1.5 µm thick, smooth to punctate-verruculose .... ***S. africanum***
– Spores larger, wall evenly thick 11
11. Spores 8–10.5 µm long, finely punctate to verruculose. Spore profile smooth .... ***S. cryptum***
– Spores larger, densely verrucose-echinulate. Spore profile wavy to finely serrulate 12
12. Spores 8–12(–13) µm long .... ***S. ovarium***
– Spores 9.5–15 µm long .... ***S. mixtum***

The smut fungi of *Arundinella* (Poaceae)

Arundinella Raddi, with c. 50 species in the tropics and subtropics, mainly in Asia, belongs to the tribe Arundinelleae of the subfamily Panicoideae (Calyton & Renvoize, 1986:316). At least ten smut fungi have been reported on *Arundinella*: **1.** ***Macalpinomyces effusus*** (Syd. & P. Syd.) Vánky, **2.** ***Melanotaenium arundinellae*** M.S. Patil, **3.** ***M. tuberculatae*** M.S. Patil, **4.** ***Sorosporium arundinellae*** Syd. & P. Syd., **5.** ***S. concelatum*** L. Ling,

6. ***Tilletia arundinellae*** L. Ling, **7.** ***Ustilago arundinellae*** Bref., **8.** ***U. arundinellae-hirtae*** S. Ito, **9.** ***U. pimprina*** Thirum. & Pavgi, and **10.** ***U. shimadae*** Sawada. The recognised eight species, including a new one, are:

1. ***Macalpinomyces effusus*** (Syd. & P. Syd.) Vánky, 1997a:129.
Ustilago effusa Syd. & P. Syd., in H. & P. Sydow & Butler, 1906:425. — *Endosporisorium effususm* (Syd. & P. Syd.) K. Vánky, 1995:212. — Type on *Andropogon muricatus* Retz. (= *Vetiveria zizanioides* (L.) Nash), India, Assam, Sylhet Distr., Kanaighat, 21.V.1905, E.J. Butler 450. Holotype HCIO 450, isotypes BPI 160327, 160328, 188930, HUV 16416.

M. effusus was also collected on *Arundinella bengalensis* (Spreng.) Druce. It is questionable if the healthy inflorescence of *A. bengalensis* and the smutted plants in HCIO 1417 represent the same species. If I accept it, I do it only because this collection was made by E.J. Butler, an outstanding botanist and mycologist, who knew very well the grasses and their smuts of India, and also collected the type specimen of *M. effusus*.

For description see Vánky, 1995:212 (as *Endosporisorium effusum*).

On *Arundinella bengalensis* (Spreng.) Druce, and *Vetiveria zizanioides* (L.) Nash; S. Asia (India).

2. **"*Melanotaenium*" *arundinellae*** M.S. Patil, 1992:179.
Type on *Arundinella setosa* Trin., India, Maharashtra State, Sangli, XI.1985, S.R. Yadav, HCIO 30107!

Sori in the leaves as lead coloured angular or linear, nonerumpent spots, c. 1 mm wide and up to 15 mm long. *Spores* embedded in the leaf tissue in the intercellular spaces of mesophyll cells, globose, subglobose, ovoid to slightly irregular, 6–9.5 x 7–11 μm, yellowish-brown; wall even or slightly uneven, 0.8–1.5 μm thick, smooth.

On *Arundinella setosa* Trin.; S. Asia (India).

3. **"*Melanotaenium*" *tuberculatae*** M.S. Patil, 1992:180.
Type on *Arundinella tuberculata* Munro, India, Maharashtra State, Kolhapur, Shivaji University Campus, 15.XII.1985, M.S. Patil, HCIO 30108!

Sori in the leaves as lead coloured spots, 1–5 x 2–15 mm or larger by confluence. *Spores* embedded in the leaf tissue, usually irregularly subpolyhedral, rarely subglobose or ellipsoidal, 8–13 x 9–16 μm, dark reddish-brown; wall uneven, (1–)2–4(–5) μm thick, smooth.

On *Arundinella tuberculata* Munro; S. Asia (India).

4. ***Sporisorium arundinellae*** (Bref.) Vánky, **comb. nov.**
Basionym: *Ustilago arundinellae* Brefeld, Unters. Gesammtgeb. Mykol. 12:108, 1895. — *Sphacelotheca arundinellae* (Bref.) Mundkur, 1939:113. — Type on *Arundinella* sp., India, West Bengal, Calcutta, ?, comm. Cunningham.

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Fig. 48. Sori of *Tilletia kenyana* in all ovaries of a spikelet of *Eragrostis caespitosa* (type).
Bar = 1 mm.

Fig. 49. Sori of *Sporisorium arundinellae-pumilae* on *Arundinella pumila* (type). To the left a healthy plant. Enlarged a healthy and three infected spikelets.
Bars = 1 cm for the habit, and 2 mm for the detail drawings.

According to Brefeld's incomplete original description, the *sori* are in the ovaries, the *spores* are smooth, rounded, brown, 8–9 µm in diameter. *Spore germination* results in 4-celled basidia on which ellipsoidal basidiospores are produced on sterigmata (Brefeld, 1895:108, Pl. VI, figs. 19-23).

Fortunately, Mundkur (1939:113) studied the type specimen before it was destroyed in Berlin, and gave a more complete description for it, under the name of *Sphacelotheca arundinellae:* "Ovaricolous; sori 2.5–3 mm long, covered by a firm false membrane consisting of hyaline, globose, smooth, sterile cells; columella slightly coiled at the top. Spores mostly globose, some round and flattened when they have a concavity on both sides at the centre which looks like a large vacuole; mostly Vandyke Brown (Ridgway) but those that are flat, Cameo Brown; epispore markedly thick with a smooth edge, with surface minutely pitted; diameter 7–10 µ with a mean of 8.9 µ."

On *Arundinella* sp.; S. Asia (India). Known only from the type locality.

Sorosporium concelatum L. Ling belongs to the genus *Sporisorium*. The name *Sporisorium concelatum* being occupied, a new name is proposed for this smut:

5. *Sporisorium arundinellae-nepalensis* Vánky, nom. nov.

Replacing *Sorosporium concelatum* L. Ling, Lloydia, 14:106, 1951 (not *Sporisorium concelatum* (Zundel) M. Piepenbring, 2002:109, type on *Ischaemum latifolium*). — Type on *Arundinella nepalensis* Trin., Australia, New South Wales, Gilgandra, VII.1928, without name of collector, BPI 179453!

Sori in the ovaries, infecting all the spikelets in a panicle, 2–3 mm long, oblong, tapering at both ends, concealed by the glumes, each enclosed in a greenish peridium of host tissue and fungal cells. *Spore balls* subglobose to oblong or irregular, 25–65 x 30–70(–100) µm, reddish-brown to opaque, rather permanent. *Spores* irregularly subpolyhedral or polyhedral, 5.5–9 x 6.5–10.5 µm, dimorphic; peripheral spores deep cinnamon brown, densely verruculose on free surface, inner spores subhyaline to yellowish-brown, apparently smooth to finely punctate. No sterile cells between the spores.

On *Arundinella nepalensis* Trin.; Australia. Known only from the type collection.

6. *Sporisorium arundinellae-pumilae* Vánky, sp. nov.

Typus in matrice *Arundinella pumila* (Hochst.) Steud. (det. S. Karthikeyan, BSI), India, Maharashtra State, 2 km N. oppid. Mahabaleshwar, 17°56' N, 73°42' E, alt. cca. 1310 m.s.m., 26.X.1992, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 15761, isotypi in Vánky, Ust. exs. no. 917 (ut *Sporisorium arundinellae*).

Sori in spiculis omnibus eiusdem inflorescentiae, globoidei usque ellipsoidales, saepe cum apicibus acutis indumentorum floralium internorum partim destructorum, 0,5–0,8 x 0,6–1,2 mm, partim glumis obtecti, primum peridio crasso origine plantae nutrientis et fungali cooperti, quo ab apice eius rupto massam atrobrunneam, semiagglutinatam usque pulveream glomerulorum sporarum laxorum, sporarum et cellularum sterilium columellam centralem obtusam, tenuiescentem, ramulis apicalibus brevibus instructam circumdantem ostendentes. *Glomeruli sporarum* ephemeri. *Sporae* in maturitate singulae, subglobosae, ellipsoidales usque subpolyedrice parum irregulares, 8–11 x 9,5–14,5 µm, mediocriter atro-flavidobrunneae; pariete aequali, 0,5–1 µm crasso, subtiliter, dense punctatoverruculoso usque verruculoso-echinulato; imago obliqua sporarum levis usque leniter serrulata. *Cellulae steriles* in catervis parvis vel in catenis brevibus, cellulae singulae irregulares, lateribus uno vel pluribus deplanatis, 4–9,5 x 6,5–12 µm, subhyalinae vel colore flavidobrunneo tinctae; pariete aequali, cca. 0,5 µm crasso, levi. *Germinatio sporarum* cum hyphis ramificatis.

Sori (Fig. 49) in all spikelets of an inflorescence, globoid to ellipsoidal, often with acute tips of partly destroyed inner floral envelopes, 0.5–0.8 x 0.6–1.2 mm, partly hidden by the glumes, at first covered by a thick peridium of host and fungal origin which ruptures from its apex disclosing the dark brown, semi-agglutinated to powdery mass of loose spore balls, spores and sterile cells surrounding a stout, narrowing central columella with short apical branches. *Spore balls* ephemeral. *Spores* (Figs. 43, 44) when mature single, subglobose, ellipsoidal to subpolyhedrally slightly irregular, 8–11 x 9.5–14.5 µm, medium dark yellowish-brown; wall even, 0.5–1 µm thick, finely, densely punctate-verruculose to verruculose-echinulate, spore profile smooth to finely serrulate. *Sterile cells* (Fig. 43) in small groups or short chains, single cells irregular with one or several flattened sides, 4–9.5 x 6.5–12 µm, subhyaline or with yellowish-brown tint; wall even, c. 0.5 µm thick, smooth. *Spore germination* (Fig. 45; on water-agar, in 5 days, at room temp.) results in ramified hyphae.

On *Arundinella pumila* (Hochst.) Steud.; S. Asia (India). Known only from the type collection.

7. ***Tilletia arundinellae*** L. Ling, 1945:1.

Type on *Arundinella anomala* Steud., China, Szechwan Prov., Chengtu, coll. L. Ling, BPI 196372!

Sori in the ovaries, scattered in the inflorescence, inconspicuous, protruding between the glumes, ovoid to horn-shaped, 1–1.5 x 3–4 mm, enclosed by a firm, purplish-tinged peridium which ruptures irregularly revealing a black, pulverulent spore mass intermixed with sterile cells. *Spores* globose or subglobose, rarely broadly ellipsoidal, 21–32(–34) x 22–33(–37) µm, reddish- to blackish-brown, rarely with a papilla or a shorter or longer, sometimes coiled, hyaline appendage; wall 4–5.5 µm thick including the thin (c. 0.8 µm), uniform endospore and the exospore provided with 1.5–3 µm high warts. In SEM the warts are confluent forming shorter or longer, parallel or spirally arranged rows. *Sterile cells* smaller than the spores, 13–20 µm long, hyaline, often pedicelled; wall 1–2.5 µm thick, smooth, collapsed in old specimens.

On *Arundinella anomala* Steud.; E. Asia (China). Known only from the type collection.

8. *Tilletia lineata* R.G. Shivas & Vánky, in Vánky & Shivas, 2001:169. Type on *Arundinella nepalensis* Trin., Australia, Western Australia, Kimberley region, at the Lake Kununurra, 15°46' S, 128°44' E, alt. 20 m, 28.II.1995, leg. A.A. Mitchell, PERTH 3801454; isotype HUV 17450!

For description and illustrations see Vánky & Shivas, 2001:169.

On *Arundinella nepalensis* Trin.; Australia.

T. lineata differs from *T. arundinellae* by smaller spores (20–27(–30) µm long), warts which are not fusing into rows, seen in SEM, and by larger sterile cells (20–40 µm long).

Excluded or synonyms are:

Sorosporium arundinellae H. & P. Sydow, 1901:(2), (type on *Arundinella anomala* Steud. (= *A. hirta* (Thunb.) C. Tanaka), Japan, Saitama Pref., Omiya city, 20.XI.1899, Nishida & Nambu, BPI 179450! & 195110!) is ***Ustilaginoidea arundinellae*** Henn., an anamorphic Ascomycete (comp. also Ling, 1951:106 & 1953c:344).

Ustilago arundinellae-hirtae S. Ito, 1935:88, type on *Arundinella hirta* (Thunb.) C. Tanaka var. *ciliata* Koidz., Japan, was considered by Kakishima (1982:85) to be a synonym of *Ustilago kusanoi* = ***Sporisorium kusanoi*** (Syd. & P. Syd.) Vánky, type on *Miscanthus sacchariflorus* Hackel, tribe Andropogoneae, subtribe Saccharinae, Japan. Indeed, the two types are identical in their sori and spore morphology and indistinguishable from each other. I suspect that the host plant of *U. arundinellae-hirtae* is a *Miscanthus* sp., which was not possible to verify on the specimens at hand (see also Vánky, 2000b:156).

Ustilago pimprina Thirum. & Pavgi is ***U. egenula*** Syd., P. Syd. & Butler. *Ustilago pimprina* Thirumalachar & Pavgi (1968/1969:251) was described on "*Arundinella* sp." from India, Poona, at Pimpri, X.1955, M.J. Thirumalachar 1252. It is not known where the type is deposited. Despite the statement in the introduction, it is not in HCIO, IMI or in BPI.

An excellent drawing of the diseased plant in Thirumalachar & Pavgi, 1968/1969, Pl. XV, figs 16 & 17, shows that the host plant is an *Eragrostis,* not *Arundinella*. The description of *Ustilago pimprina* fit well with the characters of *Ustilago egenula* Syd., P. Syd. & Butler (type on *Eragrostis nutans* (Retz.) Nees ex Steud., India). Consequently, I am considering *U. pimprina* to be *U. egenula* (syn. nov.).

Ustilago shimadae Sawada ex L. Ling, Mycologia 41:260, 1949b. — *Ustilago shimadae* Sawada, 1944:34 (invalid name, no Latin diagnosis). — Type on ?*Andropogon* or ?*Arundinella,* Taiwan, Taipeh, 3.IV.1911, Y. Shimada.

It is not known where the type is deposited (Kakishima, in litt.). According to Ling (1949:260), "the *sori* entirely destroy the floral axis, transforming it into a long, curved, flagelliform structure, covered by a whitish, delicate membrane of host tissue, approximately 25 cm long. *Spores* chiefly globose to subglobose, 4.4–6.5 µm diam., smooth, light olivaceous brown". A comparison of *U. shimadae* with *Sporisorium kusanoi* (Syd. & P. Syd.) Vánky (type on *Miscanthus sacchariflorus* Hack., Japan), for which the description fits well with that of *U. shimadae*, may reveal a conspecificity.

Key to the smut fungi of *Arundinella*

1. Sori in the leaves as lead-coloured spots or stripes 2
– Sori elsewhere 3
2. Sori long linear. Spores 7–11 µm long, regular, wall 0.8–1.5 µm thick ......
.... **"*Melanotaenium*" *arundinellae***
– Sori as wide spots. Spores 9–16 µm long, irregular, wall 1–5 µm thick......
.... **"*Melanotaenium*" *tuberculatae***
3. Spores large, over 20 µm long 4
– Spores smaller 5
4. Spores 22–37 µm long. In SEM warts often confluent in rows.
Sterile cells 13–20 µm long.. ***Tilletia arundinellae***
– Spores 20–30 µm long. In SEM warts not confluent in rows.
Sterile cells 20–40 µm long.. ***Tilletia lineata***
5. Sori on the stems 6
– Sori in the ovaries 7
6. Spores external around a long, flagelliform columella...... ***Spor. kusanoi***(?)
– Spores hidden within a tubular sorus .... ***Macalpinomyces effusus***
7. Sori 0.6–1.2 mm long. Spores 9.5–14.5 µm long...
.... ***Sporisorium arundinellae-pumilae***
– Sori 2–3 mm long. Spores 6.5–10.5 µm long... 8
8. Spore balls rather permanent. Spores subpolyhedral or
polyhedral, dimorphic .... ***Sporisorium arundinellae-nepalensis***
– Spore balls ephemeral. Spores mostly globose, not dimorphic.....................
.... ***Sporisorium arundinellae***

The smut fungi on *Ischaemum* (Poaceae)

Ischaemum L., with c. 65 species throughout the tropics, but mainly in Asia, belongs to the subfamily Panicoideae, tribe Andropogoneae, subtribe Ischaeminae. The genus is often quite difficult to distinguish from *Andropogon* (Clayton & Renvoize, 1986:345). Eleven (+1?) smut fungi could be recognised on *Ischaemum*. The followings have been found to be synonyms: *Sorosporium geminellum* Syd., P. Syd. & Butler is *Sporisorium flagellatum* (Syd., P. Syd. & Butler) Vánky, *Sorosporium yoshinagae* Zundel, and *Ustilago concelata* Zundel represent *Sporisorium ischaemi-anthephoroides* (S. Ito) Vánky & Kakish.

1. *Jamesdicksonia ischaemiana* (Thirum. & Pavgi) R. Bauer, Begerow, A. Nagler & Oberwinkler, 2001:422.

Melanotaenium ischaemianum Thirumalachar & Pavgi, 1967(1968):25. — Type on *Ischaemum semisagittatum* Roxb., India, Poona, Khandala, 14.XI.1954, M.J. Thirumalachar 1242. Topotype on 19.X.1995, N.D. Sharma, C. & K. Vánky, HUV 17524!

Sori on the leaves forming black, ellipsoidal, nonerumpent spots, 1–5 x 1.5–8 mm, or larger by confluence, with spores embedded in the host tissue. *Spores* usually irregularly subpolyhedral, rarely ovoid, (8–)9–13(–15) x (9–)10–18 µm, dark olive-brown; wall irregularly thick, 1–5(–8) µm. *Spore germination* results in holobasidia. On the top of basidia, slightly bent, short ballisto-basidiospores are produced on sterigmata. Basidiospores germinate either by hyphae or give rise to secondary ballistosporidia on sterigmata (Bauer et al., 2001:419, fig. 11).

On *Ischaemum indicum* (Houtt.) Merrill, *I. semisagittatum* Roxb.; Asia (India).

2. *Phragmotaenium indicum* (Vánky, M.S. Patil & N.D. Sharma) R. Bauer, Begerow, A. Nagler & Oberwinkler, 2001:423.

Melanotaenium indicum Vánky, M.S. Patil & N.D. Sharma, in Vánky, 1997b:149. — Type on *Ischaemum indicum* (Houtt.) Merrill, India, Maharashtra State, Kolhapur, Shivaji University Campus, alt. 650 m, 24.X.1995, K. Vánky, HUV 17508!; isotype in HCIO. Paratype on *Ischaemum indicum*, India, Madhya Pradesh, Jabalpur, J.N. Agricultural University Campus, alt. c. 410 m, 27.X.1996, leg. N.D. Sharma, HCIO, HUV 18022!; isoparatypes in Vánky, Ust. exs. no. 1012.

Sori on the leaves forming small, elongated, nonerumpent, black spots, 0.2–0.5 x 0.3–1 mm, or larger by confluence. *Spores* embedded in the host tissue, subglobose, ovoid, broadly ellipsoidal to slightly irregular, 7–11 x 8–13 µm, olive-brown; wall 1–2.5(–3) µm thick, two-layered, slightly uneven, in LM smooth, in SEM finely, densely verruculose. *Spore germination* results in 4-celled phragmobasidia measuring 2–3 x 50–90 µm. On the basidia, laterally, on 1.5–3.5 µm long sterigmata, slightly bent ballisto basidiospores are produced measuring 1.5–2 x 8–11 µm. Basidiospores germinate by hyphae (comp. also Bauer et al., 2001:419, fig. 12).

On *Ischaemum indicum* (Houtt.) Merrill; S. Asia (India).

3. *Sporisorium flagellatum* (Syd., P. Syd. & Butler) Vánky, 1997a:139.

Sorosporium flagellatum H. & P. Sydow & Butler, 1907:489. — Type on *Ischaemum timorense* Kunth, India, Wynaad, Malabar, 30.IX.1904, E.J. Butler 727, HCIO 727; isotypes in Syd. Ust. no. 393, HUV 1667!

Ustilago burmanica H. & P. Sydow & Butler, 1912:250. — Type on *Ischaemum* sp. (= *I. timorense* Kunth), Burma, Moulmein, Kya-in, 9.I.1908, E.J. Butler 1424, HCIO1424; isotypes BPI 159458, 159459, 188925, CONN, HUV 15418! (syn. by Ling, 1949:132, confirmed).

Sorosporium geminellum H. & P. Sydow & Butler, 1912:253. — Type on *Andropogon* sp. (?= *Ischaemum* sp.), India, Assam, Khasia Hills, Maoryngkneng, 12.VI.1911, I.H. Burkill, HCIO 1439; isotype HUV 17284! (syn. nov.).

Sori destroying the whole inflorescence, covered by a yellowish-brown peridium and hidden by the terminal leaf sheath from which a long (up to 5 cm or longer), twisted, flagelliform columella protrudes. At maturity the peridium ruptures, disclosing the blackish-brown, granular-powdery mass of spore balls intermixed with groups of sterile cells. *Spore balls* subglobose to ovoid, 25–50 x 28–65 µm, dark reddish-brown, composed of 7–30 (or more?), rather easily separating spores. *Spores* subglobose, ellipsoidal to irregular with somewhat flattened contact sides, 9–15(–17) x 12–19 µm, reddish-brown; wall 1–1.5 µm thick, in most of the spores with a thinner area, densely and finely verruculose-echinulate which just affects the spore profile. *Sterile cells* in irregular groups, collapsed in old specimens, single cells c. 10–16 µm long, hyaline, thin-walled (c. 0.5 µm), smooth.

On *Ischaemum indicum* (Houtt.) Merrill (*I. ciliare* Retz.), *I. timorense* Kunth (*Spodiopogon blumii* Nees ex Steud.; *S. bryonis* Trin.), *Ischaemum* sp.; S. & E. Asia (Burma, India, Japan, Sri Lanka).

Report of *Ustilago burmanica* on *Ischaemum spathiflorum* Hooker fil. (= *Triplopogon ramosissimum* (Hack.) Bor), from India, Bombay (Kulkarni, ap. Butler & Bisby, 1931:48), refers certainly to *Sporisorium triplopogonis* Vánky.

4. *Sporisorium furcatum* (Syd., P. Syd. & Butler) Vánky, **comb. nov.** Basionym: *Sorosporium furcatum* H. & P. Sydow & Butler, Ann. Mycol. 10:254, 1912. — Type on *Ischaemum aristatum* L., India, Maharashtra State, Nagpur Distr., Lendru, 2.X.1908, P.A. Pandit, HCIO 1442; isotype BPI 195113!

Sori in the inflorescence, 7–15 mm long, partly hidden by the distal leaf sheath, first covered by a thick, brown peridium which ruptures irregularly disclosing the dark brown, semi-agglutinated to powdery mass of spore balls, spores and groups of sterile cells surrounding a central columella composed of several, filiform, agglutinated branches. *Spore balls* variable in shape and size, subglobose, ovoid, elongated or irregular, 40–80 x 40–100(–120) µm, dark reddish-brown to subopaque, composed of tens to hundreds(?) of spores which separate by pressure. *Spores* globose, subglobose, ovoid, ellipsoidal to slightly irregular, subpolyhedral, 7–11.5 x 8–12.5(–14) µm, yellowish-brown; wall even or nearly so, 0.5–0.8 µm thick, densely punctate to finely, densely verruculose-echinulate on the free surface, spore profile smooth, wavy to very finely serrulate. *Sterile cells* in irregular groups, subhyaline to pale yellowish-brown, single cells about the size of the spores, 8–12 µm long, collapsed in old specimens.

On *Ischaemum aristatum* L.; N. Africa (Sudan), S. Asia (India).

5. *Sporisorium hainanae* (Zundel) L. Guo, 1998:1.

Sphacelotheca hainanae Zundel, 1939:585. — *Sphacelotheca tonglinensis* (Tracy & Earle) Zundel var. *hainanae* (Zundel) L. Ling, 1953c:334. — Type on *Ischaemum rugosum* Salisb., China, Island of Hainan, Kachek, 13.X.1912, A.S. Hitchcock 19610, BPI 195080!

Sori in all ovaries of an inflorescence, ellipsoidal, 0.5–1.5 x 2–4 mm, more or less hidden by the floral envelopes, at first covered by a light brown peridium which ruptures irregularly revealing a dark brown, powdery mass of spores and sterile cells surrounding a simple, central columella, often with shorter or longer, thin, apical branches. *Spores* when mature single, globose, subglobose to broadly ellipsoidal, 6.5–9 x 7–11 µm, yellowish-brown; wall even, c. 0.5 µm thick, moderately densely, low echinulate, spore profile wavy to finely serrulate. *Sterile cells* in irregular groups, single cells subglobose, ellipsoidal, usually rounded irregular with one or several slightly flattened sides, 8–16 µm long, subhyaline to pale yellowish-brown tinted, collapsed in old specimens; wall 0.5–1.5 µm thick, smooth.

On *Ischaemum aristatum* L., *I. mangaloricum* (Hack.) Stapf ex C.E.C. Fischer, *I. rugosum* Salisb.; E. & S. Asia (China, India, Vietnem), E. Malaysia (Sarawak).

6. *Sporisorium ischaemi* (L. Ling) Vánky, **comb. nov.**

Basionym: *Sorosporium ischaemi* L. Ling, Sydowia 4:80, 1950. — Type on *Ischaemum rugosum* Salisb., India, Bombay, [Maharashtra State], Poona, Kumta, without date and collector, FH!

Sori destroying all spikelets of an inflorescence, 2–2.5 x 4–6 mm, conspicuously protruding between the spreading, deformed, outermost floral envelopes, first covered by a thick, brown peridium which ruptures irregularly from its apex disclosing the granular-powdery, blackish-brown mass of spore balls and sterile cells surrounding a stout, central, irregular columella with short, apical branches. *Spore balls* subglobose, ovoid, ellipsoidal, elongated to slightly irregular, 40–110 x 50–150 µm, reddish-brown, composed of tens of spores which separate easily by pressure. *Spores* subglobose, ellipsoidal to usually subpolyhedrally slightly angular, 9–12 x 9–13 µm, yellowish-brown; wall even, 0.5–0.8 µm thick, finely, densely verrucose-echinulate, spore profile very finely serrulate. *Sterile cells* few, in irregular, small groups, single cells 6.5–12 µm long, pale yellowish-brown, collapsed in old specimens.

On *Ischaemum rugosum* Salisb.; S. Asia (India).
Sporisorium ischaemi is close to *S. tonglinense* (Tracy & Earle) L. Guo, in which the spore balls are ephemeral, the spores slightly smaller and more prominently echinulate.

7. *Sporisorium ischaemi-anthephoroides* (S. Ito) Vánky & Kakish., **comb. nov.**

Basionym: *Ustilago ischaemi-anthephoroides* S. Ito, Trans. Sapporo Nat. Hist. Soc. 14:88, 1935. — Type on *Ischaemum anthephoroides* Miq., Japan, Honshu, Echigo Prov., Uchino, 13.VIII.1915, S. Ito, SAPA!

Sorosporium yoshinagae Zundel, 1939:589. — Type on "*Panicum repens* L." (= misnamed *Ischaemum* sp., teste K. Vánky), Japan, Trino-mura [= Shikoku I., Kochi Pref.], Tosa, 8.VIII.1922, T. Yoshinaga, BPI 195131! Topotype: 4.VIII.1940, T. Yoshinaga, SAPA! (syn. nov.).

Ustilago concelata Zundel, 1945:372. — *Sporisorium concelatum* (Zundel) M. Piepenbring, 2002:109. — Type on *Ischaemum latifolium* (Sprengel) Kunth, Colombia, Antioquia, Medellin, "La Norma", 1650 m, VII.1942, C. Garcés O., BPI 159676; isotypes in Fungi of Colombia no. 1643, BPI 196342, HUV 16758! (syn. nov.).

Sori surrounding the floral stem, comprising also the inflorescence, sometimes only its proximal part, while groups of intact spikelets may be present on its distal part, flagelliform, 1–2 mm wide, 2.5–9 cm long, at first more or less hidden by leaf sheaths and also covered with a thin, greyish peridium of host origin, which early flakes away and the dark brown, powdery mass of spores and sterile cells are scattered, leaving behind the naked floral axis as a long, stout, narrowing or flagelliform, often bifurcate columella, sometimes with short branches on its distal part. *Spores* when mature single, rounded to ellipsoidal, typically more or less flattened or even impressed on one side, appearing hemiglobose, 4–6.5 x 5–7 µm, yellowish-brown; wall thin, c. 0.5 µm, thinner on the flattened side, apparently smooth to very finely punctate, in SEM finely, sparsely verruculose. *Sterile cells* in irregular groups, short chains or single, larger than the spores, subglobose, ellipsoidal to usually irregular, with one or several flattened sides, 6–13 x 8–18 µm, hyaline to pale yellowish-brown, collapsed in old specimens; wall 0.5–1µm thick, smooth.

On *Ischaemum anthephoroides* Miq., and its var. *eriostachyum* Honda, *I. aristatum* L. var. *glaucum* (Honda) Koyama (*I. crassipes* (Steud.) Thell.), *I. latifolium* (Sprengel) Kunth, *Ischaemum* sp.; E. Asia (Japan), S. America (Colombia).

Ling (1949a:132) considered *Sorosporium yoshinagae* Zundel to be a synonym of *Sorosporium formosanum* (Sawada) Sawada (= *Sporisorium formosanum* (Sawada) Vánky), type on *Panicum repens* L., Taiwan. Indeed, the spore measurements of *S. formosanum* (5–6.5 x 5.5–7 µm) are close to those of *S. ischaemi-anthephoroides*. However, in *S. formosanum* the peridium is thick, there are numerous, filiform columellae, and the spores are sparsely, usually evidently punctate.

In the description of *U. concelata*, Zundel (1945:372) does not mention the presence of a peridium around the sori and the sterile cells between the spores. Zundel also failed to give the spore measurements, and the measurements of the sori should be 2.5–3 cm, not mm as originally given.

8. *Sporisorium ischaemicola* (L. Ling) Vánky, **comb. nov.**

Basionym: *Sphacelotheca ischaemicola* L. Ling, Sydowia 3:126, 1949a. — Type on *Ischaemum timorense* Kunth, Singapore, Botanical Garden, 21.I.1948, R.E. Holttum, IMI 38643! Paratype on *Ischaemum digitatum* Brongn. (= *I. polystachyum* Presl), Papua New Guinea, Morobe, 23.I.1939, M.S. Clemens 10265, BPI 178036!

Sori destroying the inner floral organs ("ovaries") of all sessile spikelets of an inflorescence, ellipsoidal, 1–2 x 2–4 mm, more or less hidden by the floral envelopes, first covered by a brownish peridium which ruptures irregularly at maturity, disclosing the dark brown, semi-agglutinated to powdery mass of spores and sterile cells surrounding a stout, simple, tapering columella of the length of the sorus. *Spore balls* present only in early developmental stage of the spores. *Spores* when mature single, globose, subglobose, to ovoid or ellipsoidal, rather variable in size, wall thickness and coarseness of ornamentation (certainly depending on the original position within the spore ball), 9.5–14 x 10.5–15 µm, medium to dark reddish-brown; wall even to uneven, 0.7–2 µm thick, thick-walled spores often with a much thinner part, surface densely, evidently echinulate, spore profile serrulate. *Sterile cells* in irregular groups, single cells subglobose, ellipsoidal to irregular, 6–16 µm long, subhyaline, wall thin, smooth, collapsed in old specimens.

On *Ischaemum barbatum* Retz. (*I. aristatum* L. sensu Hack.), *I. heterotrichum* Hack., *I. indicum* (Houtt.) Merrill, *I. polystachyum* Presl (*I. digitatum* Brongn.), *I. pubescens* Merr., *I. rugosum* Salisb., *I. timorense* Kunth; S. & SE. Asia (India, Vietnam), Malaysia (Sarawak, Singapore), Indonesia (W. Timor), Australasia (Papua New Guinea), Micronesia.

9. *Sporisorium ischaemi-rugosi* (J.N. Mishra) Vánky, **comb. nov.**

Basionym: *Sphacelotheca ischaemi-rugosi* J.N. Mishra, Mycologia 48:872, 1956. — Type on *Ischaemum rugosum* Salisb., India, Bihar, Netarhat, 3000 ft, J.N. Mishra, HCIO 25278; isotope in HUV 17286!

Sori destroying the whole inflorescence, c. 1–3 x 15–20 mm, nearly completely enclosed by the uppermost leaf sheaths, first covered by a thick, brown peridium which dehisces irregularly, disclosing the dark brown, semi-agglutinated to powdery mass of loose spore balls, spores and groups of sterile cells, surrounding a stout, c. 0.7 mm wide, uniform columella with shortly bifurcate tip, protruding beyond the sorus. *Spore balls* variable in shape and size, composed of numerous spores which separate very easily. *Spores* subglobose, broadly ellipsoidal to usually subpolyhedrally slightly irregular, 9.5–12 x 11–13.5 µm, yellowish-brown; wall even, 0.8–1 µm thick, densely, evidently echinulate, spore profile finely serrulate. *Sterile cells* in small or large, irregular groups or chains, single cells subglobose, ellipsoidal to slightly irregular, more or less collapsed in old specimens, 10–17 µm long, subhyaline to pale yellowish-brown; wall 0.5–1 µm thick, smooth.

On *Ischaemum rugosum* Salisb.; S. Asia (India).

10. *Sporisorium tonglinense* (Tracy & Earle) L. Guo, 1990:85 (as "*tanglinensis*").

Ustilago tonglinensis Tracy & Earle, 1895:175. — *Sphacelotheca tonglinensis* (Tracy & Earle) Zundel, 1944:406. — *Sphacelotheca tonglinensis* (Tracy & Earle) Y. Ling & Chen, 1945:10 (comb. superfl., not Zundel). — Type on *Ischaemum ciliare* Retz. (= *I. indicum* (Houtt.) Merrill), Singapore, Tanglin (as "Tonglin"), I.1893, H.N. Ridley; isotypes BPI 168200, 168202.

Ustilago ischaemi-akoensis Sawada, 1944:33 (invalid name, no Latin diagnosis). — Type on *Ischaemum akoense* Honda, Taiwan, Fêngsan, Kaohsiung, 28.X.1911, Y. Fujikuro. (syn. by Ling, 1949b:263).

Sori in all spikelets of an inflorescence destroying the inner floral organs, ovoid to ellipsoidal, 1–1.5 x 2.5–4 mm, visible between the spreading glumes, first covered by a thick, pale brown peridium which ruptures in several places disclosing the dark brown, semi-agglutinated to powdery mass of spores and groups of sterile cells surrounding a simple, narrowing central columella, sometimes with short apical branches. *Spores* when mature single, globose or subglobose, more rarely broadly ellipsoidal, 9–11 x 9–12 µm, yellowish- to pale reddish-brown; wall even, prominently echinulate, 1–1.5 µm thick, including the spines, spore profile serrate. *Sterile cells* in irregular groups, subhyaline to pale yellow, single cells 6–18 µm long, collapsed in old specimens.

On *Ischaemum akoense* Honda, *I. digitatum* Brongn., *I. indicum* (Houtt.) Merrill (*I. ciliare* Retz.), *I. muticum* L., *I. timorense* Kunth; S. & E. Asia (China, India, Japan, Sri Lanka, Taiwan), Indonesia (Java), New Caledonia.

Ling (1949b:263) corrected the specific epithet *tonglinensis* to *tanglinensis*. I prefer to retain the original spelling (see ICBN 60.3).

11. *Tilletia ischaemi* Vánky & N.D. Sharma, 2001:71.

Type on *Ischaemum rugosum* Salisb., India, Madhya Pradesh, Jabalpur, Agricultural University Campus, alt. 410 m, 4.XI.1992, N.D. Sharma, HUV 17453!; isotypes HCIO 43237, BPI.

Sori in some ovaries of an inflorescence, swollen, subcylindrical, 1–1.5 x 4–8 mm, protruding between the floral envelopes, first covered by a thick membrane of host origin (pericarp) which ruptures irregularly disclosing the black, powdery mass of spores intermixed with sterile cells. *Spores* globose, subglobose to broadly ellipsoidal, 17.5–24(–28) x 18–26(–30) μm, dark reddish-brown to almost opaque, provided with densely situated, 1–2(–2.5) μm high conical to flattened warts, in surface view appearing as dark, small polygonal areas. *Sterile cells* subglobose, ovoid, ellipsoidal to slightly irregular, 15–22 x 16–26(–30) μm, light yellowish-brown; wall 1.5–2.5 μm thick, often with two or several layers, smooth.

On *Ischaemum rugosum* Salisb.; S. Asia (India). Known only from the type collection.

? ***Sorosporium semisagittatum*** Thirumalachar & Pavgi, 1967(1968):22. Type on *Ischaemum semisagittatum* Roxb., India, Maharashtra State, Poona, Khandala, 14.XI.1954, M.J. Thirumalachar 1235.

No specimen of *S. semisagittatum* was available for study. The original description is: "*Sori* ovaricolous, infecting only few spikelets in a panicle, forming elongate, greyish-brown fusoid bodies, 1.5–2 x 4–5 mm, half enclosed by the glumes; pinkish false membrane rupturing irregularly at maturity releasing dusty, brownish-black spore mass and a fine, simple columella. *Spore balls* irregular, semipermanent and opaque. *Spores* dark brown, subglobose, mostly polyhedral with depressed surfaces, 9–13.5 μm in diameter. Epispore thick and finely verrucose. Inner sterile cells rather few in number, usually in groups of 6 to 12, hyaline to tinged yellowish, globoid, thin-walled, smooth and measuring 6–10.5 μm in diameter." Furthermore, the authors write: "The smut resembles in some extent *Sorosporium polycarpum* Syd. which is also ovaricolous, developing semi-permanent spore balls on *Ischaemum pectinatum* Trin. in Australia. However, the spores of this are 4–5 to 7 μm in diameter and much smaller than the one under study in which they are 9–13 μm." The flaw of this statement is, on one hand, that the type of *Sorosporium polycarpum* (= *Sporisorium polycarpum* (Syd.) Vánky) is on *Eremochloa muricata* Hack., on the other that *Ischaemum pectinatum* Trin. is not a member of the Australian flora (comp. Simon, 1993).

Key to the smut fungi of *Ischaemum* (*S.* = *Sporisorium*)

1. Sori on the leaves forming blackish spots 2
– Sori elsewhere, not forming blackish spots 3
2. Sori 1–5 mm wide. Spores 9–18 μm long; wall 1–5(–8) μm thick .... ***Jamesdicksonia ischaemiana***
– Sori 0.2–0.5 mm wide. Spores 8–13 μm long; wall 1–2.5(–3) μm thick .... ***Phragmotaenium indicum***
3. Sori in the ovaries or spikelets 4
– Sori in the whole inflorescence 9
4. Spores 18–26(–30) μm long, with 1.5–3 μm high warts... ***Tilletia ischaemi***
– Spores smaller 5

5\. Sori in some spikelets of an inflorescence. Spore balls semi-permanent .... ***S. semisagittatum***
– Sori in all spikelets of an inflorescence. Spore balls ephemeral 6
6\. Spores 8–10 µm long ..... ***S. hainanae***
– Spores larger 7
7\. Spores 10.5–15 µm long; wall unevenly thick ..... ***S. ischaemicola***
– Spores 9–13.5 µm long; wall evenly thick 8
8\. Spores prominently echinulate, profile serrate ..... ***S. tonglinense***
– Spores finely echinulate, profile very finely serrulate ..... ***S. ischaemi***
9(3). Spores 5–7 µm long, flattened on one side, apparently smooth to very finely punctate ..... ***S. ischaemi-anthephoroides***
– Spores larger, not flattened on one side, evidently ornamented 10
10\. Columella long, flagelliform. Spores 12–19 µm long ..... ***S. flagellatum***
– Columella not so. Spores smaller 11
11\. Spore balls 40–120 µm long. Spores 8–12.5(–14) µm long, densely punctate to verruculose-echinulate. Sterile cells 8–12 µm long ..... ***S. furcatum***
– Spore balls ephemeral. Spores 11–13.5 µm long, densely, evidently echinulate. Sterile cells 10–17 µm long ..... ***S. ischaemi-rugosi***

A new genus

Many years ago, during my work at the University of Tübingen, I formulated a working hypothesis that species of *Ustilago* are restricted to host plants in the Poaceae. The hypothesis proved fruitful. The revision of "*Ustilago*" species on host plants other than in Poaceae lead, on one hand, to the description of new genera, such as *Bauerago* Vánky (1999) for *Ustilago* species on Cyperaceae and Juncaceae, *Tothiella* Vánky (1999) on Cruciferae (recently transferred into *Thecaphora*), or *Vankya* Ershad (2000) on Liliaceae. On the other hand, it lead to new arrangements, such as the transfer of 55 *Ustilago* species into the genus *Microbotryum* (Vánky, 1998a). Application of modern methods, such as ultrastructural (Bauer, Oberwinkler & Vánky, 1997) and molecular biological (Stoll, 2001) showed also the correctness of the hypothesis.

There is a further "*Ustilago*" species, *U. euphorbiae* Mundkur, on *Euphorbia* (Euphorbiaceae) which certainly does not belong to *Ustilago* or any other known genus (comp. Vánky, 2002b). For it, I am proposing:

Ahmadiago Vánky, gen. nov.

Sori on host plants in the Euphorbiaceae. Peridium, columella and sterile cells are lacking. Spore mass powdery. Spores single, pigmented (brown, without violet or orange-yellow tint).

Sori in plantis nutrientibus familiae Euphorbiaceae. Peridium et columella et cellulae steriles nullae. Massa sporarum pulverea. Sporae singulae, pigmentiferae (brunneae, neque colore violaceo, neque aurantiacoflavido tinctae). Typus generis:

Ahmadiago euphorbiae (Mundkur) Vánky, **comb. nov.**

Basionym: *Ustilago euphorbiae* Mundkur, Trans. Brit. Mycol. Soc. 24:331, 1940. — Type on *Euphorbia dracunculoides* Lam., India, Punjab, Kalashakaku, 18.VIII.1936, S. Ahmad, HCIO; isotypes IMI, K, HUV 5475!

Sori in the seeds as ovoid or slightly irregular, c. 2 x 3 mm large bodies filled with dark chocolate-brown, powdery spore masses produced within the tissues of the endosperm, cotyledons and embryo, enclosed by the intact testa. True peridium as well as columella/ae are lacking. *Spores* globose, subglobose, ovoid, broadly ellipsoidal or slightly irregular with a more or less flattened side, 5–7(–8) x 5.5–8(–9) µm, olivaceous brown, paler on the flattened side; wall uneven, 0.7–0.8 µm thick on the darker side, 0.2–0.3 µm thick on the paler side, smooth. *Spore germination* unknown.

On Euphorbiaceae: *Euphorbia dracunculoides* Lam.; S. Asia (India). Known only from the type collection.

Etymology: This genus is named in honour of the excellent botanist, phanerogamist and mycologist, Dr. Sultan Ahmad, an explorer and indefatigable collector of micromycetes of India and West Pakistan, among them a great number of smut fungi, including *Ustilago euphorbiae*. He also described innumerable new microfungi and published, among others, the Ustilaginales of West Pakistan (1956, and several additions).

New names

Sorosporium leersiae and _Sporisorium leersiae_ represent the same fungus

Mishra (1956) described *Sorosporium leersiae* on *Leersia hexandra* from India, Bihar. The fungus belongs to the genus *Sporisorium*. The same fungus, on the same host plant, from India, Assam, was also described by Bag & Agarwal (2001) as *Sporisorium leersiae*. Mishra's name has priority, but its recombination into *Sporisorium* creates a later homonym. The proposed name, synonymy and description of this smut fungus are:

Sporisorium leersiae-hexandrae Vánky, **nom. nov.**

Replacing: *Sorosporium leersiae* Mishra, Mycologia 48:876, 1956. — Type on *Leersia hexandra* Swartz, India, Bihar, Ranchi farm, without date, coll. J.N. Mishra (type ubi?).

Sporisorium leersiae Bag & D.K. Agarwal, 2001:221. — Type on *Leersia hexandra*, India, Assam, Johrat, IV.1998, M.K. Bag, HCIO 43170; isotype HUV 20276! (syn. nov.).

Sori destroying the whole inflorescence, enclosed by the uppermost leaf sheath from which only the long, filiform columellae protrude, first covered by a delicate peridium which early ruptures disclosing the black, granular-powdery mass of spore balls and numerous filiform columellae. *Spore balls* variable in shape and size, globose, ellipsoidal, elongated, often slightly bent, 25–65 x 30–100(–110) µm, dark reddish-brown to opaque, composed of numerous spores which separate by pressure. *Spores* rather uniform, globose, subglobose, ellipsoidal to slightly subpolyhedrally irregular, 5–6.5 x

5–7(–8) µm, light yellowish-brown; wall even, c. 0.4 µm thick, finely, sparsely punctate to verruculose, spore profile smooth to finely wavy. *Sterile cells* not seen.

On Poaceae: *Leersia hexandra* Swartz; S. Asia (India).

The type of *Sorosporium leersiae* Mishra was not seen by me. Despite the statement by Mishra, it is not deposited with BPI, HCIO or IMI. However, its description corresponds with the type of *Sporisorium leersiae* Bag & D.K. Agarwal (which is partly damaged by insects; hence the large spore ball measurements in the original description which refer to insect excrements).

Sporisorium perforatum Vánky, **nom. nov.**

Replacing *Sphacelotheca mnesitheae* Mundkur & Thirum., in Thirumalachar & Mundkur, Mycol. Pap. 40:3, 1951 (not *Sporisorium mnesitheae* (Mishra) Vánky, opus praesens). — Type on *Mnesithea laevis* (Retz.) Kunth (*Rottboellia perforata* Roxb.), India, Mysore, Goribidanur, 20.XII.1944, M.J. Thirumalachar, HCIO 10786; isotypes BPI 195100, HUV 17291!

Sori destroying some spikelet-pairs of the racemes of the partially congested, witches' broom like inflorescence, bullate, 1–2 x 2–3 mm, first covered by a thick, brown peridium which ruptures irregularly disclosing the dark brown, semi-agglutinated to powdery mass of spores and sterile cells and a short, conical columella with longitudinal furrows. Distally, a sorus may bear healthy spikelet-pairs but these disarticulate early. *Spores* when mature single, globose, subglobose, ovoid to broadly ellipsoidal, 5.5–7(–8) x 5.5–8(–9) µm, medium reddish-brown; wall even, c. 0.5 µm thick, finely, sparsely punctate-verruculose, spore profile smooth to finely wavy. *Sterile cells* in small, irregular groups, single cells ellipsoidal or slightly irregular, larger than the spores (12–20 µm long), hyaline, collapsed in old specimen; wall 1–1.5 µm thick, smooth.

On Poaceae: *Mnesithea laevis* (Retz.) Kunth (*Rottboellia perforata* Roxb.); S. Asia (India). Known only from the type collection.

Sporisorium shivasii Vánky, **nom. nov.**

Replacing *Ustilago confusa* Massee, in Cooke, Grevillea 20:65, 1892 (not *Sporisorium confusum* (H.S. Jackson) Vánky, 2001:306, on *Aristida* species). — Type on *Panicum paradoxum* R. Br. (= *Pseudoraphis paradoxa* (R. Br.) Pilger), Australia, Victoria, Lake King, II.1855, F. Mueller, Herb. Berkeley 4744, in K.

Sorosporium chamaeraphis Syd., in Sydow & Petrak, 1928:431. — *Sporisorium chamaeraphis* (Syd.) Vánky, 1998b:330. — Syntype on *Chamaeraphis muricata* (L. fil.) Merr. (= *Pseudoraphis spinescens* (R. Br.) Vickery), Philippine Islands, Luzon, Pampanga Prov., Porac, X.1923, M.S. Clemens 4617. (syn. nov.).

For its description see Vánky, 1998b:330 (as *Sporisorium chamaeraphis*).

On Poaceae: *Pseudoraphis brunoniana* Griff., *P. paradoxa* (R. Br.) Pilger, *P. spinescens* (R. Br.) Vickery (*Chamaeraphis spinescens* (R. Br.) Poiret; *C. muricata* (L. fil.) Merrill; *C. aspera* (Koenig) Nees); Australia, Philippines.

By study of the type specimen of *Ustilago confusa*, Dr. R.G. Shivas (BRIP, Brisbane, Australia) demonstrated that the sori are destroying the whole inflorescence (not only the ovaries), that the spore mass and spores have no violet tinge (as stated in the original description), and peridium, columellae and spore balls are present, which are typical for *Sporisorium*. By comparison, it turned out that this fungus is identical with the later described "*Sorosporium*" *chamaeraphis* Syd.

New combinations

Since the paper of Bauer, Oberwinkler & Vánky, 1997, it is known that the dark-spored "*Entyloma*" and "*Melanotaenium*" species of grasses belong to the Georgefischeriales, not to the Entylomatales, as the true *Entyloma* species of dicotyledonous host plants do. Bauer, Begerow, A. Nagler & Oberwinkler (2001), based on spore germination and/or molecular data, demonstrated that these smuts belong to the genera *Jamesdicksonia* (7 spp.), *Eballistra* (3 spp.), or *Phragmotaenium* (1 sp). Unfortunately, for most of these smuts germination and/or molecular data are not known. Therefore, their generic place within the Georgefischeriales remains uncertain (comp. also Vánky, 2002b).

Jamesdicksonia eleocharidis (Sawada ex L. Ling) Vánky, **comb. nov.** Basionym: *Entyloma eleocharidis* Sawada ex L. Ling, Mycologia 41:255, 1949b. — *Ustilago eleocharidis* Sawada, 1943:39 (nomen invalid.; ICBN 36.1). — *Jamesdicksonia eleocharidis* (Sawada) R. Bauer, Begerow, A. Nagler & Oberwinkler, 2001:422, comb. illegit. (based on *Ustilago eleocharidis* Sawada, 1943:39, nomen invalid.). — Type on *Eleocharis dulcis* (Burm. fil.) Trin., Rep. China (Taiwan, Formosa), Taipei, 16.XI.1934, K. Sawada; isotype HUV 12056!

Entyloma eleocharidis Pavgi & R.A. Singh, 1968(1969):425, later homonym. — Type on *Eleocharis plantaginea* R. Br., India, Uttar Pradesh, Varanasi, 5.X.1964, M.S. Pavgi 351 & R.A. Singh; isotype HUV 17386!; isotopotype HUV 15995! (syn. by Vánky, 1996:92).

Sori on the culms as circular to oval spots, 0.1–1.5 mm in diameter, or larger and irregular by confluence, lead-coloured, non-erumpent. *Spores* embedded in the host tissue, subepidermal, agglutinated in rather permanent groups or parallel columns in the intercellular spaces of the mesophyll; single spores subpolyhedrally irregular, rarely subglobose, 7–11 x 9–13(–15) µm, light olivaceous-brown; wall even or slightly uneven, 0.8–1.5 µm thick, smooth. *Spore germination* results in aseptate basidia bearing an apical whorl of 2–6 subcylindrical, hyaline basidiospores measuring 2.2–2.5 x 7.5–20 µm. Basidiospores conjugate in situ giving rise to ellipsoidal or falcate secondary sporidia, 0.7–1.2 x 2.5–7.5 µm (Pavgi & Singh, 1968(1969), 1969, 1970).

On Cyperaceae: *Eleocharis dulcis* (Burm. fil.) Trin. (*E. tuberosa* Schult.), *E. plantaginea* R. Br., *Eleocharis* sp., S. & E. Asia (China, India, Pakistan, Taiwan).

Jamesdicksonia melinidis (Dennis) Vánky, **comb. et stat. nov.**
Basionym: *Melanotaenium majus* (Har. & Pat.) Cif. var. *melinidis* Dennis, Trans. Brit. Mycol. Soc. 90:471, 1988. — Type on *Melinis macrochaeta* Stapf & Hubbard, Nigeria, Vom, 27.XII.1963, R. Wheeler Harris, K.

Sori in the leaves, 0.5–2 x 1–5 mm, lead-coloured, similar to those of *Jamesdicksonia major* (Har. & Pat.) Vánky (type on *Sporobolus spicatus* (Vahl) Kunth, Chad). *Spores* subglobose to ellipsoidal, often polyhedral by mutual pressure, 8–11 x 9–14 µm, brown; wall 1–2 µm thick, smooth.

On Poaceae: *Melinis macrochaeta* Stapf & Hubbard; Africa (Nigeria). Known only from the type locality.

Type not seen. Description partly taken from Dennis, 1988:471.

Macalpinomyces neglectus (Niessl) Vánky, **comb. nov.**
Basionym: *Ustilago neglecta* Niessl, in Rabenhorst, Fungi europaei exs. no. 1200, 1868. — *Sporisorium neglectum* (Niessl) Vánky, 1985a:119. — Type on *Setaria glauca* auct., non (L.) P. Beauv. (= *S. pumila* (Poir.) Roem. & Schult.), Austria, Steiermark, near Graz, coll. G. von Niessl; isotypes in Rbh., Fgi. eur. no. 1200, HUV 4156!

For description and illustrations see Vánky, 1994:203 & 216.

This smut was transferred into the genus *Sporisorium*, based on the presence of groups of thin-walled, hyaline sterile cells between the spores. There is also a peridium around the sori, composed of host and fungal elements and a short columella-like structure in the sori. Because of the lack of spore balls and well-developed columella/ae, several mycologists preferred to retain it in the genus *Ustilago*. During the past ten years, the generic delimitation of *Macalpinomyces* was clarified and 33 species have been described or transferred into this genus. The characters of *Ustilago neglecta* fit also best with the characters of the emended *Macalpinomyces* (Vánky, 2002b:92), hence its transfer into this genus.

Sporisorium andropogonis-tectorum (L. Ling) Vánky, **comb. nov.**
Basionym: *Ustilago andropogonis-tectorum* L. Ling, Sydowia 7:152, 1953a. — Type on *Andropogon tectorum* Schum., Sierra Leone, Hill Station, 27.VII.1941, F.C. Deighton M2302. Holotype IMI 10966; isotype BPI 157098. Paratype on *Andropogon tectorum*, Nigeria, 1936, J. West 69, IMI 44426; HUV 17809!

Sori destroying the whole young floral shoots, transforming each into an elongated, somewhat curved, up to 20 cm long, whip-like structure, first covered by the epidermis which flakes away disclosing the olivaceous-brown, semi-agglutinated to powdery mass of spores intermixed with sterile cells. *Spores* globose, subglobose, often flattened on one side, 7.5–9.5 x 8–10.5(–12) µm, yellowish-brown; wall slightly thinner on one side, 0.4–0.8 µm thick, finely, densely verrucose-echinulate; spore profile wavy to finely serrulate. *Sterile cells* in irregular groups, single cells 8–16 µm long, subhyaline, collapsed in old specimens; wall c. 1 µm thick, smooth.

On Poaceae: *Andropogon tectorum* Schum.; Africa (Nigeria, Sierra Leone).

Sporisorium mnesitheae (Mishra) Vánky, comb. nov.

Basionym: *Sorosporium mnesitheae* Mishra, Mycologia 49:257, 1957. — Type on *Mnesithea laevis* (Retz.) Kunth, India, Bihar, Ramgarh, Nayasarai, 15.XI.1955, J.N. Mishra, HCIO; isotypes BPI 180070, IMI 68185, HUV 17363!

Sori in all spikelets of an inflorescence, ellipsoidal, 0.8–1 x 2–3 mm, showing between the spreading glumes, first covered by a pale brown peridium which ruptures from its apex disclosing the black, semi-agglutinated to granular-powdery mass of spore balls surrounding a stout, narrowing central columella, rarely with 1–2 short apical branches. *Spore balls* variable in shape and size, ellipsoidal, ovoid, elongated or irregular, 25–50(–70) x 25–80(–110) µm, dark reddish-brown to subopaque, composed of 10–100? (or more?) spores which separate easily by pressure. *Spores* slightly dimorphic, rounded to subpolyhedrally irregular, rarely globose or ellipsoidal, 7.5–12 x 9.5–13(–14.5) µm, reddish-brown; wall uneven, thickest at the angles, 0.5–1.5 µm thick, densely verrucose, spore profile wavy to finely serrulate. Inner spores lighter in colour, wall thinner, finely densely punctate. *Sterile cells* absent.

On Poaceae: *Mnesithea laevis* (Retz.) Kunth (*Rottboellia perforata* Roxb.); S. Asia (India).

Sporisorium stuhlmannii (Henn.) Vánky, comb. nov.

Basionym: *Ustilago stuhlmannii* Hennings, Bot. Jahrb. Syst. 17:3, 1893. — *Sphacelotheca stuhlmannii* (Henn.) Zundel, 1930:136. — Type on *Andropogon* sp., "Central Afrikan. Seengebiet" (Central African Lakes Territory), Ukami, Mrogoro, 18.V.1890, F. Stuhlmann 63, "Emin Pascha Expedition", BPI 198126!

Sori around the inflorescence axis and inflorescence, up to 10 cm long, protruding from the distal leaf sheath, covered by a brown peridium which flakes away disclosing the blackish-brown, semi-agglutinated to powdery mass of spore balls and spores, intermixed with groups of sterile cells, surrounding a stout, central columella with short lateral branches on its distal part. The inflorescence is destroyed but some, partly destroyed or even apparently healthy spikelets may be left intact. *Spore balls* globose, ellipsoidal to elongated or irregular, 40–90 x 50–120 µm, reddish-brown, composed of tens to hundred of spores which separate easily. *Spores* variable in shape and size, rounded, subpolyhedrally irregular, ellipsoidal, rarely elongated or irregular, 8–12 x 9–13.5 µm, yellowish-brown; wall even, c. 0.5 µm thick, finely, densely verruculose-echinulate, spore profile wavy to finely serrulate. *Sterile cells* in irregular groups or chains, single cells 7–13 µm long, subhyaline, collapsed in old specimen; wall even, 0.5–0.8 µm thick, smooth.

On Poaceae: *Andropogon* sp. Known only from two collections in C. and E. Africa, made by F. Stuhlmann.

Sporisorium styppeiochloae (Dennis & M.B. Ellis) Vánky, **comb. nov.** Basionym: *Sorosporium styppeiochloae* Dennis & M.B. Ellis, Kew Bull. 35:846, 1981. — Type on *Styppeiochloa gynoglossa* (Goossens) De Winter, Mozambique, Lourenço Marques, Namaacha (Namahacha), alt. 650 m, 9.XII.1948, Carvalho 300, K; isotype IMI 48001!

Sori in ovaries, ovoid, 0.5–1 x 1.5–2 mm, with an acute tip, partly hidden by the glumes, first covered by a pale brown peridium which ruptures irregularly disclosing the blackish-brown, granular-powdery mass of spore balls. Columella very short. *Spore balls* globose, ovoid, ellipsoidal, elongated to irregular, 12–28 x 15–35(–40) µm, yellowish- to dark reddish-brown, composed of 3–16 (or more?) spores which separate by pressure. *Spores* variable in shape, more or less irregular with one or several flattened sides and rounded free surface, 6–9 x 7–12 µm, yellowish-brown; wall c. 0.5 µm thick, in LM smooth on the contact sides, somewhat thicker on the free surface where provided with small, irregular tubercles, in SEM contact sides very finely verruculose. *Sterile cells* absent.

On Poaceae: *Styppeiochloa gynoglossa* (Goossens) De Winter; SE. Africa (Mozambique). Known only from the type collection.

Tilletia patagonica (Hirschh.) Vánky, **comb. et stat. nov.** Basionym: *Tilletia fusca* Ellis & Everh. var. *patagonica* Hirschhorn, Rev. Mus. La Plata 5:8, 1942. — Type on *Festuca bromoides* L., Argentina, Neuquén, Aluminé, Villa, alt. 1200 m, III.1940, E. Hirschhorn. Holotype in Herb. Hirschhorn 453, isotype LPS 4924.

Sori in all ovaries of an inflorescence, fusiform, 0.5–1 x 2–3.5 mm, showing between the spreading glumes, first covered by the pericarp which ruptures at maturity disclosing the dark brown, powdery mass of spores and sterile cells. *Spores* globose, subglobose, ovoid to ellipsoidal, rarely somewhat irregular, 22.5–28 x 23–32 µm, yellowish-brown, reticulate, 6–11 meshes per spore diameter, muri 1.5–3 µm high, in optical median view appear as acute or subacute spines, interspaces often with a small tubercle.

Sterile cells few, smaller than the spores, up to 18 µm long, subhyaline, collapsed in old specimen.

On Poaceae: *Festuca bromoides* L.; S. America (Argentina). Known only from the type collection.

Tilletia patagonica differs from *T. fusca* (= *T. bromi* (Brockm.) Brockm., sensu lato) in having larger spores, more reticulum per spore diam., higher muri and a tubercle in the interspaces. The spores of *T. bromi* are 20–28 µm long, 6–10 meshes per spore diam., the muri are 1.5 µm high, the interspaces are smooth, without tubercle.

Tranzscheliella amplexa (Syd.) Vánky, **comb. nov.**

Basionym: *Ustilago amplexa* H. Sydow, Ann. Mycol. 22:278, 1924. — Type on *Diplachne fusca* P. Beauv. ex Roem. & Schult., Egypt, Belbes in the delta of Nile River, V.1880, G. Schweinfurth; isotypes Thümen, Mycoth. univ. no. 1818, HUV 3854!

Sori surrounding upper internodes of sterile shoots, 0.2–0.3 x 10–15 cm, partly hidden by leaf sheaths, first covered by a thin, greyish peridium which flakes away disclosing the olivaceous-brown, powdery mass of spores. *Spores* globose, subglobose, rarely ovoid or broadly ellipsoidal, laterally compressed, in side view 4–5 µm wide, in plane view 5.5–6.5(–7) x 6–7(–7.5) µm, medium yellowish-brown; wall even, c. 0.5 µm thick, slightly thinner on the flattened sides, smooth in LM, finely, moderately densely verruculose in SEM.

On Poaceae: *Diplachne fusca* P. Beauv. ex Roem. & Schult.; N. Africa (Egypt).

Tranzscheliella serena (Syd.) Vánky, **comb. nov.**

Basionym: *Ustilago serena* H. Sydow, Ann. Mycol. 35:24, 1937. — Type on *Diplachne fusca* P. Beauv. ex Roem. & Schult., Australia, New South Wales, between Warren and Collie, I.1936, L. Fraser 195; isotypes IMI, HUV 17815!

Sori surrounding the uppermost culms, partly hidden by leaf-sheaths, first covered by a delicate, grey or lead-coloured peridium which flakes away disclosing the olivaceous-brown, powdery mass of spores. *Spores* globose to broadly ellipsoidal, 6.5–8 x 7–10 µm, pale yellowish-brown; wall even, c. 0.5 µm thick, smooth in LM, finely, sparsely verruculose in SEM.

On Poaceae: *Diplachne fusca* P. Beauv. ex Roem. & Schult.; Australia.

T. serena differs from *T. amplexa* especially in the larger, paler spores.

Ustanciosporium eleocharidis (Thirum. & Pavgi) Vánky, **comb. nov.**

Basionym: *Sphacelotheca eleocharidis* Thirumalachar & Pavgi, Sydowia 7:99, 1953. — Type on "*Eleocharis* sp." (= misnamed *Fimbristylis* sp., teste K. Vánky), India, Bihar, Netarhat, 2.IX.1952, M.J. Thirumalachar. Holotype HCIO 20933, isotype HUV 15510!

Sori destroying all or almost all flowers in the inflorescence, replacing them by a chocolate-brown, semi-agglutinated mass of spores, globoid, c. 0.5 mm in diameter or larger by confluence, when young covered by a fungal membrane which flakes away disclosing the agglutinated spore mass with powdery surface. *Spores* variable in shape and size, globose, ovoid, ellipsoidal, elongated or irregular, lacrymiform with an acute tip, 8–12 x 9.5–14.5(–16) µm, yellowish-brown, wall even, 0.7–1 µm thick, evidently and typically verrucose-echinulate, the warts or spines are connected by thin threads, evident especially in SEM, forming dense, irregular, often incomplete meshes.

On Cyperaceae: *Fimbristylis* sp. (as "*Eleocharis* sp."); S. Asia (India). Known only from the type collection.

Synonyms

Tothiella transferred into *Thecaphora*

The new classificatory system of the smut fungi and allied taxa (comp. Bauer, Oberwinkler & Vánky, 1997) opened new, earlier unthought-of perspectives for a better, phylogenetic grouping and rearrangement of these fungi. During the last few decades it became evident that a similar morphology does not always reflect a close relationship. This applies to the morphology of fruiting bodies of mushrooms and also to the morphology of the sori, spore balls, spores, basidia and basidiospores of the smut fungi. Ultrastructural- and molecular biological studies have revealed several cases of convergent evolution. The presence or absence of spore balls not necessarily means a close relationship. For instance, within the Doassansiaceae, ten genera have spore balls, one genus (*Doassinga*) has single spores. Within the genera *Schizonella, Orphanomyces* and *Ustanciosporium* there are species with spore balls and others with single spores (comp. also Vánky, 2002b).

I proposed (Vánky, 1999:39) the unispecific genus *Tothiella* Vánky (type *T. thlaspeos* (Beck) Vánky), with single, brown spores in the seeds of Cruciferae. It was separated from the genus *Ustilago* mainly because of the dicotyledonous host plants and its spore morphology. Despite many common characters, *Tothiella* was not included in the genus *Sorosporium* F. Rudolphi (= *Thecaphora* Fingerh.), especially because it has single spores. Based on its ultrastructural characters, *Tothiella* was placed into the Glomosporiaceae, beside *Glomosporium* and *Thecaphora* (including *Sorosporium*), two genera characterised by the presence of spore balls. However, based on a thorough comparative morphological study of the spores, and on what I now regard as the significance of spore balls, I consider it better to place *Tothiella thlaspeos* into the genus *Thecaphora*, reducing *Tothiella* to a synonym of *Thecaphora*.

Thecaphora thlaspeos (Beck) Vánky, comb. nov.

Basionym: *Tilletia thlaspeos* Beck, Verh. K. K. Zool.-Bot. Ges. Wien 35:362, 1886. — *Ustilago thlaspeos* (Beck) Lagerheim, in Sydow, Ust. No. 118, 1897. — *Bauhinus thlaspeos* (Beck) Denchev, 1997:424. — *Tothiella thlaspeos* (Beck) Vánky, 1999:39. — Type on *Thlaspi alpestre* L., Austria, Burgenland, near Redlschlag [Újvörösvágás], coll. V. Borbás, HUV 4776!

For taxonomic synonyms, such as *Ustilago seminum* Juel, *U. arabidis-alpinae* Liro, *U. cardamines* Liro, description and illustration of this species, see Vánky, 1999:39-43 (as *Tothiella thlaspeos*).

On Brassicaceae: *Alyssum reiseri* Vel., *Arabis alpina* L., *Ar. corymbiflora* Vest., *Ar. hirsuta* (L.) Scop., *Ar. sagittata* (Bertol.) DC., *Cardamine bellidifolia* L., *Cardaminopsis petraea* (L.) Hiitonen, *Draba aizoides* L., *D. alpina* L., *D. incana* L., *Erysimum diffusum* Ehrh., *E. weltschewii* Urum., *Thlaspi alpestre* L., *T. alpinum* Crantz; Europe.

Aurantiosporium colombianum is immature *A. subnitens*

Piepenbring, 2002:105, described *Aurantiosporium colombianum* M. Piepenbr. because it "differs from *A. subnitens* by larger spores in larger balls and by thicker and lighter coloured spore wall layer". These are typical characters of young, immature spores, known in several genera of smut fungi. Indeed, both sori of the isotype (BPI 840957) are hard and immature, without powdery mass of mature spores. The larger size of the spores of *A. colombianum* ("16–20(–22) µm long") is a result of the thicker exospore ("1–4(–5) µm"). In *A. subnitens* the spores are "(10–)13–17(–19) µm" long, and the spore wall is "ca. 2 µm thick" (Piepenbring, Vánky & Oberwinkler, 1996:63). Measurements of the length of the spores, without exospore, resulted in 12–16(–17.5) µm for both types of these two species.

Obviously, *A. colombianum* was described on a meagre, old collection, preserved in a phanerogam herbarium (BM 598728), on *Scleria lagoensis* Boeck., Colombia, Magdalena Div., Santa Marta, 1898–1899, leg. Smith 237 (holotype COL, isotype BPI). The sori of *A. colombianum* are typical and identical with those of *A. subnitens* (J. Schröt. & Henn.) M. Piepenbr., Vánky & Oberw., known on *Scleria melaleuca* Reichenb. ex Schltdl. & Cam. (lectotype HBG). *A. subnitens* is widely distributed in Central- and South America (Brazil, Colombia, Costa Rica, Panama, Venezuela, and certainly also in other countries). The two host plants, *Scleria melaleuca* and *S. lagoensis* are also "fairly closely related, both belonging to sect. Scleria (Euscleria)" (K. Lye, in litt.).

Consequently, I consider *Aurantiosporium colombianum* M. Piepenbr. to be a synonym of *A. subnitens* (J. Schröt. & Henn.) M. Piepenbr., Vánky & Oberw. (syn. nov.).

Farysia ugandana is *F. butleri*

Farysia ugandana Zundel, 1944:403, was described on *Carex spicato-paniculata* C.B. Clarke (as "*paniculata-spicata*"), Uganda, between Kinanira and Kisola, 3.IV.1927, D.H. Linder, BPI 170312!; isotype BPI 170313! Study of the type specimen showed that it is identical with, and a synonym of *Farysia butleri* (Syd. & P. Syd.) H. & P. Sydow, 1919:42. — Type on "*Scleria elata* Thw." (= misnamed *Carex filicina* Nees, teste K. Vánky). (syn. nov.).

For its description and illustration see Vánky, 2002b:62-63.

On Cyperaceae: *Carex* (subgenus *Indocarex*) spp., *C. condensata* Nees, *C. cruciata* Wahlenb., *C. echinochloae* Kunze, *C. filicina* Nees, *C. indica* L., *C. myosurus* Nees, *C. pyramidalis* Kük., *C. rafflesiana* Boott, *C. spicato-paniculata* C.B. Clarke, and probably other *Carex* species; Africa, SE. Asia, Indonesia, Philippines, Australasia.

The sori and spores of *Farysia ugandana* correspond with those of the type specimen of *F. butleri*. However, a part of one of the two sori of the isotype is much darker and somewhat agglutinated. The spores of this part are dark reddish-brown and almost smooth to finely punctate. The reason for this anomaly is unknown (genetic mutation?). Zundel's description does not refer to these spores.

Sorosporium aeluropodis is *Ustilago aeluropodis*

Ahmad (1956:10) described *Sorosporium aeluropodis* as having spore balls of 40–100 µm in diameter. Study of the type showed that these spore balls are artefacts, produced by insects (excrements). The sori and the spores are typical for *Ustilago aeluropodis*. Consequently, the name and synonyms of this fungus are:

Ustilago aeluropodis (Trotter) Vánky, 1985b:11.

Sphacelotheca aeluropodis Trotter, in Saccardo & Trotter, 1913:413 (as "*aeluropi*"). — *Crozalsiella aeluropodis* (Trotter) Maire, 1917:141 (as "*aeluropidis*"). — Type on *Aeluropus repens* (Desf.) Parl. (= *A. lagopoides* (L.) Trin. ex Thwaites), Libya, Misratha (Misurata), Bu Sceifa, in "sebkha", 15.IV.1913, A. Trotter.

Sorosporium aeluropodis Ahmad, 1956:10 (as *aeluropidis*). — Type on *Aeluropus lagopoides*, Pakistan, Karachi, 28.XII.1951, S. Ahmad 7000, IMI 57438! (syn. nov.).

For description and illustration see Vánky, 1994:348 & 387 (as *Ustilago* "*aeluropi*").

On Poaceae: *Aeluropus laevis* Trin., *A. lagopoides* (L.) Trin. ex Thwaites (*A. repens* (Desf.) Parl.; *A. villosus* Trin.), *A. littoralis* (Gouan) Parl.; SE. Europe (Romania), N. Africa (Algeria, Libya), C. & S. Asia (Azerbajdzhan, Iran, Kazakhstan, Pakistan, Russia, Turkmenia).

Sporisorium agropyri is *Ustilago cynodontis*

Sporisorium agropyri Bag & D.K. Agarwal (2001:219) was described on "*Agropyron strigosum* L." from India, W. Bengal, Kalimpong, IV.1999, coll. M.K. Bag, holotype HCIO 43167, isotype HUV 20277! The good intention of the young mycologist, to collect also healthy plants along with infected ones caused a mistake because the healthy plants do not belong to the smutted ones. Namely, the infected inflorescence of the isotype has remnants of several, thin, digitate, floral branches at the apex of the stem, covered by agglutinated spore mass, mixed with saprophytic fungi. Study of the spores solved the problem. These are unique and typical for *Ustilago cynodontis* (Henn.) Henn. (globose to subglobose, 6.5–8 x 6.5–8.5 µm, laterally flattened, (4.5–)5–6.5 µm wide, smooth in LM, with a small, lighter spot in the middle of the flattened sides, the place where the young spores were connected). The spores of the isotype of *S. agropyri* are partly agglutinated into irregular groups ("spore balls") because the sorus is rather young, and because of the presence of numerous filaments of saprophytic fungi. The "peridium" and "sterile cells", mentioned in the original description of *S. agropyri*, are certainly these saprophytic fungi. Regarding the host plant, of the four *Cynodon* species from the Indian subcontinent, enumerated by Bor (1960:468-471), only *Cynodon dactylon* (L.) Pers. occurs in W. Bengal (and maybe also the introduced *C. plectostachyus* (K. Schum.) Pilger, but this has inflorescences of several whorls of spikes in contrast to the digitate spikes in *C. dactylon*). Consequently, I consider *Sporisorium agropyri* to be *Ustilago cynodontis* on *Cynodon dactylon* (syn. nov.).

Sporisorium martinii is *Sporisorium lanigeri*

I revised the smut fungi of the grass genus *Cymbopogon* (Vánky, 2003b:20-32) and recognised 13 species. Recently, I obtained from Dr. D.K. Agarwal (HCIO, New Delhi, India) a fragment of the type specimen of *Sporisorium martinii* Bag & D.K. Agarwal, 2001:221 (as "*martinae*"). Type on *Cymbopogon martinii* (Roxb.) Watson, India, W. Bengal, Cooch Behar, III.1996, D.K. Agarwal, HCIO 42945, isotype HUV 20273! The specimen turned out to be *Sporisorium lanigeri* (Magnus) Vánky (type on *Cymbopogon schoenanthus*), on a new host plant (host identity not checked by me). *S. lanigeri* is known from Africa, S. Asia and Australia on at least 14 *Cymbopogon* species, and it has been repeatedly "discovered", having 13! taxonomic synonyms (syn. nov.).

Tilletia durangenis is a synonym of *T. baldratii*

Revising the *Tilletia* species of *Eragrostis*, it turned out that *T. durangenis* Durán is identical with and a synonym of the earlier *T. baldratii* Montemart.

Tilletia baldratii Montemartini, 1934:44.

Type on *Poa abyssinica* Jacq. (= *Eragrostis tef* (Zucc.) Trotter), Africa, Eritrea, Tigrai [Tegre] Prov., comm. I. Baldrati. It is not known where the type is deposited. It is not in FT or FI (C. Nepi, in litt.).

Tilletia durangenis Durán, 1970:1101. — Type on *Eragrostis mexicana* (Hornem.) Link, Mexico, Durango, 71.2 mi N.W. of J. G. Aguilera off Hwy. Mex. No. 39, alt. 2286 m, 21.X.1969, R. Durán, WSP 58554; isotype HUV 14446! Paratype WSP 58555, isoparatype HUV 14447 (syn. nov.).

Sori in the ovaries, globoid to usually ellipsoidal, 0.5–0.8 x 0.5–1 mm, dark brown, more or less hidden by the floral envelopes and covered by the fragile pericarp which ruptures irregularly disclosing the semi-agglutinated to powdery, dark brown, foetid mass of spores intermixed with sterile cells. *Spores* globose, subglobose to ellipsoidal, 17–22 x 18–24 µm (including muri but excluding the 1–5.5 µm thick hyaline sheath), yellow to pale yellowish-brown, reticulate, 3–5 meshes per spore diameter, meshes penta- or hexagonal, (2.5–)4–6(–8) µm in diameter, muri in optical median view thin, acute, 0.5–3 µm high. *Sterile cells* globose or ellipsoidal, 8–16 µm long, including the 1–4 µm thick smooth to weakly reticulate wall, but excluding the 4–9.5 µm thick hyaline sheath, content granular.

On Poaceae: *Eragrostis mexicana* (Hornem.) Link, and *E. tef* (Zucc.) Trotter (*Poa abyssinica* Jacq.); Africa (Ethiopia), N. America (USA, Mex.).

The Ethiopian specimen I have seen has somewhat lower muri (0.5–1.5 µm) than the Mexican one (1.5–3 µm) and a thinner hyaline sheath around the spores. In other respects the African and North American specimens are identical.

Ustilago amadelpha is identical with the later *U. scitaminea*, and the consequences thereof

Ustilago amadelpha H. & P. Sydow & Butler, 1912:249, was described on "*Andropogon* sp." from India, Bengal, Muzaffarpur District, Awapur, 15.IV.1911, E.J. Butler 1425, HCIO 1425; isotype HUV 16373! Regarding its host plant, Mundkur (1939:104) wrote: "A note accompanying the specimen states that the grass had no flowers and might be a species of *Saccharum*." Indeed, comparison of the type of *U. amadelpha* with the smut fungi of *Saccharum* (comp. Vánky, 2000b), showed that it is identical with the sugarcane smut, *Ustilago scitaminea* H. Sydow (1924:281), lectotype (design. by Vánky, 1991:492) on *Saccharum officinarum* L., India, Bengal, Bhagalpur, 26.VIII.1907, J.E. Butler, HUV 4454!; isolectotypes in Sydow, Ust. no. 384. *U. scitaminea* is known on *Imperata cylindrica* (L.) Raeuschel, *Miscanthus anomalus* Steud., *M. sacchariflorus* (Maxim.) Hack., *Saccharum barberi* Jeswiet, *S. giganteum* (Walt.) Pers. (*Erianthus giganteus* (Walt.) Muhl.; *E. saccharoides* Michaux), *S. officinarum* L., *S. sinense* Roxb., *S. spontaneum* L.

To avoid the change of *U. scitaminea*, the name of the common, cosmopolitan sugarcane smut into *U. amadelpha*, or maybe more correctly into "*Sporisorium amadelphum*", conservation of the name of *U. scitaminea* is proposed.

Ustilago eragrostidis-japonicana and *U. ugandensis* var. *macrospora* are *Macalpinomyces spermophorus*

Study of the type specimen of ***Ustilago eragrostidis-japonicana*** Zundel (1943:165), type on *Eragrostis japonica* Trin., South Africa, Cape Prov., Vryburg Distr., Welgelegen, IV.1925, G.A. Pentz, PREM 20621!, isotypes BPI 160370 & 188933, and that of ***Ustilago ugandensis*** Henn. var. ***macrospora*** Beeli (1922:6), lectotype (designated here) on *Panicum* sp., Congo, Leopoldville Prov., Kisantu, VII.1914, H. Vanderyst 4657, BR 1318, isolectotype BPI 194482!, revealed that they are identical with ***Macalpinomyces spermophorus*** (Berk. & M.A. Curtis ex de Toni) Vánky, 2003c:210, type on *Eragrostis poaeoides* P. Beauv. var. *megastachya* (Link) A. Gray, USA. (syn. nov.).

For description, synonyms and illustration, see Vánky, 1994:376-377, 435, and 2003c:210-212.

On Poaceae: *Bouteloua*, *Eragrostis* (principal host), *Sporobolus*, and evidently also on *Panicum* sp.; cosmopolitan.

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A new species of *Microstoma* from Taiwan

YEI-ZENG WANG
yzwang@mail.nmns.edu.tw
National Museum of Natural Science
Taichung 404, Taiwan

Abstract–This paper describes and illustrates a new species, *Microstoma apiculosporum*, collected from Taiwan. It differs from *M. floccosum* by its apiculate ascospores.

Key words–discomycetes, Pezizales, *Sarcoscyphaceae*

Microstoma apiculosporum *sp. nov.* **FIGURES 1-2**

Ab Microstoma floccosum, ascosporis ellipsoideae, 25-30 x 9-10 µm, sporae extremae ambae apiculatae, apiculi hemisphaerici, 3-3.5 x 3-4 µm, 1-gelatinosa vaginata circumcincta.

Apothecia scattered or gregarious on the substrate, stipitate, deeply cupulate, disc orange red, 0.4-0.8 cm wide, and 0.3-1 cm deep. **Margins** entire, incurved when dry. **Hairs** arising from ectal excipulum, hyaline, acute at the tip, 270-1200 x 12-15 µm, thick-walled, evenly distributed on surface of receptacle and stalk. **Stalk** cylindrical, 0.3-1.5 cm long, pale orange, base with dark brown hyphal mat. **Ectal excipulum** of *textura angularis*, polygonal cells 5-15 µm diam., tissues gelatinous, layer 30-50 µm thick, medullary excipulum of *textura porrecta*, hyphae regularly arranged, 3-4 µm wide, layer 50-80 µm thick, subhymenium 15-30 µm thick, orange, with short cylindrical cells, hymenium layer 350-400 µm thick, easily separated from excipular layer. **Asci** 8-spored, suboperculate, clavate, 325-335 x 12-14 µm, base usually contracted into a short narrow stalk. **Ascospores** ellipsoid, smooth, 25-30 x 9-10 µm, filled with oil droplets, apiculate at both ends of spores, apiculi hemispherical, 3-3.5 x 3-4 µm, surrounded with a gelatinous sheath when freshly released. **Paraphyses** branched, connected as a net around the asci, filled with many orange granules, 2-3 µm wide, septate.

Holotype: Taiwan, Nantou: Juiyenshi Nature Reserve, elev. 2400 m; on dead sticks of broadleaf tree, Sep. 24, 2003, coll. W. N. Chou, *WAN 1002* (TNM F15224).

Etymology: Latinized form of apiculate, referring to the apiculate ascospores.

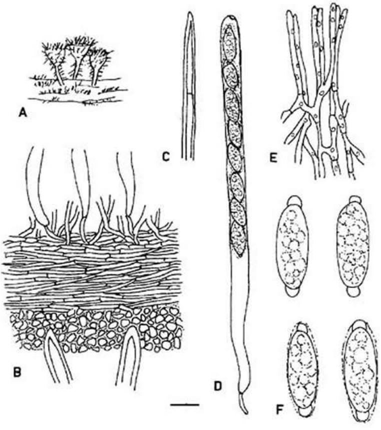

Fig. 1. *Microstoma apiculosporum*, holotype. A. Three apothecia. B. A part of excipulum C. The tip of a hair. D. An ascus. E. The upper part of paraphyses. F. Ascospores. Bar = 0.8 cm for A, 25 μm for B-D; 10 μm for E, F.

Additional specimen examined: Taiwan, Nantou: Juiyenhsi Nature Reserve, elev. 2400 m; on dead branches of broadleaf tree, Sep. 24, 2002, coll. W. N. Chou, *WAN 938* (TNM F14648).

This species is similar to *M. floccosum* (Schwein.) Raitv. and *M. macrosporum* (Y. Otani) Y. Harada and S. Kudo in the stipitate, hairy, orange colored apothecia, but the ascospores of *M. floccosum* are broader (14-16 μm in Kanuse, 1948; 10-13 μm in Wang, 2001) while those of *M. marcosporum* are larger (42-60 x 16-21 μm in Harada and Kudo, 2000; 50-56 x 19-24 μm in Zhuang and Wang, 1997), but neither of them is apiculate.

Four species of *Microstoma* are generally recognized, i.e., *M. aggregatum* Otani, *M. floccosum*, *M. macrosporum* and *M. protractum* (Fr.) Kanouse, and all have been

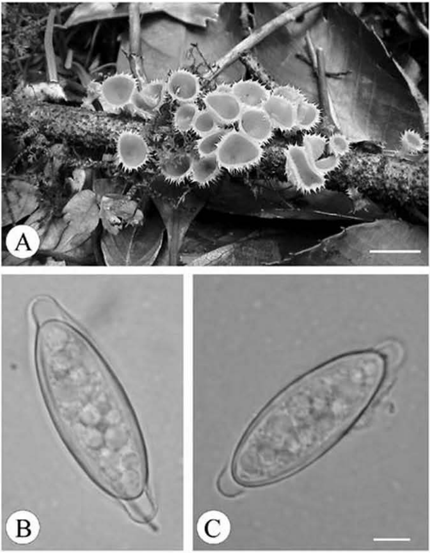

Fig. 2. *Microstoma apiculosporum*, A. Apothecia in the habitat. Bar = 1 cm. B. and C. An ascospore. Bar = 5 μm.

reported in Japan (Otani, 1990; Harada and Kudo, 2000). In Taiwan, only *M. floccosum* has been recorded, which usually occurs from February to May (Seaver, 1928; Wang, 2001).

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Further new species in the genus *Pertusaria* (Lichenized Ascomycota) fromThailand

SUREEPORN JARIANGPRASERT
s_vipoosunti@yahoo.com
Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand

ALAN W. ARCHER
alanw.archer@bigpond.com
National Herbarium of New South Wales, Mrs. Macquaries Road, Sydney, NSW 2000, Australia

VILAIWAN ANUSARNSUNTHORN
scboi012@chiangmai.ac.th
Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand

Abstract– *Pertusaria allothwaitesii, P. lansangensis, P. namensis* and *P. takensis* from Thailand are reported as new to science.

Introduction

Although a number of new *Pertusaria* species from Thailand have recently been described (Jariangprasert *et al.* 2002, 2003), additional new species have now been discovered. The new taxa are distinguished from known species on the basis of the number of spores per ascus, thalline, apothecial and spore morphology and the medullary chemistry. The chemistry of new species were analyzed by thin layer chromatography (Elix & Ernst-Russell 1993) and confirmed by high performance liquid chromatography (Elix *et* *al.* 2003). The material examined is housed in RAMK (Lichen Research Unit, Ramkhamhaeng University, Bangkok), CMU (Chiang Mai University Herbarium), PSU (Department of Chemistry, Prince of Songkla University Herbarium) and the herbarium of S. Jariangprasert (SJ).

Taxonomic Descriptions

Pertusaria allothwaitesii Jariangprasert & A.W. Archer, *sp. nov*. **Figure 1**

Similis *Pertusaria thwaitesii* sed acida norsticticum, divaricaticum et barbaticum continens differt.

Etymology: from the Greek *allos* = other, and the species' resemblance to *P. thwaitesii*.

Type: **THAILAND**. **Phitsanulok Province**, Nakhon Thai District, Phu Hin Rongkla National Park, right hand side of the road from Mhun Daeng Waterfall at thirty-seventh kilometre stone, 1560 m, on bark of *Prunus cerasoides* D. Don, in evergreen hill forest, *S. Jariangprasert 2069*, 19.i.2002; holotype: RAMK; isotype: SJ.

KEY CHARACTERS — Thallus corticolous, off-white to pale grey, smooth, dull, lacking isidia and soredia. **Apothecia** verruciform, conspicuous, concolourous with the thallus, irregular in outline, numerous, scattered, with multiple ostioles, rarely confluent, not constricted at base. **Ostioles** numerous, conspicuous, pale grey to black, surrounded with translucent tissue, protruded and becoming evenly black, 1–8–many per verruca. **Ascospores** 2 per ascus, elongate ellipsoid, 120–166 µm long, 40–52 µm wide, rough; outer ascospore wall 6–12 µm thick.
Chemistry— K+ yellow then red, KC-, C-, Pd+ pale yellow–reddish yellow, UV-; norstictic acid (major), divaricatic acid (major/minor) and barbatic acid (minor to trace).

Ecology — *Pertusaria allothwaitesii* is a corticolous species found in north and north-eastern Thailand in evergreen and scrub forests at elevations of 1100 to 1560 m.

COMMENTS — *Pertusaria allothwaitesii* is distinguished from other *Pertusaria* species with two rough ascospores by its chemistry, and especially the presence of norstictic acid as a major compound combined with divaricatic and barbatic acids. *Pertusaria allothwaitesii* resembles *P. thwaitesii* Müll. Arg. as both have numerous, conspicuous black ostioles per verruca and two rough ascospores but they differ in their chemistry. *Pertusaria thwaitesii* contains protocetraric acid (Archer 1997) while *P.*

allothwaitesii contains norstictic, divaricatic and barbatic acids. *Pertusaria allothwaitesii* is found at elevations 1100 up to 1560 m.

REPRESENTATIVE SPECIMENS EXAMINED —THAILAND. Chiang Mai Province: Mueang District, Doi Suthep-Pui National Park, right wayside before a crossing to the Buddhist temple, 1500 m, on fallen log, evergreen hill forest, *S. Jariangprasert 1654*, 16.vii.2001 (*SJ*); *ibid.*, on the way to fire protection line, 1550 m., *S. Jariangprasert 1567*, 1.vi.2001 (*SJ*); Jom Thong District, Doi Inthanon National Park, gateway to Mae Raed Headwaters, 1100 m, on bark of *Betula alnoides* Buch.-Ham. ex G. Don, in evergreen hill forest, *S. Jariangprasert 2396*, 13.iii.2002 (*SJ*).
Nan Province: Pua District, Doi Phu Ka National Park, right wayside to Pua District between 35 and 36 kilometre stone, 1500 m, on bark of *Betula alnoides* in evergreen hill forest, *S. Jariangprasert 1584*, 9.vi.2001 (*SJ*).
Loei Province: Phu Luang Wildlife Sanctuary, Pha Somdej Cliff, 1500 m, on bark of *Rhododendron moulmeinense* Hook. f., in scrub forest, *S. Jariangprasert 2199*, 3.ii.2002 (*SJ*); *ibid.*, between Pha Somdej Cliff and Pha Chang Phan Cliff, on bark of *Lithocarpus truncatus* (King) Rehder & Wilson in scrub forest, *S. Jariangprasert 2228*, 3.ii.2002 (*SJ*).

Pertusaria lansangensis Jariangprasert & A.W. Archer, *sp. nov* **Figure 2**

Similis *Pertusaria cicatricosa* sed sorediis differt.

Etymology: from the Latin *ensis* = place of origin, and Lan Sang National Park.

Type: **THAILAND. Tak Province,** Lan Sang National Park, between Tak Province and Mae Sod District, on the way between Musoe Dam and Musoe Lhueang Agricultural Station, trail to Pha Daeng unit, ridge of mountain adjacent to bamboo forest, 980 m, on unidentified tree in evergreen hill forest, *S. Jariangprasert 3779*, 20.xi.2002; holotype: RAMK.

KEY CHARACTERS — **Thallus** corticolous, glaucous-green, smooth-slightly wrinkled, shiny, crystallized under cortex, sorediate, isidia absent. **Soralia** compact, granular, semicapitate, concolourous with the thallus, numerous, scattered, 0.4–1.0 mm diam. **Apothecia** verruciform, conspicuous, scattered, not confluent, not constricted at base, flattened, concolourous with thallus, 1.4–2.0 mm diam. **Ostioles** grey, conspicuous, punctiform, surrounded with white tissue, 6—0 per verruca. **Ascospores** 2 per ascus, ellipsoid-cylindrical, (100–)126–204 µm long, (30–)40–52 µm wide, rough; outer ascospore wall 10–22 µm thick.
Chemistry — K+ yellow, KC-, C-, Pd+ dull orange, UV+ reddish orange; 2,4-dichlorolichexanthone (minor), 2,5-dichlorolichexanthone (minor), 2,4,5-trichlorolichexanthone (minor), 2-chlorolichexanthone (trace), stictic acid (major) and constictic acid (minor).

Ecology — *Pertusaria lansangensis* is a rare corticolous species from north and northeastern Thailand.

REPRESENTATIVE SPECIMEN EXAMINED —THAILAND. Loei Province: Phu Luang Wildlife Sanctuary, 1470 m, in front of the old palace, on bark of unidentified tree in oak-dipterocarp forest, *S. Jariangprasert 2181*, 3.ii.2002 (SJ).

COMMENTS — *Pertusaria lansangensis* is characterised by verruciform apothecia, asci with 2 rough ascospores and the presence of the di- and trichlorinated lichexanthones and stictic acid. It resembles *P. cicatricosa* in both chemistry and morphology but is distinguished by the production of soredia which are absent in *P. cicatricosa* (Archer 1997). The new species is also distinguished from *P. cicatricosa* by the ratio of 2,4,5-trichlorolichexanthone to the isomeric dichlorolichexanthones (major and minor respectively in the latter species).

Pertusaria nanensis Jariangprasert & A.W. Archer, *sp. nov.* **Figure 3**

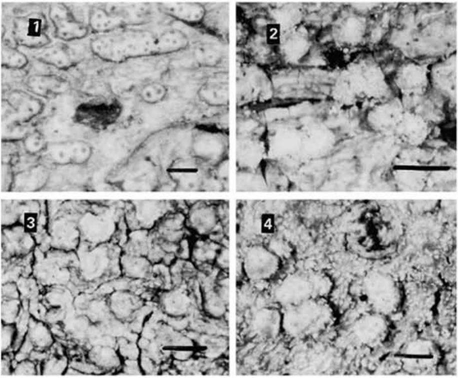
Similis P. alboaspera *sed acidum protocetraricum continens vice acidum sticticum et ostiolis nigris differt.*

Etymology: from the Latin *ensis* = place of origin, and Nan Province.

Type: **THAILAND. Nan Province,** Bo Khluea District, Bo Khluea Nhuea Community, right wayside before the fourteenth kilometre stone from Bo Kluea Nhuea to Bo Kluea District, 1000 m, on bark of Leguminosae, *S. Jariangprasert 1601*, 9.vi.2001; holotype: RAMK.

KEY CHARACTERS — **Thallus** corticolous, greyish ivory, smooth, dull, cracked and subtuberculate, lacking isidia and soredia. **Apothecia** verruciform, numerous, conspicuous, flattened hemispherical, crowded, rarely confluent, constricted at base, some irregular in outline, concolourous with the thallus, 0.5–0.9 mm diam. **Ostioles** conspicuous, grey to black, tapering or punctiform, slightly depressed, 1–2(–4) per verruca, 0.05–0.10 mm diam. **Ascospores** 8 per ascus, biseriate, subfusiform to ellipsoid, 60–98 µm long, 32–40 µm wide, smooth; outer ascospore wall 4–8 µm thick.
Chemistry: K+ pale yellow, KC-, C-, Pd+ scarlet red, UV+ yellow; lichexanthone (major), 2,2'-di-*O*-methylstenosporic acid (major) and protocetraric acid (minor).

Ecology — *Pertusaria nanensis* is an endemic corticolous species from Bo Khleua District in the north of Thailand and at present is known only from the type specimen.



Figures 1-4. New species of *Pertusaria*. **1**. *P. allothwaitesii* (holotype in RAMK); **2**. *P. lansangensis* (holotype in RAMK); **3**. *P. nanensis* (holotype in RAMK); **4**. *P. takensis* (holotype in RAMK). Scale bar = 1.0 mm.

COMMENTS — *Pertusaria nanensis* is characterised by verruciform apothecia, asci with 8 biseriate ascospores and the presence of lichexanthone, 2,2'-di-*O*-methylstenosporic and protocetraric acids. This species resembles *P. alboaspera* A.W. Archer & Elix and *P. alboaspera* var. *deficiens* Jariangprasert & A.W. Archer (Jariangprasert *et al.*, 2003) but both of these taxa have inconspicuous, pale, translucent ostioles in contrast to the black ostioles present in *P. nanensis*. In addition, *P. nanensis* contains protocetraric acid rather than stictic and constictic acids present in *P. alboaspera* (Archer & Elix 1993). The absence of stictic acid in this new species also distinguishes it from the chemically and morphologically similar *P. verruculifera* Vain. from Brazil (Vainio 1890) and *P. congesta* Vain. [syn.: *P. glaucocinera* Vain.] from Angola (Vainio 1901).

Pertusaria takensis Jariangprasert & A.W. Archer, *sp. nov.* **Figure 4**

Similis Pertusaria cicatricosa *sed isidiis differt.*

Etymology: from the Latin *ensis* = place of origin, and Tak Province.

Type: **THAILAND. Tak Province**, Lan Sang National Park, between Tak Province and Mae Sod District, on the way between Musoe Dam and Musoe Lhueang Agricultural Station, trail to Pha Daeng unit, ridge of mountain adjacent to bamboo forest, 980 m, on unidentified tree in evergreen hill forest, *S. Jariangprasert 3832*, 20.xi.2002; holotype: RAMK.

KEY CHARACTERS — Thallus corticolous, yellowish green to glaucous green, smooth, isidiate, lacking soredia. **Isidia** conspicuous, simple, globose to cylindrical, 0.1 mm diam. 0.1–0.15 mm long. **Apothecia** verruciform, conspicuous, concolourous with thallus, numerous, scattered, flattened hemispherical, slightly concave, rarely confluent, constricted at base, 0.5–1.4 mm diam. **Ostioles** inconspicuous, grey, punctiform, surrounded with translucent tissue, slightly raised, 2–8 per verruca. **Ascospores** 2 per ascus, ellipsoid-cylindrical, (84–)116–180(–206) µm long, 30–50 µm wide, rough; outer ascospore wall 7–18 µm thick.
Chemistry: K+ yellow, KC-, C-, Pd+ orange, UV+ reddish orange; 2,4-dichlorolichexanthone (minor), 2,5-dichlorolichexanthone (minor), 2,4,5-trichlorolichexanthone (minor), 2-chlorolichexanthone (trace), stictic acid (major), constictic acid (minor) and ± atranorin (trace).

Ecology — *Pertusaria takensis* is a rare corticolous species from north and northeastern Thailand.

REPRESENTATIVE SPECIMEN EXAMINED —THAILAND. Nakhon Ratchasima Province: Khao Yai National Park, Khao Khiao, roadside to the Radar Station, 1180 m, on bark of unidentified tree in evergreen hill forest, *S. Jariangprasert 1319*, 17.xii.2000 (SJ).

COMMENTS — *Pertusaria takensis* is characterised by verruciform apothecia, asci with 2 rough ascospores and the presence of the di- and trichlorinated lichexanthones and stictic acid. It resembles both *P. cicatricosa* and *P. subisidiosa* in chemistry, but is distinguished from *P. cicatricosa* by the presence of isidia and from *P. subisidiosa* by the four smaller, rough ascospores and black ostioles (Archer 1991, 1997). *Pertusaria takensis* also differs from both *P. cicatricosa* and *P. subisidiosa* in the ratio of 2,4,5-trichlorolichexanthone to the isomeric dichlorolichexanthones (major and minor respectively in the latter taxa).

CORRECTION

In our previous paper describing *Pertusaria* taxa from Thailand (*Mycotaxon* **85**: 291. 2003), the published photographs were numbered incorrectly. The top left-hand photograph should be numbered **4**, the top right-hand photograph **3**, the lower left-hand photograph **2**, and the lower right-hand photograph **1**.

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The authors are grateful to the RAMK, CMU and PSU herbaria for the loan of specimens and to Professor J.A. Elix (Australian National University) for the liquid chromatography results and editorial assistance; SJ is grateful to the Royal Golden Jubilee Ph. D. Program, The Thailand Research Fund for generous financial support, to the Royal Forestry Department for permission to collect specimens, to the Department of Biology, Chemistry, Faculties of Science, Maejo University for the use of the laboratories and equipment.

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Cryptosporiopsis actinidiae sp. nov.

P. R. JOHNSTON[1], M. A. MANNING[2], X. MEIER[2],
D. PARK[1] AND R. A. FULLERTON[2]

JohnstonP@LandcareResearch.co.nz
[1]*Landcare Research, Private Bag 92170, Auckland, New Zealand*
[2]*Hort Research, Private Bag 92169, Auckland, New Zealand*

Abstract—A fungus commonly isolated from fruit rots of kiwifruit in New Zealand, referred to previously in the New Zealand literature as *Cryptosporiopsis* sp., is described here as *Cryptosporiopsis actinidiae*. It is reported from the kiwifruit species *Actinidia arguta, A. chinensis, A. deliciosa* and *A. indochinensis*, as well as apple. Although the teleomorph of *C. actinidiae* is unknown, it is genetically similar to the teleomorph genus *Neofabraea*, which includes the widespread fruit rot pathogens *N. alba, N. malicorticis* and *N. perennans*.

Keywords—ITS, phylogeny, *Pezicula*

Introduction

A fungus commonly associated with fruit rots of kiwifruit species (*Actinidia* spp.) has been reported in the New Zealand literature as *Cryptosporiopsis* sp. (Hawthorne et al. 1982, Pennycook 1989, Brook 1990, Manning & Lallu 1997, Manning et al. 2003). Microscopically it is similar to the *Cryptosporiopsis* anamorphs of *Neofabraea* as described by Verkley (1999). In cultural appearance it is similar to the widespread apple pathogen *Neofabraea malicorticis* H.S.Jacks., although the kiwifruit pathogen differs in the intense orange-red colour of cultures on agar plates (Hawthorne et al. 1982). Despite this fungus being isolated commonly from kiwifruit fruit rots and from the surface of intact fruits, fruiting bodies have not been found in the field and the fungus is known from only the asexual state in culture. A recent publication on phylogenetic relationships amongst *Neofabraea* species (de Jong et al. 2001) has allowed this kiwifruit pathogen to be compared reliably with known species. Given that this fungus significantly limits the storage life of the kiwifruit cultivar Hort 16A (Manning et al. in press), a species name for it is important.

Methods

Cultures are described from colonies grown on Difco potato dextrose agar (PDA) and oatmeal agar (OA) for 14 days in 12 h darkness/12 h light (near ultra-violet and 'BLB' and 'Cool White' fluorescent tubes) at about 20°C. Colour notations are from Kornerup & Wansher (1963). Conidia and conidiogenous cells from cultures were measured and described in 100% lactic acid. The cultures studied have been stored in ICMP (International Collection of Microorganisms from Plants, Landcare Research, Auckland) and dried cultures derived from these have been stored in PDD (New Zealand Fungal Herbarium, Landcare Research, Auckland).

Extraction and amplification of DNA. Cultures were grown in 20 ml Vogel N medium amended with sucrose 1% and yeast extract 0.5% (Vogel 1964) in petri dishes in the dark at 18–20°C for 4 days. The cultures were filtered through Miracloth (Calbiochem), and the mycelium dried between paper tissues. The mycelium was dried by vacuum centrifuge (SpeedVac, USA) for 1 hour, then ground with liquid nitrogen in a mortar and pestle. The genomic DNA was isolated with DNeasy Plant Mini Kit (QIAGEN, USA). PCR reactions were carried out as described by White et al. (1990), with FastStart Taq enzyme (Roche) on a GeneAmp PCR system 9700 (Applied Biosystems). The complete ITS region (ITS1, ITS2 and 5.8S) was amplified using the primers ITS1 and ITS4, which anneal to the flanking small subunit and large subunit nrDNA, respectively (White et al. 1990). PCR conditions were 1 cycle at 95 °C for 4 min, 35 cycles at 94 °C for 1 min., 45 °C for 1 min., 72 °C for 1 min., and a final cycle at 72 °C for 7 min. PCR product was purified with High Pure PCR Product Purification kit (Roche, USA). Sequencing reactions were performed with ABI PRISM BigDye Terminator v 3.1 Ready Reaction Kit (Applied Biosystems) and run on an Applied Biosystems ABI prism 310 Genetic Analyser. Sequence data were analysed and edited with Sequencher v3.1 software.

Isolates included in the phylogenetic analysis are listed in Table 1. Sequences were aligned using Clustal W (Thompson et al. 1994). A neighbor-joining analysis was performed with PAUP* 4.0b10 (Swofford 2002) using Jukes-Cantor distances. A bootstrap analysis (1000 replicates) was used to test the tree. The tree has been presented with *Pezicula cinnamomea* as the outgroup.

Taxonomic Description

Cryptosporiopsis actinidiae P.R.Johnst., M.A.Manning & X.Meier, sp. nov. —Fig. 1

Ab Cryptosporiopse curvispora, conidiis (7.5–) 9–14 × 3–5.5 µm, culturis crocea.

Etymology: from the host substrate

Holotype: New Zealand: Bay of Plenty: Te Puke, on rotting fruit of *Actinidia deliciosa*, coll. G.J. Samuels, 1 Sept 1982, PDD 77784 (ex-type culture, ICMP 7826).

Cultures on PDA 45–50 mm diam. after 14 days, aerial mycelium more or less lacking, slimy in appearance, surface covered with copious conidial ooze, from above cultures intense reddish-orange to brownish-orange in colour (7B8 to 7C8), deep orange (6A8) in narrow zone near margin, margin itself colourless, similar variation in colour from below, yellow pigment diffusing into agar surrounding culture. On OA aerial mycelium sparse, cottony, white, centre part of colony covered with whitish conidial ooze, agar surface red (11B7), colony red from below. Conidiogenous cells 8.5–14.5 × 3–4 µm, more or less cylindric, tapering to narrow apex, indistinct flaring collarette and wall barely thickened at the single, apical conidiogenous locus. Conidiogenous cells usually held on irregularly branched conidiophores, sometimes arising directly from hyphae, sometimes with acropleurogenous conidiogenous loci. Conidia (7.5–) 9–14 × 3–5.5 µm, oblong-elliptic, elliptic or ovate, straight to slightly and irregularly curved, ends broadly rounded, with indistinct scar at base, 0-septate.

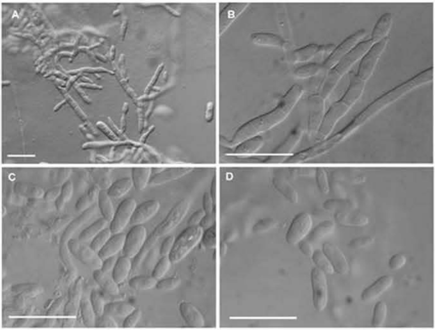

Fig 1. *Cryptosporiopsis actinidiae* (ICMP 7826). A–B, conidiogenous cells and conidiophores. C–D, conidia. Scale bars = 20 μm.

NOTES: The conidia of *C. actinidiae* are smaller than those described by Verkley (1999) for all other *Cryptosporiopsis* anamorphs of *Neofabraea*. The intense red to orange colours of the cultures are characteristic of this species, and distinguish it from the other *Neofabraea* species reported from New Zealand (*N. alba* (E.J.Guthrie) Verkley and *N. malicorticis*). The morphological differences are reflected in the ITS sequences (see phylogenetic analysis below), which show *C. actinidiae* to be also genetically distinct.

C. actinidiae has been isolated from the fruits of several kiwifruit species (*Actinidia arguta*, *A. chinensis*, *A. deliciosa*, and *A. indochinensis*), as well as apple. It has not been associated with important diseases of apple, and the single isolate known from apple (ICMP 10738) may have been a chance infection of a ripe fruit. *C. actinidiae* may have a wider host range than currently recognised, but to date it is of economic significance on kiwifruit alone.

Phylogenetic Analysis and Discussion

The neighbor-joining analysis (Fig. 2) shows that *C. actinidiae*, presently known only from its asexual state, is likely to have a *Neofabraea* teleomorph. At the species level it is genetically distinct from all described *Neofabraea* species, as well as the undescribed species from apple reported by de Jong et al. (2001).

C. actinidiae has been isolated from the fruits of apple as well as kiwifruit. The *Neofabraea* species reported from apple in New Zealand are *N. alba* and *N. malicorticis* (Dingley 1969, Pennycook 1989, in both publications as *Pezicula alba* E.J.Guthrie and *P. malicorticis* (H.S.Jacks.) Nannf.). Isolates of *N. alba* in the ICMP culture collection genetically match *N. alba* sensu de Jong et al. (2001) (ICMP 12583, ITS sequence deposited in Genbank as AY359235; ICMP 11020, ITS sequence deposited in Genbank as AY359236). Apart from *Neofabraea alba*, most *Neofabraea* isolates from apple in New Zealand have cultures darker in colour than *C. actinidiae* (M. A. Manning, unpublished data), and appear to match morphologically *N. malicorticis* and *N. perennans* Kienholz sensu de Jong et al. (2001). The only ICMP isolate from apple identified as *N. malicorticis* (ICMP 10738) had an ITS sequence matching *C. actinidiae*. The frequency of *C. actinidiae* on apple in New Zealand remains unknown.

The pathogen *Neofabraea perennans* has been considered a synonym of *N. malicorticis* in the New Zealand literature (Dingley 1969, Pennycook 1989). Following the demonstration by de Jong et al. (2001) that these names represent two distinct fungi, a molecular survey of the *Neofabraea* species on apple in New Zealand would be timely.

Table 1. Details of isolates used in the phylogenetic analysis. GenBank accessions annotated with * were generated as part of this study.

Culture name	Host	Voucher specimen	GenBank accession number
Cryptosporiopsis actinidiae	*Actinidia arguta*	ICMP 15066	*AY359233
C. actinidiae	*Actinidia chinensis*	ICMP 15025	*AY359226
C. actinidiae	*Actinidia chinensis*	ICMP 15026	*AY359227
C. actinidiae	*Actinidia chinensis*	ICMP 15027	*AY359228
C. actinidiae	*Actinidia chinensis*	ICMP 15024	*AY359229
C. actinidiae	*Actinidia deliciosa*	ICMP 7826	*AY359232
C. actinidiae	*Actinidia indochinensis*	ICMP 14423	*AY359231
C. actinidiae	*Malus* x *domestica*	ICMP 10738	*AY359234
C. actinidiae	*Actinidia chinensis*	ICMP 13964	*AY359230
Neofabraea alba	*Malus*		AF281370
N. alba	*Malus*		AF281366
N. alba	*Malus*		AF281377
N. alba	*Malus*		AF281374
N. alba	*Malus*		AF281378
N. krawtzewii	*Populus*		AF281365
N. malicorticis	*Malus*		AF281379
N. malicorticis	*Malus*		AF281385
N. malicorticis	*Malus*		AF141161
Neofabraea perennans	*Malus*		AF281392
Neofabraea sp.	*Malus*		AF141189
Neofabraea sp.	*Malus*		AF281398
Pezicula corticola			AF141179
Pezicula cinnamomea	*Betula*		AF281399

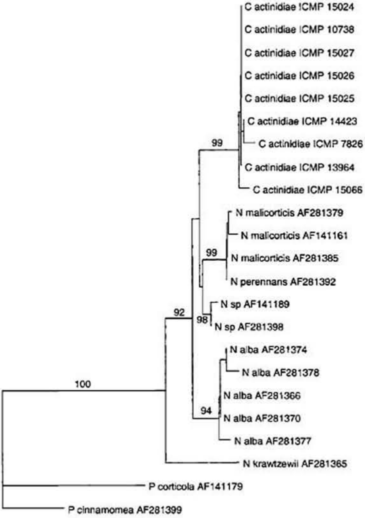

Fig. 2. Neighbor-joining tree comparing *Cryptosporiopsis actinidiae* with *Neofabraea* species studied by de Jong et al. (2001); *Pezicula cinnamomea* as outgroup. Bootstrap values recorded where above 50%. Details of isolates in Table 1.

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Variability of spore length in some species of the genus *Preussia (Sporormiella)*

F. ARENAL[1], G. PLATAS[2], & F. PELÁEZ[2]
farenal@ccma.csic.es
[1]Dpto. de Protección Vegetal, Centro Ciencias Medioambientales (CCMA-CSIC)
Serrano, 115, E-2806 Madrid, Spain
gonzalo_platas@merck.com & fernando_pelaez@merck.com
[2]Centro de Investigación Básica, Merck Sharp & Dohme Research Laboratories, Josefa
Valcárcel 38, E-28027 Madrid, Spain

Abstract—Nine *Preussia* and *Sporormiella* isolates belonging to six different species (*P. australis*, *P. intermedia*, *S. grandispora*, *P. minima*, *P. minimoides* and *S. similis*) were studied for the variation of the morphological characters used to distinguish these species upon repeated transfers. A large variability of morphological features was observed among different subcultures from the same strain; in some cases, the ascospore length particularly made a reliable identification difficult at species level. These results revealed a high diversity and instability of some morphological characters within the genus *Preussia*. Taxonomic implications are discussed and *P. grandispora* and *P. similis* are also proposed as new combinations.

Key words—Ascomycetes, coprophilous, fungi, taxonomy

Introduction

The genus *Sporormiella* Ell. & Everh. (1892), was erected to comprise species of the Dothideales with ostiolate ascomata, pluricelled ascospores of 4-16 cells with a gelatinous sheath, provided with germ slits and an exclusively coprophilous habitat. Other related genera had been erected in the family Sporormiaceae, such as *Sporormia* De Not. (1845), *Preussia* Fuckel (1866) or *Westerdykella* Stolk (1955), defined by differential features such as habitat and the morphology of ascomata and ascospores. The recognition of the different genera in the Sporormiaceae was confused by their shared features (Auerswald 1866, Munk 1957). Ahmed & Cain (1972) made a revision of *Sporormia* and *Sporormiella* describing numerous new species in the latter genus and included an identification key to both genera, which remains as the main reference for the identification of the species. Moreover, Cain (1961) published a revision of the genus *Preussia* that included species from soil, plant debris and dung, the difference between *Preussia* and *Sporormiella* being the absence of ostiolate ascomata in *Preussia*. However, it has been proved (Arx 1973, Valldosera & Guarro 1990) that these morphological features are variable in culture and are influenced by culture nutrients, light and humidity (Valldosera & Guarro

1990, Guarro et al. 1997). Other studies (Arx & Aa 1987) distinguished both genera based on their natural habitat, limiting *Sporormiella* strictly for coprophilous species whereas *Preussia* would include species isolated from plant debris, wood or soil. However, it has been demonstrated that this distinction is inconsistent, due to the existence of species such as *P. aquilirostrata* Guarro, Abdullah, Gené & Al-Saadoon or *P. intermedia* (Auersw.) S.I. Ahmed reported from soil, plant debris or dung (Guarro et al. 1997). This led us to consider *Preussia* and *Sporormiella* as synonyms. Some new *Preussia* and *Sporormiella* species have been described in recent years, and the convenience or not of treating both genera as synonyms has continued (Barrasa & Checa 1991, Lorenzo 1994, Korolyova 2000, Richardson 2001).

During a study attempting the molecular characterization of 38 *Preussia* isolates preliminarily identified as belonging to the species *P. intermedia*, *P. australis* (Speg.) Arx, *P. minima* (Auersw.) Arx and *P. minimoides* (S.I. Ahmed & Cain) Valldosera & Guarro, from diverse geographical origins, we found that some diagnostic features, like the spore length or the positioning of the germ slit, were not reproducible in sporulating subcultures, to such a degree that the same isolate could be identified as a different species depending on the subculture examined. The principal aim of this work is to assess the variability in culture of the diagnostic morphological characters defining the mentioned *Preussia* species. With this goal, nine *Preussia* isolates were subjected to sequential subculturing up to four times and in two different culture media, and the morphology of the ascospores produced was studied in detail.

Materials and Methods

All the strains studied were isolated by the authors and are preserved in the CIBE-Merck, Sharp & Dohme Culture Collection in 20% glycerol vials, as 0.6 mm diam frozen agar plugs at –80°C. The geographical origin and isolation substrata of the nine isolates are listed in Table 1. The strains were grown at 22°C and 80% relative humidity on PDA (Potato Dextrose Agar, Difco) and OTM (Oat Meal Agar, Difco). Two initial cultures from each strain were obtained by directly inoculating the frozen agar plugs derived from the original isolation plate onto two plates (one PDA and one OTM). Four sequential transfers were obtained by inoculating small agar squares (5x5 mm), taken from the margin of 7-day-old colonies, at the center of a new plate. Each subculture was inoculated from the previous transfer. To induce the sporulation, the cultures were exposed to alternate cycles of 12h UV/daylight for at least 14 days. The asporogenous cultures were also grown in CMA (Corn Meal Agar, Difco) and WA (Water Agar, Pronadisa), to try to induce the production of ascomata, without success.

Table 1. Geographical origin and isolation substrata.

Strain code	Initial taxonomy	Geographical Origin	Isolation Substrata
S9	*P. intermedia*	Hester Malan Reserve (South Africa)	Zebra dung
S11	*P. minimoides*	Fae East route. (Namibia)	Gemsbok scat dung
S15	*P. minimoides*	Hlhluwe, Zululand (S. Africa)	Zebra dung
S17	*P. australis*	Llano de los Viejos. Tenerife (Spain)	*Viburnum tinus* debris
S19	*S. similis*	Mouth Miller Canyon. Arizona (USA)	Dung
S25	*P. minima**	Puerto Rico	Plant debris
S34	*P. australis*	Villuercas, Cáceres (Spain)	*Daphne gnidium* leaves
S35	*P. minimoides*	Ritigala (Sri Lanka)	Goat dung
S37	*S. grandispora*	Ontigola, Aranjuez (Spain)	*Phragmites communis* leaves

*Epithet assigned based mainly on the presence of a kink in the germ slit, since the spore length did not fit exactly with the description of *P. minima*.

The microscopic features were examined and measured after sporulation of four sequential transfers on PDA and OTM media for each strain. The slides were made using a Leica Wild M8 dissection scope, on water or lactophenol cotton blue, and observed under a Leitz Diaplan microscope. The terminology used in this work for the microscopic features follows Ahmed & Cain (1972). The measurements of ascospore size did not include the gelatinous sheath. We made 21 measurements from each sporulating subculture to define the range of the spore length, following the recommendations of Heinemann & Rammeloo (1985). All the measurements obtained were represented in box-plot graphs, showing the median and 25 and 75 percentiles of each distribution, to give a more realistic view of the sporal length ranges for each strain. We included isolate S37 *S. grandispora* (Speg.) S.I. Ahmed & Cain as an outgroup of the species object of study, differing in the referred morphological features.

Results

According to the results obtained, and following Valldosera & Guarro (1990) and Guarro et al. (1997), we considered *Preussia* and *Sporormiella* as synonyms. Therefore, the generic name *Preussia* will be used across this paper, and we propose the following new combinations:

Preussia grandispora **(Speg.) Barrasa & Arenal, comb. nov.**

≡ *Sporormia grandispora* Speg., *Fungi Copr. Ven.* 1: 230. 1878. (basionym).

≡ *Sporormiella grandispora* (Speg.) S.I. Ahmed & Cain in Krug., *Trans. Bot. Soc. Edinb.* 41 (2): 198. 1971.

≡ *Preussia grandispora* (Speg.) Barrasa, comb. inval. *Contribución al estudio de los Ascomycetes coprófilos en España. Universidad de Alcalá de Henares*: 149. 1985. Doctoral Thesis ined.

***Preussia similis* (Khan & Cain) Arenal, comb. nov.**
≡ *Sporormiella similis* Khan & Cain, *Can. J. Bot.* 57: 1178. 1979. (basionym).

The study was focused on the determination of the spore size and the morphology of the germ slit. We identified the strains, initially attending to the length of spores and germ slit features of the initial cultures obtained from the frozen agar plugs in both media, PDA and OTM. Although epithet names were assigned (Table 1), differences in the features established by Ahmed & Cain (1972) to differentiate these species, made the specific identifications doubtful, at least, for some of the cases. A more in depth study of the nine strains following the subculturing experiment described in Materials and Methods allowed us to differentiate five different morphotypes, as indicated in Table 2.

Table 2. Spore length ranges and germ slit features for the nine *Preussia* isolates studied.

Strain	Morphotype	Observed	Ascospore Length		Germ			Slit
	code	spores	Range	Median	D	O	P	Morphology
S9	I-P	105	45.5-65	53.5	no	no	yes	straight, occasionally sinuous
S11	ML	210	26-40.5	34	yes	no	no	sigmoid
S15	AM	210	30.5-42	36.5	no	yes	yes	sinuous
S17	AM	168	32.5-44	38	no	yes	no	straight, occasionally sinuous
S19	*P. similis*	210	33.5-54	45.5	yes	no	no	straight
S25	MiA	168	28.5-41.5	36.5	no	no	yes	kink
S34	A-P	126	32.5-47	40.5	no	yes	yes	straight
S35	ML	210	22.5-40.5	34	yes	no	no	sigmoid
S37	*P.grandispora*	210	42-55.5	48	yes	no	no	straight

For germ slit features, the codes are: D: Diagonal; O: Oblique and P: Parallel. Identification and morphotype codes. AM: spore features between *P. australis* and *P. minimoides*. A-P: *P. australis* with parallel germ slit. I-P: *P. intermedia* with parallel germ slit. MiA: spore features between *P. minima* and *P. australis* with sinuous germ slit. ML: *P. minimoides* with large spores.

The results of the measurements of spore length in the original cultures and throughout the transfers obtained are shown in Figures 1 to 9. Lines are drawn showing the two thresholds established in the key by Ahmed

& Cain (1972) to distinguish between *P. australis* and *P. intermedia* "47 µm" and between *P. australis* and *P. minima*/*P. minimoides* "37 µm". The limits of the box-plots indicate the 25 and 75 percentiles of the distribution of data, the line into the boxes shows the median and the upper and lower limits of the whiskers covering 95% of the population.

In isolate S9 (Fig. 1), initially identified as *P. intermedia*, all the subcultures on PDA were asporogenous, whereas those in OTM were fertile. We made 105 spore measurements, and 22% of them were outside of the range (48-59 µm) established by Ahmed & Cain (1972), clearly exceeding the upper limit. However, the median was 53.5 µm, well within the limits defined by those authors. Interestingly, the germ slit was parallel instead of oblique to diagonal. Therefore, this strain showed some variability, but it was basically within the sporal range attributed to *P. intermedia*.

- **S9. Morphotype I-P**

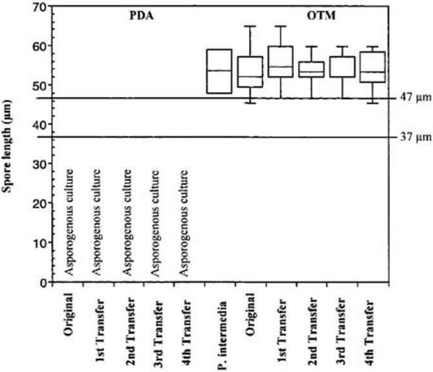

Fig. 1. Spore length of isolate S9 in PDA and OTM media. The spore size range given by Ahmed & Cain (1972) for *P. intermedia* is shown in the center of the graph.

- **S11. Morphotype ML**

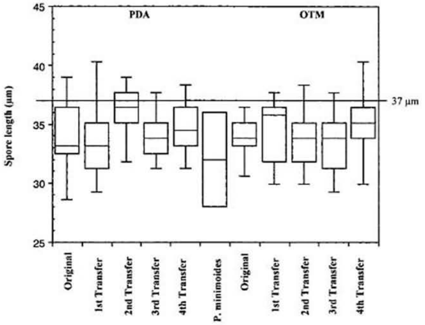

Fig. 2. Spore length of S11 isolate in PDA and OTM media. The spore size range given by Ahmed & Cain (1972) for *P. minimoides* is shown in the center of the graph.

In isolate S11, initially determined as *P. minimoides* (Fig. 2), all the subcultures were fertile. From 210 measurements, 27% exceeded the upper limit "36 µm" indicated in the key. Attending to the medians, all the subcultures fell within the theorical range of size established by Ahmed & Cain for *P. minimoides*, except for the 2nd transfer in PDA, which showed a median of 36.5 µm and was the only subculture with the percentile 75 beyond the "37 µm" threshold, indicating that more than half of the spores measured exceeded the limit of "36 µm" given by the authors to delimit the species. The germ slit was always diagonal, in agreement with Ahmed & Cain (1972).

Almost 57% of the 210 spores measured in isolate S15, initially identified as *P. minimoides*, exhibited dimensions larger than 36 µm (Fig. 3). Although the two original cultures fell within the range of *P. minimoides*, it is noticeably that most of the subcultures obtained therefrom were not. As many as five of the transfers obtained showed distributions with medians higher than 37 µm. In particular, the 1st transfer in OTM showed a distribution that was more in agreement with the size range described for *P. australis*. Taking the data as a whole, the median of the distribution of spore size data was 36.5 µm. This, in combination with the oblique to parallel disposition of the germ slit, could exclude this strain from the concept of *P. minimoides* (Ahmed & Cain 1972).

• S15. Morphotype AM

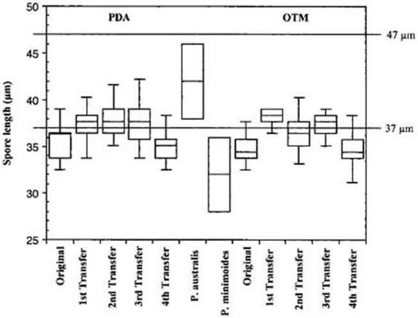

Fig. 3. Spore length of S15 isolate in PDA and OTM media. The spore size range given by Ahmed & Cain (1972) for *P. australis* and *P. minimoides* are shown in the center of the graph.

A total of 168 measurements were made from isolate S17, initially determined as *P. australis*, since two subcultures (the last ones in both culture media) resulted asporogenous. Only the original culture in PDA showed spore dimensions fitting approximately the range given for *P. australis*, with a median of 39 µm, just above the lower limit of the description provided by Ahmed & Cain (1972). The remaining subcultures were in variable degree below that lower limit, and the medians of the distributions were consistently in between the size ranges given for *P. australis* and *P. minimoides*. Overall, 41% of the spores measured were under the length range for *P. australis*, and the median for the whole distribution of data fitted exactly with the lower sporal limit (38 µm) following the dichotomous key of the genus (Fig. 4). As occurs with isolate S15, that fact could exclude this strain from the concept of *P. australis* (Ahmed & Cain 1972).

- **S17. Morphotype AM**

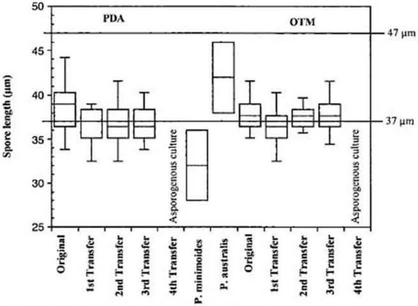

Fig. 4. Spore length of S17 isolate in PDA and OTM media. The spore size range given by Ahmed & Cain (1972) for *P. australis* and *P. minimoides* are shown in the center of the graph

In isolate S19 (Fig. 5), all the cultures obtained were fertile, so we made 210 spore measurements. This strain was initially identified as *P. similis* (Khan & Cain) Arenal, given the spore size range exhibited by the original cultures (42-52 µm). Although several of the subcultures also fitted with the description of this species, the 4th transfer in both media, as well as the 2nd one in PDA, showed much smaller spores that were consistent with the spore length range of *P. australis*.

The isolate S25 (Fig. 6) was initially identified as *P. minima* based on the distinct morphology of the germ slit, showing a characteristic kink in the middle, although the spores were consistently larger than the margins given for this species. Actually, 71% of the 168 measurements made (two tranfers in PDA were sterile) exceeded the upper limit (32(-34) µm) of *P. minima*, and even the median of the whole data set (36.5 µm) was above that limit. However, in general they were not within the range of *P. australis* either (except for the original culture in PDA and the 2nd subculture in OTM), and, interestingly, the ascospores always showed a characteristic kink in their germ slit. On the other hand, the differences among the different subcultures were also remarkable (see, for instance, the 3rd subculture in PDA and the 2nd transfer in OTM).

- **S19. *P. similis***

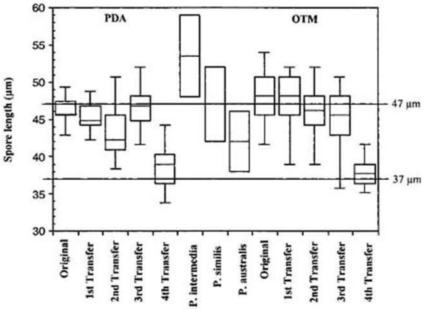

Fig. 5. Spore length of S19 isolate in PDA and OTM media. The spore size range given by Ahmed & Cain (1972) for *P. intermedia*, *P. similis* and *P. australis* are shown in the center of the graph.

In isolate S34 (Fig. 7), initially determined as *P. australis*, one of the subcultures in PDA and three in OTM were sterile. More than 90% of the 126 ascospores measured were within the range of size described for *P. australis,* and the differences among the subcultures were not as noteworthy as observed for other isolates. However, the germ slit showed a consistent trend to adopt an atypical parallel disposition, quite different from the oblique to diagonal germ slit described for this species (Ahmed & Cain 1972).

All the subcultures obtained from the isolate S35 were fertile (Fig. 8). The isolate was identified as *P. minimoides*, based on the observations made on the first culture obtained in PDA. Although only 18.5% of the spores measured were out of the limits established by Ahmed & Cain (1972), and the median (34 µm) was within those limits (although close to the upper limit), two of the cultures (the original one in OTM and the 2nd transfer in this medium) showed spores with dimensions consistently higher, although too small to be considered *P. australis*.

- **S25. Morphotype MiA**

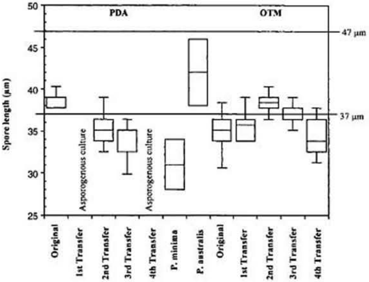

Fig. 6. Spore length of S25 isolate in PDA and OTM media. The spore size range given by Ahmed & Cain (1972) for *P. minima* and *P. australis* are shown in the center of the graph.

- **S34. Morphotype A-P**

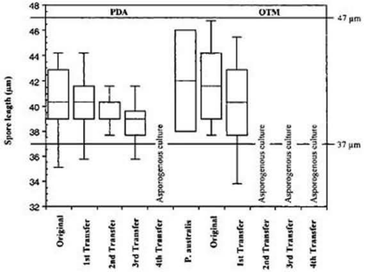

Fig. 7. Spore length of S34 isolate in PDA and OTM media. The spore size range given by Ahmed & Cain (1972) for *P. australis* is shown in the center of the graph.

• S35. Morphotype ML

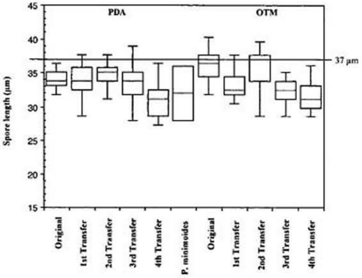

Fig. 8. Spore length of S35 isolate in PDA and OTM media. The spore size range given by Ahmed & Cain (1972) for *P. minimoides* is shown in the center of the graph.

• S37. *P. grandispora*

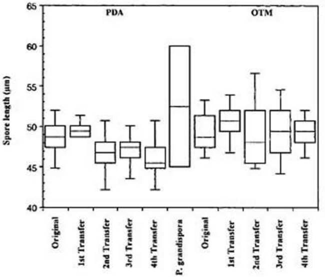

Fig. 9. Spore length of S37 isolate in PDA and OTM media. The spore size range given by Ahmed & Cain (1972) for *P. grandispora* is shown in the center of the graph.

Finally, in the isolate S37 (Fig. 9), identified as *P. grandispora*, more than 90% of the 210 spores measured were within the expected range. The remaining ascospores were always smaller than the lower limit given for the species, and in general all the spores measured were consistently in the lower part of the theoretical distribution, hardly ever surpassing 53 µm. The variation across the subcultures was lower than for other isolates. The spore length range exhibited by this isolate would be also consistent with that of *S. tenuispora* Khan & Cain, a species very close to *P. grandispora*. However, the isolate S37 fits better with the description of *P. grandispora*, based on its broader ascospores and oblique germ slit.

Discussion

The main conclusion of our work is the instability of some morphological features used for the identification of *Preussia* species observed after repeated subculturing. Ascospore length, which is the main character used to distinguish species in the group *P. intermedia/P. australis/P.minimoides*, can vary to such a degree from one subculture to another, that this character alone could induce the same strain to receive different epithets depending on the culture studied. For instance, the isolate S15 could be identified as *P. minimoides* in the original culture in OTM, or as *P. australis*, in the 1st transfer in the same medium (Fig. 3). Likewise, the isolate S19 would be *P. similis* in the original and 1st transfer in OTM, whereas it would fit with *P. australis* in the 2nd and 4th transfers in PDA and the 4th in OTM.

Also, ascospores very frequently exceeded the size limits established in the descriptions given by Ahmed & Cain (1972), or they showed intermediate sizes between the species accepted by these authors. This poses an additional challenge on mycologists, who have to decide on whether to try to adjust their observations to the existing descriptions (expanding the size range originally defined), or to erect a new species when the characters observed cannot be satisfactorily accommodated in any of the already described species, with the risk of populating the genus with new and probably meaningless species. Overall, our data revealed that the limits established to delimit the species concept in the complex *P. intermedia/P. australis/P. minimoides* are ambiguous and should be treated with caution, at the very least.

In this regard, the existence of intermediate forms between *P. australis* and *P. intermedia* was already acknowledged by Kahn & Cain (1979), who erected the species *S. similis* to accommodate strains of *Preussia* with a range of ascospore size in between those two species. The isolate S19 would fit well with the description of *P. similis*, with the caveat that three of the subcultures obtained could be reasonably ascribed to *P. australis* (Fig. 5).

Likewise, we have found at least two isolates (S15 and S17) showing an ascospore size range intermediate between *P. minimoides* and *P. australis*, and another isolate (S25) which was intermediate between *P. minima* and *P. australis*. Whether these isolates represent new species may be debatable. Although we do not feel confident that these isolates should be assigned to a new species, given the variability in characters aforementioned, it is possible that additional data less dependent on morphology (e.g. gene sequencing) could help to clarify this.

This variability has been also reported by other authors for *Preussia* species, although never in studies specifically focused on addressing this point. Thus, Cain (1961) mentioned a broad range of variation with respect to the shape of the asci, the length of the stipe and the arrangement of the asci within the pseudothecium. Moreover, he alluded to the existence of morphological variations referred to a progressive decrease in the number of asci, and an increase in the number of paraphyses, after a few transfers of the cultures. This author suggested lot of caution with respect to making species descriptions and delimitations adequate, mentioning the extensive confusion concerning this genus. Likewise, Bell (1983) reported spore populations of intermediate length between *S. intermedia* and *S. teretispora* S.I. Ahmed & Cain, in specimens collected in New Zealand, alluding also to the instability of the germ slit disposition. Finally, Khan & Cain (1979) reported the size and shape variability in the spores from other *Sporormiella* species (*S. pilosa* (Cain) S.I. Ahmed & Cain and *S. tetramera* S.I. Ahmed & Cain) in specimens collected in South Africa compared with North American isolates, and they mentioned also the length variability in *P. minima*.

Furthermore, we have observed that other diagnostic characters are also very variable in culture, even in the same culture plate. Thus, germ slit positioning with respect to the longitudinal axis of the ascospore was not constant, showing the existence of a continuum between diagonal, oblique or parallel types. The only exception was the existence of the characteristic kink in the germ slit of strains of *P. minima*, which remained constant. Moreover, we have found other strains similar to S25, showing ascospores larger than the typical length assigned to *P. minima*, but in which the germ slit morphology was easily recognizable. Other characters mentioned in the key proposed by Ahmed & Cain (1972), such as the presence or absence of ostiolate ascomata, or different features of the perithecia (pseudothecium) neck, were not constant neither (data not shown). All this makes it very difficult to make an accurate and reliable identification of members of this group of *Preussia* species.

No trends were observed in the variation in spore size across subculturing, i.e, in general we did not find that late subcultures produced consistently either larger or smaller ascospores than the original cultures.

However, asporogenous cultures and abnormal spore sizes (i.e., extreme compared to the rest of subcultures) were relatively more frequent in late transfers than in the earlier ones (see isolates S17, S19 and S34). Likewise, the culture media did not influence the morphology traits addressed in this study, and similar variability was found in either PDA or OTM. When the spore measurements were treated as Q coefficients instead of length, we observed basically the same variability across the transfers, although with a slightly more homogeneous distribution (data not shown), as could be expected from the smaller variation range observable in spore width.

In summary, our work shows a high degree of variability in the characters used to differentiate the species of *Preussia* mentioned. Sometimes, this variability makes the reliable identification of specimens at the species level difficult, and suggests that there needs to be a lot of caution before erecting new species in this group based on a morphology apparently not fitting species that have already been erected. It is however, possible, that the use of molecular techniques (i.e., sequencing of ribosomal DNA or other genes), combined with morphological characters, would facilitate a better understanding of species concept within the genus *Preussia*.

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MYCOTAXON

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Vezdaea rheocarpa new to North America

MARTIN WESTBERG
Martin.Westberg@ekol.lu.se
Botanical Museum, Lund University
Östra Vallgatan 18, SE-223 61 Lund, Sweden

Abstract—*Vezdaea rheocarpa* is documented for North America for the first time.

Key words—Lichens, lichenized fungi, Arizona, Vezdaeaceae

Introduction

During an excursion to the San Francisco Mountains, Arizona in June 1998, I collected a small crustose lichen growing on dead or dying bryophytes. A closer examination revealed that it belonged to *Vezdaea rheocarpa* Poelt & Döbbeler. As this species is not included in the North American checklist of lichen forming, lichenicolous and allied fungi (Esslinger 1997) and I have found no other reports of this species from the continent, this represents a first report of *V. rheocarpa* from North America.

The genus *Vezdaea* Tsch-Woess & Poelt currently comprises ten species world-wide. They are rather inconspicuous and difficult to find in the field and our knowledge of the distributon of the different species is probably rather poor. So far only two other species have been found in North America, *V. stipitata* Poelt & Döbbeler and *V. leprosa* (P. James) Vezda (Esslinger 1997, Buck et al. 1999). It is likely that additional records of these species, as well as finds of other species in the genus, will be made. A key to the ten species presently known was published in Giralt et al. (1993).

The species

Vezdaea rheocarpa Poelt & Döbbeler
Lichenologist 1977(9): 170. Typus. Südliches Burgenland, Bergen bei Jennersdorf, über verschiedenen Moosen, 17.3.1974, J. Poelt & P. Döbbeler (GZU-Holotype, LD-Isotype).

The characters of the specimen found agree well with the description of *V. rheocarpa* (Poelt & Döbbeler 1975, see also Coppins 1987) and with isotype-material in LD. The distinctly warted ascospores measure 18–22 x 8–11 µm in the collected specimen. Paraphyses are apparently lacking. The pointed spines are well-developed, *c.* 6–10 µm long, and covers the surface of the goniocysts. The species was found growing on moribound *Hypnum revolutum* in an alpine community close to the timberline (3400–3500 m. alt.), in a northwest-facing slope just below the top of a ridge. Other species collected nearby included *Cetraria ericetorum*, *Lecidoma* *demissa*, *Psoroma hypnorum*, *Fuscopannaria praetermissa* and *Protopannaria pezizoides* (Nash et al 2002).

In Europe, *Vezdaea rheocarpa* grows on mosses and liverworts and has also been found on foliose lichens such as *Nephroma parile* and *Peltigera praetextata*. Like other species in the genus, it is metal tolerant and is known from lead/zinc-contaminated soils and magnesium-rich limestone (Gilbert 1980, 2000).

SPECIMENS EXAMINED – UNITED STATES. ARIZONA, Coconino Co., San Francisco Mountains, on the ridge running NE from Humphreys Peak, 35°21'N, 111°41'W, *c.* 3400-3500 m. *M. Westberg 858* (LD); **AUSTRIA.** Südliches Burgenland, *J. Poelt & P. Döbbeler* [Poelt, *Lich. Alp.* no. 293] (LD -Isotype).

Acknowledgements

The excursion was organized by Dr T. H. Nash III for the Sonoran Desert Lichen Flora Project (U.S. National Science Foundation supported project DEB-9629532 & 9706984). Thanks also to Dr. Nils Cronberg for identifying *Hypnum revolutum*.

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MYCOTAXON

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Aspergillus, Penicillium and related species reported from Turkey

AHMET ASAN
ahasan@trakya.edu.tr
Trakya University, Faculty of Arts and Sciences, Department of Biology
TR-22030 EDIRNE - TURKEY.

Abstract—This database, available online, reviews 250 published accounts and presents a list of species representing the genera *Aspergillus, Penicillium* and related species in Turkey. *Aspergillus niger, A. flavus, A. fumigatus, A. versicolor* and *Penicillium chrysogenum* are the most common species in Turkey respectively. According to the published records, 365 species have been recorded from various subtrates in Turkey.

Key Words—*Eupenicillium, Gliocladium, Paecilomyces. Talaromyces*

Introduction

Aspergillus and *Penicillium* are economically, ecologically, and medically important and large genera. Species of these genera can cause the decay of stored products. They are important in view of health hazards. In addition, they are used in industrial and food fermentation processes, and they exist commonly in different type of soils, indoor and outdoor air, food and water (Domsch et al. 1980; Klich 1993; Fischer & Dott 2003). Since *Aspergillus* and *Penicillium* are found almost everywhere, they are frequently cited in species lists in ecological studies. Thus accurate identification of *Aspergillus* and *Penicillium* at the species level is essential. *Aspergillus* and *Penicillium* are not easy to identify to the species level. To further complicate things, the taxonomy of both genera still needs work, but there appear to be fewer problems in *Aspergillus* than in *Penicillium.*

More information on the taxonomy of these two genera can be found in many books (e.g., Raper & Thom 1949, Raper & Fennell 1965, Pitt 1979, Domsch et al. 1980, Ramirez 1982, Pitt & Hocking 1985, Samson & Pitt 1990, Singh et al. 1991, Pitt et al. 2000, Samson & Pitt 2000, Klich 2002, Samson et al. 2002), and articles (e.g., Christensen & Backus 1962, Pitt 1973, Klich 1993, Banke et al. 1997, Muntanola-Cvetkovic et al. 2001, Peterson et al. 2001, Tuthill et al. 2001, Tuthill et al. 2002). The recent book by Klich (2002) enables researchers to identify common *Aspergillus* species morphologically.

This *Aspergillus* and *Penicillium* database is significant for international community because the Turkish literature is not available to scientists who live outside the country; moreover, it is published in Turkish journals that are not readily available internationally.

The purpose of this database is to document the *Aspergillus, Penicillium,* and related species isolated from Turkey. The database will make the Turkish literature on the subject available to an international audience. It will also give future researchers information on whether a species is a new record for Turkey.

The online database reviews 250 published materials and presents a list of species isolated from Turkey. The species list for the *Aspergillus* and *Penicillium* species and related genera are arranged in alphabetical order in the website. The first part of this work was published by Asan (2000). But we need to update the species list. Synonyms and authors of fungal names were found in literature such as Samson & Pitt (1990), Pitt et al., (2000), Klich (2002) and www.indexfungorum.org.

The nomenclature follows updates presented in Samson & Gams (1985) and Pitt et al. (2000). Throughout my database, I assume that the authors properly identified the species reported.

There are 365 species which have been isolated and identified from the different regions of Turkey. Asan (2000) gave 251 species in 2000, and this database adds 114 species to the earlier list, bringing the total number of *Penicillium* species isolated in Turkey so far to 199 and of *Aspergillus* species to 116.

Aspergillus niger is the most commonly reported species in Turkey. It has been reported in 124 different studies, with *A. flavus* reported in 100, *A. fumigatus* in 90, *A. versicolor* in 68, *P. chrysogenum* in 65, *A. terreus in* 54, *A. ochraceus* in 51, *P. funiculosum* in 46, *Penicillium glabrum (P. frequentans)* in 44, and *A. wentii* in 41 studies respectively. These species may adapt to ecological conditions better than the other, more rarely reported, species. Species were isolated from different substrates and/or habitats such as, soil, water, air, food, etc. The database contains a summary table of this information by genus.

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Online Database

The most recent version of the complete database is available online at
<http://www.mycotaxon.com/authors/weblists.html>

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Interesting Gasteromycetes from Catamarca and La Rioja (Argentina). 1

MARÍA M. DIOS
mariamartha01@uol.com.ar
Departamento de Biología, Facultad de Ciencias Exactas y Naturales
Universidad Nacional de Catamarca, Avenida Belgrano 300
4700 - San Fernando del Valle de Catamarca, Catamarca. Argentina

GABRIEL MORENO & ALBERTO ALTÉS
gabriel.moreno@uah.es alberto.altes@uah.es
Departamento de Biología Vegetal, Universidad de Alcalá,
E-28871 Alcalá de Henares, Madrid. España

Abstract—Nine species of Gasteromycetes belonging to the genera *Chlamydopus*, *Podaxis* and *Tulostoma* are recorded from the provinces of Catamarca and La Rioja, Argentina. *Podaxis argentinus*, *Tulostoma beccarianum*, *T. herteri*, *T. mohavei*, *T. obesum*, *T. pulchellum*, and *T. striatum* are described. Photographs are also provided for the uncommon *T. herteri*.

Key words—chorology, spore ornamentation, SEM, taxonomy

The provinces of Catamarca and La Rioja are located in the Northwest of Argentina, characterized by its rugged terrain. Six phytogeographical provinces are distinguished in these areas, each one determined by the predominance of a different kind of vegetation (Morlans 1995). The samples studied in this paper have been collected from areas with xerophilic vegetation, with *Prosopis spp.*, *Aspidosperma quebracho-blanco* Schltdl., *Acacia aroma* Gillies ex Hook. & Arn., *Larrea divaricata* Cav., *Larrea cuneifolia* Cav., *Geoffroea decorticans* (Gillies ex Hook. & Arn.) Burkart, and several Cactaceae, where some Gasteromycetes, especially members of the families Tulostomataceae and Podaxaceae, can frequently be found.

We have previously published other papers on Gasteromycetes from Catamarca (Dios *et al.* 2000, 2001).

Material and Methods

The studied specimens have been deposited in the herbarium of the "Universidad de Alcalá", Spain (AH), in the herbarium of the "Instituto de Investigación para el Desarrollo Socioeconómico de Los Llanos de La Rioja, Universidad Nacional de La Rioja", Argentina (IZAC), and in the Mª M. Dios's personal herbarium ("Departamento de Biología, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Catamarca", Argentina).

The scanning electron microscope (SEM) photographs were made according to Moreno *et al.* (1995).

Chlamydopus meyenianus (Klotzsch) Lloyd, *Mycol. Notes Lloyd Libr. Mus.* 14 (note n° 236). 1903.

Material studied: Catamarca, Pomán Department, Renania farm, roadside, on bare soil, S. Segura, 27-VI-2000, AH 28477 (slides in herb. M.M. Dios n° 69).

This collection consists of only one basidiome, 60 mm high. Spore sac subglobose, 18 x 13 mm. Peridium smooth, cream-coloured. Stoma consisting of an irregular and plane apical thorn. Gleba ferrugineous. Stem 49 x 7 mm, longitudinally striate, rather cylindrical, concolorous with the endoperidium to ochraceous, widened apex up to 11 mm diam. and ending basally in a volviform scaly structure up to 9 mm diam. Spores 5-7 µm diam., globose, yellowish, patently verrucose; under SEM the ornamentation is formed by large verrucae, sometimes arranged as irregular and short crests. Threads of the gleba 3-5 µm diam., hyaline, thin walled, with some fibulated septa. Basidia and basidioles persisting in maturity, subglobose, 5-7 µm diam., grouped in typical fascicles.

Observations: *Chlamydopus meyenianus* is a rare species adapted to arid and semiarid areas, previously cited from Argentina, in the provinces of Catamarca (Spegazzini 1927; Domínguez de Toledo 1989), Mendoza (Spegazzini 1912), Salta, Buenos Aires (Spegazzini 1898), Chubut (Spegazzini 1913), La Rioja and Santiago del Estero (Domínguez de Toledo 1989). A detailed description, including good illustrations of this species, has been recently published by Lunghini (2001).

Recent molecular studies (Martín *et al.* 2000) support placing the genus *Chlamydopus* in the Phelloriniaceae.

Podaxis argentinus Speg., *Anales Mus. Nac. Buenos Aires* 6: 186. 1898 (as *Podaxon*).

= *Podaxon patagonicum* Speg., *Anales Mus. Nac. Buenos Aires* 6: 186. 1898.

Material studied: Catamarca, Ambato Department, La Puerta, east bank of Río del Valle, on bare soil near *Larrea divaricata*, M.M. Dios, 23-IV-1999, AH 28462 (slides in herb. M.M. Dios n°57); Tinogasta Department, Medanitos, roadside, R. Salinas, herb. M.M. Dios n° 67, 68 (duplo in AH 28476). La Rioja, General Ocampo Department, Campo Miraflores, between Milagro and Comandante Leal, on bare soil, F. Biurrum, L. Blanco & T. Flores, 26-III-2002, herb. M.M. Dios n° 95, (duplo in AH 19697).

Observations: The discussion regarding the presence or absence of a germ pore on the spores of *Podaxis argentinus* has been rekindled by Dios *et al.* (2001). The additional collections studied here, which present perfectly mature spores, lead us to reconsider the observations expressed in that study. We have been able to verify with certainty that the spores of this species do not present a small germ pore. However, a remnant of a hilar apiculus in the spores can clearly be observed, whose fragility often makes it appear broken or almost completely removed, leaving a small circular scar. The presence of this circular scar is the reason why several authors have described a small germ pore on the spores of *P. argentinus*, even using SEM.

Podaxis argentinus has been cited from several provinces of Argentina: Mendoza, Salta, Río Negro, Buenos Aires (Spegazzini 1906), Córdoba, (Nouhra & Domínguez de Toledo 1992), Santiago del Estero (Martínez 1971), San Luis (Domínguez de Toledo 1993), and recently from Catamarca (Dios *et al.* 2001). This is the first record from the province of La Rioja.

Tulostoma beccarianum Bres. *in* Petri, *Ann. Mycol.* 2: 413-414. 1904.
= *T. simulans* Lloyd, *The Tylostomeae* p.18. 1906.

Material studied: Catamarca, Pomán Department, gallery forest, on sand and litter of *Mimozyganthus carinatus* (Griseb.) Burkart and *Deuterocohnia longipetala* Mez, M.M. Dios, 30-X-1998, AH 28468 (slides in herb. M.M. Dios nº 73).

Basidiome 27 mm long. Spore sac 8 mm diam., globose to subglobose. Exoperidium indistinct. Endoperidium smooth, whitish, papyraceous. Stoma tubular. Stem 23 x 2 mm, cylindrical, light brown, longitudinally striate, wider at the bulbous base (3 mm diam). Gleba ferrugineous.

Spores 4-4.5 μm diam., globose to subglobose, yellowish, asperulate. Under SEM, the ornamentation is formed by verrucae and short crests. Capillitium 3-4 μm diam., thin walled, hyaline, branched and scarcely septated.

Observations: This species has previously been cited from Argentina: provinces Buenos Aires and Chubut (Wright 1987). This is the first record from Catamarca. The taxonomic position of this species has been treated by Altés & Moreno (1993).

Tulostoma fimbriatum Fr., *Systema Mycologicum* 3: 43. 1829.

Material studied: Catamarca, Capital Department, in garden with *Citrus limon* (L.) Burm.f., R. Ghanem, 10-VIII-1999, AH 28463; *ibidem*, Basural de "La Aguada", roadside, on litter of *Acacia aroma*, M.M. Dios, 7-III-2002, AH 28472 (duplo in herb M.M. Dios nº 77); Ambato Department, La Puerta, on litter of *Schinopsis haenkeana* Engl., *Acacia visco* Lorentz ex Griseb., *Prosopis nigra* Hieron., *Celtis tala* Gillies ex Planch., M.M. Dios, 23-IV-1999, herb. M.M. Dios nº 62; Capayán Department, Concepción, camping area road, on herbaceous and woody litter, M.M. Dios, 7-XI-1999, AH 28464 and herb. M.M. Dios n° 70; *ibidem*, under *Croton sarcopetalus* Müll. Arg. and herbaceous Asteraceae, M.M. Dios, 27-II-2000, AH 28479; *ibidem*, Colonia del Valle, under *Acacia aroma* and *Prosopis nigra*, M.M. Dios, 8-VI-2000, herb. M.M. Dios n° 71; Andalgalá Department, Chaquiago, on woody litter, M.M. Dios & J.M. March, 21-IV-2000, herb. M.M. Dios n° 63; Fray Mamerto Esquiú Department, Sierra Brava, roadside, M.M. Dios, 16-VI-2000, AH 28478; Valle Viejo Department, Vista Larga, on woody litter, A. Zurita, 25-V-2000, AH 28470; Pomán Department, gallery forest, on litter of *Mimozyganthus* carinatus, M.M. Dios, 30-X-1998, AH 19655 (duplo in herb. M.M. Dios n° 64).

Observations: *Tulostoma fimbriatum* is a well characterized species by the presence of a hyphal exoperidium, fimbriate stoma, and verrucose spores (4)4.5-5(5.5) µm diam. in the samples studied. This is one of the most common species of *Tulostoma* in Catamarca, always found in xeric zones, associated with the Chaco Serrano and Chaco Arido vegetation.

Tulostoma fimbriatum has previously been cited from some provinces of Argentina: Salta, Mendoza (Wright 1987), Catamarca (Wright 1987, Dios *et al.* 2000) and Córdoba (Domínguez de Toledo 1989).

Tulostoma herteri Lohwag & F. Swoboda, *Revista Sudamer. Bot.* 1: 3. 1942. (Figs. 1-6)

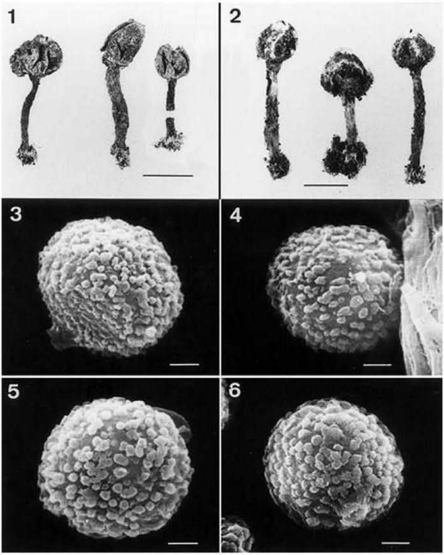
Material studied: Catamarca, Capayán Department, El Milagro, among mosses under *Larrea sp.*, L. Rodriguez, 10-VI-1994, herb. M.M. Dios n° 1 (as *T. berteroanum* (Lév.) De Toni *in* Sacc.); *ibidem*, near Quebrada de la Cébila, humus of *Larrea divaricata*, A. Vedia, 11-II-1995, herb. M.M. Dios n° 12 (as *T. perplexum* Long & S. Ahmad); Valle Viejo Department, Vista Larga, humus of *Larrea sp.*, A. Zurita, 15-XI-2000, AH 19649; *ibidem*, El Portezuelo, La Bajada, among mosses, with, *Aspidosperma quebracho-blanco*, M.M. Dios, 9-VI-2000, AH 19647, 28474, 28475; *ibidem*, among mosses, with *Larrea divaricata*, A. Agüero, 13-VI-2000, AH 19648 (duplo in herb. M.M. Dios n° 73).

Type collections compared: URUGUAY: Cerro de Montevideo, W.G. Herter 81995, 1927, Plantae Uruguayenses Exsiccatae 2184 (FH), holotypus of *Tulostoma herteri*. SOUTH AFRICA: Cape prov., Lockenburg, sandy soil, J.P.H. Acocks 18934, 18-VIII-1956, PREM 41614, holotypus of *Tulostoma gracilipes* J.E. Wright. INDIA: Rohtak, S. Ahmad 338, 15-VI-1941, Herb. Long 10261 (BPI), holotypus of *Tulostoma parvissimum* Long & S. Ahmad. AUSTRALIA: Australia merid., Tapper, PAD, holotypus of *Tulostoma pulchellum* Sacc.

Basidiomes 8-19 mm long (Fig. 2). Spore sac 3-8 mm diam., globose to subglobose. Exoperidium hyphal mixed with small particles of soil, scantily developed but usually persisting on the greater part of the spore sac. Endoperidium smooth, whitish, papyraceous. Stoma fibrillose-fimbriate, concolorous, mammose. Stem 4-15 x 0.8-1 mm, cylindric, covered by a somewhat scaly greyish brown cortex, with a bulbous base 2-3 mm diam. agglomerating sand and mycelium remains. Gleba ochraceous to ferrugineous.

Endoperidium formed by cylindrical to sinuous, thick walled hyphae, 4-8 µm diam., not broadened at the septa. Spores 4-5 µm diam. (up to 5.5 µm in the holotype), globose to subglobose, yellowish, minutely verrucose. Under SEM, the ornamentation is formed by small and numerous verrucae

(Figs 4,6), usually densely arranged, sometimes anastomosed in irregular and short crests. Capillitium 2-5 µm diam., subhyaline, thick-walled, branched, slightly or not broadened at the ochraceous septa (3-6 µm diam).



Figs. 1,3,5. *Tulostoma herteri*, Herter 81995 (FH), holotypus. 1. Basidiomes. 3,5. Spore ornamentation under SEM. **Figs. 2,4.** *Tulostoma herteri*, AH 19647. 2. Basidiocarps. 4. Spore ornamentation under SEM. **Fig. 6.** *Tulostoma herteri*, AH 19648. Spore ornamentation under SEM. Scale bars: 1,2 = 5 mm; 3-6 = 1 µm

Observations: These new Argentinian recollections have allowed us to define better and to check the constancy of the macro- and microscopic characters of this species, little known so far and considered as "not well defined" (Wright 1987). The macro- and microscopic study of the holotype of this species (Figs. 1,3,5) shows a great similarity with the characteristics observed in the Argentinian collections. *Tulostoma herteri* is characterized by its rather small basidiomes, with usually slender and not very well developed stems, the presence of a mammose and fibrillose-fimbriate stoma (it is usually similar to a bryophyte peristoma, as indicated by Wright 1987), the scantly developed hyphal exoperidium, and the spore ornamentation with small, numerous and well defined verrucae.

Some species can be confused with *Tulostoma herteri* because of its similar aspect: *T. gracilipes* J.E. Wright and *T. parvissimum* Long & S. Ahmad. Both of these also possess small basidiomes and fibrillose-fimbriate stoma, although not mammose, and even with tendency to appear indefinite in *T. parvissimum*. Nevertheless, the membranous exoperidium, that is present in these two species, provides a clear difference to *T. herteri*. Another important feature, the spore ornamentation, is also very different in *T. parvissimum*: it consists of more developed, irregular and not well defined crests and verrucae. The spore ornamentation under SEM of *T. gracilipes* is much more similar to that of *T. herteri*.

Another species with certain similarity to *Tulostoma herteri* is *T. pulchellum* Sacc., especially in features such as the type of stoma and the spore ornamentation. But in this case the basidiomes are usually bigger, reaching up to 50 mm long, with a larger spore sac (up to 15 mm diam.), with a typical membranous exoperidium, and larger spores (4.5-6.5 µm diam.) with somewhat broadened and flattened verrucae (Moreno *et al.* 1995).

Tulostoma herteri has been cited from Argentina, Bolivia, Uruguay and the USA (Wright 1987). The only Argentinian records are from the provinces of Santa Cruz (as *T. patagonicum* Speg.) and Tucumán (Wright 1987). After checking the material from the province of Catamarca cited by Dios (1997) as *T. berteroanum* (Lev.) De Toni *in* Sacc. and *T. perplexum* Long & S. Ahmad, it is clear that these collections belong to *T. herteri*. Therefore, *T. perplexum* must be eliminated from the American gasteromycetes catalogue. *Tulostoma herteri* is a new record from Catamarca.

Tulostoma mohavei Lloyd, *Mycol. Notes Lloyd Libr. Mus.* 64: 992-993. 1920.

Material studied: Catamarca, Pomán Department, gallery forest, on humus of *Bulnesia retamo* Griseb., M.M. Dios, 30-X-1998, AH 19656 (duplo in herb. M.M. Dios n° 75); Capayán Department, on humus of *Larrea sp.* and *Cercidium praecox* (Ruíz & Pav.) Harms, M.M. Dios, 19-XI-1993, AH 28487 (slides in herb. M.M. Dios n° 9); *ibidem*, Quebrada de La Cébila, on bare soil, M.M. Dios, 22-III-1995, herb. M.M. Dios n° 10. La Rioja, Chamical Department, Salina La Antigua, under *Prosopis reptans* Benth., F. Biurrun & E. Mercado, 31-V-2000, AH 28469 (duplo in IZAC 6469 bis, and slides in herb. M.M. Dios n° 76).

Basidiomes 24-32 mm long. Spore sac 9-15 mm diam., globose to subglobose. Exoperidium hyphal. Endoperidium smooth, whitish, papyraceous. Stoma tubular. Stem 20-38 x 2-4 mm, cylindrical, light-brown, longitudinally striate. Gleba pale brown to ferrugineous.

Spores 4-5 µm diam., globose to subglobose, smooth, yellowish. Under SEM the spore surface appears asperulate to rugose. Capillitium 2-8 µm diam., hyaline, branched.

Observations: *Tulostoma mohavei* is characterized by the tubular stoma, hyphal exoperidium and asperulate to rugose spores. Other species with similar features, according to Wright (1987), are: *T. amnicola* Long & S. Ahmad, cited from India, *T. brevistipitatum* B. Liu, Z.Y. Li & Du, cited from China, *T. chersonense* Sosin, cited from Ukraine, *T. evanescens* Long & S. Ahmad, cited from India and Argentina, *T. fusipes* Har. & Pat., cited from Africa (Mali), the Middle East (Jordan) and North America (USA), and *T. meristostoma* Long, cited from USA and Argentina. The difficulty to distinguish all these species makes the revision of the type collections necessary, in order to evaluate possible synonymies within the genus. In the meantime, we prefer to use the older epithet for the American material.

Tulostoma mohavei has previously been cited from Catamarca and Mendoza (Wright 1987), thus this is the first record from the province of La Rioja.

Tulostoma obesum Cooke & Ellis, *Grevillea* 6: 82. 1878.

Missapplication: *T. volvulatum sensu* Hollós, *Die Gasteromycetes Ungarns*. 1904.

Material studied: Catamarca, Pomán Department, Campo de Saujil, Bolsón de Pipanaco, on dry soil without vegetation, M.M. Dios, 23-V-2000, AH 19638; ibidem, G. Rodriguez, 3-VI-2000, AH 28460; Capital Department, on dry soil without vegetation, M. Medina, 20-VI-1999, AH 19639 (duplo in herb. M.M. Dios n° 65); *ibidem*, on humus of *Aspidosperma quebracho-blanco* and *Prosopis nigra*, M.M. Dios, 16-XI-1999, AH 19644. La Rioja, Chilecito Department, Sierra de Velasco base (800 m), roadside, under *Sclerophylax sp.*, *Bouteloua barbata* Lag., *Euphorbia sp.*, *Atriplex sp.*, *Trianthema argentina* Hunz. & Cocucci and *Amaranthus sp.*, F. Biurrun, E. Pagliari & R. Gatica, 15-II-2002, AH 28461 (duplo in herb. M.M. Dios n° 66, and IZAC 7027).

Basidiomes 37-95 mm long. Spore sac 12-20 mm diam., globose to subglobose, sometimes dorsiventrally depressed as a result of its fructification in stony areas. Exoperidium slightly membranous to hyphal, usually not very well developed and persisting in the basal half of the spore sac. Endoperidium smooth, whitish to pale brown, papyraceous in mature specimens but very coriaceous when immature. Stoma circular, plane, becoming indefinite and lacerate with age. Gleba dark brown. Stem 30-110 x 3-7(10) mm, whitish to pale brown, cylindric to tortuous, longitudinally striate, and sometimes squamose, ending basally in a volviform structure up to 15 mm diam, some specimens with a well developed mycelial cord.

Spores 4-6 µm diam., globose to subglobose, yellowish, completely smooth both under LM and SEM. Capillitium 4-10 µm diam., thick walled up to 2 µm, with characteristic short lateral branches, and with scarce septa due to their disarticulation.

Observations: *Tulostoma obesum* is a species morphologically very variable, usually robust and large, with plane circular stoma, which easily breaks giving rise to a lacerate tear. The stem is very variable in length and thickness, usually with a well developed volviform structure at the base. The gleba is typically dark chocolate-brown. The spores are subglobose and smooth under SEM. The capillitium is different from other members of this genus, with short branches and with scarce and easily broken septa.

The macroscopic variability and the presence of this species in xeric areas of several continents are the reasons why several authors have described it with different epithets. A study about this problem has been published by Altés *et al.* (1999).

Only two records of this species are known from Argentina, the first from the province Chubut as *Tulostoma volvulatum* var. *elatum* Har. & Pat. (Wright 1987), and the second from the province of Catamarca as *T. volvulatum* I.G. Borshch. (Domínguez de Toledo 1989). The new collections studied here confirm the presence of *T. obesum* in Catamarca, where it seems to be an infrequent species. This is the first record from La Rioja province. The collection AH 28461 is of special interest because it consists of numerous mature basidiomes (14).

Tulostoma pulchellum Sacc., *Bull. Soc. Mycol. France* 5: 118. 1889.

Material studied: Catamarca, Pomán Department, Bolsón de Pipanaco, under *Suaeda divaricata* Moq., G. Rodríguez, 20-X-2000, AH 28480 (slides in herb. M.M. Dios n° 72).

Basidiome 36 mm long. Spore sac 11 mm diam., globose to subglobose. Exoperidium membranous, persisting at the base of the spore sac. Endoperidium smooth, whitish, papyraceous. Stoma fimbriate, mammose. Stem 30 x 3 mm, cylindrical, pale brown, squamose, longitudinally striate. Gleba ferrugineous.

Spores 4-5 µm diam., globose to subglobose, yellowish, verruculose. Under SEM the spore ornamentation appears formed by small verrucae and short crests. Capillitium 5-8 µm diam., thick walled, hyaline, branched and septate.

Observations: *Tulostoma pulchellum* has been previously cited from the province of Tucumán (Wright 1987). Therefore, this is the first record from Catamarca.

Tulostoma striatum G. Cunn., *Proc. Linn. Soc. New South Wales* 50: 255. 1925.

Material studied: Catamarca, Ambato Department, La Puerta, on woody litter of *Schinopsis haenkeana*, *Acacia visco* and *Prosopis nigra*, M.M. Dios, 23-IV-1999, herb. M.M. Dios nº 58, 59; Capayán Department, Concepción, camping area road, in humus of *Croton sarcopetalus* Müll. Arg., M.M. Dios, 7-XI-1999, AH 28465, 28467; Paclín Depatment, Palo Labrado, on humus and woody litter of *Celtis tala* and *Larrea cuneifolia*, J.M. March, 12-XI-1999, herb. M.M. Dios nº 60; Capital Department, Las Heras camp, on humus, M. Perea, 12-VI-2000, herb. M.M. Dios nº 61; Andalgalá Department, Chaquiago, under *Larrea cuneifolia* and Cactaceae, M.M. Dios & J.M. March, 22-IV-2000, AH 19646.

Basidiomes 22-40 mm long. Spore sac 7-11 mm diam, globose to subglobose, sometimes dorsiventrally depressed. Exoperidium typically membranous, whitish inside and covered by particles of substrate outside, persisting in the lower half of the spore sac. Endoperidium smooth, cream-coloured to pale brown. Stoma fibrillose. Gleba ferrugineous. Stem 9-29 x 1-3 mm, rather short and cylindrical, sometimes tortuous, longitudinally striate, with bulbous base, 2-4 mm diam.

Spores 4-7 µm diam., globose to subglobose, notably striate. Under SEM the spore ornamentation consists of irregular arranged crests, with small verrucae among them. Capillitium 3-7 µm diam., hyaline to yellowish, thick walled, branched, slightly broadened at the scarce coloured septa.

Observations: *Tulostoma striatum* has been cited from several Argentinian provinces: Entre Ríos, Jujuy, Mendoza, Salta and Santa Cruz (Wright 1949, 1987). The studied material represents the first record from Catamarca. This is a widely distributed species in America (Wright 1987), recently cited in Cuba by Moreno *et al.* (2001).

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Proposed list of extinct, rare and/or endangered macrolichens in Wisconsin

JAMES P. BENNETT

jpbennet@wisc.edu
U. S. Geological Survey and Institute for Environmental Studies
University of Wisconsin, 504 Walnut St.
Madison, WI 53726 USA

CLIFFORD M. WETMORE

wetmore@umn.edu
Department of Plant Biology
University of Minnesota, 1445 Gortner Ave.
St. Paul, MN 55108 USA

Abstract—We propose that 41 species of macrolichens be listed for rare status in Wisconsin, along with 6 other species we think are now extinct in the state. Almost 60% of the species occur in the northern part of the state. Some of the extinct species occurred in the southern part. The rare and extinct species exist(ed) in 43% of the counties. None of the rare and extinct species are endemic to Wisconsin, and they represent 7% of the total lichen flora of the state. One species was last collected in 1884, but others were collected only recently. Forty-seven percent of the listed species are ranked critically imperiled (S1).

Key words—state ranks, disjunct, distribution, Midwestern states

INTRODUCTION

Wisconsin, the center state of three upper Midwestern United States, has an area comparable to Michigan, but less than Minnesota, and a population density less than midway between the other two states (Table 1). Recently, the lichen flora of the state was published as a result of John W. Thomson's lifetime collecting in the state (Thomson 2003). The total numbers of lichen genera and species are less than the numbers for the neighboring states (Table 1; Fryday et al. 2001; Fryday 2002; Wetmore, unpublished data). The lower number of species for Wisconsin is probably a result of differing collecting intensities rather than biological realities.

Table 1. Numbers of lichen genera, species, and areas and population densities (2000 U. S. Census data) of three upper Midwestern states, in east to west order.

State	Genera	Species	Area (km^2)	Population density (persons/km^2)
Michigan	187	792	147,136	67.6
Wisconsin	164*	662*	140,672	38.1
Minnesota	205	780	206,207	23.9

Includes 16 new genera and 47 new species from the 2002 Tuckerman Workshop (Appendix, Thomson, 2003)

An earlier, unpublished list of rare lichens of Wisconsin listed 290 species (Thomson & Will-Wolf 2000). This list was considered too large and was difficult to use because of identification uncertainties and cross-listings. Both Michigan and Minnesota have lists of rare and endangered macrolichen species: Michigan has an unofficial list with 34 species (Fryday & Wetmore 2002), and Minnesota has an approved list with 17 (including Special Concern species: *www.dnr.state.mn.us/ets/lichens.html*). These numbers vary because the Minnesota list is an official state government list which must be shorter for practical reasons, while the Michigan list is an unofficial list of proposed species. The publication of *Lichens of Wisconsin* facilitated the assembly of a list of rare and endangered lichens for Wisconsin. This paper reports on 41 such species, and an additional 6 species believed to occur no longer in the state.

METHODS

Our approach was similar to Fryday & Wetmore's (2002) in that only macrolichens were considered. Microlichens such as crustose, lichenocolous fungi, and stubble (calicioid) lichens were excluded because they are under-collected by most lichenologists and are often impossible to identify in the field. The authors are aware of several rare crustose species in the state but do not feel confident to report them here until more field work is undertaken.

Specimens at WIS, MIL, MIN, MSC, and F were examined to verify identifications, and label data were compiled. Synonyms were also checked. In addition, the collections on Thomson's dot maps (2003) were tallied along with those from the number of specimens from the other herbaria. Some specimen label data were compared to determine if there was any overlap between specimens. A final total number of specimens was tallied and used for determining state element ranks using the *Wisconsin Natural Heritage Working List* guidelines. The proposed rankings for the species in this paper are listed below and are also available on the web at www.dnr.state.wi.us/org/land/er/working_list/taxalists/key.htm.

SX = Apparently extirpated from the state.

SH = Of historical occurrence in Wisconsin, perhaps having not been verified in the past 20 years, and suspected to be still extant.

S1 = Critically imperiled in Wisconsin because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.

S2 = Imperiled in Wisconsin because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.

The distinction between SH and SX on the basis of being collected in the past 20 years or not is not very useful for lichens because there are not that many collectors working in the state and a species could go uncollected for that long very easily. Nevertheless we adhered as much as possible to the state guideline in order for the list to be useful to the state.

For each species, the year of the last collection, the North American distribution based on Brodo et al. (2001) and Thomson (2003), the distribution in Wisconsin (northern (N), central (C), southern (S) or scattered), and the occurrence in Wisconsin in relation to the distribution outside of Wisconsin was tabulated. Most of our nomenclature is based either on Thomson (2003) or Esslinger (1997).

RESULTS

Table 2 lists 41 macrolichen species that we consider rare and 6 thought to be extinct in Wisconsin. Of the 47 total species, 47% are foliose, 45% are fruticose, and the remaining 9% are squamulose.

Table 2. Rare and extinct macrolichens of Wisconsin[*]

Species	Total number of collections	Last collected	Growth form	North American distribution	WI occurrence	WI distribution	Proposed state rank
Ahtiana aurescens (Tuck.) Thell & Randlane	3	1972	Foliose	NE US	Edge of range	N	SH
Anaptychia setifera Räsänen	5	1996	Foliose	NE US	Edge of range	N	S1
Anzia colpodes (Ach.) Stizenb.	3	1945	Foliose	E US	Edge of range	N	SH
Bryoria capillaris (Ach.) Brodo & D. Hawksw.	2	1987	Fruticose	E & W only	Edge of range	N	S1
Bryoria nadvornikiana (Gyelnik) Brodo & D. Hawksw.	3	2001	Fruticose	E Canada	Edge of range	N	S1
Cetraria arenaria Karnefelt	8	1979	Foliose	E US	In range	Scattered	SH
Cladonia arbuscula (Wallr.) Flotow.	4	1980	Fruticose	NE US	In range	N	SH
Cladonia cornuta (L.) Hoffm.	6	2001	Fruticose	Arctic/ boreal	Edge of range	N	S2
Cladonia decorticata (Flörke) Sprengel	6	1988	Fruticose	Arctic/ boreal	Edge of range	N	S1
Cladonia incrassata Flörke	4	1987	Fruticose	NE US	In range	C & N	S1
Cladonia stygia (Fr.) Ruoss	3	1987	Fruticose	Arctic/ boreal	Edge of range	N	S1
Cladonia sulphurina (Michaux) Fr.	1	1987	Fruticose	E & W only	Edge of range	N	S1
Collema polycarpon Hoffm.	4	1978	Foliose	W US	Edge of range	C & N	SH
Dirinaria frostii (Tuck.) Hale & Culb.	3	1957	Foliose	E US	Edge of range	S central	SH
Evernia prunastri (L.) Ach.	1	1983	Fruticose	E & W only	Disjunct	NE	SH
Fuscopannaria leucophaea (Vahl) P. M. Jørg.	3	1965	Squamulose	E & W only	In range	N	SH
Fuscopannaria leucosticta (Tuck.) P. M. Jørg.	1	1990	Squamulose	SE US	Edge of range	N	S1
Heppia lutosa (Ach.) Nyl.	3	1965 2003	Squamulose	US	In range	S central	S2
Hypogymnia tubulosa (Schaerer) Hav.	4	1987	Foliose	E & W only	Edge of range	N	S1
Leptogium arsenei Sierk	4	1990	Foliose	W US	Disjunct	N	S1
Leptogium teretiusculum (Wallr.) Arnold	2	1992	Foliose	E & W only	Disjunct	N	S1
Menegazzia terebrata (Hoffm.) A. Massal.	4	2002	Foliose	E & W only	Edge of range	N	S1
Nephroma bellum (Sprengel) Tuck.	5	1988	Foliose	E & W only	Edge of range	N	S1
Parmotrema chinense (Osbeck) Hale & Ahti	4	1964	Foliose	MW & W US	Edge of range	C & N	SH
Parmotrema stuppeum (Taylor) Hale	2	1964	Foliose	MW & W US	Disjunct	C & N	SH
Peltigera scabrosa Th. Fr.	1	1987	Foliose	Arctic/ boreal	Edge of range	N	S1

Species	Total number of collections	Last collected	Growth form	North American distribution	WI occurrence	WI distribution	Proposed state rank
Peltigera venosa (L.) Hoffm.	1	1944	Foliose	E & W only	Edge of range	N	SH
Physcia tenella (Scop.) DC.	3	1994	Foliose	E & W only	Disjunct	N	S1
Physciella melanchra (Hue) Essl.	5	1990	Foliose	E US	In range	central	S2
Protopannaria pezizoides (Weber) P. M. Jørg.	4	1974	Squamulose	Arctic/ boreal	Edge of range	S central	SH
Pseudevernia consocians (Vainio) Hale & Culb.	3	1987	Fruticose	E US	Edge of range	N	S1
Pseudocyphellaria crocata (L.) Vainio	4	2002	Foliose	E & W only	Edge of range	N	S1
Ramalina farinacea (L.) Ach.	1	1967	Fruticose	E & W only	Disjunct	central	S1
Ramalina pollinaria (Westr.) Ach.	1	1971	Fruticose	E & W only	Disjunct	NE	SH
Ramalina unifolia J. W. Thomson	4	1990	Fruticose	Central US	Edge of range	N	S1
Solorina saccata (L.) Ach.	5	1965	Foliose	E & W only	In range	C & N	SH
Sticta beauvoisii Delise	6	2002	Foliose	E & W only	Disjunct	C & N	S1
Teloschistes chrysophthalmus (L.) Th. Fr.	3	1893 1999	Fruticose	E US	Edge of range	S central	SH
Usnea ceratina Ach.	18	1992	Fruticose	E & W only	In range	N	S2
Usnea trichodea Ach.	8	1971	Fruticose	E US	Disjunct	N	S2
Extinct							
Cladonia acuminata (Ach.) Norrlin	1	1935	Fruticose	Arctic/ boreal	Edge of range	S central	SX
Ephebe lanata (L.) Vainio	2	1939	Fruticose	E US	In range	C & N	SX
Parmotrema perforatum (Jacq.) A. Massal.	1	1884	Foliose	SE US	Disjunct	S	SX
Usnea angulata Ach.	8	1927	Fruticose	US	In range	central	SX
Usnea longissima Ach.	3	1896	Fruticose	E & W only	Edge of range	N	SX
Usnea rubicunda Stirton	10	1945	Fruticose	E & W only	Disjunct	central	SX

*The number of collections column contains the total number of collections known in the herbaria studied. The occurrence of the species within Wisconsin in relation to the North American distribution is listed in the "WI occurrence" column, followed by the distribution within Wisconsin and the proposed state rank.

Their distribution in Wisconsin ranges across the state (Table 3) although over half occur in the northern part. Over half (55%) of the listed species are at the edges of their ranges in Wisconsin, and under one half are either disjuncts or well within their known ranges (21-23% each). None of the species appear to be endemic to the state.

Table 3. Distribution of rare and extinct macrolichens within Wisconsin

Region of Wisconsin	Percent
North	57
Central and northern	15
South central	11
Central	9
Northeast	4
South	2
Scattered	2

Two fifths of the species occur nationally either in the eastern or western United States, followed by another 17% from the eastern U. S. only (Table 4). The arctic boreal elements are only 15% of the list. The remaining 29% occur normally from seven other regions of the country.

Table 4. North American distribution of rare Wisconsin lichens

North American Distribution	Percent
East and west only	38
Eastern United States	17
Arctic/boreal	15
Northeastern United States	9
Midwestern and Western United States	4
Southeastern United States	4
United States	4
Western United States	4
Central United States	2
Eastern Canada	2

Almost half (47%) of the 47 species are considered Critically Imperiled (S1) in the state, and almost one third are considered historical occurrences (SH) (Fig. 1). Thirteen percent are thought to be extinct (SX) and the remaining 9% are imperiled.

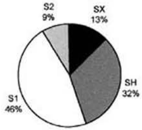

Figure 1. Distribution of state element rankings of 47 rare and extinct Wisconsin macrolichens

One species, *Parmotrema perforatum*, was last collected in 1884, while several species were last collected as recently as 2002 during the Tuckerman Workshop (Thomson 2003).

The 47 extinct and rare Wisconsin macrolichens have been found in 31 of Wisconsin's 72 counties (Fig. 2). Of the 114 species x county occurrences for these species in herbaria, the top 50 (44%) occur in northern counties, with Bayfield having the most. This is primarily due to the high degree of collecting at Apostle Islands National Lakeshore (Wetmore 1988; Wetmore and Bennett 2002). It is also evident that many of the extinct species were found in counties at the southern, central and northwestern parts of the state.

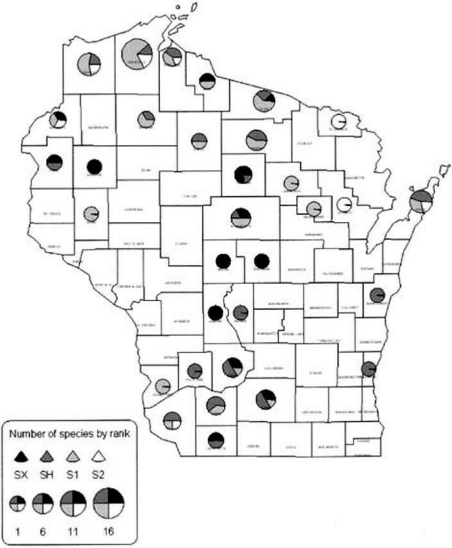

Figure 2. Number of extinct, rare and endangered lichen species by county

DISCUSSION

Our list for Wisconsin contains seven more species than cited on the Michigan list (Fryday & Wetmore 2002). Seven species are on both lists: *Anzia colpodes, Collema polycarpon, Peltigera scabrosa, Peltigera venosa, Pseudocyphellaria crocata, Ramalina farinacea,* and *Sticta beauvoisii.* Both *Peltigera venosa* and *Pseudocyphellaria crocata* are also on the Minnesota list, as are *Ahtiana aurescens* and *Anaptychia setifera.* This leaves 38 species that are uniquely rare or extinct in Wisconsin and not in the other two states.

The most recent herbarium specimen of one species, *Teloschistes chrysophthalmus,* was collected in 1893. We are aware of a recent collection in Dane County in 1999, but it has not been deposited in a herbarium nor published. The specimen was a very tiny piece (~2 mm), and no other specimens could be found. For these reasons we propose it be given an SH rank instead of extinct, in the hope that it can be located again. Collectors are advised that the species on our proposed list should not be collected but rather be photographed and recorded as sight records so as not to eliminate them.

We are including *Usnea ceratina* even though there are 18 specimens in herbaria because Thomson (2003) states it is very rare in the state. We are proposing that *Usnea rubicunda* be ranked extinct even though Thomson (2003) thought it might still occur in the state. The first author has searched for this species where it was last found and has not been able to find it again.

Three species on the proposed list are also thought to be endangered in Canada: *Fuscopannaria leucosticta, Usnea ceratina,* and *U. rubicunda* (Goward et al. 1998). The usneas are also found in the western U. S., but the *Fuscopannaria* is limited to the eastern U. S.

The authors discovered and collected *Heppia lutosa* in October, 2003 at Sugar Creek State Natural Area, Crawford County, a species that was last collected almost 40 years earlier. This information is not available in Thomson (2003). This species is very small and grows in shady limestone crevices and is easily over-looked. It may occur in other obscure limestone localities in the southern part of the state. Although Brodo et al. (2001) state that this species is very rare and the common species is *H. conchiloba,* we are following Thomson (2003), who synonymized the two species. Our specimens are olive-brown in color, pruinose, and have cortices, which are more consistent with the *H. conchiloba* morphotype. However, no specimens of the genus from the MIN or WIS herbaria were studied by Henssen in her revision of the genus (1994), clouding the picture of this species in Wisconsin. Until this is cleared up in the future this species might be better referred to as *H. lutosa sensu lato*.

The rare lichens of Michigan have their centers of distribution in North America in three areas: northern, eastern, and Appalachian/Great Lakes (Fryday & Wetmore 2002). Wisconsin rare lichens originate from these same areas, but in addition, there are species from the western and southern U. S., probably due to the location of the state being more central than Michigan. This probably explains the small amount of overlap between the two lists. The distributions centers of the rare lichens of Minnesota are comparable to those for Wisconsin.

There are 18 records of extinct species, some from the southern end of the state. All but one of the extinct species occurred in the central or southern parts of the state, implying that extinction of rare species in the central and southern parts is a definite fact. Conversely, over 80% of the records of imperiled or historical records of rare species are from the northern part of the state, suggesting that there is the potential for more extinction to occur there than in the south. However, this observation may be somewhat confounded by the high probability that collecting intensity has been higher in the northern part of the state compared to the southern part. Even though the southern part is more developed, collecting should still continue in some areas. The northern part is more at risk at this time from logging and development impacts. Among the three states, only Minnesota grants legal protection to lichens in the form of a state approved list. Michigan and Wisconsin do not yet have official lists.

The geographic distribution of these 47 species in Fig. 2 may be influenced by several factors. First, some of the northern, central and southwestern areas may show occurrences because of the collecting activities of Hale, Culberson, Thomson and others. Not all parts of the state have been equally sampled. Second, some of the pattern may follow the Wisconsin River valley because there are more natural area remnants along that feature. Much of the rest of the state is in agriculture or forestry.

The number of endangered lichen species represent 4, 7 and 2% of the total number of lichen species in Michigan, Wisconsin and Minnesota, respectively. These percentages would be double if just the macrolichens were used in the calculations, based on the assumption that macrolichens are usually about half of the total number of species. These percentages are all comparable, and even though the species themselves are different in each state (small amount of overlap), it suggests that rarity in these states is less than 10% of the total floras. This compares favorably with 3% for British Columbia (Goward 1996), 9% for Maine (Hinds & Hinds 1998; based on half of the 18% they give for the macrolichens alone in their Table 1). The slightly higher rarity factor for Wisconsin may be an artifact resulting from the generally higher collecting activities in the other two states.

Wisconsin probably has other potentially rare, endangered and/or extinct macrolichen species. Several others have been suggested but our investigations of these have not led to a high degree of certainty about their status. Obviously more work is needed on more species to increase our knowledge. The species proposed in this study should be regarded as the minimum for listing and protection.

ACKNOWLEDGEMENTS

We dedicate this paper to John W. Thomson, whose work made this report possible.

We are grateful to Alan Fryday, Michigan State University, and Robert Lücking, Chicago Field Museum, who both provided data on Wisconsin collections at MSC and F, respectively. Kevin Lyman, Milwaukee Public Museum, allowed us to examine numerous collections at MIL. We also thank Philippe Clerc, Switzerland, who checked the identities of *Usneas* on loan from WIS. Craig Anderson, Wisconsin Department of Natural Resources, Bureau of Endangered Resources, provided the impetus to complete this work, as well as checking some specimen data. Helpful comments on the first version of this paper were provided by John Thomson, Irwin Brodo and Alan Fryday. Funding support from the Wisconsin Academy of Sciences, Arts and Letters to the first author for field work associated with this project is gratefully acknowledged.

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MYCOTAXON

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Biogeography and hosts of poroid wood decay fungi in North Carolina: species of *Phellinus* and *Schizopora*

L.F. GRAND & C.S. VERNIA

larry_grand@ncsu.edu
Department of Plant Pathology, North Carolina State University
Raleigh, North Carolina 27695-7616 USA

Abstract—Distribution and host plants in North Carolina are given for 21 species of *Phellinus* and three species of *Schizopora*. A county distribution map is provided for each species. *Phellinus johnsonianus*, *P. linteus* and *P. melleoporus* and *Schizopora flavipora* are reported for the first time in North Carolina. Numerous new fungus-host plant associations are reported. Species checklists and figures can be accessed at: http://www.cals.ncsu.edu/plantpath/Personnel/Faculty/Grand/mycotaxon_1.pdf

Keywords—fungus distribution, polypores

Introduction

The importance of fungal biodiversity in ecosystems is well-documented (Lodge 1996, Molina et al. 2001, Rossman & Farr 1997). Recent studies have emphasized fungal biodiversity in unique ecosystems and within unique geographical areas (Esqueda et al. 2003, Gilbertoni & Calvacanti 2003, Keller & Skrabal 2002, Mueller & Mata 2001, Riccardi & Bashore 2003, Rossman et al. 1998). Such studies provide a basic foundation of data that can aid future researchers in knowing what species of fungi are present as well as their distribution within defined areas.

The diversity of ecosystems in North Carolina is reflected by its diversity of flora (Kartesz 1999, Pittillo et al. 1998, Radford et al. 1968). The diversity of woody plant species allows for an equally diverse and large number of poroid wood-decay fungi.

Previous studies (Grand & Vernia 2002, Grand & Vernia 2003, Jung 1987, Vernia & Grand 2000) have reported species of fungi, chiefly poroid wood decay species, from a variety of sites in North Carolina. These studies (Grand & Vernia 2002, Vernià & Grand 2000) addressed new geographical occurrences and new host-plant combinations in North Carolina and the United States and emphasized the need for providing host and distributional data for this important group of fungi. Distributions of *Phellinus* and *Schizopora* in the Southeast by state were reported by Farr et al. 1989, Grand et al. 1976, Gilbertson & Ryvarden 1987, Larsen & Cobb-Poulle 1990, Lowe 1966, Lowe & Gilbertson 1961, and Overholts 1953.

This is the first of a series of papers that provides data on species, host plants and distribution of poroid wood decay fungi in North Carolina.

Materials and Methods

Intensive collecting was done in North Carolina over the past six years (1997-2003). Additional collections in the Mycological Herbarium, Department of Plant Pathology, North Carolina State University (NCU) were examined and records of the Plant Disease and Insect Clinic, Department of Plant Pathology, NCSU were utilized in the results. Previous studies (Grand et al. 1975, Jung 1987) that contained information on specific county locations of poroid wood-decay species were used in developing the distribution maps. Likewise, data from the BPI website (Farr et al. n.d.) provided some county data.

Collections were made of all uncommon species of *Phellinus* and *Schizopora,* unusual forms of these species and species occurring on new or unusual hosts. Specimens were placed in paper bags in the field usually with a sample of decayed wood and appropriate field notes. Specimens were examined in the laboratory and identified using existing taxonomic treatments (Breitenbach & Kraenzlin 1986, Gilbertson & Ryvarden 1986, 1987, Jung 1987, Larsen & Cobb-Poulle 1990, Lowe 1966, Lowe & Gilbertson 1961, Overholts 1953). Collections of *Schizopora apacheriensis* (Gilb. & Canf.) Gilb. & Ryvarden and *S. flavipora* (Cooke) Ryvarden were compared to type specimens (BPI #0237818 and #0239985). Nomenclature and authorities are from Gilbertson & Ryvarden (1986, 1987) and Kirk & Ansell (1992) for the fungi and Kartesz & Kartesz (1980) for the host plant species.

The majority of collection sites were in state parks, game lands and natural areas, Nantahala, Pisgah, Croatan and Uwharrie National Forests, the Blue Ridge Parkway and the Great Smoky Mountains National Park. Counties collected in are shown in Fig. 1. A county distribution map is provided for each species (Figs. 2-25).

Results and Discussion

Twenty-one species of *Phellinus* were found on 56 host species. *Phellinus gilvus* (Schwein.:Fr.) Pat. is the most wide-spread species with *P. gilvus* and *P. contiguus* (Fr.) Pat. reported on the greatest number of host species. *Phellinus johnsonianus* (Murrill) Ryvarden, *P. linteus* (Berk. & M.A. Curtis) Teng and *P. melleoporus* (Murrill) Ryvarden are reported for the first time in North Carolina. All three of these species were previously reported from the Gulf Coast region with *P. johnsonianus* ranging into northeastern United States through the Mississippi River Valley.

All three species of *Schizopora* reported in the United States (Gilbertson & Ryvarden 1987) were found on 41 host species. *Schizopora paradoxa* (Fr.) Donk was the most widespread and most frequently encountered species of *Schizopora*. *Schizopora flavipora* is reported for the first time in North Carolina. *Schizopora apacheriensis* is reported on 20 host species which represents a substantial increase from the 11 hosts reported by Farr *et al.* (1989). *Schizopora apacheriensis* was only recently reported in North Carolina for the first time on *Carpinus caroliniana* Walt. (Grand & Vernia 2002). This study substantially increases the geographic and host species ranges of *S. apacheriensis.* Gilbertson & Ryvarden (1987) indicated this species occurs in Arizona and the Gulf Coast region and contend that it has often been confused with *S. paradoxa.* Likewise, the relatively widespread occurrence of *S. flavipora* in North Carolina (Fig. 24) substantiates the statement by Gilbertson & Ryvarden (1987) that *S. flavipora* also is often confused with *S. paradoxa* and that the geographical range of *S. flavipora* is unclear.

Checklists for the species and maps of the species distributions within North Carolina can be found at:

http://www.cals.ncsu.edu/plantpath/Personnel/Faculty/Grand/mycotaxon_1.pdf

Acknowledgements

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MYCOTAXON

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First record of *Scytinopogon* from Mexico, with notes on its systematics

RICARDO GARCÍA-SANDOVAL, JOAQUÍN CIFUENTES,
MARGARITA VILLEGAS

garcia_s@ciencias.unam.mx
Herbario FCME, UNAM
Apto. Postal 70-399, C.P. 04510
Cd. Universitaria, México D.F., México

Abstract—The first report of *Scytinopogon* from Mexico is presented. Descriptions of Mexican material of *S. pallescens* and *S. robustus* are included, and the nomenclature of the described species is discussed along with the systematic and phylogenetic affinities of the genus.

Keywords—Aphyllophorales, taxonomy, tropical mycobiota, clavarioids

Introduction

Scytinopogon Singer is a genus of no more than eight described species with a fundamentally tropical distribution. It was segregated from *Lachnocladium* by Singer (1945) based on the presence of sub–fleshy basidiomata, and verrucose–echinulate, sub–angulate yellow spores. The genus is distinguished from other similar genera such as *Pterula* by the consistency of its basidiomata and the color of its spores. Singer (1945) designated *Pterula pallescens* Bres. [≡ *Lachnocladium pallescens* (Bres.) Bres.] as the type species. The etymology of the name *Scytinopogon* refers to its macromorphological resemblance to leather barbs (Donk 1954).

The genus *Scytinopogon* has been included in the past in several families — Clavariaceae (Corner 1970), Thelephoraceae (Donk 1964), Gomphaceae (Maas Geesteranus 1963) and Scytinopogaceae (Jülich 1981) — and has been linked to a variety of genera — *Cristella, Trechispora* (Jülich 1981, Larsson 1992), *Hydnodon* (Corner 1970, Maas Geesteranus 1963, Reid 1971), *Bankera* (Corner 1970, Maas Geesteranus 1963, Reid 1971), *Phellodon* (Corner 1970), *Polyozellus* (Corner 1950), *Thelephora* (Corner 1950, Donk 1964), *Ramariopsis* and *Clavulinopsis* (Corner 1970).

In the Americas *Scytinopogon* has been reported from Bolivia, Brazil, Panama, Puerto Rico, the United States, Uruguay, and Venezuela (Corner 1950, 1970; Petersen 1988a; Reid 1965; Singer 1945), as well as in Asia, Africa Australia, and New Zealand (Corner 1970, Petersen 1988b).

There are few reports of clavarioid Aphyllophorales in Mexico (see García-Sandoval et al. 2002, Villareal & Pérez-Moreno 1991), or these fungi are occasionally found in general species lists (García-Romero et al. 1970, Varela & Cifuentes 1979). The objective of this study is to present the first report of *Scytinopogon* Singer in Mexico and discuss the systematics of this genus.

Methods

A revision was made of the mycological collections of the following herbaria: Facultad de Ciencias, UNAM (FCME), Escuela Nacional de Ciencias Biológicas del Intituto Politécnico Nacional (ENCB), Herbario Nacional de México, Instituto de Biologia, UNAM (MEXU), and Universidad Autónoma de Tlaxcala (TLMX). Taxonomic determination of the material was corroborated using the monographic works of Corner (1950, 1970) and Petersen (1988b) as well as additional selected descriptions (Coker 1923; Petersen 1984, 1988a). Microscopic observations were realized using standard mycological techniques (Cifuentes et al. 1986, Largent et al. 1980). Herbaria acronyms were assigned following Holmgren & Holmgren (1995) and Holmgren et al. (1990).

Taxonomic Descriptions

Scytinopogon pallescens (Bres.) Singer. 1945. Lloydia 8: 139.
≡ *Pterula pallescens* Bres. 1899. Bull. Soc. R. Bot. Belg. 38: 157.
≡ *Lachnocladium pallescens* (Bres.) Bres. 1915. Hedwigia 56: 304.
= *Thelephora dewevrei* Bres. 1899. Bull. Soc. R. Bot. Belg. 38: 156.
= *Thelephora serrei* Pat. & Har. 1906. Bull. Soc. Mycol. Fr. 22: 116.
= *Thelephora lactea* Pat. 1923. Bull. Soc. Mycol. Fr. 39: 47.
= *Clavaria durbana* Vand der Byl. 1932. S. Afr. J. Sci. 29: 322.

Plate 1: Figs. **a**, and **b**

Basidiome: size up to 140 mm in length, very branched, white to cream, generally branched from the base, then the stipe poorly differentiated, smooth to subtomentose in this area. **Branches:** dichotomous or polytomous, flattened, glabrous; internodes irregular in length but diminishing gradually towards the apex; rounded axils; apex subcristate to flattened-palmate.

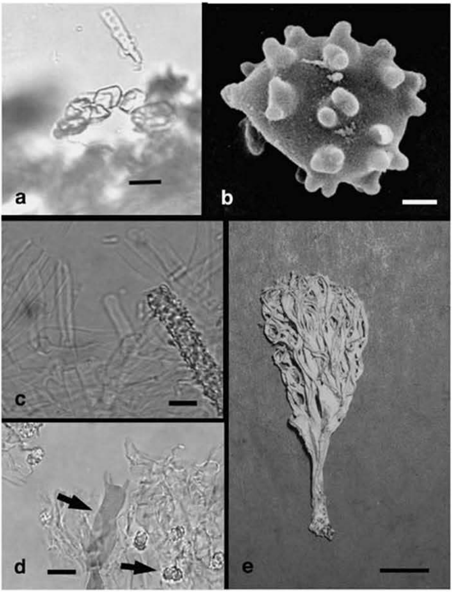

Plate 1. a) Irregularly-shaped crystals in the mycelial hyphae at the base of the stipe of *Scytinopogon pallescens;* **b)** Scanning electron micrograph of the spores of *S. pallescens* showing characteristic ornamentation and shape; **c)** Hyphae with irregularly-shaped crystals in the mycelial hyphae at the base of the stipe in *Scytinopogon robustus;* **d)** Basidia and basidiospore of *S. robustus;* **e)** Dried basidiome of *S. robustus.* Scale bars: a = 10 µm; b-c = 1 µm; d = 5 µm; e = 1 cm. Photographs a, c-e: R. García–Sandoval; b M. Villegas.

Mycelium: at the base of the stipe whitish. **Context:** coriaceous–fibrous to coriaceous, whitish. **Taste and odor:** not clearly distinguishable. **Context:** monomitic, with thin-walled hyaline generative hyphae 1.4 to 3.5μm wide, scarcely clamped **Mycelial hyphae:** at the base of the stipe have thick and irregularly–shaped crystals (Figure a), rare inflated–like septa. **Hymenium:** thickening. **Basidia:** subcylindrical to clavate, bisporic to tetrasporic, the majority tetrasporic. **Basidiospores:** hyaline, 4.2–5.6 x 2.8–4.2μm, subglobose to broadly ellipsoid, with nodular–echinulate ornamentation, then with an angular–cuspidate to irregular elliptical appearance under light microscopy (LM), positive reaction to cotton blue (cyanophilous); hilar appendix not clearly evident, conical; under scanning electron microscopy basidiospores were observed from elliptical to subangulate, with tuberculate–nodulate ornamentation, generally grouped in pairs (Figure b); hilar appendix rounded with an acuminate base.

Habitat: terrestrial, gregarious. In Mexico this taxon has only been collected from secondary vegetation (Acahual) at an altitude of 15 masl.

> SPECIMEN EXAMINED. MEXICO. OAXACA: **Mpio. Chiltepec**, Tuxtepec. 12.X.1967 *Martinez–C.* (ENCB)

COMMENTS. The pattern of basidiospore ornamentation exhibited by this species seems to correspond to the ornamentation of paired spines reported by Petersen (1988a) in *Scytinopogon dealbatus* (Rick) Corner. During the examination of the Mexican specimen, it was possible to observe a structure similar to inflated septa in the mycelium at the base of the stipe; these septa have been reported for the genus *Trechispora*, and is the basis for a postulated relationship between the two genera (Jülich 1981, Larsson 1992). These septa were not observed in the mycelial cords due to the poorly preserved state of the Mexican specimen, and its presence was only corroborated in the mycelia at the base of the stipe.

This species was considered by Corner (1950) as a synonym of *Clavaria angulispora* Pat. [≡ *Scytinopogon angulisporus* (Pat.) Corner]. Because the name *C. angulispora* is older, it has priority over the name *Pterula pallescens* Bres. — in consequence, *Scytinopogon* Singer should be typified by *Clavaria angulispora* instead of *P. pallescens* as originally proposed. However, Petersen (1988b) had revised the type of *Clavaria angulispora*, and concluded that it belongs to the genus *Clavulina* (tentatively *Clavulina connata* Corner), thus removing this taxon from *Scytinopogon* and leaving the genus with the type originally assigned by Singer (1945). Three varieties of *Scytinopogon angulisporus* were described by Corner (1950): *S. angulisporus* var. *curtus* Corner, *S. angulisporus* var. *parvus* Corner, and *S.*

angulisporus var. *gracilis* Corner. Currently, the types of these varieties have not yet been re-examined to corroborate their generic status. Additionally, a number of specimens have been reported as *Clavaria angulispora* (for example Coker 1923) in the literature, but according with description and photographs seem to correspond to *Scytinopogon*. The status of these specimens deserve to be addressed.

Scytinopogon robustus (Rick) Corner. 1970. Beih. Nova Hedwigia 33: 91.
≡*Clavaria robusta* Rick. 1931. Egatea 16: 120.

Plate 1: Figs. **c-d**

Basidiome: up to 50 mm in length in dried material, very branched, completely white when fresh to cream colored in herbarium material; mycelial cords white and delicate at the base. **Stipe:** differentiated, 15–25 x 3–5 mm, flat, smooth to subtomentose. **Branches:** dichotomous or polytomous, flattened, glabrous to subtomentose towards the internal parts; internodes irregular in length though diminishing gradually towards the apex; axils subacute; apex subcristate to flattened–palmate. **Context:** coriaceous–fibrous to coriaceous, whitish. **Taste and odour:** not clearly distinguishable. **Mycelium:** forming monomitic mycelial cords, with uninflated and abundant simple clamp connections. Mycelial hyphae at the base of the stipe of two types: with swollen walls with small, elongated crystals, or naked with only slightly swollen walls (Figure c). **Context:** of the stipe and branches monomitic, with hyaline thin-walled generative hyphae, scarcely clamped, inflated 2.8–19.6 µm wide, slightly dextrinoid. **Hymenium:** slightly thickening. Basidia subcylindrical to clavate, bisporic or tetrasporic, the majority tetrasporic. **Basidiospores:** hyaline, 4.2–5.6 x 2.8–4.2 µm, seen under light microscopy (LM) to have angular–cuspidate to irregular elliptical appearance; nodular echinulate ornamentation; positive reaction to cotton blue (cyanophilous); hilar appendix poorly evident, conical (Figure d).

Habitat: humicolous, gregarious. In Mexico only collected in deciduous forest at an altitude of 1500 masl.

SPECIMEN EXAMINED. **MEXICO. HIDALGO: Mpio. Molango**, Laguna de Atezca. 9.VII.1980 *Cifuentes J. 676* (FCME 1201).

COMMENTS. Of the currently recognized species, only this species and *Scytinopogon echinosporus* (Berk. & Broome) Corner have inflated hyphae and spores larger than 5 µm. Even so, the latter species presents basidiomata with apex light brown and smaller spores (4.5–5.5 x 3.5 µm). This species seems to be well delimited and the combination of diagnostic characters distinguishes it from another species leaves no doubt about its generic affinities.

Comments and Conclusions

This study constitutes the first report of *Scytinopogon* in Mexico. The distribution of the genus in the Americas seems to be limited to tropical zones or localities with warm climates, with its northern limit in the southeastern United States.

The number of species in this genus is still uncertain. The proposed names include *Scytinopogon dealbatus*, *S. echinosporus*, *S. robustus*, *S. pallescens*, *S. chartaceum* (Pat.) R.H. Petersen, *S. papillosus* Corner, and *S. scaber* (Berk. & M.A. Curtis) D.A. Reid, but several of these names have been proposed as synonyms and a complete monographic treatment of the genus is still necessary.

The phylogenetic affinities of *Scytinopogon* are ambiguous. The phylogeny of the clavarioid Aphyllophorales should be contextualized within the efforts to elucidate the phylogeny of the Homobasidiomycetes (Binder & Hibbett 2002, Hibbett & Thorn 2001, Pine et al. 1999) due to the polyphyletic nature of the group. In the absence of formal phylogenetic studies for *Scytinopogon,* only a few preliminary hypotheses can be offered. A phylogenetic analysis of *Ramariopsis* (Garcia-Sandoval, unpublished data) included four species of this genus and seems to confirm the close relationship between *Scytinopogon* and *Ramariopsis* as proposed by Corner (1970). This is at least partially sustained by the positive cyanophilous reaction of the spores, a character shared by the family Gomphaceae (Villegas et al. 1999); this conclusion cannot be seen as definitive given that the principal objective of the above work was not elucidate the affinities of *Scytinopogon*. Other important hypotheses include the proposed relationship with *Hydnodon* (Corner 1970, Maas Geesteranus 1963, Reid 1971) based on the presence of crystals in the hyphal mycelia at the base of the stalk, the form of the ornamentation of the spores (see figure a-c) and the positive cyanophilous reaction of the spores. The relationship with *Trechispora* (Jülich 1981, Larsson 1992) is supported by the positive cyanophilous reaction of the spores, the form of the spores, and the presence of inflated septa. Among these characters, the positive cyanophilous reaction of the spores has been of phylogenetic use in other groups of the Aphyllophorales (Villegas et al. 1999), but its utility in this case remains to be evaluated.

The evaluation of the affinities of *Scytinopogon* necessarily requires that the majority of the hypotheses previously postulated be taken into account in the context of the phylogeny of the Homobasidiomycetes.

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New species of *Asterina* in HMAS, China

BIN SONG* & TAI-HUI LI

binsong@gdas.ac.cn
Guangdong Provincial Key Laboratory of Microbial Culture
Collection & Application, Guangdong Institute of Microbiology
Xianlie Road Central, Guangzhou 510 070, China

Abstract—*Asterina champereiicola* parasitic on *Champereia manillana*, *A. hainanensis* parasitic on *Microdesmis casearifolia*, *A. malloti-apelti* parasitic on *Mallotus apelta*, and *A. sawadai* parasitic on *Capparis kikuchii* are described and illustrated as new species.

Key words—*Asterinaceae, Capparaceae, Euphorbiaceae, Opiliaceae, Pandaceae*

Introduction

A recent critical restudy of specimens deposited in the Herbarium Mycologicum Instituti Microbiologici, Academiae Siniae (HMAS), China shows that at least four separate taxa of the genus *Asterina* occurring in Taiwan and Hainan, China are at present incorrectly assigned. They are here described and illustrated as new species.

Asterina champereiicola B. Song & T. H. Li, *sp. nov.* Fig. 1

Similis Asterina cansjericola sed differt appressoriis minoribus (9-10 X 5-6 µm) et 5% alternatis; et a A. cansjericola var. indica differt ascosporis echinatiis.
Etymology: *champereiicola, in reference to the host, Champereia manillana.*

Colonies amphigenous, mostly hypophyllous, black, thin to nearly dense, arachnoid or nearly velvety, up to 4 mm in diameter, rarely confluent. Hyphae brown, nearly straight or sinuous, opposite branching acutely or obtusely, loosely or closely reticulate, cells mostly 16-30 X 5.5-7 µm. Appressoria unicellular, opposite or 5% alternate, spreading, straight or nearly bent, ovate or conoid, nearly acute at apex, entire, 9-10 X 5-6 µm. Ascomata lax aggregate to scattered, black, orbicular or hemispherical, up to 150 µm in diameter, no hole or stellulately dehiscent at centre, irregularly crenate to shortly tasseled at periphery, surface cells 2-3 µm wide. Ascospores oblong, brown, 1-septate, obtuse, constricted at septum, echinulate, 23-24 X 9-10 µm.

Holotype: *On leaves of Champereia manillana Merr. (Opiliaceae). Chishui, Taizhong, Taiwan Province, China. Nov. 29. 1928, K. Sawada, HMAS 05100.*

The new species is closely related to *Asterina cansjericola* Hansf. & Thirum. and *A. cansjericola* var. *indica* Hosag., N. P. Balakr. & Goos. *A. cansjericola* is differentiated by having larger (12-16 X 6-8 µm) appressoria of which 5% are opposite while *A.*

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[*] *Corresponding author*

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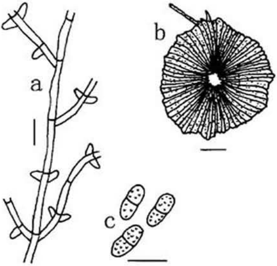

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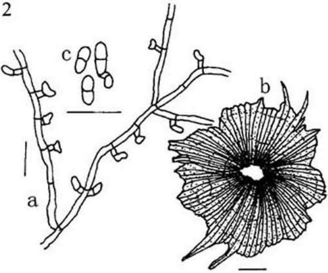

Fig.1 *Asterina champereticola* (a. hyphae with appressoria; b. ascomata; c. ascospores) (Bars=25μm).
Fig.2 *Asterina hainanensis* (a.hyphae with appressoria; b. ascomata; c. ascospores and one germinating ascospore) (Bars=25μm).

cansjericola var. *indica* is distinguished by smooth ascospores (Hansford &Thirumalachar 1948; Hosagoudar et al. 1996). The newly named *A. champereiicola* also resembles *A. decipiens* Syd. & P. Syd. (distinguished by alternate—or at least not opposite, smaller—7-9 X 3-4 µm— appressoria; see Sydow & Sydow 1912) and (ii) *A. elmeri* Syd. & P. Syd. (with smooth, larger ascospores, 25-30 X 10-14 µm; see Sydow & Sydow 1911). In addition, *A. champereiae* Hansf. produces bicellular appressoria and smooth, smaller (14-16 X 12-14 µm) ascospores (Hansford 1949).

The new species was found mixed with *Meliola champereiae* Syd. & P. Syd.

Asterina hainanensis B. Song, *sp. nov.*

Fig. 2

> *Similis Asterina manihotis sed differt ascosporis minoribus (14-15 X 5.5-6.5 µm) et appressoriis grandioribus (12-17 µm); et a A. punctiformis differt ascosporis minoribus.*
> Etymology: *hainanensis*, in reference to the type locality, the Hainan Province.

Colonies amphigenous, mostly hypophyllous, black, thin, arachnoid or nearly velvety, up to 6 mm in diameter, mostly confluent. Hyphae brown, sinuous or nearly straight, branching opposite, acutely or obtusely, loosely reticulate, cells mostly 20-30 X 5-6.5 µm. Appressoria bicellular, alternate or unilateral, 2% opposite, spreading, straight or nearly straight, 12-17 µm long; stalk cells cuneate or cylindrical, 3-5 µm long; head cells cylindrical, entire or nearly lobate and angulose, 9-12 X 4.5-5.5 µm. Ascomata scattered, black, orbicular to hemispherical, up to 160 µm in diameter, stellulately dehiscing at the centre, irregularly crenate to short tasseled at periphery, surface cells 2.5-3.5 µm wide. Ascospores nearly oblong, brown, 1-septate, obtuse, constricted at septum, smooth, 14-15 X 5.5-6.5 µm.

> **Holotype:** *On leaves of Microdesmis casearifolia Planch. (Pandaceae). Xinglong, Hainan Province, China. July 3, 1956, G.J. Jiang and S.J. Han, HMAS 33464.*

The new species is closely related to *Asterina manihotis* Syd., parasitic on *Manihot*, from Sierra Leone and *A. punctiformis* Lév., parasitic on *Conceveiba*, from Java (Sydow 1939; Stevens & Ryan 1939). The main distinguishing characters of *A. manihotis* are that ascospores are slightly larger (17-20 X 8.5-10 µm), and the appressoria are smaller (6-8 X 4-5 µm). The main distinguishing characters of *A. punctiformis* are that the its ascospores are larger (22-26 X 10-12 µm). The new species is also closely related to *Asterina tragiae* S. Hughes, parasitic on *Tragia*, from the Gold Coast (Hughes 1952), but which differs in having verrucose and larger ascospores (16-19 X 8-9 µm). In addition, the appressoria of these three species all are alternate, not opposite, allowing easy distinction from the new species.

Sydow & Sydow (1914) reported *Asterinella ramuligera* Syd. & P. Syd., parasitic on *Microdesmis casearifolia* Planch ex Hook., from the Philippines; Ryan (Stevens & Ryan 1939) combined it as *Prillieuxina ramuligera* (Syd. & P. Syd.) Ryan; Petrak (1947) recombined it as *Asterina ramuligera* (Syd. & P. Syd.) Petr. The main distinguishing characters of *Asterina ramuligera* are that the ascospores are verrucose and larger (20-26 X 10-12 µm), and the appressoria are longer (20-30 µm) (Sydow & Sydow 1914; Hosagoudar & Abraham 2000), distinguishing these it from the new species.

Asterina malloti-apelti B. Song, *sp. nov.*

Fig. 3

Similis Asterina fraseriana sed differt ascosporis laevis et minoribus (17-20 X 7.5-9 µm); et a A. malloti differt ascosporis minoribus et cellulis apicalis clavatis vel suboblongiis.
Etymology: malloti-apelti, in reference to the host, Mallotus apelta.

Colonies amphigenous, mostly epihyllous, black, thin, arachnoid or nearly velvety, up to 5 mm in diameter, mostly confluent. Hyphae brown, nearly straight to sinuous, irregularly branching acutely or obtusely, loosely reticulate, cells mostly 20-30 X 3.5-4.5 µm. Appressoria bicellular, alternate or unilateral, spreading, bent or nearly straight, 10-17 µm long; stalk cells cuneate to cylindrical, 2-3 µm long; head cells clavate to nearly oblong, entire or sometime nearly lobed, 8-14 X 4-7 µm. Ascomata scattered, black, orbicular to hemispherical, up to 120 µm in diameter, stellulately dehisced at the centre, irregularly crenate to short tasseled at periphery, surface cells 2-3 µm wide. Ascospores oblong, brown, 1-septate, obtuse, constricted at septum, smooth, 17-20 X 7.5-9 µm.

Holotype: *On leaves of Mallotus apelta Muell.-Arg. (Euphorbiaceae). Xinglong, Hainan Province, China. July 3, 1956, S.J. Han, HMAS 33462.*

Up to now, two species of the genus *Asterina*, *Asterina malloti* Sawada & W. Yamam. and *A. malloticola* Hosag., M. Kamarudeen & G. Rajkumar, are recorded as occurring on *Mallotus*, but both those species have larger ascospores (former for 22-27 X 10-12 µm and later for 19-23 X 11-13 µm) and that *A. malloticola* have verrucose ascospores (Yamamoto 1959; Hosagoudar *et al.* 2003). The new species is closely related to *Asterina fraseriana* Syd., parasitic on *Claoxylon*, from New South Wales (Australia) (Sydow 1937). The main distinguishing characters of *A. fraseriana* are larger, verrucose ascospores that are larger (21-24 X 10.5-12 µm). The new species is also closely related to *Asterina scaberrima* Syd., parasitic on *Mareya* from Sierra Leone, but which differs from *A. malloti-apelti* in having nearly globose (6-8 X 5-7 µm), entire appressoria, and broader, verrucose ascospores (19-22 X 10-12 µm) (Sydow 1938).

This species was also found mixed with *Asteridiella malloticola* (W. Yamam.) Hansf.

Asterina sawadai B. Song, *sp. nov*

=*Asterina koshunensis* Sawada, Rep. Gov. Res. Inst. Formosa 87:5. 1944, not validly published. Fig. 4

Similis Asterina capparidicola sed differt ascosporis longioribus (29-33 X 11-13.5 µm), appressoriis minoribus (6-9 X 5-6 µm); et a A. capparidis differt ascosporis echinulatis et grandioribus, appressoriis minoribus.
Etymology: *this species is named in honour of the Kaneyoshi Sawada, collector of the type, a mycologist of Japan, for his outstanding contributions to study on the fungi.*

Colonies amphigenous, black, thin, arachnoid or nearly velvety, up to 4 mm in diameter, mostly confluent. Hyphae brown, nearly straight to sinuous, oppositely branching acutely or obtusely, loosely reticulate, cells mostly 15-23 X 5.3-6.8 µm. Appressoria unicellular, opposite or 20% alternate, spreading, straight or bent, ovate or nearly conoid, entire, 6-9 X 5-6 µm. Ascomata scattered, black, orbicular to hemispherical, up to 230µm in diameter, stellulately dehisced at the centre,

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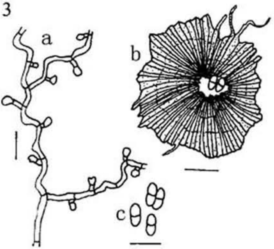

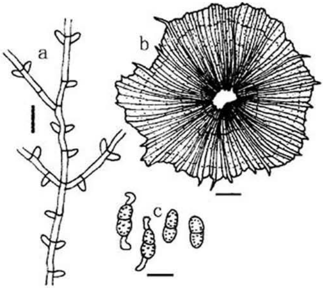

Fig.3 *Asterina malloti-apelti* (a. hyphae with appressoria; b. ascomata; c. ascospores) (Bars = 25 μm).
Fig.4 *Asterina sawadai* (a. hyphae with appressoria; b. ascomata; c. ascospores and germinating ascospores) (Bars = 25 μm).

irregularly crenate to short tasseled at periphery, surface cells 2-3 µm wide. Ascospores oblong, brown, 1-septate, obtuse, constricted at septum, echinulate, 29-33 X 11-13.5 µm.

Holotype: *On leaves of Capparis kikuchii Hay.(Capparaceae). Taidong, Taiwan Province, China. April 27, 1909. K. Sawada, HMAS 05098.*

Asterina koshunensis Sawada was published in 1944 without a Latin description, and thus the name is invalid [Art. 36.1 of C. B. N.].

The new species is closely related to *Asterina capparidicola* Doidge from Africa, but which has shorter and wider ascospores (22-27.5 X 12.5-15 µm), and larger appressoria (10-15 X 5.5-7.5 µm for the head cells) (Doidge 1942). The new species is also closely related to *Asterina capparidis* Syd. & P. Syd. & E. J. Butler (1911) from the India, Madras, and the Philippines, but that species has smooth, smaller ascospores (17-18.5 X 6-7 µm), and slightly larger appressoria (6-12.5 X 6-9.5 µm for the head cells). These species are all parasitic on species of *Capparis*, and their appressoria all are bicellular, allowing easy distinction from the new species. In addition, the new species is also close to *Asterina stixis* B. Song, T.H. Li & Hosag., but which differs in having thin hyphae (3-4 µm), smaller ascospores (20-27.5 X 7.5-14 µm), and appressoria 1-2-lobate (Song et al. 2003).

It was found mixed with the *Meliola sawadai* B. Song.

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Studies on the genus *Asteridiella* of China 2

BIN SONG* & TAI-HUI LI

binsong@gdas.ac.cn
Guangdong Provincial Key Laboratory of Microbial Culture
Collection & Application; Guangdong Institute of Microbiology
Xianlie Road Central, Guangzhou 510 070,China

Abstract—*Asteridiella heliciae* parasitic on *Helicia cochinchinensis* and *A. sloaneae* parasitic on *Sloanea sinensis* are described and illustrated as new species.

Key words—*Meliolaceae, Proteaceae, Elaeocarpaceae*

The genus *Asteridiella* was proposed by McAlpine in 1897, its type being *A. solani* McAlpine (McAlpine 1897; Hansford 1961). The species of this genus are obligate parasites on higher plants and widely distributed in the tropical and subtropical regions of the World. Although attempts have been made to culture these fungi, both in the laboratory and on host plants (Hansford 1961; Goos 1978), no one has yet succeeded in doing so. The genus *Asteridiella* is similar to the *Amazonia, Appendiculella, Irenopsis*, and *Meliola*, but it differs from these genera of *Meliolaceae* in having cells protruding on the perithecial surface, and lacking appendages or setae (Mibey & Hawksworth 1997). *Asteridiella* is also the larger genus of the family *Meliolaceae*. Up to now, over 250 taxa of the genus have been described in world (Kirk et al. 2001), and over 54 taxa have been reported in China (Hu et al. 1996, 1999; Song et al. 1996, 2002). Two new species are described and illustrated here.

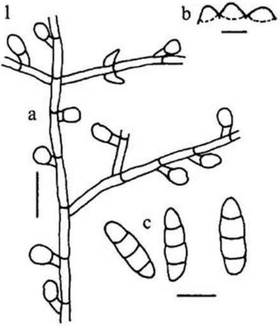
Asteridiella heliciae B. Song & T. H. Li, *sp. nov* Fig. 1

Similis Asteridiella knightiae sed differt appressoriis brevioribus (17-25 µm) et ascosporis minoribus (38-45×13-17 µm).

Etymology: *heliciae*, in reference to the host, *Helicia cochinchinensis*.

Colonies amphigenous, black, dense, velvety, scattered, up to 9 mm in diameter, rarely confluent. Hyphae brown, straight to nearly straight, with branches opposite and acutely branching, closely reticulate, cells mostly 17-30×5-6.4 µm. Appressoria alternate or unilateral, spreading, straight to slightly curved, 17-25 µm long; stalk cells cylindrical to cuneate, 5-10 µm long; head cells ovate or ellipsoidal, entire or sometime nearly lobate, 12-16 × 9-10 µm. Phialides mixed with appressoria, opposite to alternate, ampulliform, 13-18 × 6-8 µm. Mycelial setae absent. Perithecia scattered, black, globose, verrucose, up to 200 µm in diameter, surface cells conoid to mammillate, 13-20 µm high and 20-30 µm wide. Ascospores brown, cylindrical, obtuse or nearly acute at ends, 3-septatae, slightly curved, constricted at septum, 38-45 × 13-17 µm.

Corresponding author



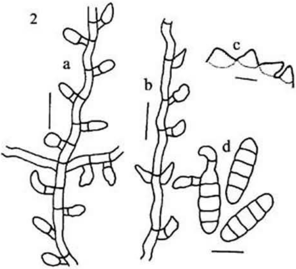


Fig.1 *Asteridiella heliciae* (a. hyphae with appressoria and phialides; b. surface cells; d. ascospores) (Bars = 25 µm)

Fig.2 *Asteridiella sloaneae* (a. hyphae with appressoria; b. hyphae with appressoria and phialides; c. surface cells; d. ascospores and one germinating ascospore) (Bars = 25 µm)

> **Holotype:** *On leaves of Helicia cochinchinensis Lour.(Proteaceae). Ruyang County, Guangdong Province, China. November 30,1995, B. Song, HMIGD 34185.*

The new species is close to *Asteridiella knightiae* S. Hughes, but differs from this species in having longer appressoria (32-65 µm) and larger ascospores (72-79 × 25-28 µm) (Hughes 1978). It is also close to *Asteridiella caseariae* Hansf., but which differs in having irregularly branching hyphae, longer appressoria (23-30 µm), and head cells shallowly 2-3-lobate, nearly globose (14-19 × 15-18 µm) (Hanford 1961). In addition, two species of meliolaceous fungi, *Meliola heliciae* W.Yamam. and *Meliola heliciicola* Hansf., are recorded as occurring on *Helicia*, but both those species have mycelial setae and 4-septate ascospores (Yamamoto 1941; Hansford 1961).

This species is also a first record of *Asteridiella* on *Helicia*.

Asteridiella sloaneae B. Song, *sp. nov.* Fig. 2

> *Similis Asteridiella elaeocarpicola sed differt ascosporis minoribus (45-52 × 16-19 µm); et a A. amoena differt appressoriis non-oppositis et longioribus (15-22 µm), ascosporis grandioribus.*
>
> Etymology: *sloaneae*, in reference to the host, *Sloanea sinensis*.

Colonies epiphyllous, black, dense, arachnoid to velvety, scattered, up to 8 mm in diameter, sometime confluent. Hyphae brown, sinuous or nearly straight, mostly opposite branching acutely or lately, dense reticulate, cells mostly 15-22 × 6-7.5 µm. Appressoria bicellular, in alternate or unilateral arrangement, spreading, straight or bent, 15-22 µm long; stalk cells cuneate to cylindrical, 3-7 µm long; head cells cylindrical to ellipsoid or ovate, entire to angulose at apex, 12-17.5 × 7.5-11 µm. Phialides mixed with appressoria, opposite or alternate, ampulliform, 15-23 × 5.5-8 µm. Perithecia scattered to nearly aggregate, black, globose, up to 260 µm diam., surface cells conoid to mammillate, 15-19 µm high and 10-25 µm wide at base. Ascospores brown, oblong to nearly ellipsoid, obtuse, 4-septate, constricted at septum, 45-52 × 16-19 µm.

> **Holotype:** *On leaves of Sloanea sinensis (Hance) Hemsl.(Elaeocarpaceae) Chebaling, Guangdong Provinica, China. November 2, 1993, Y. S. Ouyang and B. Song, HMIGD 34013.*

The new species is closely related to *Asteridiella elaeocarpicola* Hansf. parasitic on *Elaeocarpus monoceratis* from Philippines, which has larger ascospores (53-63 × 20-26 × 15-19 µm) (Hansford 1961). The new species is also similar to *Asteridiella amoena* (Syd.) Hansf. parasitic on *Sloanea faginea* from Costa Rica, which has opposite and shorter (9-13 µm) appressoria, and smaller ascospores (35-41 × 15-16 µm) (Hansford 1961).

This is the second record of *Asteridiella* on *Sloanea*.

Acknowledgments

The authors wish to thank Prof. Dr. R. D. Goos of Department of Botany, University of Rhode Island (U.S.A.) and Prof. Dr. Richard P. Korf for serving as pre-submission reviewers and for their valuable comments and suggestions. They also acknowledge Prof. S Q Chen of South China Institute of Botany, Academia Sinica, Guangzhou, for identifying the host plants, and to Mr. Y.H. Shen of Guangdong Institute of Microbiology, Guangzhou, and Ms. A.L. Zhang for the technical assistance. This project was supported by the National Science Foundation of China (no. 30370012), the Natural Science Foundation of Guangdong (20000205; 020470), the Natural Science Fund for Distinguished Young Scholars from Guangdong Academy of Sciences, and the Foundation of Guangdong Institute of Microbiology.

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MYCOTAXON

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A new species of *Perrotia* from New Zealand

GERARD J. M. VERKLEY
Verkley@cbs.knaw.nl
Centraalbureau voor Schimmelcultures, Fungal Biodiversity Centre
P. O. Box 85167, NL-3508 AD, Utrecht, The Netherlands

Abstract—A new species of *Perrotia* is reported from the Tongariro area in New Zealand. *Perrotia microspora* is described from branches of *Halocarpus bidwillii*. The ovoid ascospores and other hymenial elements indicate that *P. microspora* is closely related to *P. robusta* and *P. gallica* var. *gallica* known from Europe, and *P. gallica* var. *phyllocladi*, which is only known from a single locality in New Zealand.

Key-words—culture, Hyaloscyphaceae, key

Introduction

During a visit to the North Island of New Zealand in January and February 2003, an interesting discomycete was collected on a foray in the Tongariro National Park, on the foothills of Mt. Ruapehu. Microscopic examination showed that it is a species of *Perrotia*, which differed in morphology from all known species in the genus (Zhuang & Yu 2001), and is therefore described as new. The fungus was found growing on recently dead branches of *Halocarpus bidwillii*, a podocarp tree endemic to New Zealand. The culture that was isolated remained sterile.

Material and Methods

The material was studied in water and Lugol's iodine solution (IKI) and Melzer's reagent (Mlz). All measurements were taken in water, and drawings were made with a drawing tube. Colony colours were described according to Rayner (1970). The type specimen of *Perrotia microspora* has been deposited in the New Zealand Fungal Herbarium (PDD) of Landcare Research, Auckland.

Taxonomic Description

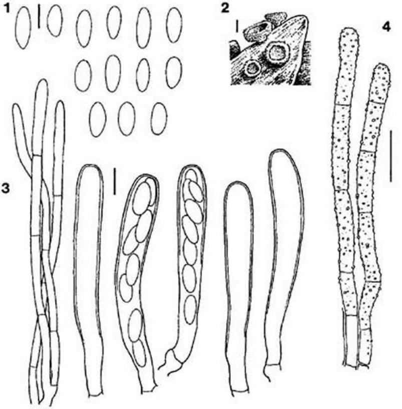
Perrotia microspora sp. nov. FIGURES 1–4

> *Apothecia erumpentia, solitaria vel gregaria, breve-stipitata; discus plano-concavus, pallide aurantiacus, 0.4–1.2 mm diametro (siccus); receptaculum cupulatum, pilis albis dense vestitum; stipes centralis, cylindricus, pilis albis vestitus. Pili cylindrici, 4–7-septati, obtusi, 70–100(–130) × 2.5–3.5 µm, parietibus hyalinis tenuis subtiliter granulosis. Excipulum ectale e cellulis prismaticis 8–15 × 5–7 µm parietibus hyalinis ad 1 µm crassis, agglutinatis compositum; excipulum medullare e hyphis intricatis 2–3 µm latis hyalinis compositum.*
> *Asci octospori, cylindrico-clavati, apice late rotundato in iodo non caerulescente, pariete apicali nullo incrassato, 35–50 × 5.5–6.5 µm; ascosporae ovoideae vel late elliptae, hyalinae, non-septatae, guttulatae, 5.5–8.5 × 2.8–3.0 µm; paraphyses filiformes, septatae, obtusae, hyalinae, 2.0–2.5 µm latae, ascis 10–20 µm longiores.*
>
> **Etymology** – From Greek *micro-*, small, and Latin *spora*, spore, referring to the relatively small sizes of the ascospores as compared to other species of *Perrotia*.

Apothecia erumpent, solitary or gregarious, short-stalked; *disc* plano-concave, pale orange and partly hidden by an inrolled margin when dry, paler when moistened, 0.4–1.2 mm diam (dry); *receptacle* cupulate, densly clothed by pure white hairs; *stipe* central, cylindrical, up to 0.3 mm high and 0.2 mm wide, the surface covered with white hairs. *Hairs* cylindrical, 4–7-septate, obtuse, 70–100(–130) × 2.5–3.5 µm, the apical cell sometimes swollen and up to 4 µm wide, with relatively thin, hyaline walls bearing fine granules all over the surface.

Ectal excipulum composed of prismatic cells 8–15 × 5–7 µm, with hyaline, up to 1µm thick, agglutinated walls, in the lower part of the receptacle oriented at a high angle to the surface, in the upper part lying almost parallel to the surface; *medullary excipulum* composed of tightly interwoven hyphae 2-3 µm diam., with slightly thickened, smooth, hyaline walls.

Asci 8-spored, cylindrical-clavate, apex broadly rounded, apical wall not thickened, not blueing in iodine (IKI-, MIz-, also after KOH pretreatment), opening by an irregular tear at the apex, gradually narrowed towards the base, croziers present, 35–50 × 5.5–6.5 µm (non-turgescent (NT), water); *ascospores* ovoid to broadly-ellipsoid, ends broadly rounded to slightly pointed, hyaline, non-septate, smooth, thin-walled, containing guttules, 5.5–8.5 × 2.8–3.0 µm; *paraphyses* filiform, septate, obtuse, some slightly narrowing toward the blunt tip, hyaline, smooth-walled, 2.0–2.5 µm wide, exceeding the asci by 10–20 µm (NT).



Figs 1–4. *Perrotia microspora*, PDD 78361, holotype (in water). 1. Ascospores. Bar = 5 µm. 2. Habit of apothecia. Bar = 0.5 mm. 3. Paraphyses and asci. Bar = 5 µm. 4. Apothecial hairs. Bar = 10 µm.

Holotype – NEW ZEALAND, North Isl., Taupo distr., Tongariro Nat. Park, near Whakapappa, Taranaki Falls track, alt. 1400 m, on recently dead, still attached branches of *Halocarpus bidwillii* (Podocarpaceae), G. Verkley 1883, 26.I.2003 (PDD 78361, holotype), also living ex-type cultures PDD and CBS 114327 (mass-sexual).

Description of cultures (15° C, n-UV, 12h-rithm) – Colony on OA reaching a diam of 24–29 mm in 18 d, with an even, glabrous and colourless margin; immersed mycelium Ochreous to Pale Luteous, and in sectors also Saffron, in the centre covered by pure white, floccose aerial hyphae; reverse concolourous. On PDA 25–28 mm diam in 18 d, margin as on OA; immersed mycelium largely colourless, without aerial mycelium; reverse with some Salmon or faintly Buff in the centre. On 3 % MEA 25–27 mm in 18 d, margin as on OA; immersed mycelium mostly hidden under pure white, felty to floccose aerial mycelium; reverse in the centre Orange, surrounded by Luteous tinges. No sporulation was observed *in vitro*.

Discussion

Perrotia microspora is placed in the genus *Perrotia* on the grounds of the structure of the asci, which are thin-walled, and have broadly rounded, inamyloid apices. Twenty species have thus far been described in *Perrotia* (Dennis 1963, Raitviir 1970, Spooner 1987, Wang & Haines 1999, Zhuang & Hyde 2001, Zhuang & Yu 2001), four of which have been found in New Zealand, viz., *P. lutea* (Phillips) Dennis, *P. alba* Dennis, *P. apiculata* (Dennis) Spooner, and *P. gallica* var. *phyllocladi* (Dennis) Spooner. *P. microspora* resembles the last mentioned species and *P. robusta* Grelet ex Spooner in habit and colour of the apothecia, and in the shape of the ascospores. There are, however, also important differences between these species. The spores of *P. gallica* var. *phyllocladi* are larger (8.5–11.5 × 5.0–6.0 µm) than those of *P. microspora*, and the hairs are longer (200–250 µm; Spooner, 1987). The ascospores of *P. robusta* are also considerably larger (11–15 × 7–9 µm) than those of *P. microspora*. *P. gallica* var. *phyllocladi* was originally described as *Trichoscyphella phyllocladi* by Dennis (1961), but Spooner (1987) found it morphologically indistinguishable from the European *P. gallica*. He accepted it at varietal rank because of the geographical isolation and difference in host.

At the site where *P. microspora* was collected, the host *Halocarpus bidwilli* grows jointly in a subalpine podocarp vegetation with *Phyllocladus aspleniifolius* var. *alpinus* (= *Ph. alpinus*), which is the only known host of *P. gallica* var. *phyllocladi*. The genus *Halocarpus* is endemic to New Zealand, where three species are known.

Key to the species of *Perrotia* in New Zealand

1. Ascospores multiseptate, 100–160 µm long .... *P. lutea*
1. Ascospores 0–1-septate, not over 20 µm long 2

2. Ascospores rhomboidal, on bark of *Nothofagus* .... *P. apiculata*
2. Ascospores ovoid, ellipsoid or cylindrical 3

3. Ascospores cylindrical to ellipsoid, 1-septate, 12–17 × 3.5–4.5 µm, on twigs of *Aristotelia fruticosa* .... *P. alba*
3. Ascospores ovoid or broadly ellipsoid, continuous, on other substrates 4

4. Ascospores 8.5-11.5 × 5.0-6.0 µm, apothecial hairs 200-250 µm long, on *Phyllocladus* .... *P. gallica* var. *phyllocladi*
4. Ascospores 5.5–8.5 × 2.8–3.0 µm, apothecial hairs 70–100(–130) µm long, on *Halocarpus bidwillii* .... *P. microspora*

Acknowledgements

Dr Peter R. Johnston, Landcare Research, Auckland is thanked for arranging collecting permits. The Johanna Westerdijkfonds is acknowledged for financially supporting the foray. Profs Wen-Ying Zhuang and Richard P. Korf are kindly acknowledged for reviewing the manuscript prior to submission.

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MYCOTAXON

Volume 89(1), pp. 211-223 *January-March 2004*

Book reviews and notices

Compiled by
David L. Hawksworth[1]
The Yellow House, Calle Aguila 12, Colonia La Maliciosa, Mataelpino
E-28492 Madrid, Spain.

General

Centenary Review of the Fungal Diversity Investigations in Bulgaria. Edited by Cvetomir M. Denchev & Ganka G. Bakalova. 2002. Bulgarian Mycological Society, c/o Institute of Botany, 23 Acad. G. Bonchev Street, BG-1113 Sofia, Bulgaria. Pp. 71. ISBN 954 995911 2. [In Bulgarian with English summary.] Price: Not indicated.

This booklet commemorates 100 years of mycological research in Bulgaria. It describes the history of investigations of various non-lichenized groups and the problems and trends of mycological studies in the country. There are extensive lists of literature references to some sections, and a red-list of 215 macromycetes for the country first issued in 2000 is reproduced. The issue of endangered micromycetes is also raised, especially with reference to smut fungi, although it is noted that plant pathogens might be viewed as an "anti-resource" the desirability for the conservation of which needed to be assessed case by case. Provided this work is widely circulated in the country, it should do much to raise the level or awareness of conservationists and ecologists of the need to pay more attention to the fungi. It also provides a starting point for someone wishing to study the Bulgarian mycobiota for the first time. The editors are to be congratulated on this initiative.

Origen de Los Nombres Científicos de Los Hongos. By Miguel Oltra. April 2003. Second edition. Real Jardín Botánico, Claudio Moyano 1, E-28014 Madrid, Spain. [Monografías de la Sociedad Micológica de Madrid No. 1.] Pp. 160. ISSN 0214 140 X. Price: € 9.

A second edition of this extensive glossary, first released in 1996, which provides the meanings in Spanish of generic and specific names used for macromycetes and a few other fungi, together with details of the Latin, Greek, other words, or individuals on which they are based. Much seems to be unchanged from the original printing, however, and the most recent title in the bibliography dates from 1991. Nevertheless, as the meanings of words do not "date", it remains of value not only to Spanish speakers but also to other mycologists endeavouring to track down the origins of particular fungal names.

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[1] Books for consideration for coverage in this column should be mailed to the Book Review Editor (address above) in the first instance. Fax (+34) 91 857 3640; e-mail: myconova@terra.es

Recommended English Names for Fungi in the UK. By Elizabeth Holden. [2003.] Plantlife International, 14 Rollestone Street, Salisbury, Wiltshire SP1 1DX, UK. [Available from Plantlife Bookstore, Summerfield Books, Main Street, Brough, Cumbria CA17 4AX, UK.] Pp. 24. ISBN 1 872613 99 3. Price £ 6.

This book represents the output of an initiative of the UK's Fungus Conservation Forum, supported by the British Mycological Society, Countryside Council for Wales, Environment Heritage Service (Northern Ireland), English Nature, Plantlife International, and Scottish Natural Heritage. The aim was to provide recommended English names for around 1000 species to provide them with "a more popular, accessible identity" (p. 5). Names were gleaned from 30 modern field guides and other sources (listed on p. 6), and English names coined for the first time for around 400 species. Where competitive names occurred, a project steering group made a choice. However, the steering group could not agree on five species for which "two equally well-established names" existed, and for those both names are retained (!; e.g. Magic Mushroom or Liberty Cap for *Psilocybe semilanceata*). Scientific names are generally avoided, although "Amanita" was permitted as it is accepted in a leading English dictionary. The list is wide-ranging, including not only macromycetes but also some rusts and smuts and a few other pathogens of native plants, but no mildews. Names of crop and garden pathogens are generally omitted, as are those for lichenized fungi, which makes the overall title somewhat misleading. However, despite the inputs of numerous mycologists, some errors and strange names remain. For example, I was shocked to see *Ophiostoma ulmi* down for Dutch Elm Disease (*O. novo-ulmi* was the cause of the last UK epidemic), and fail to understand why *Schizophyllum commune* should be referred to as the Common Porecrust when it has neither pores nor forms a crust. I really wonder if creating names in colloquial languages where there were none improves accessibility, and question the wisdom of encouraging the use of common names. The idea may appeal to conservation agencies familiar with dealing with birds, mammals and plants, but for fungi it can only serve to complicate exchanges with specialists nationally and both amateur and professional mycologists internationally. Hopefully, the print run was small.

Atlas of the Geographical Distribution of Fungi in Poland. Fascicle 2. Edited by Władysław Wojewoda. December 2002. Władysław Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL-31 512 Kraków, Poland. Pp. 129. ISBN 83 85444 98 X. Price € 17.

The first fascicle of this series was issued in 2000 and covered in *Mycotaxon* **82**: 477 (2002); it treated ten species. This second fascicle covers 26 basidiomycetes belonging to 23 genera: *Amyocorticium, Antrodia, Bovista, Clavariadeplphus, Clavulicum, Conohypha, Daedaleopsis, Diplotomitoporus, Eichleriella, Fomitoporia, Fomitopsis, Hymenochaete, Irpicodon, Punctularia, Pycnoporellus, Rhodotus, Scotomyces, Sistotrema, Suillus, Syzygospora, Thanatephorus, Trichaptum*, and *Tubulicrinis*. As in the previous fascicle, detailed discussions of the ecology and distribution are followed by distribution maps with records divided by date categories, and lists of specimens studied. A note from the Editor includes corrigenda to author citations and places of publication of names given in fascicle 1, which were pointed out as needing attention in the *Mycotaxon* review of that part. I was pleased to see that more attention has been accorded to nomenclatural details in this second fascicle, which augurs well for subsequent installments. The increase in the number of species covered in this second part is commendable, and hopefully that will the continued or increased further in future fascicles

Basidiomycetes

Xerocomus* s. *l. By Heidi Ladurner & Giampaolo Simonini. June 2003. Edizioni Candusso, Via Ottone Primo 90, I-17021 Alassio SV, Italy. [Fungi Europaci Vo. 8.] Pp. 528, col. photographs 290, col. plates 21, figs 343. ISBN 88 901057 2 0. Price € 56.

At last we can purchase a well-produced major work published simultaneously in Italian and English. It contains many descriptive photographs, good illustrative plates and many line drawings; so many in fact that at times they give little help in identification. The keys are excellent and very much to the point. The complete work is printed on good quality paper, which gives perfect reproduction to the photographs, and is well bound.

The Introduction states the following. 'After many years of frustration, the decision was taken to make every effort to describe and illustrate in detail as many European *Xerocomus* species as possible'. This it has done, but the conclusion is far from the full international opinion, and I find increases the frustration; it is this factor that makes the book compulsive reading. Again it must be emphasised that much of the work is original, crying out to be read and pondered over, it is for this reason that individual species have not been selected for comment in this review

To anyone at all interested in *Boletus* this book is a must, it will confuse at times but on the other hand one should take a long look at it and consider the points it is putting forward before reaching one's own conclusion. The one regret British mycologists should have is that the only British material examined by the authors was *Boletus (Xerocomus) rubellus* and *Pseudoboletus (Xerocomus) parasiticus*.

ALAN E. HILLS
16 Acremead Road, Wheatly, Oxford OX33 1NZ, UK.

***Mycena* D'Europe.** By Giovanni Robich. May 2003. Associazione Micologica Bresadola, Via A. Volta 46, I-38100, Trento, Italy. Pp. 728, col. plates. ISBN not indicated. Price: € 85.

This beautifully presented book is not a critical work on the genus; neither does it cover all European *Mycena* species, so the title is rather misleading. One hundred and forty three taxa are described, comprising 117 species of *Mycena* plus 26 varieties or forms. Eight species and three forms are described for the first time. The author accepts the sections of Maas Geesteranus (1992) in a broad sense and organises the descriptions of species studied by the author within these sections. There is no appraisal of the taxonomic uncertainties in *Mycena* s.l. nor reference to recent developments, such as the separation of the *Calodontes* group into *Prunulus* (Redhead et al. 2001). A phytogeographical commentary is not included, neither is the distribution of species in Europe discussed. Most of the collections studied are from Italy and a number of European species, some common, are surprisingly missing. However, whatever the criticisms, this is a formidable piece of work; the author has sought to locate most European species and in some cases even found species described from America. There are unique illustrations including many not seen before in any book. The author is to be congratulated in having the courage to produce such a work on *Mycena*, a difficult genus with new species being frequently described. At least here we have the first European illustrated book solely on *Mycena*, an historical achievement.

The introduction is a short paragraph with no details of materials and methods. After a description of the genus is a key to the sections; all keys are duplicated in English, otherwise the text is in Italian, or Latin in the case of new taxa.

Each taxon is dealt with under the headings: basionym, synonyms, original diagnosis, introduction, reference illustrations, macroscopical description, microscopical description, exsiccata, and bibliography. Each has one or more colour plates and a page of microscopical drawings. These are sensibly arranged in a standard pattern but unfortunately have no legend. The drawings are a striking feature of the book, being an excellent synthesis from microscopical observation, although the author does not indicate if these are schematic or made with a drawing tube. It is not stated if the drawings are derived from one or more collections or whether they represent intraspecific variation. It would be more helpful to keep drawings from separate collections identifiable; however, I consider the drawings mostly faithful to his understanding of the taxa known to me. At the beginning of the large sections, like *Filipedes* and *Fragilipedes*, there is a page of drawings with a limited legend and it is unclear what purpose they serve. Most entries are greatly lengthened by the inclusion of an extensive list of illustrations; clearly, the author keeps a database of such illustrations. For example, *Mycena pura* (i.e. *Prunulus purus*) has 89 illustrations cited. It would have been reasonable to cite good representative examples up to a maximum of five, thus reducing the size of the book and permitting inclusion of detailed legends to the drawings and photographs. The latter are mostly very good but lack ecological information and details of the collection shown. The authors of the photographs are listed at the beginning of the work, rather than with the illustration. Several appear to be unrepresentative of the species. For example, those of *M. urania* and *M. mirata* appear to be of *M. filopes*. The former is a violet coloured species and the latter has fewer lamellae than illustrated.

The author frequently provides tables for comparison of similar species, which is very helpful; however, it is not clear if the details given encompass intraspecific variation. In some cases, the tables usefully include species that are not otherwise described in the book. The author does not seem to appreciate the value of aspect ratio values for spores (q values); these are very useful in *Mycena*, but they are not cited and the statistical validity of the spore measurements given is unclear.

In sect. *Adonideae*, *M. floridula* is accepted as a separate taxon to *M. adonis*, yet the question of the status of *M. floridula* sensu Kühner is not addressed. The sour tasting form of *M. flavoalba* is accepted as a separate variety; it seems odd that this has been noticed, since taste in not usually a feature of *Mycena*, and perhaps a closer look at these varieties will yield other differences. In sect. *Basipedes* the author sensibly includes in his key species Maas Geesteranus allocated to their own section. There are valuable accounts of *M. rhenana* and *M. tenuispinosa* with useful photographs; these are a real coup for the author. It is strange, however, that *M. mucor* and *M. bulbosa* are only covered in the key, since both are common and widespread in Europe. Users should beware of an error in the key here; *M. bulbosa* has a plicate basal disk when young, rather like *M. stylobates*.

Section *Calodontes*, recognised by Redhead et al. (2001) as separate from *Mycena* and referred to *Prunulus*, is covered with six varieties or forms of *P. purus* and two of *M. rosea* but there is no entry for *M. kuehneriana* or *M. pearsoniana*. Since the forms of *P. purus* do not differ microscopically, these could have been covered by two pages of photographs and one set of drawings. Only two species are described in sect. *Cinerellae*, *M. clavicularis* and *M. pseudopicta*, both with excellent photographs. *M. cinerella*, a common species does not appear even in the key, neither does *M. concolor*.

Among the extra species recently described in sect. *Filipedes* is *M. erianthi-ravennae* (Robich & Marchetti 1999). The photograph and description shown here are identical with my understanding of *M. chlorantha*, which is a species the author does not include in the book, so is apparently unknown to him. In the table comparing the newly described species, the author states that *M. chlorantha* has 16-22 lamellae reaching the stipe and no caulocystidia. In fact collections in my possession have from 14 to over 30 full lamellae and caulocystidia like those depicted in the drawings given for the new species. The substrates for both are marine grasses.

The values used for *M. chlorantha* by the authors are taken from Maas Geesteranus (1992), rather than by direct observation. Another of the recently described species in this section, *M. ticensis* (Robich 1966), looking remarkably like *M. flavescens*, is compared with *M. xantholeuca*, which is quite dissimilar microscopically; it would have been more appropriate to compare it with *M. flavescens* and *M. arcangeliana*.

In the burgeoning section *Fragilipedes* the author describes three new taxa, and adds some species, described from America, previously unrecorded from Europe. *Mycena calceata* (Robich 1996) is strangely placed in sect. *Insignes*. The author refers to the radiating fibrils attaching the stipe to the substrate as justification. This form of attachment is common in *Mycena*, and especially notable with *M. arcangeliana*. *Insignes* species are characterised by a viscid pileus and stipe, in some cases with a separable pellicle. *M. calceata* has neither of these characters. Curiously, the stipe is also described as insititious, and with a basal disk. In the sect. *Polyadelpha*, a new species, *M. catalaunica* is described growing on the leaves of *Quercus ilex* but it is not compared with *M. quercus-ilicis*, but three other species. *M. quercus-ilicis* is a widespread and common species in southern Europe so it is surprisingly missing from the book. The citrine colour of the stipes in the photograph of the described species, suggest that it might be Kühner's invalidly published *M. quercus-ilicis* var. *citrina* (see Maas Geesteranus 1989).

Bearing in mind the criticisms and cautionary remarks contained in this review, there is much of value to be obtained from this work.

Maas Geesteranus RA. 1989. Conspectus of the Mycenas of the Northern Hemisphere 11 - *Proceedings of the Koninklijke Nederlanse Akademie van Wetenschapen, C,* **92**: 89-108.

Redhead SA, Vilgalys R, Moncalvo J-M, Johnson J, Hopple JS. 2001. *Coprinus* Pers. and the redisposition of *Coprinus* species *sensu lato*. *Taxon* **50**: 203-241.

Robich G. 1996. On a new species of *Mycena* from Spain. *Persoonia* **16**: 245-248

Robich G, Marchetti M. 1999. *Mycena erianthi-ravennae*, una nuova specie della sezione *Filipedes* dall'Italia. *Rivista di Micologica* **42**: 291-298

ERNEST E. EMMETT
Drumlins, Newtonmore Road, Inverness PH21 1HD, UK

Die *Cortinariaceae* Österreichs. By Gerwin Keller & Meinhard M. Moser. 2001. [Catalogus Florae Austriae Vol. 3(2); Biosystematics and Ecology Series 19.] Pp. 20, 48 col. plates. Austrian Academy of Sciences, Vienna. Price € 45.

The aim of the *Catalogus Florae Austriae* series is to describe and document the biodiversity and the biological resources of the country. The difficult task of addressing the biodiversity of *Cortinariaceae* was carried out by Meinhard Moser, one of the world's experts in agarics, especially *Cortinarius*, in collaboration with his former student Gerwin Keller. The genera *Cortinarius* (353 spp.), *Dermocybe* (353 spp.), *Galerina* (51 spp.), *Gymnopilus* 11 spp.), *Hebeloma* (46 spp.), *Inocybe* (140 spp.), *Leucocortinarius* (1 spp.), *Naucoria* (13 spp), *Phaeocollybia* 6 spp.), *Phaeogalera* (4 spp.), and *Rozites* (1 spp.) are considered. The data for these books were compiled from the literature; moreover, herbarium specimen have been examined and included while uncertain records and determinations have been omitted. Importantly, the floristic information is supplemented by ecological data and remarks on similar species. An appendix with 48 original colour pictures is included. A register of genera and species epithets helps one to easily find data of interest. This book is very useful to Austrian mycologists in comparing and checking their collections. Furthermore, due to the well-documented ecological data, it is valuable for everybody interested in *Cortinariaceae* and their ecology in boreal habitats in general.

URSULA PEINTNER
Institute of Microbiology, University of Innsbruck, Technikerstrasse 25
Innsbruck 6020, Austria.

Tanzanian Mushrooms: Edible, harmful and other fungi. By Marja Härkönen, Tuomo Niemelä & Leonard Mwasumbi. October 2003. Botanical Museum, Finnish Msueum of Natural History, University of Helsinki, P. O. Box 7, FIN-00014 Helsinki, Finland. [Norrlinia Vol. 10.] Pp. 200, figs 205. ISBN 952 10 1420 2. Price: € 25.

What a superbly researched and presented book, "born of a love for fungi and a love for Tanzanians" (p. 5). In essence it is a second edition of *Edible Mushrooms of Tanzania* (1995), which has long been out of print, combining information on the traditional uses of fungi with modern knowledge – and illustrated almost entirely in colour. It starts with an overview of habitats, the kinds of fungi, and what they do, highlighting mycorrhizas, lichens, *Termitomyces* mutualisms, and wood decay, through methods of study, to Mushrooms and Tanzanian people. This last section is based on interviews with members of 35 tribes, using a standardized series of questions, an approach to ethnomycological studies pioneered by Marja Härkönen. Following further sections on edible mushrooms (with traditional and adopted recipes) and poisonings, detailed treatments of about 100 species follow, all beautifully illustrated by colour photographs. For each, the scientific name and local vernacular names are provided, followed by comments on edibility, a description, habitat information, notes on possible confusions, and details of the spores. Reflecting the paucity of our knowledge of African macromycetes, a number of the species are only identified "aff.", three are newly described (*Clavulina wisoli, Phellinus amanii, Russula harkoneniana*), and one new combination is made (*Funalia polyzona*, syn. *Polyporus polyzonus*).

This book, provided it can be made widely available in Tanzania, is sure to stimulate the study of the larger fungi in the country, and will also serve as a great field guide for mycologists and other naturalists enjoying safari holidays there. The modest cost results from funding by the Department for Development Policy in the Ministry for Foreign Affairs in Finland; they are to be congratulated on appreciating the long-term development value of such a book.

Classis *Ustomycetes* (Ordines *Tilletiales, Ustilaginales* et *Graphiolales*). By Cvetomir M. Denchev. 2001. Academica "Prof. Marin Drinov", BG-1113 Sofia, Bulgaria. [Fungi Bulgarica Vol. 4.] Pp. 286, figs 67. ISBN 054 430 755 9. Price: Not indicated.

This treatment of the smut fungi and their allies of Bulgaria covers 114 described and 30 as yet unnamed species, occurring on 162 host plants. Keys and descriptions are provided, along with habit sketches of infection and scanning electron micrographs of the spores of many of the species. The text is first given in Bulgarian and then followed by a 49 page version in English. The latter includes descriptions and keys, together with information on hosts and localities in the country. A host index is also provided. The work is generally well produced, although there are some minor nomenclatural glitches, and the quality of the paper scarcely does justice to the scanning electron micrographs. This is clearly a major contribution to our knowledge of the smut fungi of the region, and the author is to be congratulated upon it. However, the continued extensive use only of different hosts as distinguishing characters in the keys to some genera grated . . . . and makes me worry over both species concepts and the impression the approach gives to non-mycological systematists who might chance to see it.

Setas de Madrid. By Francisco de Diego Calogne. October 2003. Consejería de Medio Ambiente, Comunidad de Madrid, Madrid, Spain. Pp. 262, col. plates. ISBN 84 451 1530 8. Price € 12.

The Sociedad de Micológica de Madrid already has a fine series of four full-colour booklets on the fungi of the Comunidad de Madrid, the most recent of which was reviewed in *Mycotaxon* **80**: 515 (2001). The Comunidad covers some 8000 km – and embraces some of the most important areas of upland biodiversity in Spain, including the Le Pedriza UNESCO Biosphere Reserve. Following a brief introduction to macrofungi and their environmental importance, and lists of points to bear in mind when collecting in relation to both fungal conservation and safe-eating, the bulk of the work comprises over 200 first-rate colour photographs with facing text explaining the key features of the species, their ecology, and comestability (or otherwise). The emphasis is naturally on edible species, but especially impressive is a section that not only lists the species associated with particular trees, but has line-drawings of the diagnostic features of the trees themselves to facilitate their identification — an excellent case of lateral thinking! I used this during the British Mycological Society's overseas foray to Mataelpinio, Madrid, in November 2003 and was most impressed by the utility of this last section to one still learning the trees of the region, let alone the fungi! It could only have been produced by 'Paco' Calogne, the President of the Sociedad de Micológica de Madrid, who has such an in-depth understanding of the macrofungi of the region, and that its importance and need has been recognized by the Comunidad (reflected in the price) is heart-warming. The print-run was 3000, and the immediate stocks evidently ran out on the first day of the Sociedad's annual exhibition in Madrid. The local demand will be huge; if you are interested in the macrofungi of upland mediterranean areas it would be wise to order a copy quickly.

Fungi, Basidiomycota, Aphyllophorales: Coniophoraceae, Corticiaceae, Gomphaceae, Hymenochaetaceae, Lachnocladiaceae, Stereaceae, Thelephoraceae. Tulasnellales: Tulasnellaceae. By Alina G. Greslebin. March 2003 ['2002']. Consejo Nacional de Investigaciones Científicas y Técnicas de la República Argentina, Buenos Aires, Argentina. [Distributor: Koeltz Scientific Books, Herrnwaldstrasse 6, D-61462 Königstein, Germany.] [Flora Criptogámica de Tierra del Fuego Vol. 11(4).] Pp. 212, figs 31. ISBN 950 9859 84 2. Price: US $ 30.

This installment covers the families *Coniophoraceae* (2 genera), *Corticiaceae* (36), *Hymenochaetaceae* (1), *Lachnocladiaceae* (3), *Stereaceae* (1), *Thelephoraceae* (2), and *Tulasnellaceae* (1). It is based on both previously published reports and particularly 1700 collections made by the author in seven visits in spring and autumn during the years 1995-99.

Keys to genera and species are provided, with lists of synonyms, detailed descriptions, information on habitat and collections studied, and particularly carefully prepared line drawings of microscopic features. Many of the drawings are reproduced from earlier works by other mycologists, although this is not indicated in the legends themselves; this is mentioned in the Introducción, but without the full bibliographic citations. Sadly, no photographs were provided, which is unfortunate as many of these fungi have distinctive basidiomata.

Nomenclaturally, the usage of ": Fr." in the citations of accepted species is somewhat erratic, and authors names of species should not have been cited where other than the type infraspecific taxon was being referred to. Interestingly, the normally algicolous or lichenicolous *Athelia arachnoidea* is cited as growing on fallen wood of *Nothofagus antarctica*; I wonder if the algae or lichens were overlooked. It is also a pity that the obsolete ordinal name *Aphyllophorales* was retained, and that no account of the relationships of the treated families as revealed by molecular phylogenetic studies was included.

Nevertheless, there is no doubt that this study has been carefully executed, and that it will be of value to all endeavouring to identify corticioid and similar resupinate fungi not only in Tierra del Fuego but also in other parts of southern South America.

Ascomycetes

Clavicipitalean Fungi: Evolutionary biology, chemistry, biocontrol, and cultural impacts. Edited by James F. White Jr, Charles W. Bacon, Nigel L. Hywel-Jones & Joseph W. Spatafora. 2003. Marcel Dekker, 270 Madison Avenue, New York, NY 10016, USA. [Mycology Series Vol. 19.]. Pp. xi + 575. ISBN 0 8247 4255 9. Price: US $ 195.

This is a wide-ranging monograph, as will be evident from the title, and is covered here as it includes seven chapters with a taxonomic focus. Gams & Zare provide keys to the clavicipitaceous anamorphs parasitizing nematodes and other invertebrates, with some illustrations; this will now be the first place to go to identify these fungi! Hodge then covers a wider range of anamorphs, and Bischoff & White the teleomorphs on plants, just to the generic level and with keys to genera but not the species; it is pity that step could not have been taken to complement Gams & Zare's contribution, but I guess space could then have presented a problem.

Lewis, Sullivan & White survey the features of the *Balansieae*, and enumerate 25 accepted species, giving details of hosts but not distribution nor a key. In the case of *Epichloë*, Leuchtman tabulates details of ten species with experimentally tested host ranges, including diagnostic details of the ascospores. A tabular approach is also used by Alderman for *Claviceps*, which covers 39 species; 42 are discussed in detail in the text, this is the fullest compilation of species of the genus to have appeared for many years and is to be particularly welcomed. Finally, Ryley introduces the new generic name *Nigrocornus* for the single species *N. scleroticus* (syn. *Epichloë sclerotica*), and provides detailed information in its *Ephelis* anamorph and host range.

Other chapters in the book concern issues of speciation, evolution, secondary metabolites, molecular genetics of alkaloid biosynthesis, genetic manipulations, the molecular basis of host-pathogen interactions, toxicity, commercial applications, use in biocontrol, and possible defensive roles in grasses.

While the systematic sections particularly lack the cohesive approach to be expected in a single- or few authored book, there is no doubt that this much needed reference work on these fungi will be valued by all struggling to identify them as well as utilize or understand their biologies.

Lichen-forming Fungi

Catalogue of the Lichen Family *Porinaceae*. By Patrick M. McCarthy. August 2003. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, D-14129 Berlin. [Bibliotheca Lichenologica No. 87.] Pp. 164, figs 13, tables 1. ISBN 3 443 58066 1. Price: € 46.

This family of pyrenocarpous lichens in the *Trichotheliales* as interpreted here includes three genera and 394 species: *Polycornum* (1 species), *Porina* (359), and *Trichothelium* (34). Over 700 synonyms are listed, as are various doubtful and excluded species, many referable to other quite unrelated families. For each accepted species, places of publication and synonyms are provided, followed by lists of countries from which the species have been reported, together with references to the pertinent published reports. In the case of commoner species, distribution maps are also presented.

Although this is a catalogue of the taxa and their records (and so without descriptions and keys), it is a masterly and critically researched world overview of one of the commonest groups of pyrenocarpous lichens in the tropics. Europe contributes at least 80 % of the literature reports, and at least 50 % of the synonymy, but supports less than 15 % of the species. The author estimates that the true world-wide diversity of the family "will probably exceed 500 taxa" (p. 10); I suspect that will prove to be on the low side from my own brief encounters with the genus in the tropics, especially southern India.

Three new scientific names are introduced: *Porina biroi* comb. nov. (syn. *Clathroporina biroi*), *P. coarctata* nom. nov. (syn. *P. aggregata* nom. illegit.), and *P. peregrina* sp. nov.

It is evident that there is much research behind this work that is not presented here, particularly with reference to the types Dr McCarthy has personally checked and on which rest some of the taxonomic decisions presented. Hopefully he will have time to do that and prepare a subsequent publication in due course, so that this catalogue can evolve into a world monograph. For the moment, however, we have a valuable reference source that should serve to stimulate further work on and facilitate identifications in the family.

Catalogue of Lichens in Japan, 1879-2000. By Yoshiatsu Ikoma. 2002. Y. Ikoma, Teramachi 45, Tottori City, Japan. Pp. v + 667. ISBN not indicated. [In Japanese.] Price: ¥ 13 000.

Checklist of Japanese Lichens. Edited by Syo Kurokawa. July 2003. National Science Museum, Tokyo, Japan. Pp. iv + 128. ISBN and Price: Not indicated.

Two checklists of lichens known from Japan published within a year or so of each other, but the first is not listed or mentioned in the Introduction to the second. Yet the two are to a considerable extent complementary. The first must have been known to the editor and team working on the second, as it was reviewed and also advertised in the Japanese journal *Lichenology* 1(2): 86-87 (2002).

Ikoma's catalogue provides full citations for the places of publications of names, details of publications with records from Japan, citations of exsiccates, sometimes details of type collections (whether from Japan or not), and reports of species named only to genus, and cross-references of synonyms to accepted names. It is therefore very much a valuable sourcebook for researchers rather than a checklist for easy reference, but it is not clear whether all the bibliographic references have been checked. While the Japanese citations may well all have been verified, some of the older ones could have been copied from Zahlbruckner's *Catalogus* as in at least some cases they reproduce his mistakes. In some cases there are refreshingly frank notes, such as "must re-examine" (p. 171).

If the *Catalogue* suffers from reference overload, the *Checklist* is the other extreme. It accepts 1557 species reported "before July of 2003" (p. iv) and cross-references synonyms to accepted names, but gives no literature references whatsoever by the generic or species entries. There is, however, an extensive list of "Selected literature" at the end of the work, which also omits earlier works by Ikoma (e.g. Ikoma 1983).

The Kurokawa *Checklist* is surely the more authoritative, and involved an Editorial Board of eleven lichenologists from four countries, but will need to be used in conjunction with Ikoma's *Catalogue*.

Ikoma, Y. (1983) *Macrolichens of Japan and Adjacent Regions.* Tottori City: Y. Ikoma.

Bibliography of Japanese Lichenology. By Yoshiatsu Ikoma. 2001. Y. Ikoma, Teramachi 45, Tottori City, Japan. Pp. iv + 173. ISBN not indicated. [In Japanese.] Price: ¥ 2000.

This work is an alphabetical listing of publications on the lichens of Japan, including Japanese and other titles. It endeavours to be as complete as possible, including reviews and notices of publications in Japanese journals as well as the works themselves. In the absence of any topic index, the volume is not one that can be a first port of call in any identification work, but where it is necessary to check the complete works of a particular Japanese worker it will be invaluable.

A History of Japanese Lichenology. By Yoshiatsu Ikoma. 2002 ['2001']. Y. Ikoma, Teramachi 45, Tottori City, Japan. Pp. x + 401. ISBN not indicated. [In Japanese.] Price: ¥ 12 000.

This work is not so much a literary history, but an annotated bibliography of works on the lichens of Japan, including facsimile reproductions of key papers in whole or in part. It spans the Linnaean period and Thunberg's contributions through to those by Asahina, Degelius, Gyelnik, Hale, and Ahti, but does not mention studies by most of the author's Japanese contemporaries.

Dr Ikoma has been publishing on lichens since 1951, and his doctoral dissertation of 1957 was on the macrolichens of Japan. He is thus well placed to consider the history of the subject after his active immersion in it for over half a century.

The present work is very much a personal eclectic of what he found of interest, with copies of portraits, title pages, plans of the Vega ship used in early explorations, lists of publications by selected workers, etc, etc. There is also a very detailed discussion of Asahina and his work, with some previously unfamiliar photographs (and list of the new names he introduced).

This Dr Ikoma wrote "for the young men for studying the lichenological affairs (so this book is written in Japanese) but the details of History has not appeared, so I wrote this" (Y. Ikoma in litt., with English corrections) This is clearly something that all aspiring Japanese lichenologists will benefit from dipping into and be fascinated by, providing a personal impression of the characters as well as a scientific assessment of the contributions of different workers.

Flechten Japans. By A. Yasuda. 1925 [Reprinted 2002]. Y. Ikoma, Teramachi 45, Tottori City, Japan. Pp. 132, plates 25. ISBN not indicated. [In Japanese.] Price: ¥ 10 000.

Yasuda's work was originally written in German in 1923 but was lost in the Kanto earthquake that year, and Yasuda died in 1924. Yasukio Asahina gathered together a proof copy and translated it into Japanese, but few copies are available. This is a reprint of the Asahina translation, first published by The Saito Gratitude Foundation, Sendai, in 1925. The text is in Japanese with scientific names, and accompanied by copies of the original 25 half-tone plates in a separate envelope. This is the first time this work has ever really become available to the scientific community at large and will be of interest to lichenologists working on taxa Yasuda treated.

***Lichenes Pertusariales*: *Coccotremataceae, Megasporaceae, Pertusariaceae*.** By María Inés Messuti & Gernot Vobis. January 2003 ['2002']. Consejo Nacional de Investigaciones Científicas y Técnicas de la República Argentina, Buenos Aires, Argentina. [Distributor: Koeltz Scientific Books, Herrnwaldstrasse 6, D-61462

Königstein, Germany.] [Flora Criptogámica de Tierra del Fuego Vol. 13(13).] Pp. 106, pl. 5. ISBN 950 9859 83 4. Price: € 40, US $ 46.

This revision covers species in the genera *Coccotrema* (5 spp.), *Lepolichen* (1 sp.), *Megaspora* (1 sp.), *Ochrolechia* (5 spp.), and *Pertusaria* (17 spp.). Keys, descriptions, details of ecology and distribution, and synonymy are provided, together with half-tone habit photographs of all 29 accepted species. No new scientific names are introduced, new taxa already found in the course of the study having already been published separately. A further 18 names reported are discussed but not accepted for various reasons. The discussions are detailed and I was pleased to see lists of specimens examined included (drawn from 29 herbaria). The bibliography seems comprehensive as regards records for the region. However, I was surprised not to see at least ascospore outlines and schematic diagrams of ascoma types included in view of their fundamental importance in the order. The taxonomy at the generic level is somewhat conservative in the light of recent molecular studies, which show that *Pertusaria* in particular is not monophyletic, but this does not invalidate the species concepts adopted which are the primary concern in floristic studies.

It is pleasing to see this work being authored by lichenologists based in the region, and also marking the return of the second author to the field after a long sojourn with the actinomycetes.

This is a valuable continuation of this important series, although the use of '*Lichenes*' as a group name has long been obsolete, irritates, and still needs to be addressed by the series editors.

Index of Type Specimens of Lichens preserved in the National Science Museum, Tokyo. By Hiroyuki Kashiwadani & Syo Kurokawa, March 2003. National Science Museum, Tokyo, Japan. Pp. 148. ISBN and Price: Not indicated.

The National Science Museum in Tokyo (TNS) is the most important lichen herbarium in Japan. Although the lichen collection was established only in 1962 by Syo Kurokawa, it now holds about 140 000 specimens, including some 30 000 collections of the herbarium of Yasuhiko Asahina. This publication details the 978 type specimens in the collection, providing the places of valid publication of the names, the kind of type, and the label details - transliterated to Roman script when the original was in Japanese. The entries are arranged alphabetically by the original scientific names, and include types in exsiccates of which the museum has sets. There is no doubt that this will save those wishing to locate the original material of Japanese lichen names considerable time, and increase the accessibility of the museum's holdings.

Atlas of the Geographical Distribution of Lichens in Poland. Part 3. Edited by Urszula Bielczyk, Stanisław Cieśliński & Wiesław Fałtynowicz. October 2002. Władysław Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL-31 512, Kraków, Poland. Pp. 114. ISBN 83 85444 93 9. Price € 25.

This part, the first to have appeared since 1999, covers 20 species belonging to 15 genera: *Acarospora, Anema, Caloplaca, Catillaria, Cyphelium, Diploschistes, Fuscopannaria, Micarea, Nephroma, Pannaria, Peccania, Psorotichia, Rinodina, Solorina,* and *Umbilicaria.* As in the companion series on non-lichenized fungi, detailed discussions are followed by maps with records indicated by date category and lists of specimens examined and literature sources. However, a significant and welcome difference is the continued provision of English as well as Polish versions of the discussions side by side – something that can only increase the accessibility of the included data.

The labelling of the *Atlas* as a third part of a series that started in 1993, however, scarcely does credit to the nine fascicles of the *Atlas of Geographical Distribution of Spore-*

Plants in Poland (1971-1988). Fortunately, this 'third part' does include an index of the species treated in the earlier nine volumes of its predecessor *Atlas*.

As the series covers more and more species, it will become increasingly valuable to lichenologists within and outwith the country. The authors and editors are to be congratulated on what has been achieved to date, and encouraged to cover yet further species in such excellent detail in the future.

Conidial Fungi

***Leptographium* Species: Tree pathogens, insect associates, and agents of blue-stain.** By Karin Jacobs & Michael J. Wingfield. 2001. APS Press, 3340 Pilot Knob Road, St Paul, MN 55121-2097, USA. Pp. xiv + 207, figs 156. ISBN 0 89054 278 3. Price: US $ 69.

Despite their importance as tree pathogens and agents of blue wood-stain, there has been no world monograph of the genus available. However, this is much more than a synthesis of what is known, for, as pointed out by Keith Seifert in the book's Foreword, the authors "have been most tenacious in their exploration of the globe for undiscovered *Leptographium* species, . . ". Of the 46 species treated, 31 have been described as new by the authors alone or with others in different publications.

The monograph starts with an overview, discussions of similar genera, associated synnematous synanamoprhs, and *Ophiostoma* teleomorphs, diseases, associated insects (with a table including references to all original sources), host trees (with a similar table), biogeography, methods of isolation, culture and preservation, and genetic methods. After a discussion of terms and how they are employed (e.g. including the conidiogenous cells *within* the conidiophore), both dichotomous and synoptic keys are provided – including ones to the teleomorphs.

Each species is provided with detailed descriptions, information of hosts, associated insects, lists of specimens examined, and first-rate line drawings, and superb light and cryo-scanning electron micrographs. Six excluded or dubious species are discussed, which could not be certainly placed as type material or cultures could not be located.

Three names in *Leptographium*, for which *Ophiostoma* teleomorphs had already been named, are indicated as "sp. nov.": *L. brevicolle*, *L. franke-grosmanniae*, and *L. leptographoides*). None of these names appear to be validly published as no Latin diagnosis was located nor a designated type for just the anamorphosis. I would have preferred to see just the *Ophiostoma* name alone used, as to introduce names for anamorphs where teleomorphs are known is contrary to the spirit of Art. 59 of the *Code*. After all, the authors did use the *Ophiostoma* names first in their arrangement!

This carefully executed and well-presented monograph is sure to remain the standard work on these fungi for many decades, even though the discovery and description of further species is sure to be stimulated by it. The authors indicate that it represents the results of studies over some 20 years, and the quality of the result certainly reflects this and demonstrates again the value of long-term monographic studies in mycology.

Taxonomy and Pathology of *Cylindrocladium* (*Calonectria*) and allied Genera. By Pedro W. Crous. 2002. APS Press, 3340 Pilot Knob Road, St Paul, MN 55121-2097, USA. Pp. xv + 278, figs 320. ISBN 0 89054 290 2. Price: US $ 69.

This superbly researched and presented monograph blends traditional morphomycology with molecular systematics, biochemistry, and plant pathology. Following detailed discussions of the diseases caused and well-illustrated accounts of how to isolate and study these fungi, the results of molecular and other biochemical approaches are presented as a prelude to the systematic treatment. This starts with keys to the anamorphs in the group, first to the genera and then to the species. The species keys have helpful marginal line drawings of the vesicles, which terminate the conidiophores in these fungi and prove to be of immense value in their separation. The teleomorphs in these hypocrealean fungi have clearly evolved less distinctive features than their anamorphs, indeed the author notes that the "teleomorphs . . . would be difficult if not impossible to distinguish without knowledge of their respective anamorphs". This begs the question as to whether subgeneric divisions of a single teleomorph might have been a more prudent taxonomic conclusion, but that is an issue best left for debate elsewhere.

In total, 54 species are accepted in five genera in this monograph: *Cylindrocladium* (39 spp.; 28 with *Calonectria* teleomorphs), *Curvicladium* (1 sp.), *Cylindrocladiella* (8 spp.; two with *Nectricladiella* teleomorphs), *Gliocladiopsis* (1 sp.; teleomorph *Glionectria*), and *Xenocylindrocladium* (1 sp.; teleomorph *Xenocalonectria*). Three new combinations are made, and three new species names introduced. Two of the latter are names proposed for anamorphs where the teleomorphs in *Calonectria* are known, and so quite unnecessary!

The species accounts include nomenclatural information on both anamorph and teleomorph (where known), references to published illustrations, a description, details of cultural characteristics, symptoms of diseases caused, hosts and distribution (with maps), type material and cultures studied, pertinent notes, and both excellent line drawings and unfortunately often too dark photomicrographs. An extensive bibliography, perhaps too-short glossary, and both host and fungal names indices conclude the work.

Notwithstanding differences in approach to the naming of anamorphs and teleomorphs, this is a most impressive contribution destined to be of lasting value to both mycologists and plant pathologists, and is made available at a most reasonable price.

ERRATA

VOLUME EIGHTY-FIVE

The photographs below were numbered incorrectly. Renumber as shown.

Page 291, top left	for	**1**	read	**4**
Page 291, top right	for	**2**	read	**3**
Page 291, lower left	for	**3**	read	**2**
Page 291, lower right	for	**4**	read	**1**

VOLUME EIGHTY-EIGHT

Cover 2, 4th line from bottom	for	*Cltocybe*	read	*Clitocybe*
Page 235, line 11	for	FIGURES 2–9	read	FIGURES 1–9
Page 235, last line	for	*cioceras*	read	*crioceris*

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