

MYCOTAXON

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**FURTHER INVESTIGATIONS ON PHAEOCOLLYBIA WITH NOTES
ON INFRAGENERIC CLASSIFICATION****VICTOR M. BANDALA**

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ABSTRACT

Two new subgenera are proposed, *Fibulophaeocollybia* and *Phaeocollybia*, the former with sections *Subattenuatae* Sing. and *Radicatae* Sing., and the later with sections *Phaeocollybia*, *Versicolores* Smith and *Microsporae* Sing. On the other hand, *Ph. smithi* and *Ph. guzmani* are described as new species and *Ph. subattenuata* Sing., *Ph. oligoporpa* Sing. and *Ph. quercetorum* Sing. are recorded from *Quercus* forests in new localities in Costa Rica. The concept of *Ph. hilaris* (Fr.) s. Horak is discussed resulting to be a synonym of *Ph. arduennensis* Bon. Observations on this later species and on *Ph. ambigua* Horak & Halling and *Ph. similis* (Bres.) Sing. are also presented, based in the types.

INTRODUCTION

The genus *Phaeocollybia* (Heim, 1931) is a well documented genus as Horak and Halling (1991) pointed out. With the monographic study by Horak (1977), classic European species and other described from America (Smith, 1957; Bigelow and Barr, 1963; Singer, 1970; Smith and Trappe, 1972), Asia (Horak, 1974) and Australasia (Horak, 1973) are well known, although some European species are still difficult to delimitate because to differences of interpretation by the authors (Jacobsson and Stridvall, 1982-83; Laber, 1982, 1991; Gulden, 1983; Singer, 1987; Bon, 1992).

Two new subgenera are proposed here based on type studies and others collections either from Europe, SE Asia or North and Central America, and two new species are recognized in sections *Radicatae* and *Microspora*. Also, some collections of *Phaeocollybia* from oak forests of Costa Rica were studied, resulting to be new records for this country. The observations on the analysis developed mainly on European specimens identified as *Ph. hilaris* (Fr.) Heim and *Ph. arduennensis* Bon are presented; the interpretation of *Ph. hilaris* s. Horak (1977) was reconsidered. Preparations for microscopic study were mounted in KOH 5%, Congo red or in Melzer's reagent. Colors indicated in descriptions are based in Kornerup and Wanscher (1978).

Key to subgenera of *Phaeocollybia*

- 1a. Clamp connections present, frequently at the base of cheilocystidia, scarce and scattered on pileus and hymenophoral trama hyphae, sometimes inconspicuous
 **Subgen. Fibulophaeocollybia**
- 1b. Clamp connections absent **Subgen. Phaeocollybia**

***Phaeocollybia* subgenus *Fibulophaeocollybia* subgen. nov.**

Fibulis praesentibus. Sporis ovoideis minutis at limoniformibus magnus. Cheilocistidiis versiformibus.

Type species: *Phaeocollybia subattenuata* Sing., Sydowia 15: 78, 1961.

Phaeocollybia was considered by Smith (1957) with two sections based on cheilocystidia form. Singer (1970; 1987) studying neotropical representatives, included clamp connections and spore size into the analysis of infrageneric classification and added three new sections. Following this proposals, the presence of clamps in two of the three sections by Singer, *Subattenuatae* Sing. and *Radicatae* Sing., can be considered to place this taxa taxonomically isolated in a new subgenus which is proposed here. Members of this subgenus show a notable presence of clamps at hyphal septa, being more common at bases of cheilocystidia and sometimes at basidia. However, in some species such as *Ph. oligoporpa* Sing., *Ph. latispora* Guzmán, Bandala & Montoya and *Ph. spoliata* Horak, clamps are scarce and scattered being almost inconspicuous.

Key to Sections of Subgenus *Fibulophaeocollybia*

- 1a. Spores more than 7 μm length, ellipsoid to limoniform
 **Sect. *Subattenuatae***
- 1b. Spores smaller, up to 7 (-7.5) μm length, ovoid to
 subellipsoid **Sect. *Radicatae***

Section *Subattenuatae* Sing., *Fl. Neotr.* 4: 4, 1970.

Type species: *Phaeocollybia subattenuata* Sing., Sydowia 15: 78, 1961.

Ph. latispora Guzmán, Bandala & Montoya, *Ph. spoliata* Horak, *Ph. viridis* Horak, *Ph. oligoporpa* Sing. and *Ph. subattenuata* Sing. belong to this section, the two later are discussed in detail below. Singer (1987) also included *Ph. brasiliensis* Araujo ex Sing., *Ph. elaeophylla* Sing. and *Ph. megalospora* Araujo ex Sing. (and its *var. tetraspora* Sing.). Another species belonging to section Subattenuatae is *Ph. deceptiva* Smith & Trappe according with descriptions in Smith and Trappe (1972) and Horak (1977).

Most of the species in this section are associated with broad-leaved trees, in subtropical or tropical regions (Singer, 1970; 1987; Horak, 1973; 1977; Horak and Halling, 1991). However, *Ph. deceptiva* Smith & Trappe, *Ph. latispora* and *Ph. spoliata* are exclusively distributed in coniferous forests (Smith and Trappe, 1972; Horak, 1973; 1977; Bandala *et al.*, 1989). This section was not considered by Bon (1991; 1992) and according to his data, species considered in this section could be grouped either in his sect. *Phaeocollybia*, subsect. *Phaeocollybia* or in his sect. *Versicolores*, subsect. *Versicolorinae* (Smith) Bon. It must be taken in to account that Bon exclusively studied European species of which only *Ph. arduennensis* Bon has clamps, and is considered here as a typical conifer-associated member of sect. *Radicatae* (see below).

The following new records of sect. *Subattenuatae* were studied.

***Phaeocollybia oligoporpa* Sing., *Mycol. Helvetica* 2: 250, 1987.**

Figs. 1-3

This species occurs under *Quercus* and is known from Costa Rica (type locality) (Singer *op. cit.*), Mexico (Bandala *et al.*, 1989) and Colombia (Horak and Halling, 1991). The material studied here proceeds from a *Quercus* forest at a new locality of Costa Rica and agree with descriptions given by those authors and with the type material, except by having a strong farinaceous odor. *Ph. oligoporpa* has been reported with

raphanoid odor to somewhat like watermelon (Horak and Halling, *op. cit.*) or without distinctive odor (Singer, 1987). The studied specimen presented pileus up to 70 mm in diam., conic, reddish-orange to reddish-brown, lubricous, lamellae cream color when young; spores 9.6-11.2 (-12) x 5.6-6.4 μm , limoniform, mucronate, \pm strongly verrucose, clamps scarce, cheilocystidia versiform and occasionally clamped at base, epicutis gelatinized.

Material studied. COSTA RICA: km 24 road to The Crater, Irazú Volcano, Jul. 17, 1991, *García 7185* (ITCV; XAL). Cartago, Chonta, km 55 route 1, Jul. 11, 1982, *Gomez 18196* (Type, F 1052230).

Phaeocollybia subattenuata Sing., *Sydowia* 15: 78, 1961.

Figs. 4-8

Relevant microscopic features to recognize this species are the epicutis and the form and size of spores and cheilocystidia. The apical germ pore of the spores was not indicated by Singer (1961; 1970), who described spores 7.5-8.2 x 4.5-5.5 μm . On the other hand, Horak (1977) described *Ph. subattenuata* without clamps (although these structures appear in his drawings) and spores 6.5-8 x 4-5 μm , with a germ pore at apex. This author synonymized *Ph. amazonica* Sing. with *Ph. subattenuata*, a species also occurring in tropical forests, but in accordance with the description by Singer (1961; 1970) *Ph. amazonica* has spores with an apical callus and without a true germ pore.

Ph. subattenuata is recorded for the first time from Costa Rica and it is not restricted to tropical forests. It was known only from the type locality in Bolivia, growing in tropical rain forest (Singer, 1961; 1970). The material studied was collected on the ground in a montane forest with *Quercus*. It has pileus up to 16 mm in diam., conic to campanulate with an acute apex, reddish-brown (\pm 8F7) with paler center, hygrophanous, glabrous, margin translucent-striate, lubricous to viscid.

Lamellae subadnexed, close, thin, ochraceous-brown (7D8). Stipe up to 105 x 1 mm, cylindric, smooth, attenuate upwards, apical portion concolorous with pileus surface, base almost blackish. Context yellowish-orange to orange-brown, with radish odor. Spores 7.2-8 (-8.8) x (4.4-) 4.8-5.2 μm , subellipsoid to subamygdaliform, with an apical germ pore which sometimes is inconspicuous, minutely verrucose to verrucose-punctate, thin walled, yellowish to yellowish-brown, inamyloid. Basidia 4-spored, claviform, hyaline. Pleurocystidia absent. Cheilocystidia (16-) 20-36 (-40) x (3.2-) 4-5.6 μm , numerous, subcylindric to subcylindric-clavate, with subcapitate apex, flexuous, commonly clamped at base, hyaline, thin walled. Epicutis little differentiated with slightly gelatinized hyphae. Clamps numerous.

Material studied. COSTA RICA: Poas Volcano slope, Alajuela, Jul. 18, 1991, *García 7192* (ITCV; XAL). BOLIVIA: Las Piedras, Prov. Madre de Dios, Departamento Pando, April 5, 1956, *Singer B-2510* (Type, LIL).

Additional species studied of sect. *Subattenuatae*:

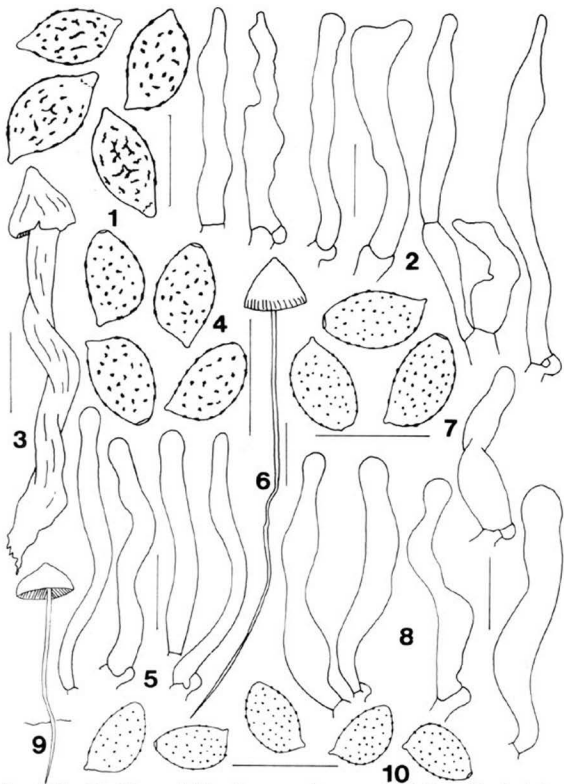
Ph. latispora Guzmán, Bandala & Montoya, MEXICO: Hidalgo, road Mineral del Monte to El Chico, under *Abies religiosa*, Aug. 13, 1980, *Chacón 8* (Type, XAL).

Ph. spoliata Horak, INDIA: Himachal Pradesh, Narkanda, in clearing of *Pinus wallichiana*-*Picea smithiana* forest, Aug. 6, 1964, *Maas Geesteranus 14167* (Holotype, L; Isotype, ZT 70/272; XAL).

Ph. viridis Horak, NEW GUINEA: Papua, Morobe District, Wau, Kaindi, under *Nothofagus*, April 3, 1972, *Horak & Benecke* (Holotype, ZT 72/357; Isotype, XAL).

Section *Radicatae* Sing., *Fl. Neotr.* 4: 4, 1970.

= Sect. *Versicolores* subsect. *Radicatinae* (Sing.) Bon, *Doc. Mycol.* 83: 37, 1991.



Figs. 1-10. 1-3: *Phaeocollybia oligoporpa*, 1: spores; 2: cheilocystidia (both from the type); 3: basidiome (García 7185). 4-8: *Ph. subattenuata*, 4: spores; 5: cheilocystidia (both from the type); 6: basidiome; 7: spores; 8: cheilocystidia (García 7192). 9-10: *Ph. arduennensis*, 9: basidiome; 10: spores (both from the type) (scale bar = 10 μ m, except 3= 20 mm; 6= 16 mm; 9= 15 mm).

Type species: *Phaeocollybia radicata* (Murr.) Sing., Lilloa 22: 567, 1951.
 - *Naucoria radicata* Murrill, North Amer. Fl. 10: 181,
 1917.

Most representatives of this section are associated with broad-leaved trees but some species occur under conifers. The North American species *Ph. radicata* (Murr.) Sing., which grows associated with conifers (Murrill, 1917; Smith, 1957; Horak, 1977; Goetz, 1979), was considered by Singer (1970) as the type of this section. Later, Singer (1987) placed in this section *Ph. subarduennensis* Sing. and *Ph. flava* Araujo ex Sing., the former from a *Quercus* forest in Costa Rica and the later from a lowland forest in Amazonia, along with *Ph. arduennensis* Bon, an European conifer-associated species (Bon, 1979, 1992; Gulden, 1983; Singer, 1987; Laber, 1982; Contu, 1991)(see below). Other species belonging to this section according to data published by Horak (1973; 1977) and Smith and Trappe (1972) are *Ph. oregonensis* Smith & Trappe, *Ph. bicolor* Horak, *Ph. minuta* Horak, and *Ph. tentaculata* Horak, the former growing in coniferous forests in North America and the other three under *Nothofagus* in New Guinea and New Zealand.

Among the species included in this section, *Ph. arduennensis* was studied and a new species from North America are described, both growing under conifers.

***Phaeocollybia arduennensis* Bon, Doc. Mycol. 9: 42, 1979.**

= *Ph. cidaris* s. Bresinsky, Zeit. f. Pilzk. 26: 114, 1960.

= *Ph. jennyi* s. Moser (s. Lange).

= *Ph. hilaris* s. Horak, Sydowia 29: 64, 1977.

non *Ph. arduennensis* s. Bandala et al., Mycotaxon 35: 137,
 1989.

Figs. 9-15

For macroscopic details see Bon (1979; 1992), Laber (1982;

1991), Jacobsson and Stridvall (1982-83), Gulden (1983), Singer (1987) and Contu (1991).

Spores (4.8-) 5.6-6.4 (-6.8) x 3.2-4 (-4.4) μm , subovoid to subamygdaliform, with a rounded apex (not attenuate), bearing a minute, sometimes inconspicuous germ pore, asperulate to finely punctate, thin walled, yellowish, inamyloid. Basidia 4-spored, clavate, hyaline, thin walled. Pleurocystidia absent. Cheilocystidia (19.2-) 28-60 (-64) x 2.4-4 (-4.8) μm , cylindric, sometimes versiform, occasionally submoniliform, flexuous, with a subcapitate or capitate apex (2.4-) 4-6.4 (-7.2) μm in diam., numerous, hyaline, thin walled, frequently clamped at base. Epicutis poorly developed as a thin, not gelatinized, interrupted layer of repent, hyaline to yellowish-brown hyphae, 1.6-5.6 μm in diam. Clamp connections numerous.

Habitat. Gregarious, on soil under conifers.

Material studied. FRANCE: Ardennes, Servigny, Oct. 1977, *Bon s.n.* (Type, Lille 771002). Env. St. Brieve, Aug. 29, 1987, *Citerin s.n.* (Lille 870829). GERMANY: Bayern, Bayrischer Wald, Kohlplatz östlich Bodenmais, Sept. 6, 1967, *Moser s.n.* (IB 67/113); Bayern, Wellenburg bei Augsburg, Aug. 1960, *Bresinsky s.n.* (M 124-92/3). Bayern, Umgebung von Augsburg, Berheim, Aug. 13, 1960, *Stangl & Bresinsky s.n.* (M 124-92/1); Aug. 13, 1960, *Stangl & Bresinsky s.n.* (M 124-92/2).

Observations. This species is distinguished by its small spores with an apical germ pore, presence of clamps and cheilocystidia form. It is typical from coniferous forests in Europe (Bon, 1979; 1992; Laber, 1982; Jacobsson and Stridvall, 1982-83; Gulden, 1983; Singer, 1987; Contu, 1991). Laber (1982) suggested that *Ph. hilaris* s. Horak was a synonym of this species and afterwards both Laber (1991) and Gulden (pers. comm.) reaffirmed it. The collections at M and IB herbaria indicated above and identified by Horak (1977: 64) as *Ph. hilaris* present clamps (figs. 12-15) and undoubtedly they are conespecific with *Ph. arduennensis*.

On the other hand, Gulden (1983) studied all Danish collections interpreted by Lange as *Ph. jennyi* (concept frequently found in European literature), concluding that they correspond to *Ph. arduennensis*. Records of *Ph. arduennensis* from Mexico by Bandala *et al.* (1989) correspond to a different taxon which has clamps but its spores are slightly rostrate at apex and without a true germ pore, therefore closer to *Ph. subarduennensis* Sing.

***Phaeocollybia smithi* Bandala et Montoya, sp. nov.**

Figs. 16-17

Pileus 10-30 mm latus, conico-umbonatus ad conico-expansus, castaneus ad pallidus fuscoaurantiacus, viscidus, glabrous. Lamellae subadnexae, conferta, ochraceae. Stipes 50-90 x 25-40 mm, attenuato-radicatus, cum pseudorriza, pileo concolor, basim fuscovinaceus, glabrous, subcartilagineus. Sporae (4.8-) 5.2-6 (-6.4) x 3.2-3.6 (-4) μm , subgloboseae ad subovoideae, minute verrucosae, pallide ochraceae. Cheilocystidia (16-) 17.6-25.6 (-28) x (1.6-) 2.4-4 μm , clavata vel cilindrico-clavata. Epicutis gelatinous. Fibulis praesentibus. Ad terram in coniferous sylvis.

U.S.A., Michigan, Jabquamenon Falls State Park, July 23, 1951, Smith 37092 (MICH, Type).

For macroscopic details see *Ph. jennyi* in Smith (1957).

Spores (4.8-) 5.2-6 (-6.4) x 3.2-3.6 (-4) μm , subglobose to subovoid, finely verrucose to verrucose-punctated, yellowish with yellowish-brown ornamentation, thin walled. Basidia 17.5-24 x 4-5.6 μm , tetraspored, claviform, hyaline. Cheilocystidia (16-) 17.6-25.5 (-28) x (1.6-) 2.4-4 μm , claviform to cylindric-claviform, hyaline, thin walled, numerous, sometimes inconspicuous. Epicutis a thin layer of hyaline to yellowish, gelatinized hyphae, 1.6-8 μm in diam., smooth or frequently with small incrustations. Subcutis hyphae 4-16 μm in diam., yellowish or yellowish-

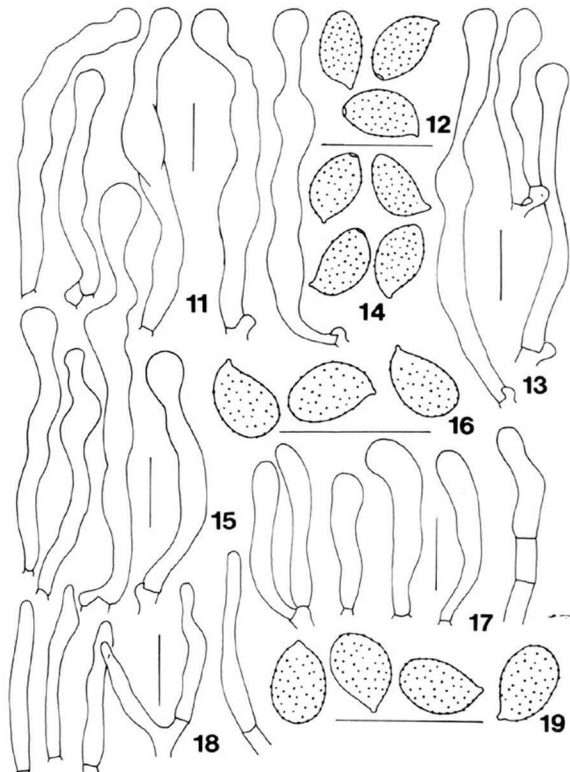
brown, but orange-brown in mass, subventricose, smooth or incrusted. Context hyphae 4-24 μm in diam., smooth, hyaline. Hymenophoral trama regular, hyphae 2.4-16 μm in diam., smooth, hyaline. All hyphae thin walled and most of the septa clamped, especially those of hymenophoral trama.

Habitat. Gregarious in the ground among *Pteridium* rhizomes, under conifers.

Studied material. U.S.A.: Michigan, Jabquamenon Falls State Park, July 23, 1951, *Smith 37092* (**Type, MICH**); July 16, 1951, *Smith 36892* (**MICH**, as "*Ph. jenniae*").

Observations. Smith (1957) interpreted the studied specimens as *Ph. jennyi* (Karst.) Heim, but he pointed out '... the interpretation of this species given here is based on the type specimen ... microscopic characters checked exactly with those of my collection with one exception ... on the type no clamp connections were found'. A comparison with the type material of *Ph. jennyi* (see below) showed in fact, that the North American specimens are not identical with this European species and belong to an independent taxon which is distinguished by spores size, clamped hyphae and cheilocystidia form. It must be considered as an isolated new species in section *Radicatae*.

The type of *Naucoria jennyi* Karst., Finland: Tavastia australis. Tammela, Syrjä, Aug. 13, 1881, *Karsten s.n.* (**H 1612**) (figs. 18-19), has clampless hyphae and claviform cheilocystidia characteristic of section *Microspora* Sing. Relevant microcharacters of it are: spores 4.8-5.6 x 3.2-3.6 (-4) μm , subglobose to subovoid, finely verrucose to verrucose-punctated, yellowish. Cheilocystidia (11.2-) 16-28 (-32) x 1.6-2.4 μm , cylindric to cylindric-filamentose, numerous, hyaline, thin walled. Epicutis poorly developed as a thin, frequently interrupted layer with gelatinized hyphae 1.6-6.4 μm in diam., hyaline, smooth or finely punctated. Subcutis hyphae 8-20 μm in diam., yellowish, thin walled, incrusted. Context



Figs. 11-19. 11-15: *Phaeocollybia arduennensis*, 11: cheilocystidia (type); 12: spores; 13: cheilocystidia (both from Moser 67/113); 14: spores; 15: cheilocystidia (both from Bresinsky Aug., 1960); 16-17: *Ph. smithi*, 16: spores; 17: cheilocystidia (both from the type). 18-19: *Ph. jennyi*, 18: cheilocystidia; 19: spores (both from the type of *Naucoria jennyi*)(scale bar = 10 μ m).

hyphae up to 16 μm in diam., hyaline, thin walled, smooth. Hymenophoral trama subregular, hyphae 3.2-12 μm in diam. Clamps absent.

Ph. smithi is close to *Ph. radicata* (Murr.) Sing. and *Ph. oregonensis* Smith & Trappe, both also North American species. However, the first one differs in its capitata cheilocystidia, and the second by the bigger subellipsoid spores 6-7.5 x 3.5-4.5 μm (Smith, 1957; Smith and Trappe, 1972; Horak, 1977).

The name of this species is in honor of Dr. Alexander H. Smith, pioneer in the study of *Phaeocollybia* in North America.

***Phaeocollybia* subgenus *Phaeocollybia* subgen. nov.**

Fibulis absentibus. Sporis subglobosis vel subovoides minutis ad ellipsoidiis vel limoniformibus magnus. Cheilocystidiis clavatis vel subcylindricis vel filamentoso-subclavatis vel capitatis.

Type species: *Phaeocollybia festiva* (Fr.) Heim, *Encycl. Myc.* 1:70, 1931.

Absence of clamp connections is the most relevant character. Like in subgenus *Fibulophaeocollybia*, species associated either with conifers or broad-leaved trees are also found. Sections *Phaeocollybia*, *Versicolores* Smith and *Microsporae* Sing. are placed here.

Key to sections of subgenus *Phaeocollybia*

- 1a. Spores up to 6.5 (-7) μm length; subglobose
to subovoid or subellipsoid

..... **Sect. *Microsporae***

- 1b. Spores larger than 6.5 (-7) μm length;
 ellipsoid, subamygdaliform or sublimoniform
 to limoniform (distinctly mucronated) 2
- 2a. Cheilocystidia notably capitate or attenuate at
 apex **Sect. Versicolores**
- 2b. Cheilocystidia filamentous, cylindrical or clavate,
 never decidedly capitate or attenuate at apex
 (sometimes only with a weak constriction below
 the tip, appearing as subcapitate)
 **Sect. Phaeocollybia**

Section Microspora Sing., Fl. Neotr. 4: 6, 1970.

= Sect. Versicolores subsect. Microspora (Sing.) Bon, *Doc. Mycol.* 83: 37, 1991.

Type species: *Phaeocollybia jennyi* (Karst.) Heim, *Encycl. Mycol.* 1: 70, 1931.

= *Naucoria jennyi* Karsten, *Hedwigia* 12: 178, 1881.

= *Phaeocollybia christinae* s. Heim, *Bull. Soc. Myc. Fr.* 46, tab. 38., 1930.

Two species that occur in forest with conifers were studied: *Ph. jennyi* from Europe and a new species from Mexico. According with descriptions in Horak (1973; 1977) and Horak and Halling (1991) also can be placed here *Ph. corneri* Horak, *Ph. querqueti* Corner & Horak, *Ph. caudata* Horak & Halling, *Ph. parvispora* Horak and *Ph. ratticauda* Horak. Concerning to the type of the section Singer (1970; 1975; 1986) considered *Ph. christinae* s. Heim (1930) as the type, which is conespecific with *Ph. jennyi* (Horak, 1977; Laber, 1982, 1991; Jacobsson and Stridvall, 1984-83; Singer, 1987).

***Phaeocollybia guzmani* Bandala et Montoya, sp. nov.**= *Ph. hilaris* s. Bandala et al., *Mycotaxon* 35: 138, 1989.

Figs. 20-23

Pileus 25-52 mm latus, convexo-umbonatus, brunneo ad brunneo-aurantiacus vel fulvo-aurantiacus, viscidus, glabrous. *Lamellae* subliberae, conferta flavo-brunneae ad brunneo-ferrugineae. *Stipes* 50-75 x 2-3 mm, fusiformis, radicans, pileo concolor, glabrous. *Sporae* 4.8-5.6 (-6.4) x (2.4-) 2.8-3.2 (-4) μm , subovoideae ad subellipsoideae, asperulatae ad minute-verrucosae. *Cheilocystidia* 20- 40 (-44) x 1.6-6.4 μm , rotundato-cylindraceae ad subcylindraceae, apicem 2.4-4.8 (-5.6) μm latus. *Epicutis* gelatinous. *Fibulae* desunt. Ad terram in *Abies sylvis*.

Mexico, State of Mexico, Prope Popocatépetl, Amecameca-Tlamacas, July 24, 1966, *Guzmán 5178* (holotype ENCB; isotype XAL).

For macroscopic details see *Ph. hilaris* in Bandala et al. (1989).

Spores 4.8-5.6 (-6.4) x (2.4-) 2.8-3.2 (-4) μm , subovoid to subellipsoid, with a rounded apex, asperulate to minutely punctate, yellowish, thin walled, inamyloid. Basidia 4-spored, clavate, hyaline. Pleurocystidia absent. Cheilocystidia 20-40 (-44) x 1.6-6.4 μm , cylindric to \pm subcylindric-clavate with subcapitate apex 2.4-4.8 (-5.6) μm in diam., numerous but sometimes inconspicuous, hyaline, thin walled. Epicutis developed as a layer of repent, interwoven, hyaline to yellowish hyphae, 2.4-6.4 μm in diam., gelatinized. Clamp connections absent.

Habitat. Gregarious on soil under conifers.

Material studied. MEXICO: State of Mexico, road Amecameca to Tlamacas, near Tlamacas, Popocatepetl Volcano, Jul. 24, 1966, *Guzmán 5178* (Holotype ENCB; Isotype XAL); Nov. 6, 1983, *Sampieri 540* (XAL).

Observations. *Ph. guzmani* is distinguished by the brown to orange-brown color of the basidiomata, the size and form of the spores and cheilocystidia as well as by the absence of clamps. It is related with *Ph. jennyi* and *Ph. rancida* Horak, both associated with conifers, the former from Europe (Horak, 1977; Laber, 1982; 1991; Jacobson and Stridvall, 1982-83; Gulden, 1983; Bon, 1992) and Canada (Redhead y Malloch, 1986), and the latter from India (Horak, 1974; 1977). *Ph. jennyi* (figs. 18-19) differs by its subglobose spores $4.8-5.6 \times 3.2-3.6$ (-4) μm and by its filamentous to cylindrical cheilocystidia $1.6-2.4 \mu\text{m}$ wide. *Ph. rancida* can be distinguished by the lilaceous color in lamellae and stipe context when young, the rancid odor of the context and the cheilocystidia $4-5 \mu\text{m}$ wide, notably ventricose-fusoid (Horak, 1974; 1977).

One of the collections indicated above (Sampieri 540) was interpreted by Bandala *et al.* (1989: 138) as *Ph. hilaris* s. Horak (1977) mainly because the absence of clamps. The concept of *Agaricus hilaris* Fr. has been confused. Singer (1986, foot note p. 665) outlined the difficulties in considering the correct interpretation either by Ricken (1915 as *Naucoria*) or by Horak (1977 as *Phaeocollybia*) because "... neither is based on authentic or toptotypical material..." Since data provided by Horak (1977) were based and compared with authentic and European collections of *Phaeocollybia*, his proposals were followed. *Ph. hilaris* was accepted having minute spores, subcapitate cheilocystidia and clampless hyphae, whereas *Naucoria hilaris* s. Ricken (1915) was accepted contaxic with *Phaeocollybia christinae* (Fr.) s. Heim 1931 (Kühner and Romagnesi, 1957; Horak, 1977; Moser, 1978; Laber, 1982; Singer, 1986). Bresinsky (1960) accepted *Naucoria hilaris* following Ricken's concept.

However, nowadays (see above) and in accordance with other authors (Laber, 1982; 1991; Gulden, 1983) is clear that all collections named by Horak (1977) under *Ph. hilaris* are conespecific with *Ph. arduennensis*. Jacobsson and Stridvall (1982-83) and Bon (1982; 1992) collected European specimens recognizing *Ph. hilaris* following Horak (1977). Nevertheless, Laber (1991) stated that in collections by Jacobsson

and Stridvall (1982-83) cheilocystidia were not observed and Gulden (pers. comm.) concluded that these materials not belong to *Phaeocollybia*. On the other hand, data of *Ph. hilaris* given by Bon (1992) are not also conclusive. One material from France at Lille (Foret de Somail, Oct. 20, 1982, *Bon s.n.*, Lille 82282) used in Bon's description was studied here, but it is in very poor conditions. It present spores 5.6-6.4 (-7.2) x 3.6-4 (-4.4) μm , gelatinized epicutis, clampless hyphae and cheilocystidia (?) (20.8-) 22.4-32 x 2.4-4 μm (figs. 24-25). Actually a satisfactory interpretation of *Agaricus hilaris* Fr. is not available and at least it seems to be a very rare species even in the area of Femsjö where Moser (pers. comm.) collected during 22 seasons and found that *Ph. christinae* (Fr.) Heim, *Ph. lugubris* (Fr.) Heim and *Ph. festiva* (Fr.) Heim are more common.

The name of this species is in honor of Dr. G. Guzmán by his arduous labor of more than 35 years researching and teaching the taxonomy of Mexican fungi.

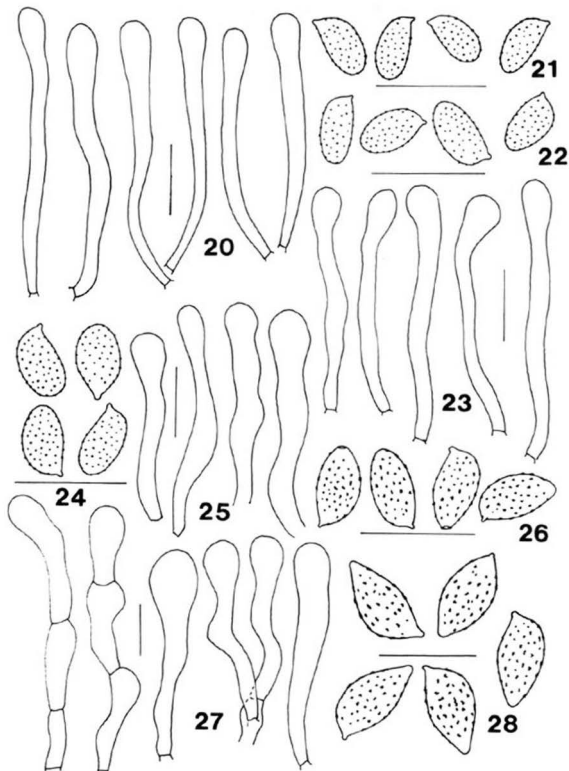
Section *Versicolores* Smith, *Brittonia* 9: 209, 1957.

Type species: *Phaeocollybia lugubris* (Fr.) Heim, *Encycl. Mycol.* 1: 71, 1931.

Members of this section are distinguished mainly by cheilocystidia subventricose or sublageniform, having a long neck or sometimes subcylindric and tapering apically, with a remarkably capitate apex. Singer (1970; 1986) considered here *Ph. columbiana* Sing. and *Ph. cidaris* (Fr.) Heim s. Horak (1977), together with some species listed below which were studied also. Moreover, Singer (1986) grouped *Ph. spoliata* in this section according to Horak's description (1974; 1977), but by the clamps found in the type, now it is placed in sect. *Subattenuatae*.

Studied species of sect. *Versicolores*:

Ph. californica Smith, U.S.A.: California, Crescent city, Del Norte Co.,



Figs. 20-28. - 20-23: *Phaeocollybia guzmani*, 20: cheilocystidia; 21: spores (both from the type); 22: spores; 23: cheilocystidia (both from Sampieri 540). 24-25: *Ph. hilaris* (s. Bon), 24: spores; 25: cheilocystidia (both from Lille 82282). 26-27: *Phaeocollybia ambigua*, 26: spores; 27: cheilocystidia (both from the type). 28: *Ph. quercetorum*, 28: spores (type)(scale bar = 10 μ m).

under conifers, Nov. 23, 1956, *Smith 55610* (Type, MICH).

Ph. lugubris (Fr.) Heim, GERMANY: Bayern, Wellenburg im Lkr. Augsburg im Fichtenjungholz, Aug. 17, 1959, *Bresinsky s.n.* (M). SWITZERLAND: Seengen, AG, Eichberg, Oct. 9, 1964, *Horak s.n.* (ZT 64/334; XAL).

Ph. martinicensis Guzmán, Bandala & Montoya, MEXICO: Veracruz, SW Banderilla, Cerro de La Martinica, Banderilla Co., mesophytic forest (subtropical), Aug. 10, 1976, *Guzmán 16380* (Holotype, ENCB; Isotype, XAL; ZT).

Ph. olivacea Smith, U.S.A.: Oregon, Grant's Pass., Josephine Co., in oak and pine woods, Nov. 17, 1956, *Smith 55767* (Type, MICH).

Ph. pseudofestiva Smith, U.S.A.: California, Crescent city, Del Norte Co., under spruce, Oct. 31, 1937, *Smith 8272* (Type, MICH).

Section *Phaeocollybia*

Type species: *Phaeocollybia festiva* (Fr.) Heim, *Encycl. Mycol.* 1: 70, 1931.

Distinctive characteristics of this section are those considered in the key. Fourteen species associated to conifers or broad-leaved trees were studied, three of which are discussed as follows.

Phaeocollybia ambigua Horak & Halling, *Mycologia* 83: 464, 1991. Figs. 26-27

Horak and Halling (*op. cit.*) described this species from a *Quercus* forest in Colombia and considered it to be an intermediate member between sect. *Microspora*e and sect. *Phaeocollybia* according the length of the spores. They stated that unless by ecological requirements this species keys out close to Mexican specimens of *Ph. hilaris* (actually under *Ph. guzmani* as indicated above). However, the type of *Ph. ambigua* has big spores [(6.4-) 7.2-8 x 4-4.4 (-4.8) μm] inclusive bigger than those reported by Horak and Halling and cheilocystidia (12-) 20-36 (-40) x 3.2-

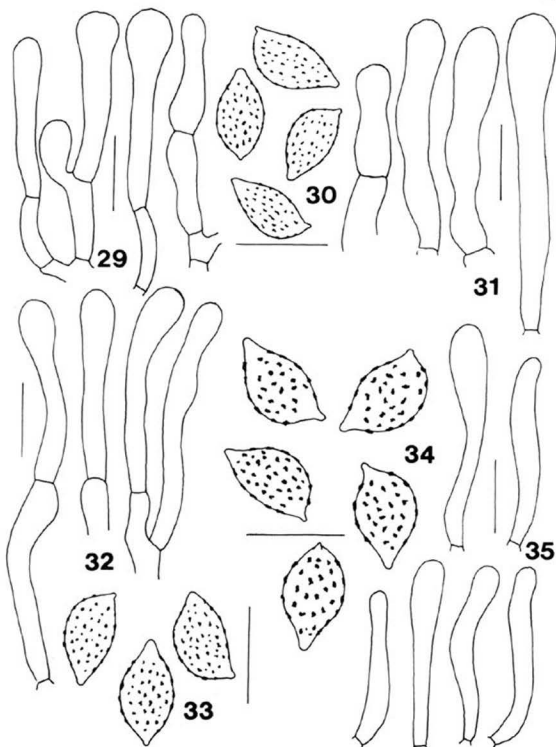
4.8 μm , clavate to subcylindric-clavate. This authors described spores (5.5-) 6-7 x 3.5-4 μm and cheilocystida 10-30 x 4-12 μm , polymorphic or clavate.

Material studied. COLOMBIA: Dept. Nariño, Mpio. de Pasto, 8 km E of Chachagüí, Bosque El Común, Nov. 22, 1988, *Halling 6131* (Holotype NY).

Phaeocollybia quercetorum Sing., *Mycol. Helvetica* 2: 254, 1987.

Figs. 28-33

This species was described from a *Quercus* forest in Costa Rica (Singer, 1987) and later reported from a *Quercus* forest in Colombia (Horak and Halling, 1991). The studied specimens were collected from a new locality in Costa Rica also associated with *Quercus* and present the following features: pileus 30-70 mm in diam., conic-campanulate, viscid, glabrous, orange-brown (7C6) to reddish-brown (8F6); lamellae almost free, close, pale brown (5C4) to yellowish-brown (\pm 5B6); stipe 130-170 x 8-11 mm, tapering towards the base, \pm concolorous with pileus surface; context white to cream color, with farinaceous odor; spores (8-) 8.8-9.6 x (4.4-) 4.8-5.6 μm , sublimoniform to sublimoniform-ellipsoid, attenuate towards the tip, apex slightly mucronate, apiculous conspicuous, finely verrucose, yellowish; cheilocystidia (16-) 20-40 (-48) x 2.4-4 μm , clavate to subcylindric-clavate, hyaline, thin walled, numerous; epicutis gelatinized; clamps absent. This material was compared with the type (*Singer B 12399*, F)(figs. 28-29). Singer (1987) reported a phenol like odor while Horak and Halling (1991) described a raphanoid odor. The farinaceous odor recorded in materials from Costa Rica relate it with *Ph. singerii* Guzmán, Bandala & Montoya from Mexico (Guzmán *et al.*, 1987), which also occurs under broad-leaved trees, but this later species is distinguished by its smaller, subellipsoid to subamygdaliform spores (weakly attenuate towards apex), 7.2-8 (-8.8) x 4-4.8 (-5.6) μm and claviform-globose, subutriform or cylindric-clavate cheilocystidia 17.6-25.6 x 4-6.4 (-7.2) μm .



Figs. 29-35.- 29-33: *Phaeocollybia quercetorum*, 29: cheilocystidia (type); 30: spores; 31: cheilocystidia (both from García 7143); 32: cheilocystidia; 33: spores (both from García 7141). 34-35: *Ph. similis*, 34: spores; 35: cheilocystidia (both from type of *Naucoria similis*)(scale bar = 10 μ m).

Material studied. COSTA RICA: Heredia, Barba, San José de la Montaña, Paso Llano, under *Quercus*, Jul. 15, 1991, *García 7141; 7143* (ITCV). Cartago, El Empalme, in a *Quercus* forest, Jul. 23, 1981, *Singer B12399* (Type F as *Ph. querceti*).

Phaeocollybia similis (Bres.) Sing., *Lilloa* 22: 567, 1949.

= *Naucoria similis* Bres., *Icon. Myc.* 16, tab. 794, 1930.

non *Ph. similis* s. Smith, *Brittonia* 9: 207, 1957.

Figs. 34-35

This species was placed by Singer (1987) in sect. Subattenuatae according to the presence of clamps. However, Horak (1977) revising the type, pointed out the absence of these structures. Material from China at **WU** considered by Singer *op. cit.* as the isotype, was studied here and no clamps were found, which situates *Ph. similis* in subgen. *Phaeocollybia*, as a member of sect. *Phaeocollybia*. This material has spores 8.8-11.2 x 5.6-7.2 (-8) μm , limoniform to limoniform-globose, with attenuated apex forming a mucron, apiculous conspicuous, thin walled, strongly verrucose, yellowish with yellowish-brown ornamentation, inamyloid; basidia 4-spored, clavate, sometimes trisporic, hyaline; pleurocystidia absent; cheilocystidia (18.4-) 20-29.6 x 3.2-4 (-4.8) μm , subcylindric to subcylindric-clavate, numerous but sometimes inconspicuous, hyaline, thin walled and epicutis not gelatinized.

Ph. similis, *Ph. neosimilis* Sing. and *Ph. attenuata* (Smith) Sing. are the only species in this section that has limoniform-globose, mucronate, and strongly or \pm strongly verrucose spores. The type of *Ph. similis* was collected probably in fagaceous forest (Singer, 1987). The two latter species occur in forests dominated by conifers and also are distinguished by their smaller spores, (8.4-) 8.8-9.6 (-10.4) x (5.2-) 5.6-6.4 μm in *Ph. neosimilis* which is known only from Mexico (Singer, 1957; 1970) and spores (6.4-) 7.2-8.8 x 4.8-5.6 μm in *Ph. attenuata* from U.S.A. (Smith, 1937; 1957). On the other hand, Horak (1977) and Singer (1987) agree

in that the specimen described by Smith (1957) under *Ph. similis* corresponds to a different taxon. Horak (1977) considered it probably to be *Ph. piceae* Smith & Trappe while Singer (1986; 1987) suspected it to be *Ph. neosimilis* Sing.; may be this latter determination be correct due to the limoniform-globose spores and non caespitose habit described by Smith (1957).

Material studied. CHINA: Prov. Yünnan bor.-occid., circa vicum Ngulukö prope urbem Lidjang, in regione temperata, Sep.-Oct. 1916, *Handel-Mazzeti 12690* (WU, **Isotype** of *Naucoria similis* Bres.).

Additional species studied of sect. Phaeocollybia:

Ph. attenuata Smith, **U.S.A.:** Washington, near Lapush, Clallam Co., under Douglas fir, Oct. 2, 1935, *Smith 3343* (**Type MICH**).

Ph. christinae (Fr.) Heim, **SWEEDEN:** Smaland, Femsjö, under conifers, *Bresinsky 4-312* (M as *Ph. lateraria*). **SWITZERLAND:** Valle di campo Fumina, under conifers, Sep. 5, 1974, *Horak 74/304* (ZT).

Ph. fallax Smith, **U.S.A.:** Washington, near Lapush, Quillayute river, Clallam Co., under sitka spruce, Oct. 26, 1935, *Smith 3342* (**Type MICH**).

Ph. kauffmanii (Smith) Sing., **U.S.A.:** Oregon, Lake Tahkenitch, Douglas Co., under spruce, Nov. 18, 1935, *Smith 3523* (**Type MICH**).

Ph. muscicolor Horak, **NEW GUINEA:** Papua, Morobe district, Bulolo, Watut, in *Nothofagus* forest, Jan. 23, 1972, *Horak 72/115* (**Holotype ZT; Isotype XAL**).

Ph. neosimilis Sing., **MEXICO:** Estado de Mexico, Popocatépetl Volcano, San Pedro Nexapa to Paso de Cortés, under *Abies religiosa*, Jul. 24, 1957, *Singer M1586* (**MICH, Type** of *Ph. attenuata* ssp. *mexicana* Sing.).

Ph. odorata Horak, **NEW GUINEA:** Papua, Morobe district, Bulolo, Watut, in *Lithocarpus* forest, Nov. 22, 1972, *Horak 73/313* (**Holotype ZT; Isotype XAL**).

Ph. piceae Smith & Trappe, **U.S.A.:** Oregon, Cascade Head Experimental Forest, Tillamook Co., under spruce and hemlock, Oct. 16, 1970,

Smith 79085 (Type MICH).

Ph. procera Horak, **NEW GUINEA**: Papua, Eastern Highlands, Mt. Michael, Frigano, in *Nothofagus* forest, Dic. 6, 1971, *Horak 71/380* (**Holotype ZT; Isotype XAL**).

Ph. singerii Guzmán, Bandala & Montoya, **MEXICO**: Veracruz, 3 km N of Coatepec Viejo, Coatepec Co., mesophytic forest (subtropical), Aug. 28, 1986, *Bandala-Muñoz 1008* (**Holotype XAL; Isotype IBUG; ZT**).

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STUDIES ON KERATINOPHILIC FUNGI. V.
TWO NOTEWORTHY SPECIES FROM TROPICAL SOURCES

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ABSTRACT

Two noteworthy keratinophilic fungal species isolated from tropical soils are briefly described and illustrated: *Ascocalvatia alveolata* Malloch et Cain and *Malbranchea filamentosa* Sigler et Carmichael.

RESUMEN

Se describen brevemente e ilustran dos especies queratinofílicas interesantes aisladas de suelos tropicales: *Ascocalvatia alveolata* Malloch et Cain and *Malbranchea filamentosa* Sigler et Carmichael.

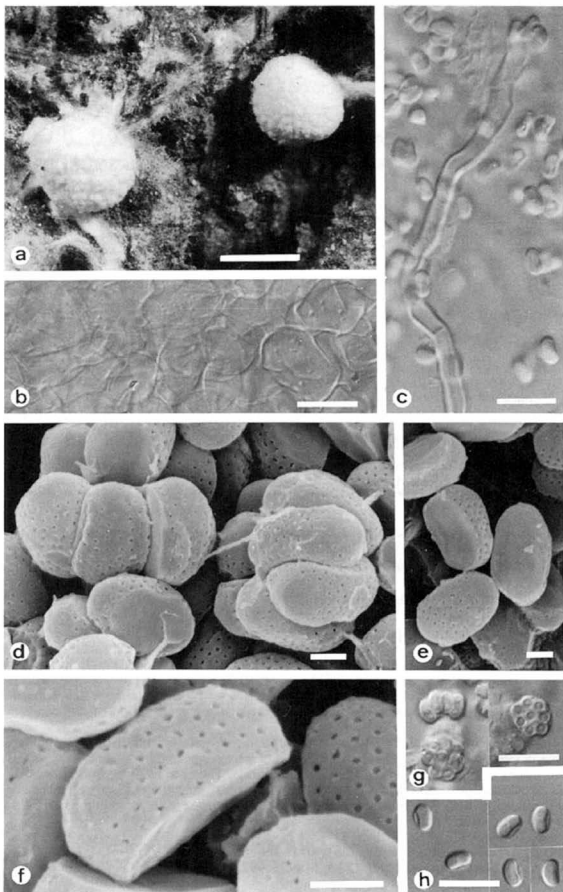
During a survey of keratinophilic fungi on tropical soils, two interesting species were isolated. Both species are uncommon and had only been isolated on very few occasions.

Ascocalvatia alveolata Malloch et Cain, *Can. J. Bot.* **49**: 840, 1971 (Fig. 1,2)

Colonies on Leonian's medium, at 25°C, in the darkness, sparse dense, white to light buff, powdery, margin undefined, presence of ascomata on all the surface, reverse pale brown. **Ascomata** subglobose to globose, 1-4.5 mm diam., white to light yellow. **Asci** subglobose 7-8 x 5-6 µm, eight-spored. **Ascospores** kidney-shaped with a hyaline longitudinal crest in the middle of the concave wall (0.5 µm at the widest part), 4-4.5 x 2-2.5 µm, hyaline, one-celled, finely pitted with the exception of the concave surface.

Arthroconidia rapidly delimited by septation of undifferentiated fertile hyphae, usually intercalary, adjacent or alternate, in which case connected by hyaline, thin-walled and fragile cells which soon collapse and deteriorate. They are hyaline, smooth-walled, clavate with truncate base and non-septate when terminal; or cylindrical, barrel-shaped or unilaterally swollen with truncate ends, non-septate to two-septate when intercalary, 4.5-14(18) x 1.5-3(3.5) µm.

Material examined: FMR 4201 (=IMI 356788, CBS 283.93), isol. J. Cano, from forest soil, Soroa, Pinar del Río, Cuba, March 1992.



Ascocalvatia Malloch et Cain (Malloch & Cain, 1971) is a very peculiar genus with a set of characteristics not observed in other genera of the Eurotiales, such as: 1) closed ascomata with masses of asci separated by thick sterile bands; 2) asci with closely packed parallel rows of ascospores; 3) ascospores kidney-shaped with pitted walls and 4) a rare arthroconidial anamorph. Despite great differences with the other members of the family, most authors agree on the placement of this genus in the family Onygenaceae (Malloch & Cain, 1971; Currah, 1985; v. Arx, 1987). The shape of the ascospores is reminiscent of *Renispora* Sigler *et al.* (Sigler *et al.*, 1979) and *Bifidocarpus* Cano *et al.* (Cano *et al.*, 1994), but in the former they are pigmented and in the latter they are smooth. Other diagnostic characters are very different in both genera. The features of the anamorph of *A. alveolata* are also unusual. In some aspects, its pattern of conidial dehiscence (rhexolysis and schizolysis) resembles that observed in *Hormographis* Guarro *et al.* (Guarro *et al.*, 1986) and in *Onychocola* Sigler (Sigler & Congly, 1990), but in the first well differentiated conidiophores, forming synnemata, are present; and in the second the conidia usually persist in long chains and disjunctors are absent. Our isolate is the second of this species. The type was collected in Canada from carnivore dung.

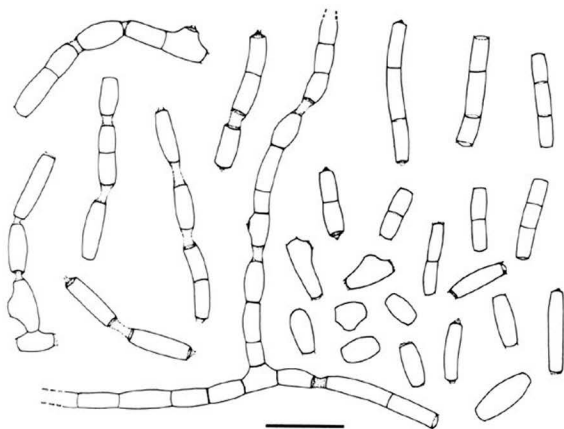


Fig.2.- *Ascocalvatia alveolata* (FMR 4201). a, Anamorph (bar= 10 μ m).

Fig.1.- *Ascocalvatia alveolata* (FMR 4201). a, Ascomata (bar= 1 mm). b, Peridial cells (bar= 10 μ m). c, Capillitium-like thread (bar= 10 μ m). d, g, Asci (d, bar= 1 μ m; g, bar= 10 μ m). e, f, h, Ascospores (e, f, bar= 1 μ m; h, bar= 10 μ m).

Malbranchea filamentosa Sigler et Carmichael, *Mycotaxon* 15: 468, 1982 (Fig.3)

Colonies on PYE at 25°C in the dark, measuring 35-40 mm diam. at 21 days, initially white, becoming cream-coloured to buff, floccose to cottony and slightly raised at the centre, velvety or powdery at the periphery, folded, margin irregular, slightly lobulate, sometimes with hyaline to cream-coloured exudate droplets; reverse pale to dark brown. **Vegetative hyphae** hyaline, 1.1-2.1 µm diam., smooth-walled, straight. **Arthroconidia** borne on straight, arcuate or curved lateral branches grouped in tufts, subhyaline, tan in mass, smooth-walled, cylindrical or curved, 2.0-5.0(6.0) x 1.2-2.0 µm.

At 37°C growth is slower (25-29 mm diam. in 21 days).

On OMA measuring 22-29 mm diam. at 21 days, cream-coloured to buff, powdery to granular in the periphery with a white and floccose central umbo, margin irregular and gradually extending as concentric zonations; reverse reddish-brown. Elongate, spinose elements numerous on all the tested media (PYE, OMA, PDA, Sabouraud 1/10 dil. + salts), straight or slightly flexuous, rigid, brown, sparsely septate, thick-walled, smooth or slightly echinulate, tapering toward the apex, 1-2.5 µm diam., branched and anastomosed forming a rigid network.

Material examined: FMR 3858 (=CBS 198.92, RV 24803), isol. Ch. de Vroey, from soil, Benatshimpuma, Kasai, Zaire, Aug. 1968; FMR 3859 (=CBS 199.92, RV 24801), isol. Ch. de Vroey, from soil, Benatshimpuma, Kasai, Zaire, Aug. 1968; FMR 3860 (=CBS 201.92, RV 24790), isol. Ch. de Vroey, from poultry farm soil, Kuriange, Burundi, Jun. 1968; UAMH 4097 (type).

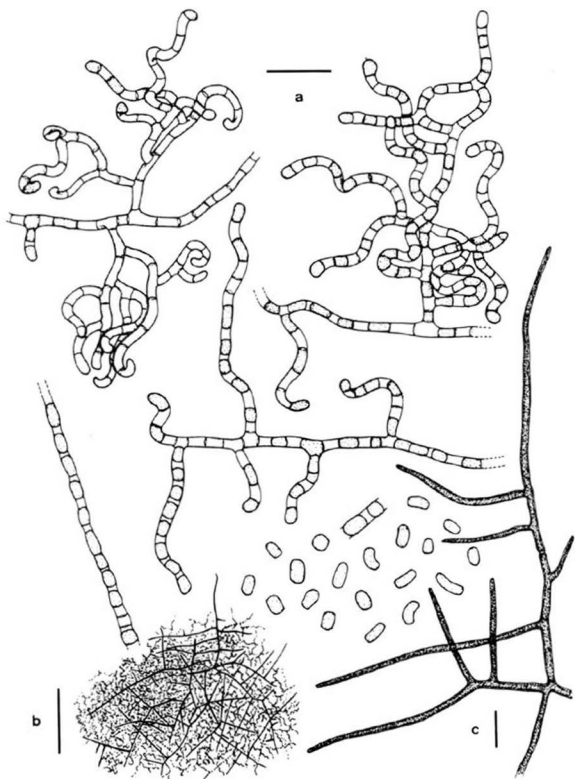
The most distinctive feature of *M. filamentosa* is the presence of the long spinose appendages, resembling those of *Myxotrichum* Kunze (Orr *et al.*, 1963). However, all the possible crosses between the available strains of *M. filamentosa* failed and thus we were unable to obtain ascomata. Our isolates, except in small details, are close to the type, which was isolated from soil in Argentina (Sigler & Carmichael, 1982) and to date these and other strains of the same origin were the only ones known.

ACKNOWLEDGEMENTS

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Fig. 3.- *Malbranchea filamentosa* (FMR 3858). a.- Fertile hyphae and athroconidia (bar= 10 μ m), b.- Habit (bar= 100 μ m), c.- Esterile hyphae (bar= 10 μ m).

**COMMENTS ON THE EXSICCAT "LECANOROID
LICHENS" II**

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Abstract: The second fascicle of the lichen exsiccata "Lecanoroid Lichens" is being issued by the Botanical Institute, University of Essen, Germany. Some remarks on the taxonomy, nomenclature and chemistry of the species distributed are made. *Haematomma neglectum* Lumbsch & Feige, *Halecania australis* Lumbsch and *Lecanora elixii* Lumbsch are described as new. *Schistoplaca* is reduced into synonymy with *Lecanora* and *S. alvearialis* with *L. sphaerospora*.

The Botanical Institute of the University of Essen in Germany is continuing the publication of a series of lichens associated with the Lecanoraceae s. lat., by the distribution of Fascicle II of "Lecanoroid Lichens". This fascicle consists of 20 numbers (nos. 21-40). The majority of the specimens being distributed were collected in Australia (6), while five specimens come from Central Europe, two from the Balears (Spain) and three from Turkey. One specimen was collected on Madeira, two on the British Isles and one in the Asian part of Russia.

As before, the exsiccata is being distributed in 20 complete and some incomplete sets on an exchange basis. The recipients of this fascicle are identical to those of the first fascicle (Lumbsch & Feige 1992). Material (including undetermined specimens) for distribution in our exsiccata, is always gratefully appreciated.

Material and Methods

Material. Specimens were studied from the following herbaria: BRI, CBG, ESS, GZU, H, M, TUR, UPS and the private herbaria of PD Dr. Klaus Kalb (Neumarkt/Opf.) and H.T. Lumbsch.

Methods. Microscopy. Thalli and apothecia were cut using a freezing microtome in 16-20 μm thickness and stained with lactophenol cottonblue.

Chemistry. The chemical constituents were identified using thin layer chromatography, TLC (Culberson 1972, Culberson et al. 1981, Culberson & Johnson 1982) and gradient-elution high performance liquid chromatography, HPLC (Feige et al. 1993).

Annotated list of the specimens

No. 21: *Haematomma neglectum* Lumbsch & Feige spec. nov.

Typus: Portugal, MADEIRA, Llevada near Blandys Garden, 1 km NW of Camacha, 32°41'N, 16°50'W, ca. 150 m alt. On *Castanea vesca*, 10.II.1993, G.B. Feige (ESS-Holotypus).

= *Haematomma leprarioides* auct. europ. non (Vainio) Vainio

= *Haematomma puniceum* auct. europ. non (Ach.) Massal.

Planta corticola. Thallus crustaceus, uniformis, adnatus, tenuis, continuus vel rimosus, albido-griseus usque ad lividogriseus, epruinosis. Soralia (0,1-)0,5-0,8 mm in diametro, rotundata, applanata vel paulum convexa; soredia farinosa. Prothallus atrogriseus.

Apothecia 0,3-0,9 mm in diametro, sessilia, disci coccinei. Margines apotheciorum albido-grisei, laeves vel parum crenulati, nonnumquam sorediati. Cortex hyalinus, inspersus, uniformis. Amphithecium crystallina magna continens. Parathecium hyalinum, ca. 10-15 μm crassum. Epihymenium clare aurantiaco-brunneum, granulatum, 10-15 μm altum. Hymenium hyalinum, 60-85 μm altum. Subhymenium hyalinum. Paraphyses simplices. Asci clavati, 55-85 x 9-14 μm . Ascospores 40-75 x 4-5,5 μm , 8-12 (-16)-septatae, elongatae.

Thallus atranorinum et chloroatranorinum continens.

Thallus crustose, uniform, adnate, thin, continuous to rimose, whitish grey to pale grey, epruinose. Soralia (0,1-)0,5-0,8 mm in diam., rounded, flat or slightly convex; soredia farinose. Prothallus blackish grey.

Apothecia 0,3-0,9 mm in diam., immersed when young, sessile at maturity, discs scarlet, thalline margin concolorous with thallus, entire or crenulate, sometimes sorediate. Cortex hyaline, interspersed with small crystals, uniform. Amphithecium with large crystals, which do not resolve in KOH. Parathecium

hyaline, ca. 10-15 μm thick. Epihymenium bright orange-red, with orange crystals, not dissolving in KOH, 10-15 μm thick. Hymenium hyaline, 60-85 μm tall. Subhymenium hyaline. Paraphyses simple, apically slightly thickened. Asci clavate, 55-85 x 9-14 μm . Ascospores 40-75 x 4-5,5 μm , 8-12 (-16)-septate, elongate, one end attenuated.

Chemistry: Thallus and soralia K + yellow, PD + pale yellow, C -, UV -. Apothecial discs K + purple, PD -, C -, UV -. Major substance: atranorin; minor substance: chloroatranorin.

Haematomma neglectum is a lichen of the oceanic part of Western Europe, where it occurs in Ireland, Brittany and Portugal (Purvis et al. 1992) as well as on Madeira (Tavares 1952). Two collections of *H. neglectum* from Brazil (Prov. Rio de Janeiro) were kindly submitted by Dr. Klaus Kalb (Neumarkt/Opf.). The species has been misidentified as *H. puniceum* or more recently as *H. leprarioides* by European authors (cf. Clauzade & Roux 1985, Guillaumot 1951, Ozenda & Clauzade 1970, Poelt & Vezda 1977, Purvis et al. 1992). *Haematomma puniceum* is an esorediate species which differs further by containing placodiolic acid in addition to atranorin (Rogers 1982). The type specimen of *H. leprarioides* (TUR-V 4147) also differs from *H. neglectum*. The type was collected in Brazil ("ad corticem arboris prope Rio de Janeiro") and contains thiophaninic acid (=2,4-dichloro-6-O-methylnorlichexanthone) as the major substance and atranorin and chloroatranorin as minor compounds. So far *H. leprarioides* s.str. is known with certainty only from South America. A third corticolous and sorediate *Haematomma* species is *H. sorediatum* described from Australia. This species is distinguished by the presence of placodiolic acid in addition to atranorin (Rogers 1982).

No. 22: *Halecania australis* Lumbsch spec. nov.

Typus: AUSTRALIA, New South Wales, Oaky Creek, 37 km NE of Boorowa, on Reids Flat Road. *Brachychiton* dominated steep slope with large granite outcrops. 34°08'S, 149°54'E, 450 m alt. On eutrophic siliceous rocks in a river bed. Associated lichens include *Candelaria concolor* and *Phaeophyscia* spp., 14.VIII. 1991, H.T. Lumbsch & H. Streimann (CBG-Holotypus).

Planta saxicola. Thallus crustaceus, uniformis, adnatus, tenuis, continuus usque ad disperso areolatus, viridulo-brunneus vel flavobrunneus, epruinosis. Soredia nulla. Prothallus nigrescens vel deficiens.

Apothecia sessilia vel subimmersa, usque ad 0,7 mm in diametro, disci obscure griseo-brunnei, epruinosi. Margines apotheciorum viridulo-brunnei vel flavobrunnei, tenues, verrucosi vel crenulati. Excipulum lecanorinum, cortex absens, sed stratum algarum cum stratum epinecralum. Epihymenium fuscobrunneum, egranulosum. Hymenium ca. 60-80 μm altum. Hypothecium et subhymenium hyalinum. Paraphyses ca. 2 μm crassae, septatae, capitatae. Asci clavati, 8-spori. Ascosporae hyalinae, ellipsoideae, 1-septatae, 12,5-16,0 x 4,5-6,5 μm .

Thallus atranorinum, chloratranorinum et zeorinum continens.

Thallus crustose, uniform, adnate, thin, continuous to dispersed areolate, greenish brown to yellowish brown, epruinose. Soredia absent. Prothallus blackish grey or absent.

Apothecia sessile or subimmersed, up to 0,7 mm in diam., discs dark grey-brown, red-brown when wet, epruinose. Apothecial margins concolorous with thallus, thin, verrucose to crenulate. Excipulum lecanorine, cortex absent, but algae containing layer covered by an epinecral layer. Epihymenium red-brown, pigmentation not altered in KOH, without granules, Hymenium ca. 60-80 μm high. Hypothecium and subhymenium hyaline. Paraphyses ca. 2 μm thick, septate, apically slightly ramified and capitate, paraphysal apices with brown tips. Asci clavate, 8-spored. Ascospores hyaline, ellipsoid, 1-septate, 12,5-16,0 x 4,5-6,5 μm .

Chemistry: Atranorin and zeorin as major substances and chloroatranorin as minor.

Halecania australis is so far only known from the type locality, where it grew on eutrophic rocks in a river bed in pasture land together with nitrophilous lichens such as *Candelaria concolor*. The genus *Halecania* is characterized by halonate ascospores and a *Catillaria*-type ascus and was placed in the Catillariaceae by M. Mayrhofer (1987, 1988). The genus consists of six species. The new species can be distinguished from the similar *Halecania alpivaga* (TH. FR.) M. MAYRH. and *H. ralfsii* (SALWEY) M. MAYRH. by its bright thallus colour and the thin thallus with a rough thallus surface. *Halecania alpivaga* has a thicker and darker thallus and the apothecial discs are darker, while *H. ralfsii* has a darker thallus with a smooth surface. It occurs on coastal rocks in Scandinavia and the British Isles (Mayrhofer 1987).

No. 23: *Lecanora actophila* Weddell

GREAT BRITAIN, Scotland, Inner Hebrides, Isle of Islay, Singing Beach, 3 km W of Port Ellen, 55°37'N, 6°13'W, 0-5 m alt. On siliceous rocks in the mesic supralittoral zone with *Caloplaca marina*, *C. thallicicola*, *Catillaria chalybeia* and *Lecanora helicopsis*, 26.VIII.1993, E. & H.T. Lumbsch.

No. 24: *Lecanora argopholis* (Ach.) Ach.

RUSSIA, Altai, Tschibit, 10 km W of Aktasch, 50°21'N, 87°27'E, ca. 1100 m alt. Steppe vegetation near the main road. On S-exposed siliceous rocks, 16.VIII.1993, T. Lunke.

A detailed description of *L. argopholis* and discussion of its relationships was provided by Vänskä (1984). The species can be distinguished from the morphologically similar *L. frustulosa* (Dickson) Ach. by the different spore size

and chemistry. While *L. frustulosa* has narrowly ellipsoid spores and usnic acid as the constant secondary metabolite, *L. argopholis* possesses broadly ellipsoid spores and contains atranorin as major constituent.

Vänskä (1984) described a remarkable chemical variation within *L. argopholis* and distinguished nine chemodemes. Some of the chemical variation reported, however, might be due to insensitive equipment being unable to detect minor substances. In the specimens of *L. argopholis* we examined, we could always detect atranorin as major substance and epanorin, chloroatranorin and zeorin in varying quantities. Norstictic acid was always present a minor substance, connorstictic acid was sometimes detected in traces. Moreover unidentified fatty acids were always found.

The taxonomic position of *L. argopholis* has been discussed by Brusse (1987). He described the genus *Schistoplaca*, which was placed in the Biatraceae on the basis of ascus structure. The ascus was said to belong to the *Biatora* type, although the drawing by Brusse showed an ascus type rather different from those considered to be of the *Biatora* type by Hafellner (1984). He included *Lecanora argopholis* in his new genus and supposed that more species currently placed in *Lecanora* should be transferred to *Schistoplaca*. A reexamination of the asci of both the type species of *Schistoplaca*, *S. alvearialis* Brusse (UPS - isotype) and *Lecanora argopholis*, revealed that the asci of both species belong to the *Lecanora* type sensu Hafellner (1984) and that therefore it does not seem necessary to separate either species at generic level from *Lecanora*. Consequently, we propose to reduce the genus *Schistoplaca* into synonymy with *Lecanora*. Moreover *S. alvearialis* was found to be a synonym of *L. sphaerospora* Müll. Arg., a common species on limestone in Southern Australia (Lumbsch & Feige 1992), thus extending the distribution of that species to South Africa.

No. 25: *Lecanora campestris* (Schaerer) Hue

SPAIN, Balears, Menorca, Santa Roca S'Indio, 39°58'S, 4°06'E, ca. 200 m alt. On sandstone with *Caloplaca scoriophila*, *Lecanora sulphurata*, *Peltula euploca*, *Polysporina simplex* and *Protoparmelia montagnei*, 15.IV.1992, G.B. Feige.

Lecanora campestris is a rather common saxicolous lichen in Europe. It also occurs in California (Brodo, 1984). All records from other parts of the world are based on misidentifications (Lumbsch 1994). The species has a disjunct western North American - European distribution. This distribution type has been discussed by Kärnefelt (1980). The typification of *L. campestris* is discussed by Brodo & Vitikainen (1984). A sorediate morphotype was described as ssp. *dolomitica* Gilbert (1984). A discussion of that subspecies and its relation to other saxicolous, sorediate species in Europe is given by Brodo et al. (1994).

By HPLC and TLC atranorin and Lcm-1 could be detected as major substances and the triterpenoids Lgr-1, Lgr-2 and chloroatranorin as minor compounds. Kümmerling (1991) detected zeorin in her material of *L. campestris*, but failed to detect chloroatranorin. We could not find zeorin in the specimens of *L. campestris* we examined, including material from Central Europe. Chloroatranorin could always be detected by means of HPLC.

No. 26: *Lecanora carpinea* (L.) Vainio

TURKEY, Anatolia, Prov. Izmir, Bozdağköy, Bozdağ Mtn., 38°21'N, 28°05'E, ca. 1150 m alt. On *Castanea sativa* with *Caloplaca* spp., *Lecanora chlarotera*, *Ochrolechia* spp., *Porina aenea* and *Ramalina fraxinea*, 18.IV.1992, H.T. Lumbsch.

This Holarctic species is easily recognized by the C + orange reaction of the apothecial disc, due to the presence of sordidone in the pruina, and the thick, gelatinous amphithecial cortex. A full description of the species is given by Imshaug & Brodo (1966). Sordidone and atranorin were detected as major substances by TLC and HPLC, and eugenitol, as well as chloroatranorin, as minor secondary products.

No. 27: *Lecanora chlarotera* Nyl.

TURKEY, Anatolia, Prov. Izmir, Çesme Peninsula, Akdağ near Karaburun. Pine forest on the western slope of Akdağ between Karaburun and Yaylaköy, 38°37'N, 26°28'E, alt. ca. 500 m. On *Pinus* twigs, 12.IV.1992. H.T. Lumbsch.

This species is rather common and polymorphic in Europe. Populations with verrucose apothecial margins have been distinguished as *L. rugosella* Zahlbr. However, there are no consistent anatomical or chemical differences between the two morphotypes, therefore we would prefer - in agreement with various authors (Poelt 1952, Ozenda & Clauzade 1970, Wirth 1980, Clauzade & Roux 1985) - to include *L. rugosella* in *L. chlarotera*. Several other authors prefer to keep the two morphotypes as distinct species (Brodo 1984, Purvis et al. 1992, Santesson 1993).

Brodo (1984) reported *L. chlarotera* from North America, but noticed chemical and morphological differences of the North American and the European populations. The species has not been reported from Japan (Miyawaki 1988). However, we examined two specimens agreeing both anatomically and chemical with *L. chlarotera* s.str., which were collected by T. Ahti (Helsinki) in South America.

Lecanora chlarotera contains gangaleoidin and atranorin as major compounds and chloroatranorin, norgangaleoidin and roccellic acid as minor substances.

No. 28: *Lecanora circumborealis* Brodo & Vitikainen

SWITZERLAND, Graubünden, Surselva, TK 25: 1193 Tödi, Tschegn Dago, Muletg

Gron, 1700 m alt. On *Picea abies*, 24.VIII.1990, E. & H.T. Lumbsch.

Lecanora circumborealis is a boreal species. The difficulties in the distinction of *L. circumborealis* and *L. pulicaris* were discussed by Brodo (1984) and Brodo & Vitikainen (1984). The colour of the apothecial discs is variable in both species and the distributed material shows some variation of the disc colour. The spore size differs between the two species but there is an overlap in spore size. Chemically both species differ. While *L. pulicaris* contains the fumarprotocetraric acid chemosyndrome, *L. circumborealis* contains atranorin and roccellic acid as major compounds and chloroatranorin as a minor substance. However, it should be noted that sometimes fumarprotocetraric acid deficient populations occur in *L. pulicaris*.

No. 29: *Lecanora elixii* Lumbsch spec. nov.

Typus: AUSTRALIA, New South Wales, Wolumba Peak, 16 km WNW of Merrim-bula, 36°53'S, 149°44'E, 750 m alt. Dry sclerophyll forest on rocky ridge, often burnt. On basaltic rocks with *Diploschistes euganeus*, *Pertusaria lophocarpa*, *Rhizocarpon geographicum* and *Tephromela atra*, 16.VI.1991, H.T. Lumbsch & H. Streimann (CBG-Holotypus).

Planta saxicola. Thallus crustaceus, uniformis, adnatus, tenuis, continuus vel disperso-verrucosus, luteo-albidus usque ad luteo-griseus, vel albido-griseus, epruinosis. Soredia nulla. Margo thallinus indeterminatus. Prothallus non evolutus.

Apothecia sessilia, 0,3-0,9 mm in diametro, disci griseo-fusci, subcaeruleo pruinosi. Margines apotheciorum luteo-albidi vel luteo-grisei, tenues, laeves, verrucosi vel crenulati. Cortex hyalinus, basaliter gelatinosus, inspersus, lateraliter 15-20 μm , basaliter 20-40 μm . Amphithecium crystallina minuta continens. Parathecium hyalinum, crystallina deficiens, ca. 10-15 μm crassum. Epihymenium rubrofusum, granulosum, ca. 15 μm altum. Hymenium hyalinum, 65-75 μm altum. Hypothecium et subhymenium hyalinum. Paraphyses ca. 1,5 μm crassae, septatae. Asci clavati, 50-65 x 12-14 μm , octospori. Ascospores hyalinae, non-septatae, late ellipsoideae, 8,5-12,5 x 5,5-7,5 μm .

Thallus atranorinum, chloratranorinum, zeorinum et diversa xanthona continens.

Thallus crustose, uniform, adnate, thin or very thin, continuous to disperse verrucose, yellowish white to yellowish grey, epruinose, sometimes reduced to small parts surrounding the apothecia. Soredia absent. Thallus margins indefinite. Prothallus not visible.

Apothecia sessile, 0,3-0,9 mm in diam., discs grey-brown to bluish grey, bluish to bluish grey pruinose. Apothecial margins concolorous with thallus, thin, smooth, verrucose to crenulate. Cortex distinct at base, hyaline, more or less gelatinous, slightly inspersed with small crystals, 15-20 μm laterally and 20-40 μm at the base. Amphithecium with small crystals (Pol +), crystals

rapidly dissolving in KOH (*campestris* type). Parathecium hyaline, without crystals (Pol -), 10-15 μm thick. Epithymenium reddish brown, the pigmentation completely dissolving in KOH, with crystals on the epithymenium (Pol +) (*chlarotera* type). Hymenium hyaline, 65-75 μm high. Hypothecium and subhymenium hyaline. Paraphyses ca. 1,5 μm thick, septate, apically slightly ramified and not thickened. Asci clavate, 50-65 x 10-14 μm , 8-spored. Spores broadly ellipsoid, 8,5-12,5 x 5,5-7,5 μm .

Chemistry: Thallus and apothecial margins: K + yellow, C + orange, KC + orange, PD + yellowish orange. Major substances: atranorin, 5,7-dichloro-3-O-methylnorlichexanthone, isoarthothelin, 3-O-methylasemone and 2,5,7-trichloro-3-O-methylnorlichexanthone; minor substances: arthothelin, asemone, chloroatranorin, 2,7-dichloronorlichexanthone, 5,7-dichloronorlichexanthone, 2,5,7-trichlorolichexanthone.

Etymology: The new species is named in honour of our friend Prof. Dr. John A. Elix (Canberra, Australia), who is well known as an outstanding lichen chemist and taxonomist.

Habitat: The new species grows on siliceous rocks in more or less exposed habitats. Associated lichens found growing with the new species include *Lecanora subglaucodea*, *Pertusaria lophocarpa*, *Tephromela atra* and *Xanthoparmelia* spp.

Distribution: So far *L. elixii* has been collected on the South Island of New Zealand and in temperate southeastern Australia. The species seems to be distributed in temperate Australasia and to be restricted to montane altitudes. However, due to the small number of known collections these remarks must remain preliminary.

Remarks: *Lecanora elixii* is characterized by the presence of the 2,5,7-trichloro-3-O-methylnorlichexanthone chemosyndrome, relatively small and broadly ellipsoid spores, the reduced thallus and pruinose apothecial disks. Moreover the epithymenium belongs to the *chlarotera* type according to Brodo (1984), with the epithymenial pigmentation rapidly resolving in KOH. A detailed discussion of the *Lecanora* species containing the 2,5,7-trichloro-3-O-methylnorlichexanthone chemosyndrome is given by Lumbsch et al. (1994).

Additional specimens examined (=paratypes): **Australia:** New South Wales: Blue Mts., 3 km SE of Leura, Sublime Point Lookout, 33°44'S, 150°20'E, 905 m alt., 1.2.1986, *G. Rambold* 4114 (M). - Mt. Kaputar National Park, W Kaputar Rocks, 30°16'30"S, 150°09'E, 1450 m alt., 8.2.1987, *P. Merrotsy* 450 (BRI-491507). **New Zealand:** South Island: Canterbury, Mt. Peel, Lynn Stream Valley, Long Speer above Acland's Hut, 43°50'30"S, 171°10'30"-171°11'30"E, 600-1100 m alt., 15.1.1985, *H. Mayrhofer* 9054. *H. Hertel & B.P.J. Molloy* (GZU).

No. 30: *Lecanora helva* Stizenb.

AUSTRALIA, Queensland, Laguna Bay, a few km NE of Tewantin, ca. 140 km N of Brisbane, 26°20'S, 153°03'E, 5 m alt. Seashore vegetation with *Casuarina glauca* and *Banksia integrifolia*. On *Casuarina*, 23.VIII.1992, K. & A. Kalb.

Lecanora helva is morphologically similar to *L. leprosa*. Both species have a pantropical distribution. Chemically they are readily distinguished. *Lecanora leprosa* contains the gangaleoidin and atranorin chemosyndromes (Lumbsch & Elix 1993), while atranorin and 2'-*O*-methylperlatolic acid can be detected in *L. helva* as major compounds and chloroatranorin, 2'-*O*-methylhyperlatolic, 2'-*O*-methylisohyperlatolic and 2'-*O*-methylsuperlatolic acids as minor compounds. A full description and discussion of the relationships of *L. helva* is given by Lumbsch (1994).

No. 31: *Lecanora jamesii* Laundon

GREAT BRITAIN, Scotland, Inner Hebrides, Isle of Islay. On the roadside between Ardbeg and the Kildalton church, Loch a Chnuic. Remnant forest in heathland, 55°40'N, 6°04'W, 20 m alt. On *Salix* with *Degelia atlantica*, *Lecanora confusa*, *Ochrolechia androgyna* and *Pertusaria pertusa*, 24.VIII.1993, E. & H.T. Lumbsch.

A detailed discussion of this sorediate species, known from Western Europe and South America, was given by Brodo & Elix (1993). The specimen distributed contains usnic acid and chloroatranorin as major compounds and atranorin and 2-*O*-methylsulphurellin as minor substances.

No. 32: *Lecanora lividocinerea* Bagl.

SPAIN, Balears, Menorca, S part of the island, Punta Galdana, Pinar at the coast, 39°56'N, 3°58'W, 20-30 m alt. On *Pinus maritima*, 10.V.1991, G.B. & I. Feige.

This lichen occurs in regions of winter rainfall in Southern Europe and Western Australia (Lumbsch 1994). Data concerning the distribution in Europe and its sociology are presented by Abassi Maaf & Roux (1984). It has been overlooked in Europe and often misidentified as *L. chlarotera*. The latter species can be distinguished, however, by the presence of the gangaleoidin chemosyndrome (thallus C -, while *L. lividocinerea* is C + red), darker apothecial discs and narrower ascospores.

Lecanora lividocinerea contains atranorin and 3,5-dichloro-2'-*O*-methylanziaic acid (=sulphurellin) as major substances and chloroatranorin and depsides related to sulphurellin as minor compounds. The structure of the new minor substances is currently under investigation by Prof. Elix (Canberra) and coworkers. The presence of sulphurellin has already been reported by Brodo & Elix (1993).

No. 33: *Lecanora muralis* (Schreb.) Rabenh.

GERMANY, Sachsen-Anhalt, Wimmelburg, copper schist dumps of the Otto Schächte at the Hüneberg near Eisleben. On copper schist, 5.IX.1991, G.B. & I. Feige & S. Huneck.

No. 34: *Lecanora plumosa* Müll. Arg.

AUSTRALIA, Northern Territory, Curtain Falls, 38 km ESE of Batchelor. Shaded narrow, creek side with *Corallia*, *Calophyllum* and *Ardisia*, 13°05'S, 130°40'E, 60 m alt. On siliceous rocks on forest floor, 3.VII.1991, H.T. Lumbsch, J.A. Elix & H. Streimann.

Lecanora plumosa is chemically identical to *L. helva* in containing the atranorin and the 2'-*O*-methylperlatolic acid chemosyndromes. This saxicolous lichen is widely distributed in northern and eastern Australia (Lumbsch 1994). We recently examined a specimen of this species collected in South Africa from München (M) (South Africa, Natal, Howick, 29°29'S, 30°14'E, ca. 950-1000 m alt., 15.III.1990, *Triebel & Rambold 712f*), thus extending the distribution of *L. plumosa* to a second continent and suggesting a Gondwanian type of disjunction.

No. 35: *Lecanora pseudistera* Nyl.

AUSTRALIA, Victoria, Western District, Wangoom, 38°70'S, 142°35'E, ca. 100 m alt. Basaltic outcrops in pasture land. On basaltic rocks. Associated lichens include *Candelariella vitellina*, *Diploschistes scruposus*, *D. sticticus*, *Parmotrema reticulatum*, *Punctelia subrudecta* and *Xanthoparmelia scabrosa*, 29.VII.1991, H.T. Lumbsch & W.H. Ewers.

Lecanora pseudistera is characterized by large crystals in the amphithecium, the *glabrata* type epihymenium and the presence of the 2'-*O*-methylperlatolic acid chemosyndrome. It is a common, subcosmopolitan lichen, which grows on siliceous rocks and on soil. It is known from southern Europe (Brodo 1984, Nimis 1993), North America (Brodo 1984), southern Africa and America, as well as Australasia (Lumbsch 1994). The species has been reported by Miyawaki (1988) from Japan under the name of *L. galactinula*. In Australasia it is the most common saxicolous species of the *L. subfusca* group and has been often misidentified as *L. campestris*. This species, however, differs both anatomically and chemically (see above).

No. 36: *Lecanora pulicaris* (Pers.) Ach.

GERMANY, Bavaria, Kr. Ebersberg, Egelburger See, avenue at the S border of the lake. 48°28'N, 11°96'E, alt. ca. 550 m. On *Alnus*, 8.III.1993, H.T. Lumbsch.

This lichen contains fumarprotocetraric acid and atranorin as major substances and confumarprotocetraric and protocetraric acids and chloroatranorin as minor substances. See above for the distinction of *L. pulicaris* and *L. circumborealis*.

No. 37: *Lecanora reuteri* Schaerer

AUSTRIA, Steiermark, Bez. Bruck an der Mur, Hochschwabgruppe, W-Abbrüche der Pribitz-Mauer gegen die Pfarrer Lacke, ca. 920 m alt. On overhanging limestone, 20.VI.1993, H. Köckinger, H. Pittoni & J. Poelt.

Lecanora reuteri is a Mediterranean-alpine lichen, which grows on calciferous rocks. A description is given by Poelt (1958). This member of sect. *Saccharon* of the subgen. *Placodium* proved to be a rich source of norlichexanthones.

By HPLC and TLC we detected arthothelin, norlichexanthonone, 2,5-dichloronorlichexanthonone, 3-*O*-methyларthothelin (=thuringion) and 4-chloro-6-*O*-methylnorlichexanthonone as major substances; 2-chloronorlichexanthonone and 2,4-dichloronorlichexanthonone as minor compounds, and isoarthothelin, thiophanic acid (=2,4-dichloro-6-*O*-methylnorlichexanthonone), 2-chloro-6-*O*-methylnorlichexanthonone, 4-chloronorlichexanthonone, 4,5-dichloronorlichexanthonone and 6-*O*-methyларthothelin as well as unidentified xanthones in traces. Arthothelin and norlichexanthonone were already reported by Santesson (1968) from *L. reuteri*.

No. 38: *Lecanora swartzii* ssp. *caulescens* (Steiner) Leuckert & Poelt

TURKEY, Anatolia, Prov. Izmir, Bozdag Mtn., E of Bozdagköy, 38°21'N, 28°06'E, ca. 1700 m alt. On overhanging, shaded slate rocks, 18.IV.1992, H.T. Lumbsch.

This subspecies is characterized by small fruticose thalli (Leuckert & Poelt 1989). Chemically ssp. *caulescens* is identical with ssp. *swartzii* in having sordidone and atranorin as major compounds and eugenitol and chloroatranorin as minor substances. Poelt (1989) described a detailed anatomical study of this remarkable small fruticose lichen in a group of crustose taxa.

No. 39: *Lecanora tropica* Zahlbr.

AUSTRALIA, Northern Territory, Table Top Range, Litchfield Park, 25 km SE of Batchelor, 13°11'S, 130°50'E, 180 m alt. Burnt *Eucalyptus* woodland with dense understorey of *Grevillea*, *Owenia*, *Acacia* and *Pouteria* amongst sandstone boulders. On *Ficus*, 2.VII.199, H.T. Lumbsch, J.A. Elix & H. Streimann.

This pantropical species is treated in some detail by Lumbsch (1994). The name *L. tropica* was introduced by Zahlbruckner (1928) for *L. subcrenulata* (Nyl.) Nyl. non Müll. Arg. *Lecanora byssinula* Kalb is a superfluous name suggested for the same taxon as discussed by Lumbsch (loc. cit.). Atranorin, chodatol, demethylchodatol and zeorin can be detected as major substances by TLC and HPLC, and chloroatranorin, 3-*O*-methylthiophanic acid, thiophanic acid and further unidentified xanthones as minor compounds.

No. 40: *Tephromela armeniaca* (DC.) Hertel & Rambold

Austria, Tyrol, Pfunds, Platzalm, 46°59'N, 10°39'E, 2100-2200 m alt. On siliceous rocks. Associated lichens included *Bellemeria alpina*, *Lecanora bicincta*, *L.*

oreinoides and *Ophioparma ventosa*, 22.VIII.1990, H.T. Lumbsch, B. Mies, S. Paus & G. Bremer.

The material distributed contains alectorialic, barbatolic and roccellic acids as major compounds and alectorialin, barbatolin, 5,7-dihydroxy-6-methylphthalide and 6-formyl-5,7-dihydroxyphthalide as minor substances. In principal these results are agreement with those by Huneck & Elix (1993).

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A NEW SPECIES OF LACTARIUS FROM MEXICO

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ABSTRACT

Lactarius mexicanus is described as a new species of Subsection *Scrobiculati*. It is common and abundant in coniferous or mixed forests on the highest volcanoes in Central Mexico in association with *Abies religiosa*. This taxon has previously been confused with *L. scrobiculatus* in Mexico. It is similar to *L. scrobiculatus* var. *montanus* and *L. intermedius*, but distinct by pileus color, lamellae frequency, stipe size and ornamentation, spore print color, basidiospore size and height of the ornamentation, basidia and macrocystidia size, and habitat. A detailed description, together with illustrations and information about the distribution, habitat, phenology, and frequency of this taxon are presented.

RESUMEN

Lactarius mexicanus se describe como una especie nueva de la Subsección *Scrobiculati*. Es común y abundante en los bosques de coníferas o mixtos de los grandes volcanes del centro de México en asociación con *Abies religiosa*. En

México este taxón ha sido previamente confundido con *L. scrobiculatus*. Es similar a *L. scrobiculatus* var. *montanus* y a *L. intermedius*, pero se distingue por el color del píleo, frecuencia de las láminas, tamaño y ornamentación del estípite, color de la esporada, tamaño de las basidiosporas y altura de su ornamentación, tamaño de los basidios y macrocistidios, y por el hábitat. Se presenta una descripción detallada, con ilustraciones e información acerca de la distribución, hábitat, fenología y frecuencia de este taxón.

INTRODUCTION

Although the genus *Lactarius* Pers. ex S.F. Gray is a conspicuous element of the forest mycota of Mexico, it has received careful attention only in the last few years (Guevara et al., 1987; Montoya et al., 1990).

Montoya et al. (1990) presented a check list of 45 species reported in Mexico prior to 1989. Since this date, another 9 species previously unknown from Mexico have been reported (Cifuentes et al., 1989, 1993; Singer, 1990; Laferrière & Gilbertson, 1992; Lalli & Pacioni, 1992). Including the taxon described in this paper, 55 taxa of *Lactarius* are presently known from Mexico. The total number of taxa in Mexico is unclear since many early reports are not substantiated by voucher collections and the occurrence and correct determination of additional species remains to be ascertained.

MATERIALS AND METHODS

Capitalized color terms followed by alphanumerical notations in parentheses are from Kornerup & Wanscher (1978). Uncapitalized color terms are the author's approximations of colors. Spore deposit color followed by alphanumerical notations in parentheses are from Romagnesi (1967).

Basidiospore size, excluding ornamentation, and shape were determined by measuring at least 30 spores per specimen from spore deposits. Basidiospore volume was determined using the formula of Breitenbach & Kränzlin (1991). The following notations are used for reporting basidiospore data: L = mean length range; W = mean width range; Q = mean length/width range; V = mean volume range. Description of

basidiospore ornamentation is given as it appears in Melzer's reagent; other structures were studied in 5% KOH. Basidia length excludes sterigmata length. For the purpose of this study, we consider macrocystidia to be the pleurocystidia and cheilocystidia typical of the Russulaceae, pseudocystidia as cystidia which terminate laticiferous hyphae and project into the hymenium, and marginal cells as non-macroscystidia which terminate the hyphae of the lamellar edge (Kühner & Romagnesi, 1953; Buyck, 1991). Drawings of microscopic structures were made with the aid of a camera lucida. Stippling indicates the contents of macrocystidia and laticiferous hyphae.

Most of the specimens studied were deposited in the Instituto Politécnico Nacional at the Mycological Herbarium of the Escuela Nacional de Ciencias Biológicas (ENCB). When the abbreviation TLXM follows specimen data, it means the specimen was deposited in the Universidad Autónoma de Tlaxcala at the Herbarium of the Centro de Investigaciones en Ciencias Biológicas which is not listed in *Index Herbariorum* (Holmgren et al., 1990).

For comparison with the species of *Lactarius* described here, other members of Subsection *Scrobiculati* from Europe and North America were examined including one collection of *L. scrobiculatus* (Scop.: Fr.) Fr. *sensu stricto* (Switzerland, leg. G. Guzmán, det. H. Clemençon, in ENCB) and two collections of *L. scrobiculatus* var. *canadensis* (Smith) Hesler & Smith (United States, leg. & det. A.H. Smith, in ENCB from MICH; leg. & det. A.S. Methven, in TLXM from EIU).

To evaluate the spatial frequency of *L. mexicanus*, we followed the methods described by Villeneuve et al. (1988) and Brunner (1989). Four 1600 m² permanent plots (40 x 40 m), each divided into 64 subplots (5 x 5 m), were established. Two of the plots were in a fir stand and two in a pine-fir stand at 3300-3500 m altitude on the Cañada Grande of La Malintzi Volcano, state of Tlaxcala, Mexico. The study plots have an eastern exposure and a slope of ± 15%. The forest is dominated by *Abies religiosa* (HBK.) Schl. & Cham. mixed with *Pinus hartwegii* Linbl, *Salix paradoxa* HBK., and *Alnus jorullensis* HBK. Fir plots (numbered 1 and 2) are composed of 98 - 100% *A. religiosa* and 0 - 2% *S. paradoxa*. Pine-fir plots (numbered 3 and 4) are composed of 5 - 30% *P. hartwegii*, 66 - 95% *A. religiosa*, and 0 - 4% *A. jorullensis*. Plots were visited every two weeks from May to November 1990 and from May to December 1991, with the exception of week 37 in 1991. Basidiomata were mapped and removed from the study plots. A frequency of 1 indicates occurrence of basidiomata in all 64 subplots, 0.5 indicates occurrence in 32 subplots, 0 indicates no occurrence. The spatial frequency coefficient corresponds to the number of subplots from both plots of a given forest stand in which basidiomata were present during the study period. The spatial frequency coefficient was established according to the following classes (Villeneuve et al., 1988): extremely infrequent (basidiomata in 1 - 4 subplots per stand), very infrequent (5 - 8 subplots), infrequent (9

- 16 subplots), frequent (17 - 32 subplots), very frequent (33 - 64 subplots), and extremely frequent (65 - 128 subplots).

DESCRIPTION OF THE TAXON

Lactarius mexicanus Kong et Estrada, sp. nov.

Fig. 1 - 5

Pileus 95 - 200 mm latus convexo-depressus dein plano-depressus vel infundibuliformis, margine fibrilloso et involuto dein glabro et arcuato undulato, subviscidus vel glutinosus azonatus vel obscure zonatus glaber vel margine adnato-fibrilloso, subflavus vel cremeus, brunneus ubi contusus. Caro alba aeri exposita sulphurea prope lamellas, odore fragranti sapore subacri vel miti. Latex albus aeri expositus sulphureus, sapore acri. Lamellae adnatae vel decurrentes confertae vel subdistantes prope stipitem furcatae subcrassae 5 - 13 mm latae lamellulis numerosis subflavae dein cremeae vel cremeoroseae, flavae dein brunneae ubi contusae. Stipes 70 - 180 mm longus 20 - 60 mm crassus elongatus cylindratus subventricosus vel clavatus siccus apice pruinoso inter lamellas scrobiculatus albus vel cremeus, base pileo concoloris, flavus dein brunneus ubi contusus, cavus. Sporae in cumulo cremeae (IIb-IIc Romagnesii) (7.9-) 8.2 - 9.7 (-10.9) x (6.7-) 7.1 - 7.9 (-8.4) μm ($L = 8.96 \pm 0.66 \mu\text{m}$; $W = 7.48 \pm 0.35 \mu\text{m}$) subgloboosae vel late ellipsoideae ($Q = 1.19 \pm 0.06$; $V = 262.48 \mu\text{m}^3$) ornamento subreticulato (0.3-) 0.6 - 0.9 (-1.2) μm alto. Basidia (39.1-) 48.9 - 65.4 (-77.0) x (8.6-) 9.3 - 11.9 (-16.7) μm clavata tetrasterigmatica, sterigmatibus 5.4 - 10.8 x 1.5 - 2.4 μm . Macrocytidia (50.5-) 62.4 - 90.2 (-110.8) x (6.8-) 8.1 - 12.3 (-16.2) μm fusioidea vel subventricosa mucronata dispersa (0-) 13 - 27 (-35) μm proiecta nulla vel rara in acie. Pseudocystidia (5.2-) 6.2 - 10.2 (-17.7) μm lata plerumque cylindrica numerosa (0-) 12 - 35 (-46) μm proiecta. Cellulae marginales (10.2-) 13.0 - 33.4 (-39.5) x (5.5-) 6.1 - 9.8 (-10.3) μm versiformes. Pileipellis crassitudine inconstanti hyphis horizontalibus vel intertextis, gelatinosa composita. Stipitipellis hyphis horizontalibus intertextis vel erectis, pseudoparenchymatosa in scrobiculis, non gelatinosa composita. Hyphae inamyloideae defibulatae.

Ad terram arenosam (solo non calcareo). Solitario vel gregatim. In abietibus et silvis mixtis semper sub *Abiete religiosa*. Iunius - Novembris.

HOLOTYPE: MEXICO, Tlaxcala, Municipio de Huamantla, Parque Nacional La Malinche, ladera Este del Volcán La Malintzi, Cañada Grande, 28.VIII.1992, A. Kong 2448 (Herb. TLXM; Isotypus: ENCB, EIU).



Fig. 1. Basidiomata of *Lactarius mexicanus*. A. Holotypus, A. Kong 2448, x 1/4. B. Part of the Holotypus, x 2/5.

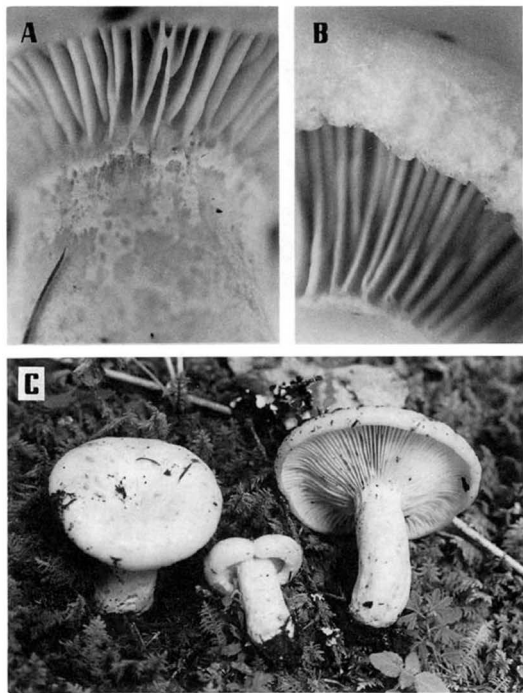


Fig. 2. *Lactarius mexicanus*. A. Stipe apex from young basidiomata of the *Holotypus*, x 3. B. Margin from young basidiomata of the *Holotypus*, x 3. C. Basidiomata, A. Kong 2240, x 3/7.

Pileus (Figs. 1 - 3) 70 - 200 (-270) mm broad, convex-depressed with margin inrolled when young becoming plano-convex to infundibuliform with uplifted arching margin in age; surface subviscid to viscid, glabrous to innately fibrillose toward margin, azonate or rarely obscurely zonate, Pastel Yellow (2A4) or Cream color (4A3) at times with Grayish Yellow (2B5, 3B5, 4B5, 4C5) tones, staining Yellowish Brown (5E5, 5F7), Light Brown (7D6) or Brown (6D7, 6D8, 7E6) when bruised or in age; margin initially fibrillose-tomentose but soon glabrous, irregular.

Context 5 - 10 mm thick at midradius, hard, brittle, white, colored like the pileus beneath the cuticle, quickly turning Yellow (2A6) on exposure, mainly as a line of latex above the lamellae, slowly staining Yellowish Brown (5D5) on exposure, odor mild, taste mild or slightly acrid.

Latex white, abundant to scanty, quickly turning Yellow (2A6) on exposure, staining flesh and lamellae yellow then brown; taste slowly acrid.

Lamellae adnate when young, subdecurrent or decurrent in age, close to subdistant, forking near the stipe, with numerous lamellulae, 5 - 13 mm broad, brittle, at first Pale Yellow (2A3) then Cream (4A3), with Salmon (6A4) to Pale Red (7A3, 7A4) tones, staining yellow then Yellowish Brown (5E4, 5E5, 5E6, 5E7), Brown (6E4, 7E4) or Reddish Brown (8E4) when bruised.

Stipe 60 - 100 (-180) x (15-) 20 - 45 (-70) mm, equal, subventricose or obclavate, centrally attached or slightly eccentric; surface dry, pruinose at top, pruina continuing up between the lamellae, smooth to longitudinally wrinkled or corrugated toward the base in age; scrobiculate or obscurely scrobiculate; initially white then Yellowish White (1A2), Pale Yellow (1A3) or Pastel Yellow (1A4, 2A4), pale brown, brown or concolorous with the pileus toward the base in age, staining yellow then Light Brown (5D6, 6D6, 7D6) or Brown (7E6) when bruised; scrobiculae Grayish Yellow (1B4, 2B4, 3B4, 4B4), Pale Yellow (3A3), Dull Yellow (3B4) or Yellowish Brown (5E6); tomentose around the base, with several attached rhizomorphs, tomentum concolorous with the surface; cortex hard, hollow, concolorous with pileus context, staining Yellow (2A6) on exposure, then Light

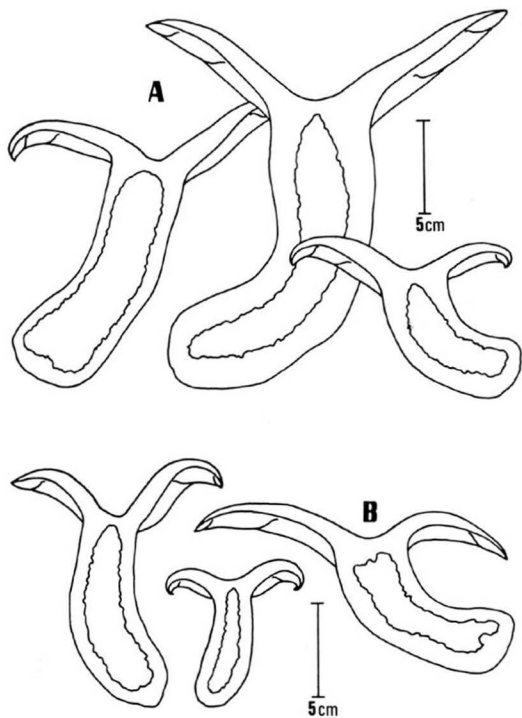


Fig. 3. Sections of basidiomata of *Lactarius mexicanus*. **A.** Holotypus. **B.** A. Kong 2240.

Brown (5D6, 6D6, 7D6) or Brown (7E6).

Macrochemical reactions: 10% FeSO_4 - pinkish grey on context. **Guaiacol** - reddish or purplish red on context. 5% **KOH** - yellowish orange on pileus; yellowish orange to yellowish on context; Reddish Orange (7B8) on latex. 2% **Phenol** - purplish brown to dark reddish brown on context. **Sulfoformol** - purplish brown to purplish red or purplish grey on context.

Spore deposit cream color (IIb-IIc) in thick deposits on white paper. **Basidiospores** (Fig. 4A) ($n = 330$) (7.4-) 7.9 - 9.8 (-10.9) \times (6.3-) 6.6 - 7.9 (-8.4) μm ($L = 8.39 - 9.50 \mu\text{m}$; $W = 6.86 - 7.48 \mu\text{m}$); subglobose to broadly ellipsoid ($Q = 1.19 - 1.34$; $V = 206.73 - 262.48 \mu\text{m}^3$); ornamentation amyloid, 0.3 - 0.9 (-1.3) μm high, consisting of interconnecting verrucae, lines and ridges, forming a broken or partial reticulum with scattered isolated verrucae; plage inamyloid or at times with a diffuse amyloid coating. **Basidia** (Fig. 4B) (39-) 48 - 70 (-80) \times (7-) 9 - 13 (-17) μm , clavate to subventricose, four-sterigmate, rarely two-sterigmate; hyaline or with brownish yellow contents in KOH; sterigmata 5 - 11 \times 1.5 - 2.5 μm . **Macrocystidia** (Figs. 4C, 5A, 5B) (40-) 50 - 115 (-130) \times (6-) 8 - 13 (-17) μm , fusoid, subcylindric or subventricose, with mucronate, obtuse apices and subapical constrictions; scattered in the hymenium, absent or rare in the lamellae edge; projecting 10 - 45 (-65) μm beyond the basidioles, rarely embedded in the hymenium; contents yellowish brown and refractive in KOH, dark purple, blackish purple or black in Sulfovanillin (SV). **Pseudocystidia** (Fig. 5C) (5-) 6 - 11 (-18) μm broad, cylindric and sinuous, at times forked; apices obtuse, rarely subcapitate or mucronate, at times with subapical constrictions; abundant in the hymenium, often present at the edge of the lamellae; embedded or projecting up to 65 μm beyond the basidioles; contents similar as the macrocystidia. **Marginal cells** (Fig. 5D) (9-) 15 - 34 (-40) \times (4-) 6 - 10 (-12) μm , variable in shape, short cells with a broad base and subisodiametric joint cells; rarely large, ventricose, clavate, subfusoid or cylindric;

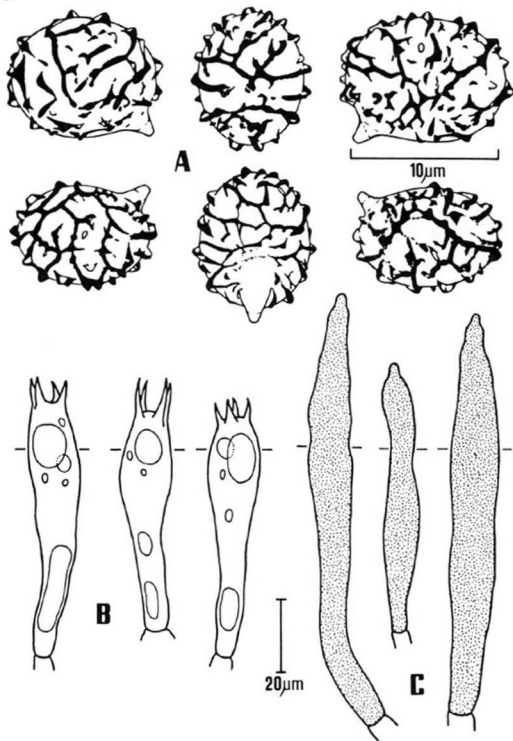


Fig. 4. Microscopic features of *Lactarius mexicanus*, *Holotypus*. **A.** Basidiospores. **B.** Basidia. **C.** Macrocytidia.

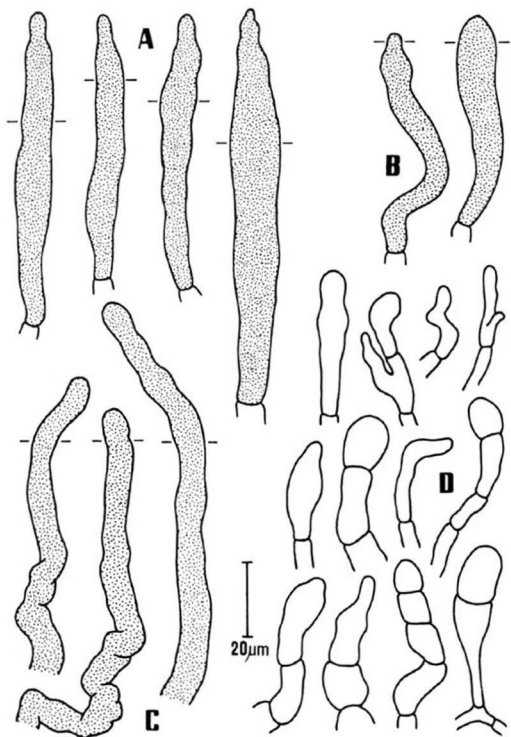


Fig. 5. Microscopic features of *Lactarius mexicanus*, Holotypus. A. Macrocystidia. B. Macrocystidia of the lamellar edge. C. Pseudocystidia. D. Marginal cells.

apices obtuse to mucronate; hyaline in KOH, no reaction in SV. **Subhymenium** filamentous to subcellular, hyphae 3 - 10 μm broad, hyaline in KOH. **Laticiferous hyphae** (2-) 4 - 13 (-17) μm broad, yellow-brown, refractive contents in KOH, orange-brown to orange-yellow in Melzer's reagent, dark purple, blackish purple or black in SV; present in the lamellar trama and context. **Lamellar trama** interwoven, hyphae (2-) 3 - 10 (-13) μm broad, hyaline in KOH; sphaerocysts up to 30 - 90 μm broad, hyaline in KOH, in rosettes up to half the breadth of the lamellar trama. **Context** interwoven, hyphae (2-) 3 - 10 (-13) μm broad, hyaline in KOH; sphaerocysts in rosettes, up to 30 - 90 μm broad. **Pileipellis** an ixocutis (50-) 80 - 335 (-435) μm thick, hyphae 1.5 - 8.5 μm broad, interwoven, hyaline or with granular contents, brownish yellow in KOH, without incrustations in Melzer's reagent; terminal cells cylindrical, sinuous, apices obtuse. **Stipitipellis** variable, a modified trichodermium at apex, pseudoparenchymatic over the scrobiculae.

Solitary, gregarious, or caespitose. On soil or rarely on rotten wood. Coniferous or mixed forests, in association with *Abies religiosa*. 2800-3600 m altitude. June to November.

ETYMOLOGY: Named after the geographical location where it grows.

MATERIAL EXAMINED. HOLOTYPE: MEXICO, Tlaxcala, Municipio de Huamantla, Parque Nacional La Malinche, ladera Este del Volcán La Malintzi, Cañada Grande, 28.VIII.1992, A. Kong 2448 (TLXM; ISOTYPE: EIU, ENCB). PARATYPE: *Ibid.*, 31.VII.1988, A. Kong 751 (ENCB; PC); *Ibid.*, 28.IX.1988, A. Kong 972 (ENCB); *Ibid.*, 18.VIII.1989, A. Montoya Esquivel 457 (TLXM); *Ibid.*, 27.VI.1990, A. Kong 1497 (TLXM); *Ibid.*, 25.VII.1990, A. Estrada Torres 3019 (TLXM); *Ibid.*, 17.X.1990, A. Kong 1821 (MICH, TLXM); *Ibid.*, 17.VII.1991, A. Kong 1994 (TLXM); *Ibid.*, 19.VII.1991, A. Kong 2003 (TLXM); *Ibid.*, 31.VII.1991, A. Kong 2037 (EIU, TLXM); *Ibid.*, 28.VIII.1991, A. Kong 2106 (TLXM); *Ibid.*, 30.VIII.1991, A. Kong 2134 (EIU, TLXM); *Ibid.*, 8.XI.1991, A. Kong 2240 (TLXM); *Ibid.*, 19.VIII.1992, A. Kong 2422 (FCME, TLXM).

DISTRIBUTION, HABITAT, PHENOLOGY, and FREQUENCY. In Central Mexico *Lactarius mexicanus* is common and abundant in *Abies religiosa* forests on the

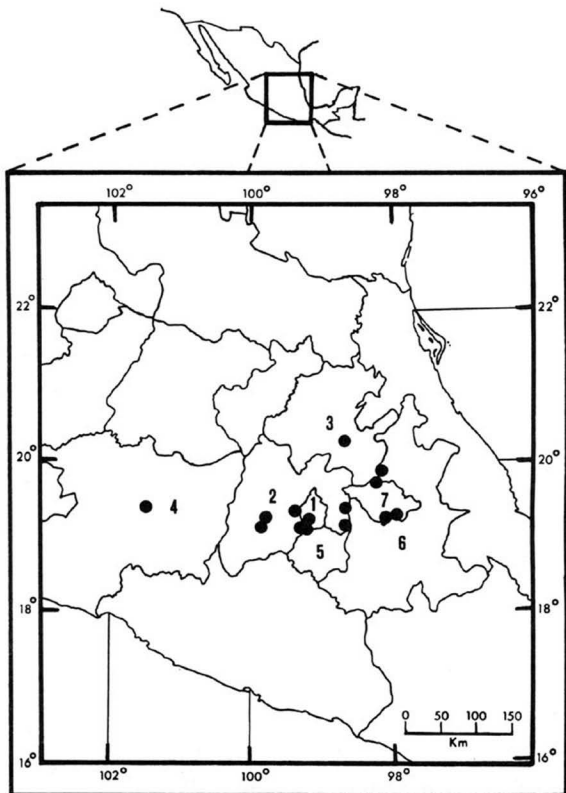


Fig. 6. Distribution of *Lactarius mexicanus* based on the material examined. 1. Distrito Federal. 2. Estado de México. 3. Hidalgo. 4. Michoacán. 5. Morelos. 6. Puebla. 7. Tlaxcala.

volcanoes of the Eje Neovolcánico Transversal (e.g., Nevado de Toluca, Popocatepetl, Iztaccíhuatl, La Malintzi). Based on our data, *L. mexicanus* is distributed along the central part of the Eje Neovolcánico Transversal (Fig. 6) in the Sierras Meridionales (Región Mesoamericana de Montaña as defined by Rzedowski, 1978). Since it seems to grow in association with *A. religiosa*, *L. mexicanus* might occur in other habitats where *A. religiosa* occurs, especially high elevation volcanoes.

In the type locality, *L. mexicanus* occurs in moist depressions or along brooks, at elevations of 3200 - 3600 m, and is the most common species of *Lactarius* associated with *A. religiosa*. The soil is a sandy fluvisol (Werner, 1986) that originated from volcanic rock (andesite), with a pH ranging from 6.0 - 6.4. The basidiomata arise directly from soil or rarely on very rotten wood, overlaid by a thick, continuous layer of mosses.

Basidiomata of *L. mexicanus* occurred in the study plots from June through November. Fruiting was not observed during the period of December to May, and in 1990 the spatial frequency of the species was at least twice that of 1991 (Figs. 7 and 8).

In 1990, basidiomata of *L. mexicanus* began to appear in the fir stand (plots 1 and 2, Fig. 7) during the 24th to 26th week, when the monthly mean precipitation was >50 mm, and reached a maximum frequency of 0.36 to 0.55 during the 30th to 32nd week following heavy rainfall (>100 mm precipitation per month). By the end of September (the 38th week), the frequency decreased dramatically to less than 0.08 in both plots and no basidiomata were collected after the 42nd week (middle of October) due to the low minimum temperature (± 0 °C). The frequency in the pine-fir stand (plots 3 and 4, Fig. 7) was similar to that of the fir stand although the maximum frequency values were 0.25 to 0.32. In all plots, basidiomata were most abundant when the difference between the minimum and maximum temperature was least and the precipitation reached the first maximum peak.

In 1991, basidiomata of *L. mexicanus* appeared one month later than in 1990 (Figs. 7 and 8). In

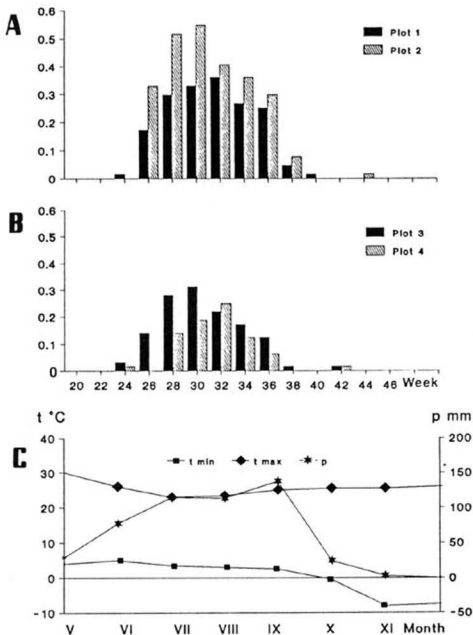


Fig. 7. Frequency of basidiomata of *Lactarius mexicanus* and climatic conditions in 1990. **A.** Frequency (f) in *Abies religiosa* stand: plots 1 and 2. **B.** Frequency in *Pinus hartwegii-Abies religiosa* stand: plots 3 and 4. **C.** Climatic conditions during 1990 collecting season (Huamantla climatic station): monthly mean, **t min**: minimum temperature in °C, **t max**: maximum temperature in °C, **p**: precipitation in mm.

the fir stand (plots 1 and 2, Fig. 8), fruiting began in the 29th week after the first maximum precipitation peak, and reached a maximum in the 33rd to 35th week with a frequency value between 0.17 and 0.27. Although the basidiomata frequency decreased during the 35th to 43rd week as a result of a decrease in rainfall, it increased again in the 45th week to a frequency value of 0.06 to 0.10 due to a second maximum precipitation peak. In the pine-fir stand (plots 3 and 4, Fig. 8), the frequency was similar to that of the fir stand.

During 1990, basidiomata of *L. mexicanus* occurred at plots 1 and 2 in 38 and 39 subplots respectively (77 subplots in total), and in 1991 in 22 and 28 subplots respectively (50 total). According to the established frequency classes (Villeneuve et al., 1988), *L. mexicanus* is therefore a very frequent to extremely frequent species in the fir stand. In 1990 at plots 3 and 4, basidiomata occurred in 29 and 19 subplots respectively (48 total), and in 1991 occurred in 15 and 9 subplots respectively (24 total). This represents a frequent to very frequent species in the pine-fir stand.

SYSTEMATIC POSITION. Following the classification of Hesler & Smith (1979), *Lactarius mexicanus* belongs to Subgenus *Piperites*, Section *Piperites*, Subsection *Scrobiculati* due to the viscid, yellowish pileus, tomentose-fibrillose margin which becomes glabrous in age, white latex which changes to yellow on exposure, scrobiculate stipe, and a lack of hyphal incrustations in the pileipellis.

OBSERVATIONS. *Lactarius mexicanus* is recognized macroscopically by large basidiomata, pale coloration, azonate pileus, margin which is scarcely tomentose-fibrillose, mild to subacid taste, close to subdistant lamellae which often fork near the stipe, large, scrobiculate stipe, cream colored spore deposit, and association with *Abies religiosa*.

Microscopically, it is distinguished by relatively large spores with an amyloid ornamentation up to 0.9 (-1.3) μm high which forms a broken reticulum, scattered, large macrocystidia

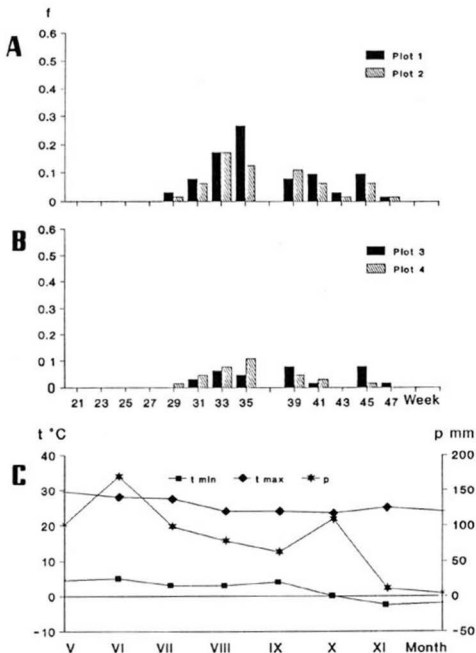


Fig. 8. Frequency of basidiomata of *Lactarius mexicanus* and climatic conditions in 1991. **A.** Frequency (f) in *Abies religiosa* stand: plots 1 and 2. **B.** Frequency in *Pinus hartwegii-Abies religiosa* stand: plots 3 and 4. **C.** Climatic conditions during 1991 collecting season (Huamantla climatic station): monthly mean, t min: minimum temperature in °C, t max: maximum temperature in °C, p : precipitation in mm.

and abundant pseudocystidia which project up to 45 - 65 μm beyond the basidioles.

L. scrobiculatus was first recorded from Mexico by Singer (1957). The specimen examined by Singer (M-1604, MICH) was reported by Hesler & Smith (1960) as *L. scrobiculatus* var. *scrobiculatus* but was later excluded from the North American treatise on *Lactarius* (Hesler & Smith, 1979).

Additional reports of *L. scrobiculatus* from *Abies* forests in Central Mexico seem to be based on *L. mexicanus* (Guzmán, 1966; Guzmán, 1972; Guzmán, 1977; Guzmán, 1978; Frutis & Guzmán, 1983; López et al., 1985; Zarco, 1986).

In their monograph, Hesler & Smith (1979) recognized two varieties of *L. scrobiculatus* from North America: *L. scrobiculatus* var. *canadensis* (A.H. Smith) Hesler & Smith and *L. scrobiculatus* var. *pubescens* A.H. Smith. The latter differs from *L. mexicanus* by a shorter stipe (1.5 - 3 cm long), white spore deposit, smaller spores (6 - 7.5 x 4.5 - 6 μm) with ornamentation up to 0.5 μm high, and association with *Pinus* (Table 1). *L. scrobiculatus* var. *canadensis* is also similar to *L. mexicanus* but differs in the "olive-buff" colors of the pileus, tomentose-fibrillose margin with appressed squamules, crowded lamellae, slightly smaller spores (7 - 9 x 5.5 - 7 μm) with ornamentation up to 0.5 μm high, and shorter basidia (Table 1). *L. mexicanus* is also similar to *L. alnicola* A.H. Smith *sensu lato*. *L. alnicola* is distinctive however by unchanging latex which stains cut surfaces yellow or very slowly changes to yellow and association with *Alnus* and *Pinus*.

Methven (1985) described *L. scrobiculatus* var. *montanus* from northern California. This variety, which occurs in association with *Abies* and *Pinus*, appears to be the most similar taxon to *L. mexicanus* in North America, but differs by the slightly shorter stipe (3 - 7 cm long), basidiospore ornamentation 0.3 - 0.6 μm high, and semihypogeous habit (Table 1).

In the type locality, two other taxa in Subsection *Scrobiculati* have been collected although both of them are associated with *Pinus*. The first, which is similar to *L. scrobiculatus* var. *pubescens*, differs from *L. mexicanus* in

Table 1. Comparison of *Lactarius scrobiculatus* var. *pubescens*, *L. scrobiculatus* var. *canadensis*, *L. scrobiculatus* var. *montanus* and *L. mexicanus*

	<i>L. scrobiculatus</i> var. <i>pubescens</i> *	<i>L. scrobiculatus</i> var. <i>canadensis</i> *	<i>L. scrobiculatus</i> var. <i>montanus</i> **	<i>L. mexicanus</i>
Pileus size	up to 10 cm	up to 10 (-12) cm	up to 15 cm	up to 20 (-27) cm
Pileus zonation	azonate	-	azonate	azonate to obscurely zonate
Lamellae spacing	close	crowded	close	close to subdistant
Lamellae forking near the stipe	some	many	yes	some to many
Stipe length	1.5 - 3 cm	3 - 11 cm	3 - 7 cm	6 - 10 (-18) cm
Spore deposit color	white	white to cream	pale cream	cream (Romagnesi 11b-11c)
Spore length	6 - 7.5 μm	7 - 9 μm	7.2 - 9 (-9.7) μm	(7.4-) 7.9 - 9.8 (-10.9) μm
Spore width	4.5 - 6 μm	5.5 - 7 μm	(5.3-) 5.7 - 7 μm	(6.3-) 6.7 - 7.9 (-8.4) μm
Height of spore ornamentation	0.2 - 0.5 μm	0.5 μm	0.3 - 0.6 μm	0.3 - 0.9 (-1.3) μm
Basidia length	-	42 - 48 μm	42 - 57 μm	(39-) 50 - 70 (-80) μm
Basidia width	-	8 - 10 μm	6 - 9 (-11.4) μm	(7-) 9 - 13 (-17) μm
Macrocyttidia length	60 - 90 μm	37 - 78 μm	52.5 - 88.5 μm	(40-) 50 - 115 (-130) μm
Macrocyttidia width	5 - 8 μm	6 - 12 μm	(4.4-) 6 - 7.9 (-9) μm	(6-) 8 - 13 (-17) μm
Macrocyttidia projecting	-	5 - 20 μm	10 - 20 μm	(0-) 10 - 45 (-65) μm
Host (genus)	<i>Pinus</i>	conifers	<i>Abies</i> , <i>Pinus</i>	<i>Abies</i>

* Data from Hesler & Smith (1979).

** Data from Methven (1985)

ectomycorrhizal host, zonate pileus, crowded lamellae, shorter stipe, smaller basidiospores, and smaller macrocystidia which are embedded in the hymenium. The second, which is close to *L. alnicola*, differs in ectomycorrhizal host, unchanging latex, fibrillous pileus surface, crowded lamellae, and shorter stipe.

The collection (**J. Cifuentes 2703**, FCME 13888) reported by Cifuentes et al. (1990) as *L. scrobiculatus* which occurred in association with *Abies* in Los Azufres, Michoacán, is macroscopically similar to *L. mexicanus*, but differs in a distinctly zonate pileus, intervenose and distant lamellae, smaller and more reticulated spores, abundant macrocystidia which scarcely project beyond the basidioles, and scattered pseudocystidia. Additional research is required before the correct identity of this specimen can be determined.

In Europe, *L. scrobiculatus* differs from *L. mexicanus* by the zonate pileus, unforked lamellae, smaller stipe (3 - 9 x 1.5 - 6.0 cm), smaller spores (7.5 - 9.5 x 5.5 - 7.6 μm), smaller basidia (37 - 50 x 8 - 11 μm), smaller macrocystidia (32-) 46 - 60 (-70) x 5 - 10 μm , and association with *Picea abies* (L.) Karsten (Neuhoff, 1956; Bon, 1980; Kytövuori, 1984; **Table 2**).

Although *L. intermedius* (Krombh.) Cke. appears to be the most similar species to *L. mexicanus* in Europe, it differs mainly by the slightly smaller pileus, slightly lighter spore deposit (A-B Crawshay), less reticulate basidiospore ornamentation, and weakly differentiated macrocystidia (Bon, 1980; Kytövuori, 1984; **Table 2**).

ADDITIONAL MATERIAL EXAMINED. MEXICO, DISTRITO FEDERAL: Delegación Tlalpan, autopista México-Cuernavaca, Este de Topilejo, Cerro Ocopiazo, 7.VIII.1968, G. Guzmán 6903 (ENCB, ut *L. scrobiculatus*). ESTADO DE MEXICO: Municipio de Amecameca, carretera Amecameca-Tlaxcala, Barranca Ameyalco, 17.VII.1957, G. Guzmán 844 (ENCB, ut *L. scrobiculatus*); *Ibid.*, 19.VII.1962, G. Guzmán 3123 (ENCB, ut *L. scrobiculatus*); *Ibid.*, IX.1969, A. López (ENCB, ut *L. scrobiculatus*); *Ibid.*, VII.1980, L. Flores 103 (ENCB, ut *L. scrobiculatus*); Municipio de Ocoyoacac, Parque Nacional Miguel Hidalgo, La Marqueza, 14.VIII.1960, G. Guzmán 2549 (ENCB, ut *L. scrobiculatus*); *Ibid.*, 12.VIII.1962, G. Guzmán

Table 2. Comparison of *Lactarius scrobiculatus*, *L. intermedius* and *L. mexicanus*

	<u><i>L. scrobiculatus</i></u> *	<u><i>L. intermedius</i></u> **	<u><i>L. mexicanus</i></u>
Pileus size	up to 20 (-25) cm	up to 12 (-15) cm	up to 20 (-27) cm
Pileus zonation	clearly zonate	azonate or doubtful	azonate to obscurely zonate
Lamellae spacing	close	-	close to subdistant
Lamellae forking near the stipe	usually not	-	some to many
Stipe length	3 - 9 cm	-	6 - 10 (-18) cm
Spore deposit color	white to cream (A-B Crawshay) **	white to cream (A-B Crawshay)	cream (Romagnesi I1b-I1c)
Spore length	8.2 - 9.5 μm	(6.5-) 8 - 9 (-10) μm	(7.4-) 7.9 - 9.8 (-10.9) μm
Spore width	6.1 - 7.6 μm	6 - 7 (-8) μm	(6.3-) 6.7 - 7.9 (-8.4) μm
Height of spore ornamentation	up to 1 μm	-	0.3 - 0.9 (-1.3) μm
Basidia length	37 - 47 μm	-	(39-) 55 - 70 (-80) μm
Basidia width	8 - 11 μm	-	(7-) 9 - 13 (-17) μm
Macrocytidia length	32 - 46 μm	weakly differentiated *	(40-) 50 - 115 (-130) μm
Macrocytidia width	5 - 7 μm	weakly differentiated *	(6-) 8 - 13 (-17) μm
Macrocytidia projecting	up to 12 μm	-	(0-) 10 - 45 (-65) μm
Pseudocystidia width	6 - 10 μm	-	(5-) 6 - 11 (-18) μm
Host (genus)	<u>Picea</u>	<u>Abies</u> - <u>Fagus</u>	<u>Abies</u>

* Data from Kytövuori (1984).

** Data from Bon (1980).

3199 (ENCB, ut *L. scrobiculatus*); *Ibid.*, IX.1962, E. González 489 (ENCB, ut *L. scrobiculatus*); Zona de Zoquiapan, Bosque de la Estación de Investigación Forestal de la Universidad de Agricultura de Chapingo en Aculco, 10.X.1980, G. Guzmán 19124 (ENCB, ut *L. scrobiculatus*); Municipio de Ocuilan, carretera Chalma-Lagunas de Zempoala, 3 Km de Santa Martha, 10.VII.1966, J. Sánchez Córdova 394 (ENCB, ut *L. scrobiculatus*); 9 Km adelante del Parque Nacional Lagunas de Zempoala, carretera a Chalma, 28.XI.1982, G. Rodríguez 1314 (ENCB, ut *L. scrobiculatus*); Municipio de Zinacantepec, Parque Nacional Nevado de Toluca, 31.VII.1982, E. Avilés 193 (ENCB, ut *L. scrobiculatus*); *Ibid.*, primer bosque de *Abies* antes de la desviación al Nevado, 14.VII.1966, G. Guzmán 5281 (ENCB, ut *L. scrobiculatus*); Municipio de Texcaltitlán, Parque Nacional Nevado de Toluca, Km 21 de la carretera Sultepec-Toluca, El Capulin, 25.IX.1983, L. Guzmán Dávalos 1244 (ENCB, ut *L. scrobiculatus*); *Ibid.*, R. Valenzuela 2599 (ENCB); *Ibid.*, 16.IX.1984, L. Colón 880 (ENCB, ut *L. scrobiculatus*). HIDALGO: Municipio de Mineral El Chico, Parque Nacional El Chico, Las Ventanas, 22.IX.1979, G. Guzmán 17877 (ENCB, ut *L. scrobiculatus*). MICHOACÁN: Municipio de Villa Madero, carretera Pátzcuaro-Tacámbaro, Cerro Cruz Gorda, 23.X.1979, R. Sánchez 82 (ENCB, ut *L. scrobiculatus*). MORELOS: Municipio de Huitzilac, Parque Nacional Lagunas de Zempoala, Este de la laguna principal, 25.VII.1973, G. Guzmán 11021-A (ENCB, ut *L. scrobiculatus*); Zona del Parque Nacional Lagunas de Zempoala, carretera a Chalma, 1.VII.1982, L. Guzmán Dávalos 196 (ENCB, ut *L. scrobiculatus*); *Ibid.*, E. Fanti 181 (ENCB, ut *L. scrobiculatus*); Municipio de Huitzilac, carretera a Chalma, ± 5 Km adelante de Huitzilac, 17.VII.1982, S. Chacón 233 (ENCB, ut *L. scrobiculatus*). PUEBLA: Municipio de Chignahuapan, 36 Km al Oeste de Chignahuapan, Piedra Ancha, 23.VII.1981, Ramírez 6-10 (ENCB, ut *L. scrobiculatus*). TLAXCALA: Municipio de San Pablo del Monte, Parque Nacional La Malinche, San Isidro Buen Suceso, 7.IX.1983, I. González Fuentes 394-A (ENCB, ut *L. scrobiculatus*); Municipio de Huamantla, Parque Nacional La Malinche, ladera Este del Volcán La Malintzi, Cañada Grande, 30.VII.1988, A. Kong 745 (ENCB); *Ibid.*, 31.VII.1988, A. Kong 751 (ENCB); *Ibid.*, 12.VIII.1988, A. Montoya Esquivel 192 (TLXM); *Ibid.*, 4.VIII.1989, A. Kong 1151 (TLXM); *Ibid.*, 12.X.1989, A. Kong 1331 (TLXM); *Ibid.*, 11.VII.1990, A. Estrada Torres 3009 (TLXM); *Ibid.*, 8.VIII.1990, A. Estrada Torres 3043 (TLXM); *Ibid.*, 22.VIII.1990, A. Kong 1684 (TLXM); *Ibid.*, 19.IX.1990, A. Kong 1777 (TLXM); *Ibid.*, 3.X.1990, A. Kong 1811 (TLXM); *Ibid.*, 23.VIII.1991, A. Kong 2090 (TLXM); Municipio de Tlaxco, Cerro El Peñón, El Rodeo, 16.VII.1992, A. Kong 2325 (TLXM).

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SOME ASTERINA, ASTEROSTOMELLA AND LEMBOSIA SPECIES
FROM SOUTHERN INDIA

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Abstract

The paper gives an account of eight taxa of epiphyllous fungi from India. Asterina euonymi, A. sabiacearum, Asterostomella daphniphylli and A. isonandreae are described as new species, while Lembosia malabarensis is listed as a new combination, based on Asterina malabarensis. Other species listed are Asterina dissiliens, A. tertia, and A. toddaliae.

Key Words: Asterina, Asterostomella, Lembosia, Southern India

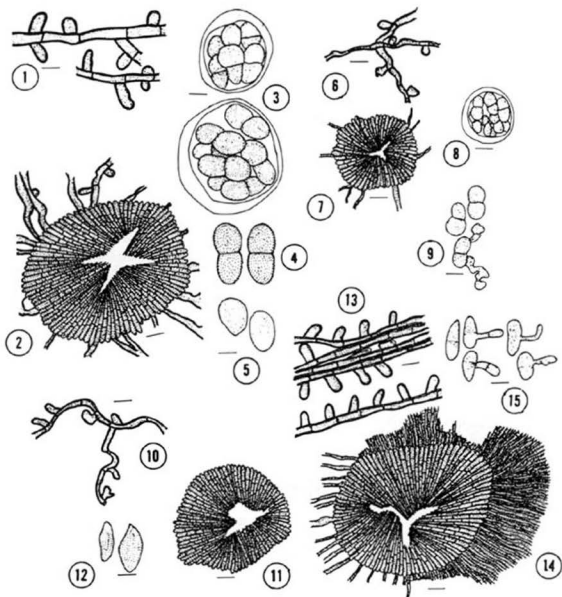
1. Asterina dissiliens (Sydow) Doidge, *Bothalia* 4: 287, 1942.

On leaves of Pleurostyliia opposita (Wall.) Alston (Celastraceae), Kaka sholai, Yercaud, Salem dist., Tamil Nadu, Feb. 1992, A.A. Ansari HClO 40848

This is the first report of this species on this host genus.

2. Asterina euonymi sp. nov. (Fig. 1-5).

Coloniae amphigenae, caulicolae, ramicolae, densae, velutinae, plerumque confluentes. Hyphae rectae vel subrectae, raro anfractuae, alternate vel irregulariter acuteque ramosae, laxae vel dense reticulatae, cellulae 21-25 X 4.5-6.5 μm . Hyphopodia continua, mammiformia, ovoidea vel cylindracea, rotunda ad apicem, integra vel raro sublobata, 6-37 X 5-7 μm . Thyrothecia dispersa vel laxae aggregata, rotunda, margina crenata vel fimbriata, stellate dehiscentia ad centrum, toties portio superior



Figs. 1-5. Asterina euonymi sp. nov. 1. Mycelium. 2. Thyrothecium. 3. Asci. 4. Ascospores. 5. Pycnidiospores.

Figs. 6-9. Asterina sabiacearum sp. nov. 6. Mycelium. 7. Thyrothecium. 8. Ascus. 9. Ascospores.

Figs. 10-12. Asterostomella isonandrae sp. nov. 10. Mycelium. 11. Pycnidium. 12. Pycnidiospores.

Figs. 13-15. Asterostomella daphniphylli sp. nov. 13. Mycelium. 14. Pycnidium. 15. Pycnidiospores. Standard Bar=10 μ m.

tabidus et perlate apertus, ad 110 μm diam. Asci numerosi, octospori, 55-75 μm diam. Ascosporae conglobatae, 1-septatae, profunde constrictae, cellula superiore ovata, cellula inferiore globosa, 31-34 X 14-16 μm , pariete verrucosa. Pycnidia pauca, similis ad thyrothecia, leniter brevior; pycnidiosporae brunneae, globosae, piriformiae, leniter rostratae, 18-25 X 14-16 μm .

Colonies amphigenous, caulicolous, ramicolous, dense, velvety, widely confluent. Hyphae straight to substraight, rarely crooked, branching alternate to irregular at acute angles, loosely to closely reticulate, cells 21-25 X 4.5-6.5 μm . Hyphopodia continuous, mammiform, obovoid to cylindrical, rounded at the apex, entire to rarely sublobate, 6-37 X 5-7 μm . Thyrothecia scattered to loosely grouped, round, margin crenate to rarely fringed, stellately dehisced at the centre, often upper portion dissolved and widely opened, up to 110 μm in diameter. Asci many, globose, octosporous, 55-75 μm in diameter. Ascospores conglobate, 1-septate, deeply constricted at the septum, upper cell ovate, lower cell globose, 31-34 X 14-16 μm , wall verrucose. Pycnidia few, similar to thyrothecia, slightly smaller; pycnidiospores brown, globose, pyriform, often slightly beaked, 18-25 X 14-16 μm .

Holotype: On leaves of Euonymus crenulatus Wall. ex Wight & Arn. (Celastraceae), Seithur hills, Kamarajar dist., Tamil Nadu, Nov. 12, 1992, V.B. Hosagoudar HCIO 40849.

Asterina dissiliens (Sydow) Doidge is the only species of Asterina reported on members of the family Celastraceae (Doidge, 1942). The new species differs from it in having numerous hyphopodia, scattered thyrothecia and larger ascospores.

3. Asterina sabiacearum sp. nov. (Fig. 6-9).

Coloniae epiphyllae, subdensae, minutae, ad 1 mm diam. Hyphae flexuosae vel leniter anfractuae, alternatae, vel irregulariter acutaeque ramosae, laxae reticulatae, cellulae 30-37 X 3-5 μm . Hyphopodia alternata, dispersa, plerumque unicellularia, raro bicellularia, mammiformia, integra vel sublobata, 3-22 X 5-7 μm . Thyrothecia aggregata ad centrum, stellate dehiscentes et perlate patulata, margina crenata, ad 60 μm diam. Ascosporae conglobatae, brunneae, 1-septatae, profunde constrictae, cellula superior magnior, cellula inferior brevior, 18-22 X 12-14 μm , periete glabro.

Colonies epiphyllous, subdense, minute, up to 1 mm in diameter. Hyphae flexuous to slightly crooked, branching

alternate to irregular at acute angles, loosely reticulate, cells 30-37 X 3-5 μm . Hyphopodia alternate, scattered, mostly unicellular, rarely two celled, mammiform, entire to sublobate, 3-22 X 5-7 μm . Thyrothecia grouped at the centre of the colony, stellately dehisced and widely opened, margin crenate, up to 60 μm in diameter. Ascospores conglobate, brown, 1-septate, deeply constricted, upper cell larger, lower cell smaller, 18-22 X 12-14 μm , wall smooth.

Holotype: On leaves of Meliosma simplicifolia (Roxb.) Walp. subsp. pungens (Wall. ex Wight & Arn.) Beus (Sabiaceae), Seithur Hills, Kamarajar dist., Tamil Nadu, Nov. 14, 1992, V.B. Hosagoudar HCIO 40850.

The new species can be compared with Asterina meliosmaticola Petrak & Ciff. reported on Meliosma sp. from which it differs in having unicellular to bi-cellular hyphopodia, and smaller thyrothecia, asci and ascospores (Petrak & Cifferi, 1932)

4. **Asterina tertia** Rac. var. **africana** Doidge, Trans. Royal Soc. South Africa 8: 264, 1920.

On leaves of Eranthemum capense L. (Acanthaceae), Seithur hills, Kamarajar dist., Tamil Nadu, Nov. 14, 1992, V.B. Hosagoudar HCIO 40851.

This taxon has not been previously recorded on this host genus.

5. **Asterina toddaliae** Kar & Ghosh, Indian Phytopathol. 39: 210, 1986 (toddalae)

On leaves of Toddalia asiatica (L.) Lam. (Rutaceae), Seithur Hills, Kamarajar dist., Tamil Nadu, Nov. 12, 1992, V.B. Hosagoudar HCIO 40852.

This species was recorded from West Bengal and is reported here for the first time from southern India (Kar & Maity, 1986). In our collection, the colonies were subdense and hypophyllous.

6. **Asterostomella isonandrae** sp. nov. (Fig. 10-12)

Coloniae hypophyllae, subdensae, patentiae. Hyphae anfractuae, irregulariter acutegue ramosae, dense reticulatae, cellulae 12-15 X 3-4.5 μm . Hyphopodia unicellula, saepe dispersa, ovata, ampullacea, mammiformea, integra vel sublobata, 9-12 X 6-8 μm . Pycnidia dispersa, stellato dehiscentes vel perlate patulata, ad 100 μm diam., margo crenatus. Pycnidiosporae unicellulariae, ovoideae, ellipsoideae, brunneae, acute rotundatae ad apicem ambo, 24-26 X 9-15.5 μm .

Colonies hypophyllous, subdense, spreading. Hyphae crooked, branching irregular at acute angles, closely reticulate, cells 12-15 X 3-4.5 μm . Hyphopodia unicellular, often scattered, ovate, ampulliform, mammiform, entire to sublobate, 9-12.5 X 6-8 μm . Pycnidia scattered, stellately dehisced to widely opened, up to 100 μm in diameter, margin crenate. Pycnidiospores unicellular, ovoid, ellipsoid, brown, acutely rounded at both ends, 24-26 X 9-15.5 μm .

Holotype: On leaves of *Isonandra lanceolata* Wight forma *anfractuosa* (Clarke) Jeuken (Sapotaceae), Seithur Hills, Kamarajar dist., Tamil Nadu, Nov. 14, 1992, V.B. Hosagoudar HCIO 40858.

This new species differs from other anamorphs of *Asterina* species reported on Sapotaceae in the infection pattern and in the morphology of hyphae, hyphopodia and pycnidiospores (Stevens & Ryan, 1939; Doidge, 1942)

7. ***Asterostomella daphniphylli*** V.B. Hosagoudar et K. Ravikumar, sp. nov. (Fig. 13-15).

Coloniae amphigenae, plerumque epiphyllae, crustosae vel velutinae, ad 2 mm diam., confluentes. Hyphae rectae, flexuosae, raro anfractuae, alternate vel irregulariter acuteque ramosae, hyphae in cursum parallelis, compactae, cellulae 9-15.5 X 4.5-7.5 μm . Hyphopodia alternata et positus externa in hyphis compactis modo, recta vel raro curvula, unicellularia, ovata vel globosa, integra, 6-12.5 X 6-9.5 μm . Pycnidia numerosa, laxe aggregata, circularia vel ovata, 130-190 μm diam., membrana amicta brunnea, nigra et opaca in maturitate, stellate dehiscentes ad centrum vel perlate patulata. Pycnidiosporae ovalae, ellipsoideae, piriformia, rectae vel leniter curvulae, pallide brunneae vel profunde brunneae, taenia hyalina ad centrum, 18-28 X 9-12.5 μm .

Colonies amphigenous, mostly epiphyllous, crustose to velvety, up to 2 mm in diam., confluent and covering the entire upper surface of the leaves. Hyphae straight, flexuous, often crooked when solitary, branching alternate to irregular at acute angles, several hyphae running closely parallel and forming a compact mycelial mat, cells 9-15.5 X 4.5-7.5 μm . Hyphopodia alternate and produced only on the outer surface of the compact hyphae, mostly straight but rarely curved, unicellular ovate to globose, entire, 6-12.5 X 6-9.5 μm . Pycnidia numerous, loosely crowded, circular in outline, often ovate, 130-190 μm in diameter, covering membrane initially brown, later becoming dark and opaque, splitting stellately at the centre or having a wide opening. Pycnidiospores oval, ellipsoidal, pyriform, straight to slightly curved, pale

brown to deep brown, often with a hyaline band at the centre, 18-28 X 9-12.5 μm .

Holotype: On leaves of Daphniphyllum neilgherrense (Wight) K. Rosenthal (Daphniphyllaceae), Madikettan sholai, Kodaikanal, Tamil Nadu, Oct. 18, 1991, K. Ravikumar HCIO 40859

Asterina daphniphylli Yamam. has been recorded on Daphniphyllum species from Formosa and Japan (Hino & Katumoto, 1957). The new species differs from it in having a very compactly reticulate mycelium and the presence of an anamorph.

8. **Lembosia malabarensis** (Sydow & Sydow) comb. nov.
Asterina malabarensis Sydow & Sydow in Sydow, Sydow & Butler, Ann. Mycol. 9: 391, 1911.

Asterinella malabarensis (Sydow & Sydow) Theiss., Broteria 10: 106, 1912.

Prillieuxina malabarensis (Sydow & Sydow) Ryan in Stevens & Ryan, Illinois Biol. Monographs 17: 80, 1939.

On leaves of Pothos scandens L. (Araceae), Gersoppa, Uttara Kannada, Karnataka, Nov. 24, 1992, P.A. Raghu HCIO 40859.

This species was collected by E.J. Butler from Kanouth of the Malabar region of the Western Ghats. Our collection is also from the Western Ghats region of Karnataka. Elongated thyrothecia with a central longitudinal slit and the presence of hyphopodia are characteristic of the genus Lembosia, justifying the new combination. This species has been relocated after a lapse of several decades.

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CLADONIACEAE AMERICANAE EXSICCATAE

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ABSTRACT

46 taxa in the lichen genera Cladina and Cladonia from the western United States are represented in 125 specimens that comprise the first fascicle of this exsiccatae. The specimens were collected during the period 1988-1991 in the far western states, including California, Oregon, Washington, Idaho, and western Montana. Many of the species and their affinities in the region are discussed in Hammer (1989a, 1989b, 1989c, 1991, 1993a, 1993b), and Hammer and Ahti (1990). Where possible, I have provided specimens here that document the breadth of morphological variation in the taxa in the region. Poorly known taxa, or taxa which are rare in the region, are represented by several numbers. Likewise, very widely distributed taxa that show a great deal of variability are duplicated. The set is being distributed by the Farlow Reference Library and Herbarium to the following herbaria: ANUC, ASU, BM, BRNM, C, CANL, COLO, DUKE, FH, GZU, H, KOENLN, NY, TNS, UCB, UPS, US, and WIS.

1. Cladina ciliata (Stirt.) Trass f. **tenuis** (Flk.)

Ahti, Beih. Nova Hedwigia 79: 42. 1984.

WASHINGTON, Island Co., Over rock, Deception Pass State Park, vicinity of Anacortes. Sea level. Growing with a profusion of *C. gracilis* (L.) Willd. subsp. *vulnerata* (Ach.) Ahti, *C. poroscypha* Hammer, *C. phyllophora* Hoffm. and *C. uncialis* (L.) Weber ex Wiggers on nature trail, sea level. Fumarprotocetraric acid and usnic acid.

Hammer 4103 23 June 1989 Determined by T. Ahti

2. Cladina portentosa (Dufour) Follm. subsp.**pacifica** (Ahti) Ahti, Beih. Nova Hedwigia 79: 37. 1984.

OREGON, Coos Co., On duff over stabilized sand dunes, Eel Creek Campground, Oregon Dunes National Recreation Area, sea level.

Hammer 3417 3 June 1989 Determined by S. Hammer

3. Cladina rangiferina (L.) Nyl., Not. Sällsk.

Fauna Flora Fennici Förh. 8: 110. 1866.

WASHINGTON, Whatcom Co., On compressed duff over boulder, East Creek Trail off Hwy. 20, ca. 900 m elev.

Hammer 4068 22 June 1989 Determined by S. Hammer

4. Cladonia artuata Hammer, Bryologist 96: 80. 1993.

CALIFORNIA, Mendocino Co., On thin soil and duff of *Arctostaphylos*, over acidic hardpan soil of Pygmy Forest, vicinity of Hwy. 408, Mendocino State Forest, ca. 100 m elev. Thamnolic acid.

Hammer 1007 25 October 1986 Determined by S. Hammer

5. Cladonia artuata

OREGON, Coos Co., On thin soil over stabilized sand dunes, Eel Creek Campground, Oregon Dunes National Recreation Area, sea level. Thamnolic acid. PARATYPE.

Hammer 3431 3 June 1989 Determined by S. Hammer

6. Cladonia bellidiflora (Ach.) Schaer., Lich.

Helv. Spic. 21. 1823.

OREGON, Coos Co., On thin layer of duff over stabilized sand dunes, Eel Creek Campground, Oregon Dunes National Recreation Area, sea level. Usnic acid, squamatic acid, bellidiflorin.

Hammer 3424 3 June 1989 Determined by S. Hammer

7. Cladonia bellidiflora

WASHINGTON, Skagit Co., On thick layer of partially decayed duff, northwest-facing overhang below summit of North Mountain, Mt. Baker Snoqualmie National Forest, ca. 800 m. elev. Squamatic acid.

Hammer 3648 9 June 1989 Determined by S. Hammer

8. Cladonia bellidiflora

WASHINGTON, Skagit Co., On compressed duff over rotting wood, Easy Pass Trailhead nr. Hwy 20, ca. 1200 m. elev.

Hammer 5512 8 July 1991 Determined by S. Hammer

9. Cladonia borealis Stenroos, Ann. Bot. Fennici 26: 160. 1989.

WASHINGTON, Mason Co., On soil, Mount Ellinor Trail, Olympic National Forest, ca. 1400 m. elev. Barbatic acid and usnic acid.

Hammer 4237 25 June 1989 Determined by S. Hammer

10. Cladonia borealis

WASHINGTON, Skamania Co., Muscicolous on thin soil over east-facing lava formations, Big Lava Bed ca. 10 km. N. of Little White Salmon Fish Hatchery, FR 66, ca. 700 m. elev. Barbatic acid and usnic acid.

Hammer 5134 26 June 1991 Determined by S. Hammer

11. Cladonia cariosa (Ach.) Spreng., Syst. Veg. 4(1): 272. 1827.

WASHINGTON, Stevens Co., On soil over trailcut, Flowery Trail, 16 km. E. of Chelewah, Colville National Forest, ca. 1300 m. elev. Atranorin.

Hammer 4023 21 June 1989 Determined by S. Hammer

12. Cladonia cariosa

IDAHO, Idaho Co., On thin soil over roadcut, Flint, ca. 1500 m. elev. Unusually large podetia. Atranorin.

Hammer 5321 2 July 1991 Determined by S. Hammer

13. Cladonia cariosa

IDAHO, Latah Co., On thin soil at roadcut, Laird Park vicinity, Moose Creek Divide, Township 42, St. Joe National Forest, ca. 1500 m. elev. Atranorin.

Hammer 3719 17 June 1989 Determined by S. Hammer

14. Cladonia carneola (Fr.) Fr., Lichenogr. Eur. Reform. 233. 1831.

WASHINGTON, Ferry Co., On rotting wood, Sherman Pass, Colville National Forest, ca. 1500 m. elev. Usnic acid and zeorin.

Hammer 4028 21 June 1989 Determined by S. Hammer

15. Cladonia carneola

IDAHO, Bonner Co., On compressed duff over thin soil, Hanna Flat Nature Trail, Hwy. 313, vicinity of Nordman, ca. 1000 m. elev.

Hammer 5434 7 July 1991 Determined by S. Hammer

- 16. *Cladonia cenotea*** (Ach.) Schaer., Lich. Helv.
Spic. 35. 1823.
IDAHO, On thin soil at roadcut, Laird Park vicinity, Moose
Creek Divide, Township 42, St. Joe National Forest, ca.
1500 m. elev. Squamatic acid.
Hammer 3801 17 June 1989 Determined by S. Hammer
- 17. *Cladonia cenotea***
IDAHO, Bonner Co., On rotting wood, Hanna Flat Nature
Trail, Hwy. 313, vicinity of Nordman, ca. 1000 m. elev.
Squamatic acid.
Hammer 3975 20 June 1989 Determined by S. Hammer
- 18. *Cladonia cenotea***
MONTANA, Flathead Co., On compressed duff over rotting wood
on shady, east-facing trailside, Numa Ridge Trail, Bowman
Lake Campground, Glacier National Park, ca. 1500 m. elev.
Hammer 3942 18 June 1989 Determined by S. Hammer
- 19. *Cladonia cervicornis*** (Ach.) Flot., Jahresber.
Schles. Ges. Vaterl. Cult. 27: 31. 1849. subsp.
cervicornis
OREGON, Curry Co., On thin soil, north-facing hilltop near
young (ca. 15 yr.) planted pines in clearcut, Wilson
Prairie Rd., NW of Loeb State Park, ca. 1000 m. elev.
Fumarprotocetraric acid.
Hammer 3366 1 June 1989 Determined by S. Hammer
- 20. *Cladonia cervicornis* subsp. *cervicornis***
WASHINGTON, San Juan Co., On thin soil, Mt. Constitution,
Orcas Island, ca. 400 m. elev. Fumarprotocetraric acid.
Hammer 4181 25 June 1989 Determined by S. Hammer
- 21. *Cladonia cervicornis* subsp. *cervicornis***
OREGON, Wallowa Co., On compressed duff over granite rocks,
Lostine River Valley south of Lostine, ca. 1600 m. elev.
Strong development of phyllopodia. Fumarprotocetraric acid.
Hammer 5264 28 June 1991 Determined by S. Hammer
- 22. *Cladonia cervicornis* subsp. *verticillata***
(Hoffm.) Ahti, Lichenologist 12: 126. 1980.
OREGON, Lane Co., On thin soil over stabilized sand dune,
Siltcoos Beach Access Road, Oregon Dunes National
Recreation Area, sea level. A common morph in the region,
numerous tiers of narrow scyphi. Fumarprotocetraric acid.
Hammer 3490 3 June 1989 Determined by S. Hammer

- 23. *Cladonia cervicornis* subsp. *verticillata***
 OREGON, Douglas Co., On compressed duff over stabilized sand dune, semi-exposed roadside, Tahkenitch Campground, Oregon Dunes National Recreation Area, sea level.
 Fumarprotocetraric acid.
Hammer 3447 3 June 1989 Determined by S. Hammer
- 24. *Cladonia cervicornis* subsp. *verticillata***
 WASHINGTON, Mason Co., On thin soil, Hamma-Hamma Recreation Area Road, ca. 5 km. W. of Hwy. 101, ca. 200 m. elev.
 Fumarprotocetraric acid.
Hammer 4379 30 June 1989 Determined by S. Hammer
- 25. *Cladonia cervicornis* subsp. *verticillata***
 WASHINGTON, Skagit Co., On thin soil over sandy, north-facing roadside, Hwy. 20, Rockport, ca. 200 m. elev.
 Fumarprotocetraric acid.
Hammer 3673 9 June 1989 Determined by S. Hammer
- 26. *Cladonia chlorophaea* (Flk. ex Sommerf.)**
 Spreng., Syst. Veg. 4: 273. 1827.
 WASHINGTON, Snohomish Co., On thin layer of duff over soil, Hwy. 530, vicinity of Darrington, ca. 300 m. elev.
 Fumarprotocetraric acid.
Hammer 3634 9 June 1989 Determined by S. Hammer
- 27. *Cladonia conista* A. W. Evans, Trans. Connecticut Acad. Arts 30: 472. 1930.**
 CALIFORNIA, San Benito Co., On thin soil, west-facing trailside, Pinnacles National Monument, ca. 1000 m. elev.
 Fumarprotocetraric acid and bourgeanic acid.
Hammer 2441 May 1989 Determined by S. Hammer
- 28. *Cladonia cornuta* (L.) Hoffm., Descr. Pl. Cl.**
 Crypt. Tab. 25 (1). 1794., subsp. ***cornuta***
 WASHINGTON, San Juan Co., Muscicolous on north-facing slope, Mt. Constitution, Orcas Island, ca. 400 m. elev.
 Exceedingly rare west of the Cascade Mountains.
 Fumarprotocetraric acid.
Hammer 4178 25 June 1989 Determined by S. Hammer
- 29. *Cladonia dimorpha* Hammer, Mycotaxon 37: 339. 1990.**
 OREGON, Curry Co., On thin soil, north-facing hilltop near young (ca. 15 yr.) planted pines in clearcut, Wilson Prairie Rd., NW of Loeb State Park, ca. 1000 m. elev.
 Immature, pycnidial phase with tiers of scyphi instead of longitudinally fissured branches. Fumarprotocetraric acid.
Hammer 3372 1 June 1989 Determined by S. Hammer

30. Cladonia dimorpha

WASHINGTON, Clallam Co., On thin soil and duff, east-facing hillside, Hurricane Ridge Road, Olympic National Park, ca. 1000 m. elev. Fumarprotocetraric acid.

Hammer 4424 30 June 1989 Determined by S. Hammer

31. Cladonia ecmocyna Leight. subsp. **intermedia**

(Robbins) Ahti, Ann. Bot. Fennici 17: 227. 1980.

WASHINGTON, Skagit Co., Muscicolous over duff, Easy Pass Trailhead nr. Hwy 20, ca. 1200 m. elev. Scyphi narrow and depauperate; approaches unnamed subspecies found mostly farther west. Atranorin and fumarprotocetraric acid.

Hammer 4067 20 June 1989 Determined by S. Hammer

32. Cladonia ecmocyna subsp. **intermedia**

WASHINGTON, Skagit Co., Muscicolous over duff, Easy Pass Trailhead nr. Hwy 20, ca. 1200 m. elev., Atranorin and fumarprotocetraric acid.

Hammer 5511 8 July 1991 Determined by S. Hammer

33. Cladonia ecmocyna subsp. **intermedia**

WASHINGTON, Pend Oreille Co., Abundant on duff over boulder in spray zone of Granite Creek Falls, Granite Creek-Roosevelt Cedars Trail, Stagger Inn Campground, Kaniksu National Forest, ca. 200 m. elev. Some podetia approach subsp. *ecmocyna*. Atranorin and fumarprotocetraric acid.

Hammer 4017 20 June 1989 Determined by S. Hammer

34. Cladonia ecmocyna subsp. **intermedia**

MONTANA, Flathead Co., On duff, shady, east-facing trailside, Numa Ridge Trail, Bowman Lake Campground, Glacier National Park, ca. 1500 m. elev. Atranorin and fumarprotocetraric acid.

Hammer 3929 18 June 1989 Determined by S. Hammer

35. Cladonia ecmocyna Leight., Ann. Mag. Nat.

Hist., ser. 3, 18: 406. 1866. (unnamed subspecies)

OREGON, Linn Co., On compressed duff, exposed hilltop, Horse Rock Ridge near Mabel, ca. 900 m. elev. Unnamed subspecies. Coll. with Dr. Martha Sherwood. Atranorin and fumarprotocetraric acid.

Hammer 3563 6 June 1989 Determined by S. Hammer

36. Cladonia ecmocyna unnamed subspecies

WASHINGTON, Pierce Co., Under pines on thin soil, entrance to Silver Springs Campground, Mt. Baker Snoqualmie National Forest, ca. 800 m. elev. Unnamed subspecies. Atranorin and fumarprotocetraric acid.

Hammer 3691 12 June 1989 Determined by S. Hammer

- 37. *Cladonia ecmocyna* unnamed subspecies**
 OREGON, Linn Co., Muscicolous on duff over lava near
 junction of Hwys. 126 and 20, ca. 1100 m. elev. Unnamed
 subspecies. Atranorin and fumarprotocetraric acid.
Hammer 3544 6 June 1989 Determined by S. Hammer
- 38. *Cladonia ecmocyna* unnamed subspecies**
 WASHINGTON, San Juan Co., Muscicolous on north-facing
 slope, Mt. Constitution, Orcas Island, ca. 400 m. elev.
 Unnamed subspecies. Fumarprotocetraric acid and atranorin.
Hammer 4203 25 June 1989 Determined by S. Hammer
- 39. *Cladonia ecmocyna* unnamed subspecies**
 WASHINGTON, Pend Oreille Co., Abundant over semi-exposed
 boulder, Stagger Inn Campground, Kaniksu National Forest,
 ca. 200 m elev. Unnamed subspecies., sympatric with subsp.
intermedia. Atranorin and fumarprotocetraric acid.
Hammer 4108 20 June 1989 Determined by S. Hammer
- 40. *Cladonia fimbriata* (L.) Fr., Lichenogr. Eur.**
 Reform. 222. 1831.
 WASHINGTON, Whatcom Co., On compressed duff, Hwy. 542, ca.
 700 m. elev. Fumarprotocetraric acid.
Hammer 4138 24 June 1989 Determined by S. Hammer
- 41. *Cladonia fimbriata***
 WASHINGTON, Kittitas Co., On compressed duff at roadside,
 Gold Creek Road, E. of Hyak, vicinity of Snoqualmie Pass,
 ca. 1000 m. elev. Fumarprotocetraric acid.
Hammer 4781 22 June 1991 Determined by S. Hammer
- 42. *Cladonia fimbriata***
 IDAHO, Bonner Co., On compressed duff over thin soil, Hanna
 Flat Nature Trail, Hwy. 313, vicinity of Nordman, ca. 1000
 m. elev. Fumarprotocetraric acid.
Hammer 3976 20 June 1989 Determined by S. Hammer
- 43. *Cladonia firma* (Nyl.) Nyl., Bot. Zeitung (Berlin)**
 19: 352. 1861.
 CALIFORNIA, San Luis Obispo Co., On sand dunes, sea level.
 Fumarprotocetraric acid and atranorin.
Bratt s.n. 1989 Determined by T. Ahti and S. Hammer
- 44. *Cladonia furcata* (Huds.) Schrad., Spic. Fl.**
 Germ. 107. 1794.
 CALIFORNIA, Del Norte Co., On thin soil over stabilized
 sand dunes, vicinity of Fort Dick, sea level.
 Fumarprotocetraric acid.
Hammer 3307 31 May 1989 Determined by S. Hammer

45. Cladonia furcata

CALIFORNIA, Del Norte Co., On thin soil over stabilized sand dunes, vicinity of Fort Dick, sea level.

Fumarprotocetraric acid.

Hammer 3344 31 May 1989 Determined by S. Hammer

46. Cladonia furcata

CALIFORNIA, Del Norte Co., On thin soil over stabilized sand dunes, vicinity of Fort Dick, sea level.

Fumarprotocetraric acid.

Hammer 3349 31 May 1989 Determined by S. Hammer

47. Cladonia furcata

OREGON, Douglas Co., On compressed duff, northbound rest stop, Hwy. 5, vicinity of Glendale, ca. 400 m. elev.

Fumarprotocetraric acid.

Hammer 3399 2 June 1989 Determined by S. Hammer

48. Cladonia furcata

OREGON, Josephine Co., Trailside, Cave Creek Campground, 10 km. W. of Oregon Caves National Monument, ca. 350 m. elev.

Fumarprotocetraric acid.

Hammer 3392 2 June 1989 Determined by S. Hammer

49. Cladonia furcata

OREGON, Coos Co., On duff over stabilized sand dunes, Eel Creek Campground, Oregon Dunes National Recreation Area, sea level. Frondose morph. Fumarprotocetraric acid.

Hammer 3401 3 June 1989 Determined by S. Hammer

50. Cladonia furcata

OREGON, Linn Co., On compressed duff, roadside of Hwy. 242, 5 km. S. of Hwy. 126, McKenzie Bridge, ca. 900 m. elev.

Frondose morph. Fumarprotocetraric acid.

Hammer 3534 6 June 1989 Determined by S. Hammer

51. Cladonia furcata

WASHINGTON, Grays Harbor Co., On thin soil and duff over stabilized sand, Twin Harbors State Park, Westport, sea level. Fumarprotocetraric acid. Pseudoscyphoid morph.

Hammer 4256 26 June 1989 Determined by S. Hammer

52. Cladonia furcata

WASHINGTON, Grays Harbor Co., On thin soil and duff over stabilized sand, Westhaven State Park, sea level. Thick, verruculose cortex and abundant imbricating squamules.

Fumarprotocetraric acid.

Hammer 4270 27 June 1989 Determined by S. Hammer

53. Cladonia furcata

WASHINGTON, Cowlitz Co., Over thin soil on north-facing, rocky outcropping, milepost 17, Hwy 504 east of Toutle, ca. 150 m. elev. Unusual podetia with abundant squamules. Fumarprotocetraric acid.

Hammer 4882 24 June 1989 Determined by S. Hammer

54. Cladonia furcata

WASHINGTON, Mason Co., On compressed duff and thin soil at roadside, Skokomish Rest Area, Hwy 101, vicinity of Shelton, Olympic National Forest, ca. 50 m. elev. Robust podetia. Fumarprotocetraric acid.

Hammer 4377 30 June 1989 Determined by S. Hammer

55. Cladonia furcata

WASHINGTON, Grays Harbor Co., Muscicolous in shady spot over thin soil, vicinity of Lake Quinalt, Olympic National Forest, ca. 100 m. elev. Unusually thick stereome and tall podetia. Fumarprotocetraric acid.

Hammer 4305 27 June 1989 Determined by S. Hammer

56. Cladonia furcata

WASHINGTON, Snohomish Co., On soil under planted pines, rest area near Marysville, northbound Hwy. 5, ca. sea level. Fumarprotocetraric acid.

Hammer 3618 9 June 1989 Determined by S. Hammer

57. Cladonia furcata

WASHINGTON, Skagit Co., On thin soil in shady area, Rockport State Park, Hwy. 20 near Rockport, ca. 200 m. elev. Longitudinal fenestrations and scyphoid openings with more or less equal branches from margins, typical of W. Washington populations of this species. Fumarprotocetraric acid.

Hammer 3665 9 June 1989 Determined by S. Hammer

58. Cladonia furcata

WASHINGTON, Island Co., Over rock, Deception Pass State Park, vicinity of Anacortes, sea level. Pseudoscyphoid morph; slender, subulate branches. Fumarprotocetraric acid.

Hammer 4159 24 June 1989 Determined by S. Hammer

59. Cladonia gracilis (L.) Willd. subsp.

turbinata (Ach.) Ahti, Ann. Bot. Fennici 17: 212. 1980.

OREGON, Coos Co., On thin soil over stabilized sand dunes, Eel Creek Campground, Oregon Dunes National Recreation Area, sea level. Fumarprotocetraric acid.

Hammer 3407 3 June 1989 Determined by S. Hammer

- 60. *Cladonia gracilis* subsp. *turbinata***
 OREGON, Linn Co., On compressed duff, exposed hilltop,
 Horse Rock Ridge near Mabel, ca. 900 m. elev., Atranorin
 and fumarprotocetraric acid.
Hammer 3593 6 June 1989 Determined by S. Hammer
- 61. *Cladonia gracilis* subsp. *turbinata***
 WASHINGTON, Mason Co., On thin soil, Lena Creek Campground,
 ca. 15 km. W. of Hwy 101, ca. 300 m. elev.
 Fumarprotocetraric acid.
Hammer 4396 30 June 1989 Determined by S. Hammer
- 62. *Cladonia gracilis* subsp. *turbinata***
 WASHINGTON, Mason Co., Muscicolous, close to the shore of
 Lake Cushman, Cushman State Park, ca. 200 m. elev.
 Fumarprotocetraric acid.
Hammer 4229 26 June 1989 Determined by S. Hammer
- 63. *Cladonia gracilis* subsp. *turbinata***
 WASHINGTON, Snohomish Co., On soil under planted pines,
 rest area near Marysville, northbound Hwy. 5, ca. sea
 level. Fumarprotocetraric acid.
Hammer 3623 9 June 1989 Determined by S. Hammer
- 64. *Cladonia gracilis* subsp. *turbinata***
 WASHINGTON, Pierce Co., On thin soil over sand, milepost
 46, Hwy. 410, vicinity of Greenwater, ca. 500 m. elev.
 Fumarprotocetraric acid.
Hammer 3688 12 June 1989 Determined by S. Hammer
- 65. *Cladonia gracilis* subsp. *turbinata***
 MONTANA, Flathead Co., On compressed duff, shady, east-
 facing trailside, Numa Ridge Trail, Bowman Lake Campground,
 Glacier National Park, ca. 1500 m. elev. Fumarprotocetraric
 acid.
Hammer 3930 18 June 1989 Determined by S. Hammer
- 66. *Cladonia gracilis* subsp. *vulnerata* Ahti,**
 Ann. Bot. Fennici 17: 207. 1980.
 OREGON, On duff over stabilized sand dunes, Eel Creek
 Campground, Oregon Dunes National Recreation Area, sea
 level. Fumarprotocetraric acid.
Hammer 2554 10 July 1988 Determined by S. Hammer
- 67. *Cladonia gracilis* subsp. *vulnerata***
 OREGON, Coos Co., On duff over stabilized sand dunes, Eel
 Creek Campground, Oregon Dunes National Recreation Area,
 sea level. Fumarprotocetraric acid.
Hammer 3400 3 June 1989 Determined by S. Hammer

- 68. *Cladonia gracilis* subsp. *vulnerata***
 OREGON, Coos Co., On duff over stabilized sand dunes, Eel
 Creek Campground, Oregon Dunes National Recreation Area,
 sea level. Fumarprotocetraric acid.
Hammer 3515 4 June 1989 Determined by S. Hammer
- 69. *Cladonia gracilis* subsp. *vulnerata***
 WASHINGTON, Island Co., Deception Pass State Park, vicinity
 of Anacortes. Fumarprotocetraric acid.
Hammer 4158 24 June 1989 Determined by S. Hammer
- 70. *Cladonia humilis* (With.) Laundon, Lichenologist**
 16:220. 1984.
 CALIFORNIA, San Benito Co., On thin soil, west-facing
 trailside, Pinnacles National Monument, ca. 1000 m. elev.
 Fumarprotocetraric acid and atranorin.
Hammer 2451 May 1989 Determined by S. Hammer
- 71. *Cladonia imbricarica* Kristinsson, Lichenologist**
 6: 143. 1974.
 IDAHO, Benewah Co., Terricolous over basalt, Santa Creek
 Bridge, Hwy. 95, vicinity of Emida, ca. 1500 m. elev.
 Sphaerophorin.
Hammer 3842 17 June 1989 Determined by T. Ahti
- 72. *Cladonia macilenta* Hoffm., Deutschl. Fl. 2:**
 126. 1796.
 WASHINGTON, Island Co., Abundant on rotting driftwood at
 beach, Joseph Whidbey State Park, Swantown Road., sea
 level. Thamnolic acid and barbatic acid.
Hammer 4120 23 June 1989 Determined by S. Hammer
- 73. *Cladonia macrophyllodes* Nyl., Flora 58: 447.**
 1875.
 OREGON, Linn Co., Muscicolous on compressed duff, Fish Lake
 Campground near junction of Hwys. 126 and 20, ca. 1100 m.
 elev. Atranorin and fumarprotocetraric acid.
Hammer 3547 6 June 1989 Determined by S. Hammer
- 74. *Cladonia macrophyllodes***
 WASHINGTON, Yakima Co., On thin soil over volcanic
 formations, Little Naches Road, Wenatchee National Forest,
 ca. 500 m. elev. Atranorin and fumarprotocetraric acid.
Hammer 3708 13 June 1989 Determined by S. Hammer

- 75. *Cladonia merochlorophaea*** Asah. J. Jap. Bot.
16: 713. 1940.
WASHINGTON, Skagit Co., Over thin soil, summit of North
Mountain, Mt. Baker Snoqualmie National Forest, ca. 1100 m.
elev. Fumarprotocetraric, merochlorophaeic, and 4-0
methylcryptochlorophaeic acids.
Hammer 3675 9 June 1989 Determined by S. Hammer
- 76. *Cladonia merochlorophaea***
WASHINGTON, Whatcom Co., Abundant over compressed duff,
Hwy. 542, ca. 800 m. elev. Fumarprotocetraric,
merochlorophaeic, and 4-0 methylcryptochlorophaeic acids.
Hammer 4153 24 June 1989 Determined by S. Hammer
- 77. *Cladonia merochlorophaea***
IDAHO, Idaho Co., Over thin layer of duff, Split Creek
Pack Bridge Trail, Lochsa River, Road 133 near Hwy. 12,
Clearwater National Forest, ca. 1000 m. elev.
Fumarprotocetraric, and merochlorophaeic acids. Note
melanotic podetia.
Hammer 3888 17 June 1989 Determined by S. Hammer
- 78. *Cladonia multiformis*** G. K. Merrill, Bryologist
12: 1. 1909.
IDAHO, Idaho Co., Over thin layer of duff at trailside,
Split Creek Pack Bridge Trail, Lochsa River, Road 133 near
Hwy. 12, Clearwater National Forest, ca. 1000 m. elev.
Fumarprotocetraric acid.
Hammer 3891 17 June 1989 Determined by S. Hammer
- 79. *Cladonia multiformis***
IDAHO, Idaho Co., Abundant on west-facing roadside under
pines, Flint, ca. 1500 m. elev. Fumarprotocetraric acid.
Hammer 5319 2 July 1991 Determined by S. Hammer
- 80. *Cladonia multiformis***
IDAHO, Bonner Co., On compressed duff, vicinity of Priest
Lake, ca. 1000 m. elev. Fumarprotocetraric acid.
Hammer 3966 20 June 1989 Determined by S. Hammer
- 81. *Cladonia multiformis***
IDAHO, Bonner Co., On compressed duff at roadside, Hwy.
313, ca. 2 km. west of Hanna Flat Nature Trail, vicinity
of Nordman, ca. 1000 m. elev. Fumarprotocetraric acid.
Hammer 3998 20 June 1989 Determined by S. Hammer
- 82. *Cladonia multiformis***
MONTANA, Lincoln Co., On compressed duff, Troy River
Campground, ca. 800 m. elev. Fumarprotocetraric acid.
Hammer 3948 19 June 1989 Determined by S. Hammer

83. Cladonia ochrochlora Flk., De Cladon. 75. 1828.
 WASHINGTON, Clallam Co., Abundant on compressed duff over decomposing wood in shady locality, Elwha Hot Springs Road, Olympic National Park, ca. 800 m. elev. Unusual form with abundant proliferations from scyphus margins.
 Fumarprotocetraric acid.

Hammer 4434 1 July 1989 Determined by S. Hammer

84. Cladonia ochrochlora

IDAHO, Bonner Co., On rotting wood, Hanna Flat Nature Trail, Hwy. 313, vicinity of Nordman, ca. 1000 m. elev.
 Fumarprotocetraric acid.

Hammer 3974 20 June 1989 Determined by S. Hammer

85. Cladonia ochrochlora

MONTANA, Flathead Co., On rotting wood, Numa Ridge Trail, Bowman Lake Campground, Glacier National Park, ca. 1500 m. elev. Fumarprotocetraric acid.

Hammer 3938 18 June 1989 Determined by S. Hammer

86. Cladonia phyllophora Hoffm., Deutsch. Fl. 2: 123. 1796.

WASHINGTON, San Juan Co., On thin soil, Mt. Constitution, Orcas Island, ca. 400 m. elev. Unusual morph with tall, slender podetia, narrow scyphi, and small, rather evenly distributed squamules, occurs from central Oregon to Puget Sound and east to Skamania Co., Washington.
 Fumarprotocetraric acid.

Hammer 4181 25 June 1989 Determined by S. Hammer

87. Cladonia phyllophora

WASHINGTON, San Juan Co., Growing with *Selaginella* on thin soil, Mt. Constitution, Orcas Island, ca. 400 m. elev.
 Fumarprotocetraric acid.

Hammer 4196 25 June 1989 Determined by S. Hammer

88. Cladonia phyllophora

OREGON, Wallowa Co., On compressed duff over granite rocks, Lostine River Valley south of Lostine, ca. 1600 m. elev. Typical morphology. Fumarprotocetraric acid.

Hammer 5237 28 June 1991 Determined by S. Hammer

89. Cladonia pleurota (Flk.) Schaer., Enum. Crit. Lich. Eur. 186. 1850.

WASHINGTON, Skagit Co., On thin soil over sandy, north-facing roadside, Hwy. 20, Rockport, ca. 200 m. elev. Zeorin and usnic acid.

Hammer 4100 22 June 1989 Determined by S. Hammer

90. Cladonia pleurota

WASHINGTON, Whatcom Co., On compressed duff, East Creek Trail off Hwy. 20., ca. 900 m. elev. Zeorin and usnic acid.

Hammer 5539 8 July 1991 Determined by S. Hammer

91. Cladonia pocillum (Ach.) Grognot, Pl. Crypt.

Saône-et-Loire 82. 1863.

IDAHO, Idaho Co., On rocky roadside, Red River Hot Springs Road outside of Elk City, ca. 1700 m. elev. Rare and restricted in the region. Characteristic brown, subfoliose primary squamules with thick, cottony undersides.

Fumarprotocetraric acid.

Hammer 5216 2 July 1991 Determined by S. Hammer

92. Cladonia poroscypha Hammer, Bryologist 96: 83. 1993.

WASHINGTON, Island Co., Over rock, Deception Pass State Park, vicinity of Anacortes, sea level. Some podetia approach *C. artuata*, but most are characteristic with slender scyphoid openings and equal branches from the margins. Thamnolic acid.

Hammer 4104 23 June 1989 Determined by S. Hammer

93. Cladonia prolifica Ahti & Hammer, Mycotaxon 37: 342. 1991.

CALIFORNIA, Del Norte Co., On thin soil over stabilized sand dunes, growing with *C. furcata*, vicinity of Ft. Dick, sea level. Fumarprotocetraric acid.

Hammer 3338 31 May 1989 Determined by S. Hammer

94. Cladonia rei Schaer., Lich. Helvet. Spic. 34: 1823.

IDAHO, Bonner Co., On thin soil, Hanna Flat Nature Trail, Hwy. 313, vicinity of Nordman, ca. 1000 m. elev.

Fumarprotocetraric acid, homosekikaic acid, and sekikaic acid.

Hammer 3989 20 June 1989 Determined by S. Hammer

95. Cladonia rei

IDAHO, Bonner Co., On thin soil, Hanna Flat Nature Trail, Hwy. 313, vicinity of Nordman, ca. 1000 m. elev. Collected only at this site and in eastern Washington. Previously considered widespread in the region, but confused with *C. verruculosa* (Vain.) Ahti and other species.

Fumarprotocetraric acid, homosekikaic acid, and sekikaic acid.

Hammer 5485 6 July 1991 Determined by S. Hammer

- 96. *Cladonia scabriuscula*** (Del.) Nyl., Compt.
Rend. Hebd. Séances Acad. Sci. Paris 83: 88. 1876.
OREGON, Douglas Co., On thin soil over stabilized sand
dune, semi-exposed roadside, Tahkenitch Campground, Oregon
Dunes National Recreation Area, sea level.
Fumarprotocetraric acid.
Hammer 3458 3 June 1989 Determined by S. Hammer
- 97. *Cladonia scabriuscula***
WASHINGTON, Grays Harbor Co., On thin soil over stabilized
sand, Twin Harbors State Park, Westport, sea level.
Fumarprotocetraric acid.
Hammer 4252 26 June 1989 Determined by S. Hammer
- 98. *Cladonia scabriuscula***
WASHINGTON, Island Co., Over rock, Deception Pass State
Park, vicinity of Anacortes, sea level. Fumarprotocetraric
acid.
Hammer 4419 23 June 1989 Determined by S. Hammer
- 99. *Cladonia singularis*** Hammer, Bryologist 96:
303. 1993.
WASHINGTON, Skamania Co., Muscicolous on thin soil over
east-facing lava formations, Big Lava Bed ca. 10 km. N. of
Little White Salmon Fish Hatchery, FR 66, ca. 700 m. elev.
PARATYPE. Squamatic acid.
Hammer 5176 28 June 1991 Determined by S. Hammer
- 100. *Cladonia squamosa*** Hoffm. Deutsch. Fl. 2: 125.
1796., var. ***squamosa***
OREGON, Linn Co., On compressed duff, roadside of Hwy. 242,
5 km. S. of Hwy. 126, McKenzie Bridge, ca. 900 m. elev.
Approaches *C. singularis*, but lacks the subulate apices,
continuous cortex under podetial squamules, and phyllopodia
of the former. Squamatic acid.
Hammer 3600 6 June 1989 Determined by S. Hammer
- 101. *Cladonia squamosa* var. *squamosa***
WASHINGTON, Pierce Co., On rotting wood, Silver Springs
Campground, Mt. Baker Snoqualmie National Forest, ca. 800
m. elev. Squamatic acid.
Hammer 3692 12 June 1989 Determined by S. Hammer
- 102. *Cladonia squamosa* var. *squamosa***
WASHINGTON, Skagit Co., Over thick layer of partially
decayed duff, summit of North Mountain, Mt. Baker
Snoqualmie National Forest, ca. 1100 m. elev. Squamatic
acid.
Hammer 3652 9 June 1989 Determined by S. Hammer

- 103. *Cladonia squamosa* var. *squamosa***
 IDAHO, Idaho Co., Abundant on rotting wood in spray zone,
 Major Fenn Trail, Hwy. 12 along Lochsa River east of
 Lowell, Clearwater National Forest, ca. 1000 m. elev.
 Squamatic acid.
Hammer 3861 17 June 1989 Determined by S. Hammer
- 104. *Cladonia squamosa* Hoffm. var. *subsquamosa***
 (Leight.) Vain., Meddeland. Soc. Fauna Fl. Fennica 6:
 113. 1881.
 OREGON, Lane Co., On thin soil over stabilized sand dune,
 Siltcoos Beach Access Road, Oregon Dunes National
 Recreation Area, sea level. Thamnic acid.
Hammer 3492 3 June 1989 Determined by S. Hammer
- 105. *Cladonia squamosa* var. *subsquamosa***
 WASHINGTON, Grays Harbor Co., Muscicolous in shady spot
 over thin soil, vicinity of Lake Quinalt, Olympic National
 Forest, ca. 100 m. elev. Thamnic acid.
Hammer 4317 27 June 1989 Determined by S. Hammer
- 106. *Cladonia subulata* (L.) Weber ex Wigg., Prim.**
 Fl. Holsat. 90. 1780.
 IDAHO, Latah Co., On thin soil at roadcut, Laird Park
 vicinity, Moose Creek Divide, St. Joe National Forest,
 ca. 1500 m. elev. Fumarprotocetraric acid.
Hammer 3794 17 June 1989 Determined by S. Hammer
- 107. *Cladonia subulata***
 IDAHO, Bonner Co., On thin soil, Hanna Flat Nature Trail,
 Hwy. 313, vicinity of Nordman, ca. 1000 m. elev.
 Fumarprotocetraric acid.
Hammer 5472 6 July 1991 Determined by S. Hammer
- 108. *Cladonia sulphurina* (Michx.) Fr., Lichenogr.**
 Eur. Reform. 237. 1831.
 WASHINGTON, Ferry Co., On compressed duff over rotting
 wood, Sherman Pass, Colville National Forest, ca. 1500 m.
 elev. Squamatic acid and usnic acid.
Hammer 4035 21 June 1989 Determined by S. Hammer
- 109. *Cladonia sulphurina***
 WASHINGTON, Stevens Co., On rotting wood, Flowery Trail,
 16 km. E of Chelewah, Colville National Forest, ca. 1300 m.
 elev. Squamatic acid and usnic acid.
Hammer 4027 21 June 1989 Determined by S. Hammer

110. Cladonia sulphurina

WASHINGTON, Pend Oreille Co., Abundant over rotting cedar logs, south-facing hillside, Granite Creek-Roosevelt Cedars Trail, Stagger Inn Campground, Kaniksu National Forest, ca. 200 m elev. Squamatic acid, usnic acid, and isousnic acid.

Hammer 4018 20 June 1989 Determined by S. Hammer

111. Cladonia thiersii Hammer, Mycotaxon 34: 115. 1989.

CALIFORNIA, Marin Co., Terricolous on sandstone formations, Kehoe Beach, ca. 1 km. from Pacific Ocean, Pt. Reyes National Seashore, ca. 20 m. elev. PARATYPE. Thamnic acid.

Hammer 2306 5 January 1988 Determined by S. Hammer

112. Cladonia thiersii

CALIFORNIA, Marin Co., Terricolous on sandstone formations, Kehoe Beach, ca. 1 km. from Pacific Ocean, Pt. Reyes National Seashore, ca. 20 m. elev. Thamnic acid.

Hammer 3231 29 May 1989 Determined by S. Hammer

113. Cladonia transcendens (Vain.) Vain., Nouv. Arch. Mus. Hist. Nat., ser. 3, 10: 262. 1898.

WASHINGTON, Grays Harbor Co., On decaying conifer wood, vicinity of Lake Quinalt, Olympic National Forest, ca. 100 m. elev. Thamnic acid.

Hammer 4283 27 June 1989 Determined by S. Hammer

114. Cladonia transcendens

WASHINGTON, Whatcom Co., On ecorticate wood in shady locality, East Creek Trail off Hwy. 20, ca. 900 m. elev. Thamnic acid.

Hammer 4094 22 June 1989 Determined by S. Hammer

115. Cladonia transcendens

WASHINGTON, Pierce Co., On rotting wood, milepost 46, Hwy. 410, vic. of Greenwater, ca. 500 m. elev. Thamnic acid. Unusual squamose form.

Hammer 3686 12 June 1989 Determined by S. Hammer

116. Cladonia umbricola Tønsberg & Ahti, Norweg. J. Bot. 27: 307. 1980.

IDAHO, Latah Co., On rotting wood, Laird Park vicinity, Moose Creek Divide, St. Joe National Forest, ca. 1500 m. elev. Squamatic acid.

Hammer 3764 17 June 1989 Determined by S. Hammer

- 117. *Cladonia uncialis* (L.) Weber ex Wiggers, Prim.**
Fl. Holsat. 90. 1780.
WASHINGTON, Skamania Co., On conifer duff over lava bed,
Gifford Pinchot National Forest, FR 8303, ca. 550 m. elev.
Hammer 5101 25 June 1991 Determined by S. Hammer
- 118. *Cladonia uncialis***
WASHINGTON, Island Co., Over rock, Deception Pass State
Park, vicinity of Anacortes, sea level.
Hammer 4101 23 June 1989 Determined by S. Hammer
- 119. *Cladonia verruculosa* (Vain.) Ahti, Bryologist**
81: 336. 1978.
CALIFORNIA, Del Norte Co., On thin soil over stabilized
sand dune, Fort Dick, sea level. Fumarprotocetraric acid.
Hammer 3343 31 May 1989 Determined by S. Hammer
- 120. *Cladonia verruculosa***
OREGON, Lane Co., On thin soil over stabilized sand dune,
Siltcoos Beach Access Road, Oregon Dunes National
Recreation Area, sea level. Fumarprotocetraric acid.
Hammer 3510 3 June 1989 Determined by S. Hammer
- 121. *Cladonia verruculosa***
WASHINGTON, Grays Harbor Co., On thin soil over stabilized
sand dune, Copalis Beach State Park, sea level.
Fumarprotocetraric acid.
Hammer 4281 27 June 1989 Determined by S. Hammer
- 122. *Cladonia verruculosa***
WASHINGTON, Grays Harbor Co., Roadside, Hwy. 109, vicinity
of Moclips, sea level. Fumarprotocetraric acid.
Hammer 4303 27 June 1989 Determined by S. Hammer
- 123. *Cladonia verruculosa***
WASHINGTON, Mason Co., On thin soil at roadside, Hwy. 101
near Shelton, ca. 50 m. elev. Fumarprotocetraric acid.
Hammer 4369 30 June 1989 Determined by S. Hammer
- 124. *Cladonia verruculosa***
WASHINGTON, Lewis Co., On thin soil at roadside, Packwood,
ca. 300 m. elev. Fumarprotocetraric acid.
Hammer 4340 30 June 1989 Determined by S. Hammer
- 125. *Cladonia verruculosa***
WASHINGTON, Skagit Co., On thin layer of partially decayed
duff, summit of North Mountain, Mt. Baker Snoqualmie
National Forest, ca. 1100 m. elev. Fumarprotocetraric acid.
Hammer 3640 9 June 1989 Determined by S. Hammer

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SPECIES OF CHAETOPLEA ON DESERT PLANTS IN CHINA

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SUMMARY

Three species of *Chaetoplea* are reported from China, featuring the new taxa *C. gregaria* and *C. longiasca*, and an extension of range and substrate for *C. crossata*.

For a long period since it was erected for the type species *Chaetoplea calvescens* (Fr. ex Desm.) Clements (Clements and Shear 1931), the genus *Chaetoplea* (Sacc.) Clements was included within *Pleospora* (Wehmeyer 1961; Arx and Müller 1975) or in *Leptosphaeria* (Eriksson and Hawksworth 1987). Barr (1990) considered that *C. calvescens* deviates from the types of *Pleospora*, *P. herbarum* (Fr.) Rabenh. and *Leptosphaeria*, *L. doliolum* (Pers.: Fr.) Ces. & De Not. She accepted *Chaetoplea* as a separate genus in the Phaeosphaeriaceae, based on a number of different features as well as the different anamorphs. Seventeen North American species in the genus, most of which were recombined from other genera such as *Cucurbitaria*, *Pleospora*, *Pyrenophora*, *Teichospora*, etc., have been recognized by her (Barr 1990). There were no species in *Chaetoplea* recorded from China, even under *Pleospora* or *Leptosphaeria* on desert plants (Eriksson and Yue 1988). Three species with typical characteristics of *Chaetoplea* were found on desert plants from Xinjiang. One of them, *C. crossata* (Ellis & Everh.) M.E. Barr is reported here for the first time from China, and the other two are proposed as new.

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All the holotype materials mentioned in the paper are deposited in the National Herbarium of Canada in Ottawa (DAOM) and the isotypes in the Herbarium of Mycology, August 1st Agricultural College (HMAAC), Urumqi, Xinjiang, China and in the New York Botanical Garden, Bronx (NY).

Chaetoplea crossata (Ellis & Everh.) M.E. Barr, Mem. New York Bot. Gard. 62: 50. 1990. Fig. 1.a
 = *Teichospora crossata* Ellis & Everh., Proc. Acad. Nat. Sci. Philadelphia 46: 331. 1884; *Strickeria crossata* (Ellis & Everh.) Kuntze, Rev. Gen. Pl. 3: 534. 1898.

Ascomata gregarious, erumpent to superficial, with short hyphal appendages over the surface, sphaeroid, 240-450 μm wide, 200-400 μm high. Asci 80-100 x 12-14 μm . Ascospores 16-20 x 8-10 μm , clear brown, broadly ellipsoid, ends obtuse, 3-5-(7-)septate, with one longitudinal or sometimes oblique septum in some cells; wall smooth.

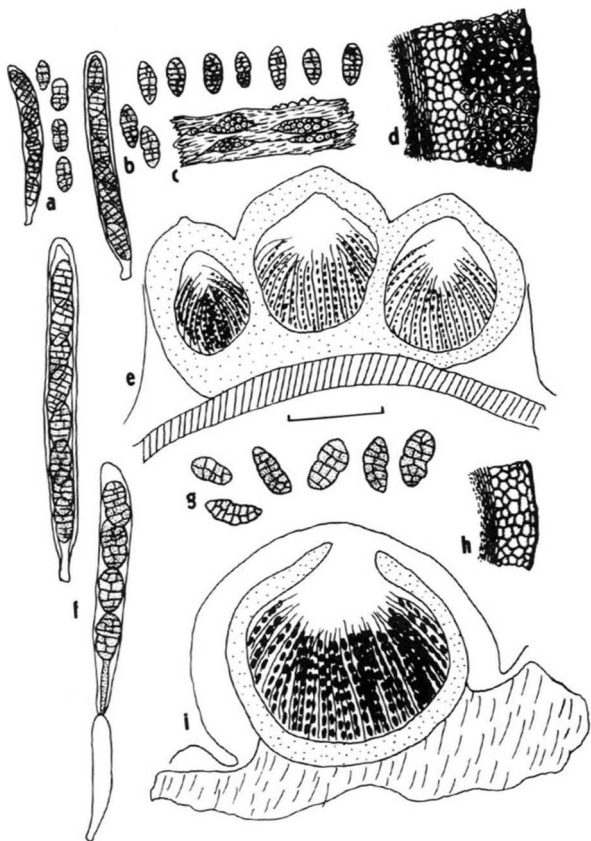
Specimen examined: on branches of *Myricaria squamosa* Desv., Liuhuanggou, Urumqi, Xinjiang, China, 14 VIII 1991, Z.Q. Yuan 910409, HMAAC 783, DAOM, and NY.

Our collection fits well *C. crossata* in habit, ascospore morphology and size. *Chaetoplea crossata* is widespread in North America on a number of woody hosts (Barr 1990). It is recorded here for the first time in China.

Chaetoplea gregaria Z.Q. Yuan & M.E. Barr, sp. nov. Fig. 1.b-e

Ascomata *gregaria* in catervatim vel ordinatim, immersa vel erumpentia, sphaeroidea, 300-450 μm lata, 240-400 μm alta; apice papillato; peridia 40-60 μm lata, e cellulis pseudoparenchymatis crassitunicatis brunneis in stratis externis et e cellulis compressis tenuitunicatis hyalinis ad brunneolis in stratis internis composita. Asci 130-160 x 12-14 μm , octospori, cylindrici. Pseudoparaphyses anguste cellulosa, 200 x 2 μm . Ascosporae 18-26 x 9-12 μm , uniseriatae, brunneae ad fuscae, elliptico-fusiformes cum extremo obtuso vel obovoideae, 5-7 transversaliter et 1-2 longitudinaliter septatae, septo formato primo constrictae, asymmetricae, hemispora superna infernae leviter longiori et latiori; exosporio glabro.

Fig. 1. Species of *Chaetoplea*. a. *C. crossata*: ascus and ascospores; b-e. *C. gregaria*: b. ascus and ascospores, c. habit, d. detail of peridium, e. ascomata in vertical section; f-i. *C. longiasca*: f. 8-spored and 4-spored asci, g. ascospores, h. detail of peridium, i. ascoma in vertical section. Standard line - 50 μm for a,b,d,f-h; 200 μm for e,i. Habit sketch not to scale.



In ramulis *Nitrariae sibiricae* Pall., Liuhuanggou, Urumqi, Provincia Xinjiangensi, Sinicarum, 8 VIII 1991, Z.Q. Yuan 910389, DAOM holotypus. Isotypi in Herb. HMAAC 785 et NY depositi.

Ascomata gregarious in groups or in lines, occasionally separate, immersed to erumpent, sphaeroid, 300-450 μm wide, 240-400 μm high; apex papillate; peridium 40-60 μm wide, of thick-walled brown pseudoparenchymatous cells in outer layers and hyaline to brownish thin-walled, compressed cells in the inner layers. Asci 130-160 x 12-14 μm , 8-spored, cylindric. Pseudoparaphyses narrowly cellular, septate, branched, 2 μm wide, up to 200 μm long. Ascospores 18-26 x 9-12 (mean 23.2 x 10.3) μm , uniseriate, brown to dark brown, elliptic-fusoid with ends obtuse or obovoid, 5-7 transversely septate, 1-2 longitudinally septate per cell, constricted at the first-formed septum, asymmetric, upper hemispore slightly longer and wider than lower; wall smooth, lacking gel coating.

Known from the type collection.

This new species has ascospores much as in *C. strigosa* M.E. Barr, but differs from the latter by its immersed to erumpent ascomata and the longer and narrower asci. *Chaetoplea strigosa* has collabent ascomata almost completely superficial with hyphae on the surface holding fragments of the host, and asci measure 80-100 x 15-20 (-23) μm (Barr 1990).

Chaetoplea longiasca Z.Q. Yuan & M.E. Barr, sp. nov. Fig. 1f-i

Ascomata discreta vel gregaria, immersa ad erumpentia, cum clypeo paulo trans ascomata immersa, sphaeroidea, 350-700 μm lata, 350-600 μm alta, e cellulis pseudoparenchymatis angulatis vel rotundatis fuscis in stratis externis et e cellulis compressis hyalinis in stratis internis composita. Asci (100-)160-200 x 18-20 μm , octospori vel raro tetraspori, cylindrici. Pseudoparaphyses anguste cellulosa, 300 x 2 μm . Ascosporae 24-36 x 12-16 μm , uniseriatae, brunneae ad rufobrunneae, obovoideae, 5-7 transversaliter et 1-2 longitudinaliter septatae, septo formato primo constrictae, symmetricae vel raro asymmetricae; exosporio glabro.

In ramis *Reaumuriae soongoricae* (Pall.) Maxim., Beishawo, Changji, Provincia Xinjiangensi, Sinicarum, 1 V 1991, Z.Q. Yuan et Z. Y. Zhao 910027, DAOM holotypus. Isotypi in Herb. HMAAC 784 et NY depositi.

Ascomata separate to gregarious, immersed to erumpent, with a small clypeus over the immersed ascomata, sphaeroid, 350-700 μm wide, 350-600 μm high; peridium 30-50 μm wide, up to 100-140 μm wide above with clypeus,

surface roughened, of dark angular to rounded pseudoparenchymatous cells in outer layers and hyaline compressed cells in inner layers. Asci (100-)160-200 x 18-20 μm , 8-spored or occasionally 4-spored, cylindrical, basal and lateral. Pseudoparaphyses narrowly cellular, septate, 300 x 2 μm . Ascospores 24-36 x 12-16 (mean 30.6 x 13.8) μm , uniseriate, brown to reddish brown, some spores with paler ends, obovoid, 5-7 transversely septate, 1-2 longitudinally septate per cell, constricted at the first-formed septum, symmetric or some slightly asymmetric; wall smooth, lacking gel coating.

Known from the type collection.

Of the known species in the genus, the new species is closest to *C. umbilicata* (Ellis & Everh.) M.E. Barr. It differs mainly from *C. umbilicata* in the much longer asci and smooth ascospore walls, as well as in the absence of a gel coating surrounding the ascospores.

The specific epithet of the new species is based on the longest asci in the known species of the genus. Of the known species, only *C. ellisii* (Sacc. & P. Sydow) M.E. Barr has asci up to 180 μm long (but mostly 93-130 μm long), the other species have asci ranging from 45-120 μm long (Barr 1990), while the predominantly 8-spored asci in the new species measure 160-200 μm long.

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A REMARKABLE NEW LICHEN GENUS
CATARRHOSPORA (ASCOMYCOTINA, PORPIDIACEAE),
FROM CAPE FLORAL KINGDOM, SOUTH AFRICA

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ABSTRACT

A unique new Porpidiaceae genus with weakly muriform, hyaline ascospores, *Catarrhospora* Brusse, is described from sandstone of the Cape Fold Mountains of South Africa. This new genus comprises two new species, *Catarrhospora mira* Brusse and *C. splendida* Brusse. The affinities, chemistry and distribution of this genus are discussed, and the differences between the two new species are highlighted.

Catarrhospora Brusse, gen. nov.

Genus ad familiam *Porpidiacearum* pertinens. *Thallus* crustosus, saxicola; prothallus ater. *Cortex* (superior) tenuis, 5 - 10 μm crassus; stratum epinecrale nullum. *Stratum gonidiale* 20 - 50 μm crassum; algae coccoideae, virides. *Medulla* albida, tenuis vel crassa. *Apothecia* immersa, nigella, parva, minus quam 1 mm diam. *Excipulum* reductum, aeruginosum vel fuscum, prosoplectenchymatum. *Subhymenium* hyalinum, J+ caeruleum. *Hymenium* hyalinum, J+ caeruleum. *Epihymenium* fuscum vel aeruginosum, N+ rosescens. Paraphyses leviter ramosae anastomosaeque, septatae, ecapitatae, luminibus 0.8 - 1.3 μm crassis. *Asci* clavati; tholus cum tubo J+ caeruleo, ut in genere *Porpidia* (figura 2). *Ascosporae* halonatae, octonae, hyalinae, 3 (-4) septatae vel parce muriformes, anguste ellipsoideae vel anguste ovatae, J-, parietibus tenuibus. *Pycnidia* globosa, immersa; spermatiphora robusta, pleurogena; spermatia hyalina, acicularia.

Typus generis: *Catarrhospora mira* Brusse.

Genus belonging to the family Porpidiaceae. *Thallus* crustose, saxicolous; prothallus black. *Cortex* (upper) thin, 5 - 10 μm thick; epinecral layer absent. *Algal layer* 20 - 50 μm thick; algae coccoid, green. *Medulla* whitish, thick or thin. *Apothecia* immersed, blackish, small, less than 1 mm across. *Exciple* reduced, aeruginose to fuscous, prosoplectenchymatous. *Subhymenium* hyaline, J+ blue. *Hymenium* hyaline, J+ blue. *Epihymenium*

fuscous to aeruginose, N+ pinkish. Paraphyses lightly branched and anastomosed, septate, ecapitate, lumina 0.8 - 1.3 μm thick. Asci clavate, 8-spored; tholus with J+ blue tube as in the genus *Porpidia* (figure 2). *Ascospores* halonate, hyaline, 3 (-4) septate to weakly muriform, narrowly ellipsoid to narrowly oval, J-, thin walled. *Pycnidia* globose, immersed; spermatia hyaline needles, pleurogenous from robust spermatophores.

Etymology: *Catarrhus* (L) - a mucous discharge; *spora* (L) - a spore; an oblique reference to the halonate ascospores of this new genus.

This is a very distinct new genus in the exclusively saxicolous lichen family Porpidiaceae, because up until now no genus in this family is known to have triseptate or weakly muriform ascospores. In other respects this new genus is very typical of the Porpidiaceae, having halonate ascospores, and more importantly asci with tholi that are of the *Porpidia*-type. Even the chemistry of *Catarrhospora* is very typical of the Porpidiaceae, containing 2'-O-methylperlatolic acid, but in some cases acid deficient specimens are encountered.

The asci of *Catarrhospora* produce a coat of gel around them, which is often thick and orange to orangy-brown in neat Lugol's iodine reagent (0.15% J). The paraphyses also produce gel, but this gel is J+ blue at Lugol's strength (The full strength Lugol's iodine solution always used is about 0.15% J, which is about half the concentration of the Lugol's iodine used in Bacteriology for the Gram stain, which is approximately 0.33% J). Therefore the gel derived from the paraphyses is clearly distinguishable from the gel produced by the asci, in this case. This orangy-brown ascus gel colour is also known in other genera of the Porpidiaceae such as *Immersaria* Rambold, *Paraporpidia* Rambold (Rambold 1989) and in several species of *Porpidia* Koerb. itself, including the type (Hertel & Knoph 1984). Despite this ascus gel colour, the tholus is still a very pale blue with a distinct blue tube in it, as in *Porpidia* and related genera, at 0.15% J concentration. This tholus type has been illustrated by Brusse (1988, 1988a) and in this paper (figures 2 & 3). There is a certain amount of variability in tholus tube length within one section, and it seems to be dependent on the thickness or depth of the tholus in question. Nevertheless the maximum tholus depth observable seems to be characteristic, and *Schizodiscus* Brusse develops a very deep tholus just before the ascospores become discernible in the ascus - up to 40% the length of the ascus bearing it. This very deep tholus development is not seen in the true members of the Porpidiaceae, and also not in *Catarrhospora*, which seem to display a different tholus ontogeny, not involving a very deep immature stage. On the contrary, the immature stage of the Porpidiaceae (including *Catarrhospora*) is more shallow than the submature stage, which then becomes shallow again in both cases as the ascospores become fully mature and ready for ejection. The amyloid tholus tube can also be thicker, as illustrated by Hafellner (1984) for *Amygdalaria pelobotryon* (Wahlenb.) Norm. (fig. 65), *Porpidia crustulata* (Ach.) Hertel & Knoph (fig. 64), *Porpidia trullisata* (Kremp.) Koerb. (fig. 67), *Koerberiella wimmeriana* (Koerb.) Stein (fig. 31), *Stenhammarella turgida* (Ach.) Hertel (fig. 69), and *Stephanocyclos henssenianus* Hertel (fig. 68), all typical members of the Porpidiaceae. I have not seen much variation in tholus tube thickness within one specimen, but rather between different specimens of

the same species. If one dilutes the Lugol's iodine reagent to about one quarter strength (about 0.04% J), the ascogel then stains blue as well, and the hymenium section is then a pure blue colour.

In this new genus the tholus-type does not change by pretreating with either 10% KOH or concentrated nitric acid, and the blue tube in the tholus remains unchanged in either case, which is also true for *Porpidia*. What is also quite interesting is that the tholus stains a grey colour in Chlorazole Black E (obtained from SIGMA; 1% aqueous solution), recently introduced into lichenology by Nash, Hafellner & Common (1990). This stain has poor penetrating powers, insofar as the asci have to be ruptured to facilitate rapid staining of the tholi. Once stained, the tube structure can again be seen (figure 3), but this time as a hyaline tube in the grey matrix of the tholus (a negative stain for the tube). There is also a hyaline area in the apical region of the tholus (figure 3), which does not show-up as blue in Lugol's (figure 2). This hyaline tube is still visible after pretreatment with either 10% KOH or concentrated nitric acid, as is the case with the positive stain, Lugol's iodine, which is also true for *Porpidia*. Chlorazole Black E highlights the dehisced asci very well, with the grey of the ruptured and extended tholus tissue contrasting well with the hyaline or very pale bottle green of the ascus walls. The dehiscence type in this genus is clearly rostrate. The tholus tissue can also be seen to be clearly distinct from the ascogel walls in this stain, and complete tholi often come out of the ascus walls on manual (unnatural) rupturing. This stain gives the definite impression that the tholus (= specialized endotunica?) differentiates from the ascoplasm of the young and developing ascus, not the walls. Most of the hymenium becomes a very pale bottle green or sea green colour in this stain. The ascospores stain grey in Chlorazole Black E in this new genus, as they also do in *Porpidia*.

The pycnidia seen in this new genus are similar in both presently known species, and resemble small discs on the thallus, lighter brown and smaller than the apothecia (figure 6). They do not appear as black spots/dots on the thallus as is usual. The pleurogenous, needle-shaped spermatia are typical of the Porpidiaceae.

Catarrhospora could be confused with the unrelated genus *Rhizocarpon*, but the latter lacks the distinctive *Porpidia*-type tholus of the former. *Rhizocarpon* has an apical J+ blue crescent in the tholus, and lacks any kind of tube structure there (Hafellner, 1984). *Catarrhospora* ascospores are quite similar to those of some species of *Rhizocarpon* however. Up until the present, there are no reports of 2'-O-methylperlatolic acid occurring in the genus *Rhizocarpon*.

Catarrhospora also superficially resembles the genus *Schadonia* Koerb., but here the ascospores, although hyaline and muriform, are not halonate, and the tholus is of the *Bacidia*-type, with an inverted cup- or thimble-shaped J+ blue structure in it (Hafellner 1984).

The crustose members of the Stereocaulaceae, such as *Stereocaulon leucophaeopsis* (Nyl.) P. James & Purvis and *St. tornensis* (H. Magn.) P. James & Purvis (Purvis & James 1985), are less likely to be confused with this new genus, because they have better developed glebular to squamulose thalli, which are recognizable in the field. *Stereocaulon* has a *Caillaria*-like tholus, and up until now no species exhibits submuriform or muriform ascospores. The ascospores are transversely 3 or more septate, hyaline, non-halonate, and are

acicular-fusiform to fusiform or scolecosporous (ie. much longer than broad). No species of the very well known genus *Stereocaulon* has been reported to contain 2'-O-methylperlatolic acid.

Another genus that is rather less likely to cause confusion is the lichen parasite genus *Dactylospora*, which although not lichenized itself, often does grow on crustose lichens (Hafellner 1979). This genus sometimes has weakly muriform, hyaline ascospores, but they often become brown when mature, and are not halonate. *Dactylospora* has a well developed exciple, which is dark brown in colour (Hafellner 1979), as opposed to the weakly developed exciple of *Catarrhospora*, which is fuscous to aeruginose in the outermost parts, and which changes to pinkish in concentrated nitric acid (N). The paraphyses of *Dactylospora* are mildly capitate with coloured gel caps, and most importantly the ascus lacks a tholus, but is surrounded by an apically thickened, J+ blue removable gel sheath however. *Catarrhospora*, on the other hand, has thinner paraphyses, which are not capitate, and the ascus possesses a well developed tholus of the *Porpidia*-type. The ascus gel in *Catarrhospora* is not thicker in the apical part, but rather down the sides of the ascus. This gel is not removable by firm squashing of the sections under a glass coverslip and is J+ orange or orange-brown in Lugol's iodine, as opposed to the blue of that of *Dactylospora*. Most *Dactylospora* species have apothecia that are sessile to adnate (sometimes even stipitate) on their hosts, whereas *Catarrhospora* has immersed apothecia, and is not a parasite, but a genuine lichen.

Catarrhospora has the damp habitat requirements of some other members of the Porpidiaceae, and often grows in or near places where water trickles when it rains, on aspects with a southern component.

This new genus is presently known from two species, both of which occur only in the Cape Floristic Region, a very restricted, but highly diverse Mediterranean-type (winter rainfall) biotic area at the southern tip of Africa. This new genus is the latest and very welcome addition to a growing and long list of genera and species endemic to the Cape Biotic Region.

Catarrhospora mira Brusse, *sp. nov.*

Fig. 5 & 6.

Thallus crustosus, saxicola, rimose areolatus, cinereus vel griseus, usque ad 10 cm diam., 0.1 - 1 mm crassus; prothallus ater. *Areolae* albidae vel griseae, 0.1 - 3 mm, plerumque 0.2 - 1 mm diam. *Cortex* (superior) circa 5 μ m crassus; stratum epinecrale nullum. *Stratum gonidiale* 30 - 50 μ m crassus; algae coccoideae, virides. *Medulla* albida, usque ad 1 mm crassa. *Apothecia* immersa, nigella, usque ad 0.7 mm diam. *Excipulum* reductum, aeruginosum vel fuscum, N+ rosescens, prosoplectenchymatum, inferne rudimentale vel ad 10 μ m crassum, in lateribus supernis 10 - 50 μ m crassis. *Hypothecium* non bene evolutum. *Subhymenium* hyalinum, usque ad 50 μ m crassum, J+ caeruleum. *Hymenium* hyalinum, 120 - 160 μ m altum, J+ caeruleum. *Epihymenium* fuscum vel aeruginosum, N+ rosescens. *Paraphyses* ramosae anastomosaeque, septatae, ecapitatae, luminibus 0.8 - 1.3 μ m crassis. *Asci* clavati; tholus cum tubo J+ caeruleo, ut in genere *Porpidia* (figura 2). *Ascosporae* halonatae, octonae, hyalinae, 3 (-4) septatae vel parce muriformes, anguste ellipsoideae vel anguste ovatae, 20 - 29 \times 7.5 - 11.5 μ m (figura 1). *Pycnidia* globosa, immersa; spermata hyalina, acicularia, recta, 6 - 8.5 \times 0.8

μm . *Thallus* acidum 2'-O-methylperlatolicum solum continens, vel acidis deficientibus.

TYPUS: SOUTH AFRICA, CAPE PROVINCE - 3418 (Cape Town): -BB (Somerset West) Hottentots-Holland Mountains. Sir Lowry's Pass between Somerset West and Elgin. On Table Mountain Sandstone on S aspects. Alt. 500 m. *F. Brusse* 3906, 15. v. 1981 (PRE, holo-; BM, iso-). Figurae 1, 2, 3, 5 & 6.

Thallus crustose, saxicolous, rimose areolate, pale grey to fairly dark grey, up to 10 cm across, 0.1 - 1 mm thick; prothallus black. *Areoles* whitish to grey, 0.1 - 3 mm, commonly 0.2 - 1 mm across. *Cortex* (upper) about 5 μm thick; epinecral layer absent. *Algal layer* 30 - 50 μm thick; algae coccoid, green. *Medulla* whitish, up to 1 mm thick. *Apothecia* immersed, blackish, up to 0.7 mm across, sometimes encircled by a crack (as in holotype). *Exciple* reduced, aeruginose to fuscous, N+ pinkish, prosoplectenchymatous, rudimentary below to 10 μm thick, 10 - 50 μm thick on upper flanks, sometimes cracked away from the surrounding thalline tissue in the upper parts. *Hypothecium* not clearly discernible. *Subhymenium* hyaline, up to 50 μm thick, J+ blue. *Hymenium* hyaline, 120 - 160 μm high, J+ blue. *Epihymenium* fuscous to aeruginose, N+ pinkish. Paraphyses branched and anastomosed, septate, ecapitate, lumina 0.8 - 1.3 μm thick. *Asci* clavate, 8-spored; tholus with J+ blue tube as in the genus *Porpidia* (figure 2). *Ascospores* halonate, hyaline, 3 (-4) septate to weakly muriform, narrowly ellipsoid to narrowly oval, 20 - 29 \times 7.5 - 11.5 μm (figure 1). *Pycnidia* globose, immersed; spermatia hyaline, straight needles, 6 - 8.5 \times 0.8 μm . *Chemistry*: only 2'-O-methylperlatolic acid present or acid deficient.

This new species is the type of the genus *Catarrhospora* Brusse, a genus of outwardly fairly non-descript grey crustose lichens. *Catarrhospora mira* is variable in macroscopic habit, and often just resembles the average saxicolous *Buellia* or *Lecideoid* lichen. The immersed apothecia would eliminate many of these, except the common *Carbonea oreinoides* (Koerb.) Brusse*, which it closely resembles. However, the type specimen is thick and mauvish-grey, and closely resembles some forms of the widespread and common, but unrelated, *Diploschistes caesioplumbeus* (Nyl.) Vain. - group. It can be distinguished from this lichen in the field, because *D. caesioplumbeus* can tolerate growing in fairly dry places, and has clearly recognizable actinostomoid apothecia, whereas *C. mira* occurs in humid places, often in or near places where water would trickle when it rains (seen as tracks of black growths of cyanobacteria, etc.), and has simple apothecia.

* *Carbonea oreinoides* (Koerb.) Brusse, *comb. nov.*

Basionym: *Aspicilia oreinoides* Koerber, Abhandl. Schles. Ges. Vaterl. Cult. 2: 32, 1862.

This species has a clearly aeruginous exciple and epihymenium, which changes to pinkish in N (*Lecidea*-green), the presently accepted key characteristic (Rambold 1989) of the genus *Carbonea*, as opposed to *Lecanora* which lacks this pigment.

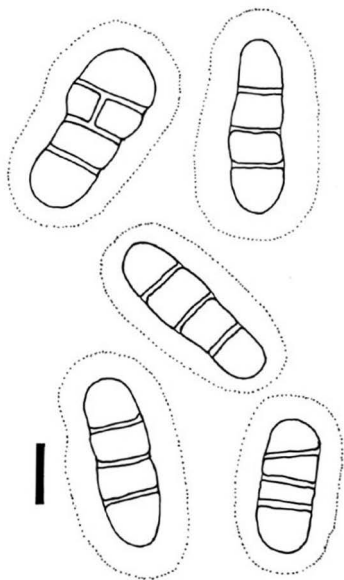
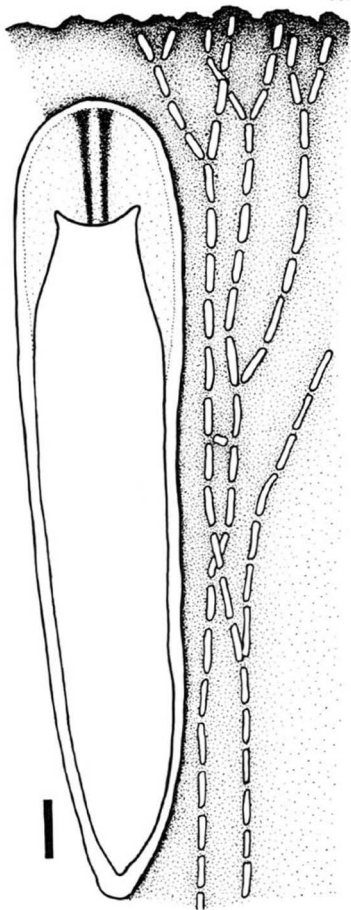


FIGURE 1. - *Catarrhospora mira* Brusse; ascospores. *F. Brusse 3906*, holotype. Bar = 10 μ m.

Catarrhospora mira can be told apart from the next species, by its much larger asci and correspondingly higher hymenium, and the lack of a well defined brown hypothecium. The medullary tissue is also J+ blue, which is not the case in *C. splendida*. The J+ blue reaction in this lichen is not always clearly discernible by direct application of Lugol's iodine solution to an obliquely sectioned areole, and the method of Common (1991) has to be used to get consistent results. This method also shows that the polysaccharide

FIGURE 2 (opp.). - *Catarrhospora mira* Brusse; ascus and paraphyses. Stippling indicates the amyloid reaction. *F. Brusse 3906*, holotype. Bar = 10 μ m.



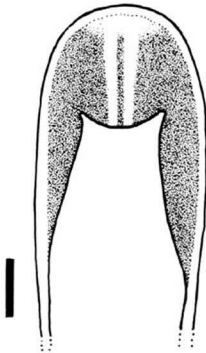


FIGURE 3. - *Catarrhospora mira* Brusse; the same ascus apex as in figure 1 in Chlorazole Black E. Stippling represents the grey staining regions of the tholus. *F. Brusse 3906*, holotype. Bar = 10 μ m.

causing this blue colour is not the true isolichenan as found in *Cetraria islandica* (L.) Ach. In my experience true isolichenan stains lavender only in Lugol's iodine made up in distilled water (at 0.15% J concentration) or in Lactophenol (at both 0.15% or 0.4% J concentrations), but not in Common's saturated zinc chloro-iodide reagent, in which completely hyaline sections are obtained, even after standing overnight. The isolichenan-like polysaccharide in *C. mira* is restricted to the medulla (not the cortex as in *Cetraria islandica*), and stains orangy brown in the zinc chloro-iodide reagent when the sections clear (ca. 10 mins.), and becomes reddish brown or maroonish on standing overnight. This clearly indicates that *C. mira* does not contain true isolichenan, but rather another J+ blue polysaccharide.

At present this new species is known from Tulbagh in the NW, to Garcia's Pass near Riversdale in the east of the Cape Fold Mountains. The Garcia's Pass specimen was acid deficient, but too meagrely fertile to cite.

Additional Specimens examined:

SOUTH AFRICA, CAPE PROVINCE - 3319 (Worcester): -AC (Tulbagh) Obiqua Mountains. Nuwekloof Pass, 7 km W of Tulbagh. On Table Mountain Sandstone on steep SW slope. Alt. 200 m. *F. Brusse 2698*, 28. iv. 1981 (PRE). - 3418 (Cape Town): -BB (Somerset West) Hottentots-Holland Mountains. Sir Lowry's Pass between Somerset West and Elgin. On Table Mountain Sandstone on S aspects. Alt. 500 m. *F. Brusse 3890*, 15. v. 1981 (COLO, LD, PRE).

Catarrhospora splendida Brusse, *sp. nov.*

Fig. 7.

Thallus crustosus, saxicola, rimose areolatus, griseus, usque ad 4 cm diam., 50 - 100 μm crassus; prothallus ater. *Areolae* albidae, 0.1 - 0.5 mm, plerumque 0.2 - 0.3 mm diam. *Cortex* (superior) circa 5 - 10 μm crassus; stratum epinecrale nullum. *Stratum gonidiale* 30 - 50 μm crassum; algae coccoideae, virides. *Medulla* albida, tenuis, usque ad 50 μm crassa. *Apothecia* immersa, nigella, usque ad 0.5 mm diam. *Excipulum* reductum, aeruginosum vel fuscum, N+ roscens, prosoplectenchymatum, inferne rudimentale vel 10 μm crassum, in lateribus supernis 20 - 40 μm crassis. *Hypothecium* badium, 30 - 50 μm crassum, N-. *Subhymenium* hyalinum, usque ad 20 μm crassum, J+ caeruleum. *Hymenium* hyalinum, 60 - 80 μm altum, J+ caeruleum. *Epihymenium* fuscum vel aeruginosum, N+ roscens. Paraphyses leviter ramosae anastomosaeque, septatae, ecapitatae, luminibus 1 - 1.3 μm crassis. Asci clavati; tholus cum tubo J+ caeruleo, ut in genere *Porpidia*. *Ascospores* halonatae, octonae, hyalinae, 3 (-4) septatae vel parce muriformes, anguste ellipsoideae vel anguste ovatae, 15 - 23 \times 7 - 9.5 μm (figura 4). *Pycnidia* globosa, immersa; spermata hyalina, acicularia, recta, 5 - 7.5 \times 0.8 μm . *Thallus acidum* 2'-O-methylperlatolicum solum continens.

TYPUS: SOUTH AFRICA, CAPE PROVINCE - 3319 (Worcester): -AC (Tulbagh) Obliqua Mountains. Nuwekloof Pass, 7 km W of Tulbagh. On Table Mountain Sandstone on steep SW slope. Alt. 200 m. *F. Brusse* 2732, 28. iv. 1981 (PRE, holo-; BM, iso-). Figurae 4 & 7.

Thallus crustose, saxicolous, rimose areolate, pale grey to fairly dark grey, up to 4 cm across, 50 - 100 μm thick; prothallus black. *Areoles* whitish to grey, 0.1 - 0.5 mm, commonly 0.2 - 0.3 mm across. *Cortex* (upper) about 5 - 10 μm thick (mostly necrotic tissue?); epinecral layer absent. *Algal layer* 30 - 50 μm thick; algae coccoid, green. *Medulla* whitish, thin, up to 50 μm thick. *Apothecia* immersed, blackish, up to 0.5 mm across. *Exciple* reduced, aeruginose to fuscous, N+ pinkish, prosoplectenchymatous, rudimentary below to 10 μm thick, 20 - 40 μm thick on upper flanks. *Hypothecium* brown, 30 - 50 μm thick, N-. *Subhymenium* hyaline, up to 20 μm thick, J+ blue. *Hymenium* hyaline, 60 - 80 μm high, J+ blue. *Epihymenium* fuscous to aeruginose, N+ pinkish. Paraphyses lightly branched and anastomosed, septate, ecapitate, lumens 1 - 1.3 μm thick. Asci clavate, 8-spored; tholus with J+ blue tube as in the genus *Porpidia*. *Ascospores* halonate, hyaline, 3 (-4) septate to weakly muriform (when mature), narrowly ellipsoid to narrowly oval, 15 - 23 \times 7 - 9.5 μm (figure 4). *Pycnidia* globose, immersed; spermata hyaline, straight needles, 5 - 7.5 \times 0.8 μm . *Chemistry*: only 2'-O-methylperlatolic acid present.

This second new species of *Catarrhospora*, is much thinner than the type species, but also has no remarkable macroscopic features by which it could be recognized in the field under a hand lens. Nevertheless, like the type species, it also grows in more humid places, near places where water trickles when it rains.

As stated in the postamble of the first species, this species can be distinguished from *C. mira* by the smaller asci (up to 80 μm long in *C. splendida*, as opposed to up to 155 μm long in *C. mira*), the correspondingly

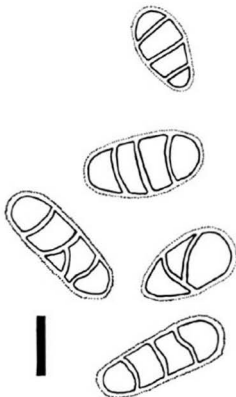


FIGURE 4. - *Catarrhospora splendida* Brusse; ascospores. F. Brusse 2732, holotype. Bar = 10 μ m.

lower hymenium and by the presence of a coherent brown layer under the subhymenium, here called the hypothecium. Incredibly, some mature ascospores of these two species can be the same size, but the asci they originate from are always very different in size. It seems that the larger halo on *C. mira* ascospores requires more ascus space, than the thin halo on those of *C. splendida*. The hymenium is more loose in *C. splendida* and the ascus apices can easily be observed without pretreatments by squashing sections under a glass coverslip with a blunt instrument. This is difficult to do in the type species (*C. mira*), because the hymenial gel is so firm. Pretreating *C. mira* sections with concentrated nitric acid loosens them up considerably, without interfering with the gel colours in iodine solutions too much. Pretreating with K turns both the gel colours deep blue in Lugol's, making observation of the tholus a little more problematical, although the tholus tube does become a deeper blue. The paraphyses are always more clearly discernible in Lugol's, after concentrated N pretreatment, and the septation which is often obscure without pretreatments or with K pretreatment, becomes quite distinct.

Although the medulla is thin in *C. splendida*, it is not J+ blue as in the type species. The medulla also does not become reddish brown in saturated zinc chloro-iodide overnight, but remains hyaline. This strongly suggests that the polysaccharide causing the blue colour in *C. mira*, is the same as the one causing the overnight reddish-brown colour in zinc chloro-iodide (There was the possibility that two or more polysaccharides could be present, as indeed is the case in *Cetraria islandica* itself).

At present this second new species is known only from the type locality, Nuwekloof just west of the historic town of Tulbagh.

ACKNOWLEDGEMENTS

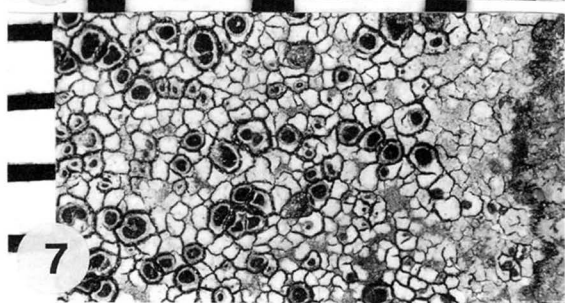
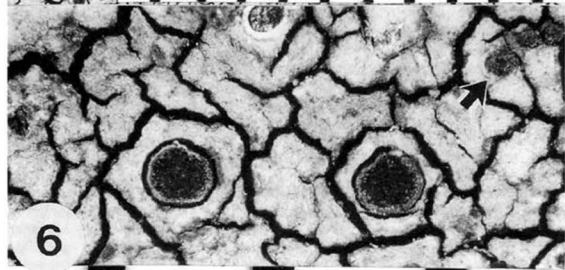
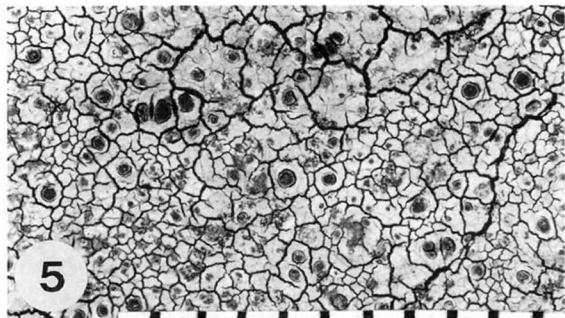
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- FIGURE 5. - *Catarrhospora mira* Brusse, habit photograph. *F. Brusse* 3906, holotype. Scale in mm.
- FIGURE 6. - *Catarrhospora mira* Brusse, close-up photograph of apothecia. The arrow points to a group of pycnidia. *F. Brusse* 3906, holotype. Scale in mm.
- FIGURE 7. - *Catarrhospora splendida* Brusse, habit photograph. *F. Brusse* 2732, holotype. Scale in mm.



**MORPHOLOGICAL AND REPRODUCTIVE ASPECTS OF
CLADOSPORIUM MACROCARPUM AND C. HERBARUM
FROM BING CHERRY FRUITS**

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SUMMARY

Absence of major morphological discontinuities characterized a series of isolates of *Cladosporium macrocarpum* and *C. herbarum*. Conidial size, degree of septation, and relative nodosity of conidiophores all decreased along a series from the former to the latter species. Termini of the series were well separated morphologically and morphometrically. Isolates toward the *macrocarpum* terminus of the series produced pseudothecia under experimental conditions, whereas isolates toward the *herbarum* terminus produced sclerotium-like bodies. Based upon the observed morphological continuum from *C. herbarum* to *C. macrocarpum* and lacking any evidence that gene flow is restricted between the two taxa, we accept the previously proposed synonymy of *C. macrocarpum* with *C. herbarum*.

INTRODUCTION

Cladosporium macrocarpum G. Preuss and *C. herbarum* (Pers.:Fr.) Link have been treated as allied, but morphologically distinct, species (De Vries 1952, Ellis 1971). Some authors have noted transitional forms (Barr 1958, Corlett 1988). There has been considerable unanimity in the morphological species concept for *C. herbarum*; von Arx (1970, 1983), De Vries (1952),

Domsch *et al.* (1980), Ellis (1971), and Matsushima (1985) illustrated and described conidia that are small relative to *C. macrocarpum*, and conidiophores that are non-nodose to nodose and occasionally geniculate. Illustrations for *C. macrocarpum* show more divergent concepts: Ellis (1971) accented the greater degree of septation (frequently 2-3 septa) of *C. macrocarpum* conidia, whereas De Vries (1952) stressed the greater size of conidia for that species, and once illustrated conidia as 0-septate, and once as 0-1-septate. Matsushima (1985) illustrated conidia of *C. macrocarpum* with a maximum of one septum, but with strongly geniculate-nodose conidiophores with short internodes. Domsch *et al.* (1980) also illustrated conidia with a maximum of one septum, and with conidiophores strongly nodose, and somewhat geniculate.

In 1992 we recovered hundreds of isolates of *Cladosporium* from *Prunus avium* L. (cultivar Bing) cherry fruits in orchards near Wenatchee, WA. Although many were *C. cladosporioides* (Fresen.) G.A. De Vries, and a few were *C. malorum* Ruehle, most were assignable to *C. macrocarpum* or *C. herbarum*, or were transitional in morphology between the two. Our isolates were recovered from a single substrate in a relatively small geographic area during one growing season, thus minimizing variations that might originate over long times, distances, or differences in substrate. Accordingly, we resolved to use the opportunity to document the transitional forms from *C. macrocarpum* to *C. herbarum*. Because *Mycosphaerella tassiana* (de Not.) Johans. has been connected to *C. herbarum* (von Arx 1983, 1950, Kienholz 1944, Ruehle 1931) and to both *C. herbarum* and *C. macrocarpum* (Barr 1958, Corlett 1988), we further resolved to attempt generation of teleomorphs and to determine whether or not there were differences in the teleomorphosis corresponding to differences in the anamorphosis.

MATERIALS AND METHODS

Cladosporium isolates were obtained from developing or mature cherry fruit collected from three locations in northcentral Washington. Surface-disinfested, excised styler or receptacular scars were placed onto ½V8 juice agar, and the *Cladosporium* isolates that grew from the excised tissues were coded by location and date, then stored on silica gel. Thirty-two isolates representative of the *C. macrocarpum*-*C. herbarum* transition that were provisionally classified upon isolation from fruits by criteria from Ellis (1971) were selected for further study: CV8-96 (classified as *C. macrocarpum*), ST2-92 (classified as *C. herbarum* transitional to *C. macrocarpum*), AV2-98, AV3-56, AV7-9a, AV9-76, CV4-100b, CV6-95a, CV9-14, CV10-63b, ST3-18, ST5-45, ST6-77a, ST8-25, ST10-47 (classified as robust variants of *C.*

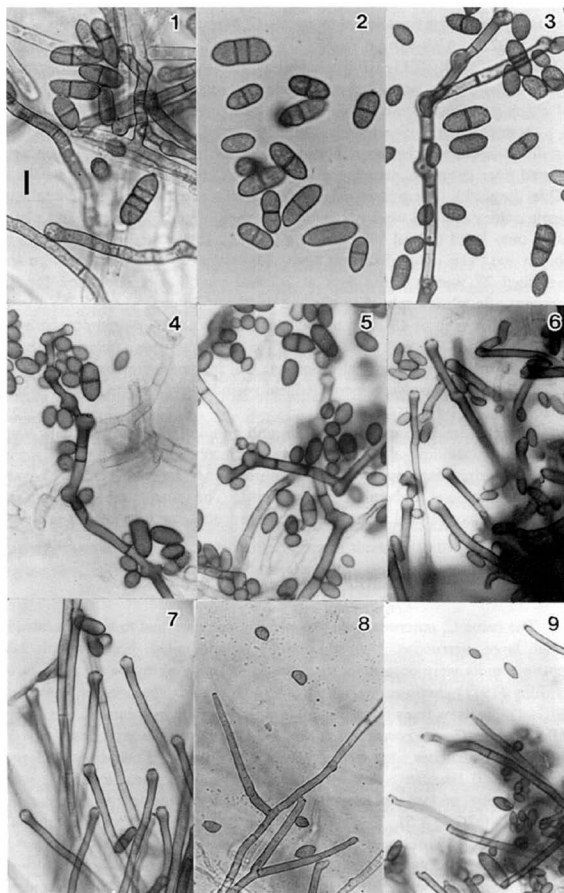
herbarum), AV4-3b, AV6-11, AV10-72, CV3-2a, CV3-81a (classified as robust *C. herbarum* transitional to gracile *C. herbarum*), and AV4-66b, AV6-9b, AV7-23b, AV9-37b, AV9-85, CV7-44, CV7-88, CV10-92a, ST5-40b, ST6-54', ST6-94, ST11-21b (classified as gracile variants of *C. herbarum*). These isolates were inoculated onto media and incubated at 5C for production of anamorphic and teleomorphic states as described below.

In preliminary experiments, AV2-98 and CV6-95a, but not CV3-2a, produced pseudothecia when plated on wheat leaf agar (15% water agar poured over chopped, autoclaved wheat leaves) and incubated 8½ weeks at 5C in the dark. For generation of teleomorphs and morphometric analysis, single colony isolates were obtained from each of the 32 isolates and plated twice onto ½V8 (90 ml V8 juice, 3 g CaCO₃, 15 g agar, 910 ml dH₂O) as above, and twice onto wheat leaf agar. Plates were sealed with Parafilm and incubated 27 weeks in the dark at 5C and periodically examined for the presence of a teleomorph. Lengths and widths of 20 conidia from ½V8 were measured for each of 13 isolates and results analyzed by paired comparisons using Systat 5.0. Lengths and widths of ascospores were similarly analyzed for those isolates producing teleomorphs. All isolates were also plated twice onto ½V8 as mass isolates, incubated and periodically inspected for 27 weeks as above.

For photomicrography of conidia and conidiophores, 13 isolates were recovered from silica gel onto ½V8 agar and incubated 3 weeks at 20C under a 12/12 hr light/darkness cycle with fluorescent (General Electric, 15 watt) and near-ultraviolet (Sylvania, 15 watt) lights. The mean number of septa per conidium was computed from 20 conidia per isolate, and the results analyzed as above.

RESULTS AND DISCUSSION

The name *C. macrocarpum* was provisionally applied to those isolates in which large, verrucose, 1-septate conidia predominated, but in which 2-3-septate conidia were occasional to common. Conidiophores were as pictured by Ellis (1971); nodose, with long internodes, and occasionally geniculate (FIG. 1). Isolates transitional from *C. macrocarpum* to robust *C. herbarum* differed from *C. macrocarpum* in that 2-3-septate conidia were less frequent (FIGS. 2,3). Isolates were termed robust *C. herbarum* if conidia were large, verrucose, 0-1-septate, frequently septate, and if conidiophores were pronouncedly nodose, commonly with short internodes and appearing sympodial (FIGS. 4,5). These isolates conformed closely to Matsushima's concept of *C. macrocarpum*. Isolates transitional from robust *C. herbarum* to gracile *C. herbarum* had smaller, usually 0-septate conidia, with conidiophores frequently but less pronouncedly nodose, seldom geniculate,



FIGS. 1-9. Conidia and conidiophores of *Cladosporium* isolates. 1. CV8-96: *C. macrocarpum*. 2,3. ST2-92, CV10-63: *C. macrocarpum* transitional to the robust variant of *C. herbarum*. 4,5. AV2-98, CV6-95a: robust variants of *C. herbarum*. 6,7. AV10-72, AV6-11: robust variants of *C. herbarum* transitional to gracile variants of *C. herbarum*. 8,9. AV9-85, CV10-92a: gracile variants of *C. herbarum*. Bar = 10 μm .

and not appearing sympodial (FIGS. 6,7). Isolates classified as gracile *C. herbarum* corresponded to illustrations commonly rendered for that species (e.g. Ellis 1971), always with small, verruculose conidia and a high proportion of non-nodose conidiophores which tapered to narrow, sometimes almost acute, conidiogenous loci (FIGS. 8,9). These latter isolates constituted the terminal end of a series that began with *C. macrocarpum*.

When these subjective assignments were compared to a series based on conidial length, the two generally corresponded (TABLE 1). That the correspondence is not perfect can be seen by the positions of CV10-63b and AV9-85; the former was originally designated a member of the robust *C. herbarum* series (see above), but later placed in the *C. macrocarpum*-robust *C. herbarum* transition on the basis of degree of conidial septation. CV10-63b had smaller conidia than ST2-92, the other member of the series. AV9-85 possessed larger conidia than the other two members of the gracile *C. herbarum* group. The mean conidial length of any isolate did not differ ($P=0.05$) in paired comparisons (Tukey's test) from that of its nearest neighbors, (and usually did not differ from isolates several places away), but isolates in the middle of the series (ST6-77a, CV10-63b, CV9-14, CV6-95a) differed from those at the termini (usually from both ultimate and penultimate members). The four uppermost members were always significantly different from the five lowermost members.

Analysis of conidial width produced a similar result (TABLE 1). Isolate ST2-92 is out of place in the sense that it possessed conidia wider (but not significantly, $P=0.88$) than CV8-96; otherwise, most deviations from a continuous decrease in width when progressing down the series were of a magnitude $\leq 0.3 \mu\text{m}$ and were also not significant. The overall pattern of significant differences was similar to that displayed for conidial length, i.e., near neighbors in the series were usually not statistically different, but the members near one terminus were significantly different from those near the other terminus, and mid-series members were significantly different from those at the termini. However, unlike conidial length, width displayed two discontinuities; ST10-47 was significantly ($P=0.004$) wider than its next widest neighbor down the series, CV10-63b, and CV6-95a was significantly wider ($P=0.04$) than its downward neighbor, AV9-85. The first discontinuity

TABLE 1. Mean length, width and number of septa of 20 conidia, and subjectively assigned group for 13 *Cladosporium* isolates from cherry fruits.

<u>Isolate</u>	<u>Length</u>	<u>Width</u>	<u># Septa</u>	<u>Group</u>
CV8-96	19.4	9.8	0.95	macrocarpum ¹
	ab	ab	ab	
ST2-92	19.1	10.5	0.95	macro-herb ²
	ac	ac	ac	
ST10-47	16.5	9.4	0.70	ro. herbarum ³
	bcde	bc	bcde	
AV2-98	14.1	7.6	0.35	ro. herbarum
	dfghi	defg	fghijk	
ST6-77a	13.2	7.7	0.30	ro. herbarum
	efjklmn	dhij	flmnopqr	
CV10-63b	12.2	7.9	0.45	macro-herb
	gjopqrs	ehk	dglst	
CV9-14	11.7	7.6	0.50	ro. herbarum
	hkotuvwx	fiklm	ehms	
CV6-95a	11.6	6.9	0.20	ro. herbarum
	ilptyab	gjlm	intuvwxy	
AV9-85	10.4	5.6	0.05	gr. herbarum ⁴
	mquyzcdef	nopq	ouzabc	
AV10-72	10.0	5.2	0.15	ro. herb-herb ⁵
	nrvzcgghi	nrst	jpvzdef	
AV6-11	9.1	5.2	0.15	ro. herb-herb
	swadgjk	oruv	kqwadg	
ST5-40b	8.3	4.7	0.05	gr. herbarum
	xbehjl	psuw	rxbeghi	
CV10-92a	7.0	4.7	0.00	gr. herbarum
	fikl	qtvw	ycfhi	

¹*Cladosporium macrocarpum*, ²*C. macrocarpum* transitional to robust *C. herbarum*, ³robust *C. herbarum*, ⁴gracile *C. herbarum*, ⁵robust *C. herbarum* transitional to gracile *C. herbarum*. Numbers sharing a common letter were not significantly different ($P = 0.05$).

occurred within the upper portion of the series dominated by the robust *C. herbarum* isolates; it may be that the upper isolate, ST10-47, was improperly assigned to that category, but given the unity of characters it shared with the lower robust *C. herbarum* isolates, it is probable that isolates with

intermediate mean widths exist. The lower discontinuity separated the robust *C. herbarum* portion of the series from the gracile *C. herbarum* isolates and isolates transitional to the gracile form. The significance level was marginal however, and the very close resemblance of robust *herbarum* isolates to those classified as transitional between robust and gracile forms would seemingly render it more so.

When the number of septa per conidium was examined (TABLE 1), three isolates appeared out of place in the current ranking; CV10-63b and CV9-14 would be higher, and AV9-85 lower, if ranked by number of septa. Ordering the series by number of septa per conidium would place CV10-63b closer to the *C. macrocarpum*-*C. herbarum* transition where it was placed in the provisional classification. CV9-14 would also be nearer this position if ranked by septation. Interestingly, when the number of sampled conidia possessing > 1 septum was counted, the ranking was CV8-96 with 3, ST2-92 and CV10-63b with 2 each, and CV9-14 with 1. CV8-96 was the only isolate whose sample contained a conidium with 3 septa. (Other isolates had scores of zero.) Ranking by septation would also place AV9-85 with the other gracile *C. herbarum* isolates, where it was placed by subjective criteria, instead of placing it above the robust *C. herbarum*-gracile *C. herbarum* transition. When the isolates were arranged in a series by conidial septation instead of conidial length, and paired comparisons made with Fisher's least significant difference (LSD) instead of Tukey's test, the results were analogous to those with conidial length above: neighboring isolates (usually 3-5 positions) did not significantly differ, but a central portion of the series differed from the termini, and members near one terminus differed significantly from members of the other terminus.

The minor discontinuities and contradictions above should not preclude viewing the isolates as part of a series. Statistically significant differences in morphometric data can occur within members of a series otherwise closely related by other qualitative or quantitative characters. This is illustrated here by ascospore dimensions. ST6-77a possessed ascospores with a mean size of $31.3 \mu\text{m} \times 9.2 \mu\text{m}$; other means were $28.7 \mu\text{m} \times 8.7 \mu\text{m}$ for AV2-98; $28.7 \mu\text{m} \times 8.1 \mu\text{m}$ for CV6-95a, and $28.8 \mu\text{m} \times 8.7 \mu\text{m}$ for CV10-63b. Ascospores of ST6-77a differed ($P \leq 0.04$) in length from those of the other three isolates, and differed ($P = 0.003$) in width from those of CV6-95a. These isolates were all from a mid-series component displaying discontinuities in neither conidial length, width nor septation and closely related by qualitative characters.

We conclude there are real differences between isolates widely separated in the series, but neighboring isolates are very similar qualitatively and seldom differ quantitatively. When they do differ quantitatively, we hold such differences to be varietal and of such a nature that intermediates likely exist.

The correspondence between series constructed on single morphometric characters (e.g., conidial length or number of septa per conidium) and the more integrative, subjective classification was good but not total (TABLE 1). This should not surprise, as divergence of characters within an evolutionary group is not likely to be confined to those characters that change quantitatively in the same direction. The limitation of the series concept is one of unidirectionality; the disposition of isolates along a single axis (defined by a single character) with morphologically distinct termini is nevertheless useful. We acknowledge that measurement of greater numbers of conidia or other structures could successfully introduce more statistically significant differences between neighboring isolates in these series. However, it is inescapably necessary to assess such statistical discontinuities in a broader context, and to decide whether they indicate specific or subspecific boundaries. In our study, major morphological discontinuities were lacking, although the termini of our simple series have long been assigned different specific names. In the absence of knowledge of sexual or vegetative compatibility, the point of division of the series into the two extant names is arbitrary. Barr (1958) suggested uniting the two under the earlier name, *C. herbarum*.

Isolates AV2-98, CV6-95a, CV10-63b, and ST6-77a were derived from single colonies and produced some mature pseudothecia on $\frac{1}{2}$ V8 and/or wheat leaf agars by 27 weeks. Most pseudothecia contained several aborted asci or only aborted asci. Isolates AV4-66b, AV7-23b, AV10-72, CV7-44, CV7-88, CV10-92a, ST5-40b, ST6-54', and ST11-21b produced irregular, sclerotium-like bodies, whereas AV3-56, CV8-96, CV9-14 and ST8-25 produced immature or aborted, often papillate pseudothecia with no asci. Mass isolates behaved as did single colony isolates. All isolates that produced mature pseudothecia belonged in the middle of the series and were classified as robust *C. herbarum*, or in the case of CV10-63b, were originally so classified and later placed in the *C. macrocarpum*-robust *C. herbarum* transition. Three of the isolates that produced only immature or aborted pseudothecia were also of the robust *C. herbarum* type, and one was the isolate classified as *C. macrocarpum*. Eight of the nine isolates that produced sclerotium-like bodies were of the gracile *C. herbarum* category, and one (AV10-72) was of the transitional group between robust-*C. herbarum* and gracile *C. herbarum*.

It is unfortunate that so few isolates produced mature pseudothecia, precluding an extensive comparison of teleomorphic characters for the series. However, it is noteworthy that all 8 isolates which produced mature or immature pseudothecia belonged to the 15 isolates in the top half of the series (*C. macrocarpum* to robust *C. herbarum*), and all 9 isolates which produced sclerotium-like bodies were in the 17 members of the bottom half (transition of robust *C. herbarum* to gracile *C. herbarum*, and gracile *C. herbarum*). This might reflect differences in environmental reproductive capacities or

strategies between parts of the series. Why the pseudothecia matured within 8½ weeks in preliminary trials, but were so tardy (27 weeks) in the later trial, is unknown.

Likewise unknown, as stated above, is the capacity for genetic exchange between different parts of the series; since the isolates producing pseudothecia were homothallic, and since the isolates on the lower portion of the series were infertile (or possibly heterothallic), it will require some ingenuity to conduct mating tests. It may be possible to assess potential gene exchange with vegetative compatibility. We have used chlorate media to generate *nit* mutants from a single isolate, and have obtained complementation between 2 such mutants, but mutants were very slow growing and complementation was similarly slow to appear (Dugan and Roberts, unpublished). Although our studies here found no major morphological discontinuities between *C. macrocarpum* and *C. herbarum*, there may be sufficient incompatibility between isolates so that gene flow is blocked or retarded. However, until experimental evidence indicates a lack or restriction of gene flow between the termini of this series, the recommendation of Barr (1958) is warranted and the species should be united under the name *C. herbarum*.

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LICHENS OF PINE BARRENS, DWARF PINE PLAINS,
AND "ICE CAVE" HABITATS
IN THE SHAWANGUNK MOUNTAINS, NEW YORK

Robert Dirig*

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ABSTRACT: The Shawangunk Mountains are a narrow quartzite conglomerate escarpment paralleling the southeastern edge of the Catskill Mountains between Rosendale and Port Jervis in Ulster, Sullivan, and Orange Counties, New York, USA. Extensive tracts of pine barrens and dwarf pine plains vegetation (similar to those on the sandy Atlantic Coastal Plain in New Jersey and on Long Island, New York) occur on bedrock atop this ridge at elevations of 550-690 m. Records of specimens collected at 15 sites throughout the region are synthesized with additional records from the literature and herbaria. Terricolous and saxicolous lichens predominate except in sheltered nooks, probably in response to occasional fires and windswept conditions. Conspicuous among the macrolichens are four species of Rock Tripes (Umbilicariaceae), including the rather rare *Lasallia pennsylvanica*. Reindeer Lichens (genus *Cladina*) are frequent, among them *C. arbuscula* (one of ca. 20 Shawangunk lichens having Arctic-alpine/boreal affinities, occurring in or near deep, ice-filled faults). *Cetraria arenaria*, *Cladonia floridana*, *Cladonia atlantica*, *Cladonia rappii* var. *exilior*, and *Cladonia submitis* are disjunct from the Atlantic Coastal Plain, as are a dozen vascular plants and bryophytes. Existing lichen records (63 taxa) include many species unusual in southeastern New York. More thorough sampling, especially of microlichens, may reveal additional notable species from these spectacular montane habitats. **KEY WORDS:** Lichens, pine barrens, dwarf pine plains, ice caves, Shawangunk Mountains, New York State, Arctic-alpine/boreal biota, Atlantic Coastal Plain disjunction, *Cetraria arenaria*, *Cladonia submitis*.



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Part I: Introduction



THE great rocks amid which our road curved were covered with brown lichens of curious form, wrote M. H. Pike (1892:460), referring to masses of Umbilicariaceae that overlaid the snowy Shawangunk quartzite. She continued (Pike 1892:471): *Lake Minnewaska is nearly a triangle in shape, ... the shores ... everywhere bold and rocky, ... its clear pure waters reflect[ing] the tint of rock and foliage, or, like a mirror, [lying] open to the sunshine and the sky. Along one side the walls of white stone ... rise perpendicular to the height of ... [27 meters], with a buttress here and there supporting an overhanging slab.... All this is covered with leathery brown lichen, indicating great age....* These sentences, written a century ago, suggest the timeless mystique and grandeur of this mountain range, with its sparkling lakes, sublime vistas, and conspicuous lichens.

It was nearly a half century later that Torrey (1932a-b, 1935), aided by Gladys P. Anderson, began to collect and notice Shawangunk lichens in greater detail, reporting *Cetraria arenaria*, *Dimelaena oreina*, *Umbilicaria muelhenbergii*, and species of *Lecanora*, *Lecidea*, *Rhizocarpon*, *Acarospora*, *Cladonia*, and *Cladina*. Anderson (1935) discovered *Cetraria culbersonii* there, and Friend (1936) first identified the four common Umbilicariaceae; while Lewis (1938) found *Pseudevernia consocians* and *Mycoblastus sanguinarius* associated with the famous deep faults ("ice caves") of the region. Smiley (1940) reported *Cladonia floridana*, correctly interpreting it as disjunct from the Atlantic Coastal Plain. Brown (1946, 1948) added a few more lichen records through her research on New York State epiphytes. Nearing (1953b), in an atmospheric essay on "Sam's Point and the Ice Caves," proclaimed the occurrence of several remarkable Arctic-alpine/boreal lichens in the faults. And Smiley & George (1974) hinted that air pollution might be causing photographically documented declines in *Umbilicaria* and *Lasallia* populations at Mohonk Lake.

I first visited the Shawangunk Mountains in 1976, and as a germinating lichenologist, was intrigued by the rugged landscapes and abundance of lichens. Here were tracts of pine barrens and pine plains vegetation that recalled similar sites on Long Island, New York, and in New Jersey, but were isolated on the summit of a high ridge overlooking the Hudson River valley to the east and the Catskill peaks to the west. Cladoniaceae covered the rocks, sand, and duff between bonsai-like pines and heaths in this pygmy landscape, while Pike's "brown lichens of curious form" still grew abundantly from the stark rock faces. I began a collection of Shawangunk lichens in 1976, adding to it on frequent visits during the next four years and thence intermittently until 1992.

This paper organizes historic literature and specimen records and reports results of personal collecting in the region. It is the first list of Shawangunk lichens, and although far from complete, may catalyze further lichenological research in these spectacular montane habitats.

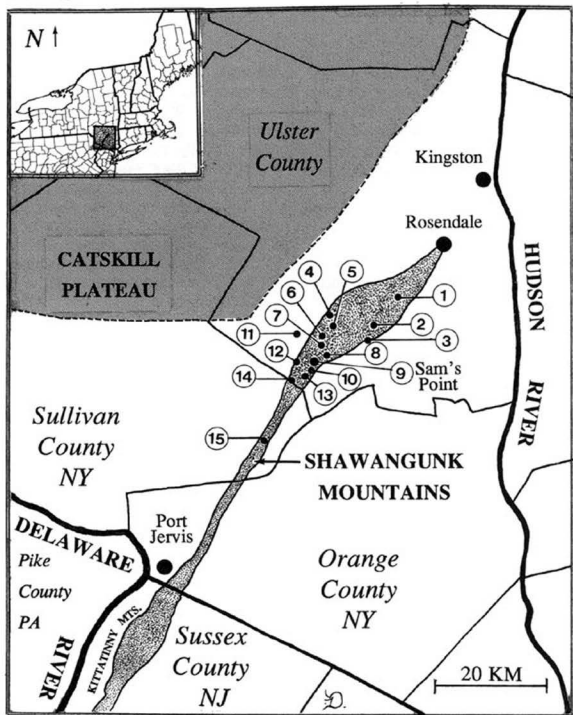


Figure 1: Location of the Shawangunk Mountains and 15 study sites in southeastern New York, USA. The inset places the area of detail in the Northeast. The Catskill Plateau boundary is from Fenneman (1938).

The Shawangunk Mountains

The Shawangunks (pronounced *shon'-gumz*) are a narrow quartzite conglomerate ridge of Silurian age extending from Rosendale, Ulster County, New York, on the west side of the Hudson River, southwestward through Sullivan and Orange Counties to Port Jervis at the Delaware Water Gap (Fig. 1). The ridge continues through New Jersey as the Kittatinny Mountains, and thence southwestward as the Blue Mountains. The conglomerate is much more resistant to weathering than adjacent shale, siltstone, and limestone strata, and in places dramatically looms to 550 m above the valleys on each side. Basal shale layers continually erode on the southeastern edge of the ridge, causing breakage of the overlying quartzite into huge blocks that tumble down, forming talus slopes. Faults occurring in the conglomerate caprock have resulted in four large mountaintop lakes (Mohonk, Minnewaska, Awosting, and Mud Pond), as well as sobering chasms. A fifth lake (Maratanza) occupies a glacially-gouged depression atop the ridge (Kiviat 1988:8-9). The Shawangunks slope upward and widen from the Hudson valley over the 30 km to Sam's Point, then narrow and slope downward over another 50 km as they approach the New Jersey border. Summit elevations range from 300 m to 690 m near Sam's Point. Other local landmarks have been christened with such picturesque names as Gertrude's Nose, Eagle Cliff, Bonticou Crag, High Point, and Cragmoor. Long famous for their landscapes, unspoiled wild lands, and rich biota, the Shawangunks are regionally important for outdoor recreation, legendary resort hotels, extensive nature preserves, and scientific research. Historic references that describe the scenery include Britton (1883), Smith (1887), Pike (1892), Smiley (1940a), and Nearing (1953b). Further information on the geology and topography of this region may be found in Eights (1836), Darton (1894a-b), Fenneman (1938:210), Lewis (1938), Sweet & Secor (1940), Nearing (1953b), New York-New Jersey Trail Conference (1971), Fried (1981), Snyder & Beard (1981), and Kiviat (1988).

Shawangunk Lichen Habitats

The focus of my field work was lichen species of pine barrens and dwarf pine plains habitats on the ridge. A few collections were also made in "ice caves" and on the flanks of the escarpment. Descriptions of these environments follow.

In northeastern North America, pine barrens vegetation is shrub savannah-like, characterized by an open canopy of widely spaced Pitch Pines (*Pinus rigida* Mill.); a shrub layer of Scrub Oak (*Quercus ilicifolia* Wang.), Dwarf Chestnut Oak (*Q. prinoides* Willd.), and heaths [frequently *Vaccinium angustifolium* Ait., *V. pallidum* Ait., *Gaylussacia baccata* (Wang.) Koch., *Kalmia angustifolia* L.]; and an herb layer of drought- and fire-resistant species. Lichens and bryophytes may cover the ground

between clumps of shrubs and grasses. Cryan (1985:29), Kiviat (1988:23), and Wheeler (1991:410) listed and mapped the locations of northeastern pine barrens, and Rittner (1976), Forman (1979), Olsvig (1980), and Reschke (1990:47-48) provided detailed biological and ecological data on northeastern barrens.

Pine barrens vegetation almost always develops in lowlands on deep sandy deposits of the Coastal Plain or on inland analogues—large sand deltas and lacustrine sand deposits associated with glacial recession. It is rarely found on rock, and thus the Shawangunk summit habitats are of special interest biologically and biogeographically. Nearing (1953b), McIntosh (1959), Selender (1980), and Olsvig (1980) have discussed pine barrens vegetation from a Shawangunk perspective.

Fires that periodically rage through pine barrens are vital forces in maintaining the open-canopied structure of the vegetation. "The Shawangunk Mountains are naturally prone to fires because of their excessively drained thin soils and their exposure to drying winds.... The result of this long fire history is that the plants of the Shawangunk ridge are well adapted to fire" (Anon. 1978). Ridgeway (1883), Pike (1892), Torrey (1932b, 1935), Nearing (1953b), Fried (1981), Snyder & Beard (1981), and Smiley & Huth (1982) mentioned historic fires in the Shawangunks, including deliberate fire-setting by persons wishing to encourage blueberries (*Vaccinium* spp.) for picking. Such fires surely damage or destroy lichens that grow in their path (see accounts of *Cladina stellaris* and *Cladonia strepsilis* in Part II).

Elsewhere in New York, pine barrens formations have developed on rock in the Thousand Islands in Jefferson County, the eastern edge of the Adirondacks in Clinton County, and also limitedly on Catskill and Hudson Highland ridge tops (Bray 1915, Selender 1980, and personal observations). In Pennsylvania, similar vegetations occur on rocky bases in Centre County and in the Poconos. None of these approaches the extent or development of the Shawangunk barrens and plains.

Dwarf pine plains may be considered an extreme variant of pine barrens vegetation. Only three are known on a global scale—one in New Jersey (Good *et al.* 1979, Windisch 1986), one on Long Island (Olsvig *et al.* 1979, Cryan 1982), and one on the Shawangunk ridge (Cryan 1982:10-11, Kiviat 1988:22-25, Reschke 1990:46). They are pygmy forests characterized by a dwarfed form of *Pinus rigida* that only reaches 1-2 m in height, similarly dwarfed or shrubby species of *Quercus*, predominance of root crown sprouting, few seedlings, and cone serotiny in *P. rigida* [see Harshberger (1970), Good *et al.* (1979), Olsvig (1980), Kiviat (1988:22), and Reschke (1990:46) for elaboration of these criteria]. The Shawangunk dwarf pine plains begin at Sam's Point, surround Maratanza Lake, and extend 4-5 km north to and beyond High Point.

The occurrence of a genuine dwarf pine plains in the Shawangunks was perceived in the mid-1970s (Olsvig *et al.* 1979, Olsvig 1980), although its small pines had been remarked upon 90 years earlier by Britton (1883), who wrote: "The flora of the top of this elevated ridge is characterized by an abundant growth of *Pinus rigida*..., very much

stunted..., fruiting indeed at...[0.6 m] from the ground and forming low, straggling bushes, few of them more than...[1.5 m] high, the leaves also shortened to half the length of those borne by ordinary trees of this species." Torrey (1932b:160), Sweet & Secor (1940:42), McIntosh (1959:482), and Fried (1981:73-75) also noted the midget pines of the Shawangunk plains. Persistent winds, nutrient-poor soil, aluminum toxicity, severely limited water, and increased fire frequency have been advanced as explanations of woody plant miniaturization at pine plains sites, but there is more likely a genetic component in *P. rigida* (Good *et al.* 1979). Reschke (1990:46) regarded the rock-based Shawangunk dwarf pine plains as the only known example of this community type in the world.

Pine barrens vegetation abuts the well known Shawangunk "ice caves" at certain points. These are partially boulder-clogged faults that accumulate snow and ice in winter. Because of their depth (30-45+ m), the snow may not completely melt in summer, producing constantly cool microclimates in which species of northern affinity can exist far south of their usual range (see Part III). Lewis (1938), Nearing (1953b), and Reschke (1990:51) have described the faults and highlighted their unusual biota. The only other similar habitats in New York are at Eagle Pass, Essex County, in the Adirondacks (Reschke 1990:51).

Shawangunk Biota

Discovery of the pine barrens shrub *Corema conradii* (Torr.) Torr. ex Loud. (Empetraceae) on a Shawangunk crag, far from its usual haunts on the Coastal Plain (Smith 1880, 1882; Peck 1883; Redfield 1884), stimulated much interest in the flora of this upland system. Ridgeway (1883), Britton (1883, 1884a), Pike (1892), Torrey (1932a-b), Nearing (1953b), and McIntosh (1959) reported further observations of Shawangunk plants. The Torrey Botanical Club regularly visited the Mohonk Lake area for several years, and reports of their field excursions listed plants encountered (Torrey 1935; Friend 1936, 1937; Lewis 1938; and Smiley 1937, 1938, 1939a-d, 1940a-b). A comprehensive vascular flora of Ulster County, which includes the northern Shawangunks, was published by Domville & Dunbar (1970). Corey *et al.* (1992) have begun a bryological survey of the northern part of this ridge, and Leonardi (1992) is studying bryophytes of the Shingle Gully Ice Caves. Except for preliminary work on lichens (summarized herein), other Shawangunk cryptogams have not been inventoried (Kiviat 1988:62).

The Shawangunk vertebrate fauna is well known, but information on invertebrates is limited. Friend (1936, 1937), Smiley (1937, 1938, 1939d, 1940a, 1971-1972), Burnley (1971), Fried (1981), Kiviat (1988), and Wheeler (1991) provided important information on the region's animals.

Daniel Smiley Jr. collected voluminous specimens and notes on the natural history of the Mohonk Lake region that are now housed at the

Daniel Smiley Research Center of The Mohonk Preserve, Inc. (Winerip 1986, Huyghe 1991). This agency maintains a Shawangunk herbarium that includes lichens, and has a large regional library. In the 1930s, Smiley "started a collection of lichens, with ... G. G. Nearing [Leach 1961] and Gladys P. Anderson [assisting with]... identification, [but] other studies diverted [him]" (his letter to me, 17 April 1980). A number of Smiley's lichen specimens and observations from this period are cited below.

The best general references on Shawangunk history, biota, and ecology are Snyder & Beard's (1981) *The Shawangunk Mountains, A History of Nature and Man*, and Kiviat's (1988) *The Northern Shawangunks, An Ecological Survey*. Both may be obtained through The Mohonk Preserve Inc., Mohonk Lake, New Paltz, NY 12561, USA.

Methods and Study Sites

I collected all macrolichen species encountered at fifteen sites along the Shawangunk ridge. Specimens were enclosed in labelled packets and identified via keys in Brodo (1968), Hale (1979), and generic monographs, using morphological characters and chemical spot test reactions. Specimens requiring further work were determined by specialists using microchemical crystal tests (John W. Thomson, WISC) and thin-layer chromatography (TLC) [Richard C. Harris (MICH, NY) and Scott A. LaGreca (DUKE)].

The accompanying map (Fig. 1) places the Shawangunk region in southeastern **New York State**, and marks the locations of **Sites 1-15**, which are briefly characterized below. All sites are in **Ulster County** except Site 15, which lies in **Sullivan County**.

Site 1: Mohonk Lake shores and nearby wild lands of The Mohonk Preserve, Towns of Marbletown and Rochester. The Mohonk Mountain House, a magnificent Victorian-era resort hotel sequestered on the N shore of the lake, is surrounded by a network of named paths through a largely undisturbed landscape (Francis 1993-1994).

Site 2: Minnewaska Lake and environs, Town of Gardiner, Minnewaska State Park. The Wildmere House and Lake Minnewaska Cliffhouse, both now gone, were former resort hotels at this lake. As at Mohonk, a network of named trails surrounds the former hotel sites. Selender (1980:4) pinpointed his study sites in the Minnewaska area.

Site 3: Gertrude's Nose, Town of Gardiner, ca. 3.3 km SSW of the S end of Minnewaska Lake. This quartzite conglomerate promontory and talus slope, named for the most noticeable facial feature of Gertruyd Bruin who settled nearby in ca. 1665 (Torrey 1932a:99), is the only inland station of *Corema conradii*.

Site 4: Ellenville Ice Caves, Town of Wawarsing, very deep, ice-filled faults near Shingle Gully, 4 km N of Maratanza Lake and 1.9 km NW of High Point.

Site 5: High Point Road and surrounding pine barrens from paved road surrounding Maratanza Lake, N to High Point; Town of Wawarsing. Open pine barrens, with boggy vegetation in shallow rocky depressions.

Site 6: Bluffs NW of Maratanza Lake, Town of Wawarsing, rim of quartzite conglomerate cliff NW of paved road around Maratanza Lake, N to Indian Rock.

Site 7: Maratanza Lake N shore and environs, Town of Wawarsing. Windswept pine barrens and dwarf pine plains vegetation on quartzite "tableland."

Site 8: "Ice Caves" NE of Sam's Point, Town of Wawarsing, Ice Caves Mountain National Landmark, tourist trail through deep fault. A map (obtainable at the tollgate on Sam's Point Road) shows named stations along the footpath.

Site 9: Sam's Point, Town of Warwasing. This crag is near the highest point of the Shawangunk ridge (elev. 690 m). It is named for Sam Gonzalus, a colonial hunter who, the legend goes, jumped over the precipice into the tops of trees to escape pursuing Leni-Lenape natives (Smith 1887:132-135; New York-New Jersey Trail Conference 1971:126; Fried 1981:13). The site is probably the most exposed of the whole region, with dwarf pine plains vegetation abutting the cliff, and several rare plant species growing on the brink. Brown (1946:40, 203) listed Sam's Point as the site of her Shawangunk observations on 19 October 1944.

Site 10: Sam's Point Road, Town of Wawarsing, near Losees Hill, SE road bank, 0.5 km SW of Ice Caves Mountain National Landmark tollgate.

Site 11: Mt. Meenahga Road, Town of Wawarsing, right angle bend in road, 0.3 km NE of its junction with South Gully Road, 0.8 km S of Ellenville; edge of open oak woods. [*Meenahga* means "huckleberry" in the aboriginal language, according to P. Huth (letter, 29 November 1993).]

Site 12: Slanted bedrock cliffs, Town of Wawarsing, 45-degree quartzite conglomerate slope supporting a *Pinus rigida-Quercus ilicifolia*-heath pine barrens on E bank of State Rt. 52, 3.2 km S of Ellenville. A sun-baked habitat with hundreds of mature Umbilicariaceae.

Site 13: Old Mountain Road, Town of Wawarsing, unpaved jeep trail from Sullivan County line to within 60 m of State Rt. 52, between Spring Glen and Bear Hill.

Site 14: Bedrock outcrops SW of Route 52, Town of Wawarsing, 1.6 km ESE of Route 209 [in Spring Glen] at Sullivan County line, and 0.8 km SW of State Rt. 52 at jct. of Cramer Rd.

Site 15: Bedrock outcrops, Town of Mamakating, SW side of State Rt. 17-east, opposite entrance to rest stop on Rt. 17-west, 2.5 km SE of exit 113, on W face of the Shawangunk escarpment, at edge of oak woods.

Unspecified: This category is used for literature reports without specific locality information.

Miscellaneous: Locality details are supplied here for specimens collected by others from additional sites.

Part II: Annotated List of Lichen Species

Specimen and literature reports are listed by site number for each lichen (32 species previously reported, 31 newly reported here). One hundred seventy-four collections were made; 369 specimens (including duplicates) have been deposited as indicated below. Herbaria are identified by standard acronyms (Holmgren *et al.* 1990). Two private herbaria are cited, The Mohonk Preserve's (as "MOHONK") and mine (as "R.D."). Specimen numbers preceded by "L" and not including a collector's name (e.g., L-641) are R. Dirig collections.

Lichen nomenclature largely follows Egan (1987) and vernacular names are from Nearing (1962a). Vascular plant names follow Mitchell (1986); vertebrate names are from Banks *et al.* (1987).

Arctoparmelia centrifuga (L.) Hale
(Ring Lichen)

Site 4: "Along the northwest wall, where the sun strikes for a little while [each] day in summer," covering fallen slabs of quartzite [Nearing 1953b:103, as *Parmelia centrifuga* (L.) Ach.]. **Site 8:** 2 August 1936 (*Smiley s.n.*, NY). **Unspecified:** Nearing (1939:101, as *P. centrifuga*). **Miscellaneous:** Cragsmoor, 1936 (*Anderson s.n.*, NY). Arctic-alpine/boreal.

Arctoparmelia incurva (Pers.) Hale
(Fist Lichen)

Site 4: Same details as preceding species [Nearing 1953b:103, as *Parmelia incurva* (Pers.) Fr.]. **Miscellaneous:** E of Ellenville (*Nearing s.n.*, FH). Arctic-alpine/boreal.

Baeomyces roseus Pers.
(Pink Earth Lichen)

Site 1: Undercliff Road at Sta. 14, 15 Sept. 1968 (*A. Jones & D. Smiley s.n.*, MOHONK). **Site 5:** (*L-1369*, R.D.). **Site 6:** (*L-1304*, R.D.). **Site 9:** (**L-135*, R.D., NY; **L-1367*, R.D., NYS). **Site 10:** (**L-1368*, R.D.). **Site 12:** (*L-75*, R.D., NY). **Site 13:** (*L-1333*, R.D.; *L-1335*, R.D., NY, NYS, US, DUKE; *L-1348*, R.D., NY). **Site 15:** (*L-390*, R.D., NY, NYS). All terricolous, sterile specimens indicated by asterisks. [Synonym: *B. fungoides* (Sw.) Ach.]

This beautiful lichen grows on disturbed clayey soil, usually in sunny spots.

Bryoria furcellata (Fr.) Brodo & D. Hawksw.
(Moustache Lichen)

Site 9: On earth, with *Cetraria arenaria*, Sept. 1935 (*Anderson MM-617*, MOHONK; *Anderson s.n.*, NY).

This species is usually found on conifers, rarely on soil (Brodo & Hawksworth 1977:104).

Candelaria concolor (Dickson) B. Stein.
(Lemon Lichen)

Site 1: On 4-year-old *Juniperus virginiana* L. log at Mohonk boat house on pier (*L-3144*, R.D.).

Cetraria arenaria Kärnefelt
(“Iceland Moss”)

Site 1: E of Sanderskill, large thalli on rock, ca. 214 m elev., 20 Aug. 1935 (*Smiley MM-663*, MOHONK). **Site 2:** Footpath between Wildmere and Cliffhouse (*L-1313*, R.D., NY, NYS, US, DUKE). **Site 3:** Brink of cliff (*L-527*, R.D., LD); Torrey (1932a:99,

1932b:160); Smiley (1939a:20). **Site 5:** Torrey (1932b:160; 1935:155). **Site 6:** Near old tower, brink of cliffs (*L-645*, R.D., NY, LD); on twigs of *Kalmia angustifolia* and *Gaylussacia baccata* at edge of precipice (*L-648*, R.D., NY, NYS, LD; Kärnefelt 1979:66). **Site 7:** Terricolous (*L-641*, *L-646*, both in R.D., NY, LD; *L-642*, R.D., LD; *L-647*, R.D., NY, NYS, LD; *L-1326*, R.D., NY, NYS, US, DUKE); Dirig (1986:41). **Site 9:** On exposed flat ledges between shrub zone and edge of cliff, Sept. 1935 (*Anderson MM-616*, MOHONK); on open rock, 1 August 1936 (*Smiley s.n.*, NY); intergrown with Cladoniaceae (*L-91*, R.D.; *L-643*, R.D., LD; *L-649*, R.D., NY, NYS, LD); Nearing (1953b:101); Torrey (1932b:160; 1935:155). **Unspecified:** Nearing (1939:61), Kiviat (1988:62), Dirig (1992). **Miscellaneous:** Delaware Water Gap (Dix 1944:129).

This is the famous "Iceland Moss" of the Shawangunk summits, reported in historic regional literature as *Cetraria islandica* (L.) Ach.

According to Kärnefelt (1979:66), the "primary habitats" of this lichen are sandy soils along the northern Atlantic Coastal Plain, around the Great Lakes, and in the eastern Great Plains of North America; but in the Appalachian Mountains, *C. arenaria* is also occasionally found in open shale barrens or on exposed calcareous ledges. These rocky, sun-baked "secondary habitats" may have environmental conditions and vegetations that closely approach those of sandy areas. In the Shawangunks, *C. arenaria* is another heretofore unrecognized Atlantic Coastal Plain disjunct, previously misinterpreted as "boreal, ... rare and found only on high, open summits, in our latitude" (Torrey 1932a:99, 1932b:160) due to nomenclatural confusion with the very similar *C. laevigata* Rass. or true *C. islandica* of the Far North.

This lichen almost always grows directly on sand, chipped rock pieces, or over duff. My specimen *L-648*, collected from twigs (Fig. 2), is one of two known corticolous examples of the species (Kärnefelt 1979:66). The rarity of *C. arenaria* records from woody substrates is probably due to its vegetative reproduction by fragmentation (Kärnefelt 1979:66). Unless loose thalli were blown, washed, or otherwise fixed against the trunks of shrubs until they became attached, growth on such surfaces would be most unlikely. The corticolous thalli illustrated are extremely depauperate.

"Iceland Moss" is subtle and rather sparse in the Shawangunks, preferring the most sunny, open, and windswept situations, not areas of dense tree or shrub cover. No Shawangunk specimens have approached the luxuriance of those from its primary habitats on eastern Long Island, New York, and Cape Cod, Massachusetts, or even from other secondary habitats elsewhere inland, as near Ithaca and Watertown, New York. All Shawangunk material seen was of the broad-lobed form (Kärnefelt 1979:64). *Cetraria arenaria* is rare off the Coastal Plain in New York, with the Shawangunks its best known inland station.

Cetraria culbersonii Hale

(Swedish Shield Lichen, Frost's *Cetraria*)

Site 1: Along a horizontal crevice near base of 3-m cliff, Sky Top Path, August 1934 (*Anderson s.n.*, NY); on mainly steep-faced rocks, May 1935 (*Anderson MM-612*, MOHONK; *Anderson s.n.*, NY); "Constantly present in all but the driest stands of the

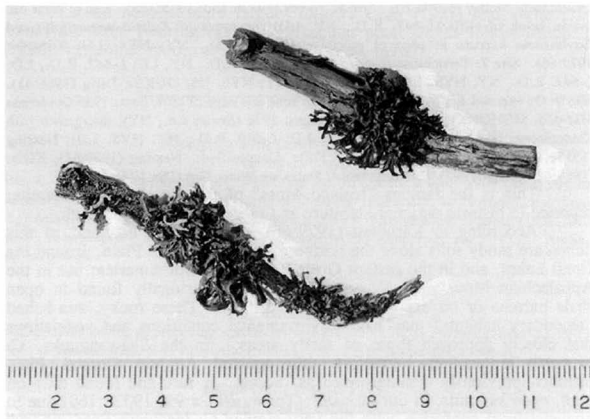


Figure 2: *Cetraria arenaria* on twigs (Dirig L-648, R.D., NY, NYS, LD). Photograph by Howard H. Lyon (CUP). Scale numbers are centimeters.

rock tripe lichen communities on the cliffs.... Dominant...in moderate shade, as where some tree has been able to find foothold on a ledge.... It grows only along the fissures at the top of the cliffs, ...is not abundant on any but the largest or most deeply imbedded of the talus blocks, ...[and] is inconspicuous,...always sterile" (Anderson 1935:49-50); Smiley (1938:16); on ledge, Humpty Dumpty Rd., E of summerhouse 112, 10 June 1986 (*D. Smiley obs.*, MOHONK). Unspecified: Nearing (1939:95). [Reported in the literature as *C. fahlunensis* var. *frostii* (Du Rietz) Zahlb.]

Cladina arbuscula (Wallr.) Hale & W. Culb.
(Woodland Reindeer Lichen)

Site 6: Terricolous (*L-1286*, R.D., WISC). **Site 7:** Terricolous, intergrown with *Cladonia uncialis*, somewhat aberrant, with open axils, thick podetia, and branches in 2's, 3's, and 4's (*L-1298*, R.D., DUKE). **Site 12:** Terricolous on steep cliff (*L-1379*, R.D., NYS, DUKE). Arctic-alpine/boreal.

Apparently infrequent on the Shawangunk ridge.

Cladina rangiferina (L.) Nyl.
(Reindeer Lichen, Reindeer Moss)

Site 1: Trail ca. 30 m N of Bonticou Camp, 26 Jan. 1973 (*Smiley obs.*, MOHONK); on slabs E of Talman Seat, Huguenot Drive, 21 Feb. 1984 (*Smiley & Huth obs.*, MOHONK); personal observations, April 1992. **Site 3:** On duff at brink of precipice,

weakly K+ (*L-525*, R.D., NY). **Site 4:** Weakly K+ (*L-1375*, R.D., NYS, DUKE). **Site 6:** Weakly K+ (*L-1315*, R.D., NY, NYS; *L-1356*, R.D., NYS, DUKE). **Site 7:** K+ (*L-1287*, R.D.); K- (*L-1308*, R.D., DUKE). **Site 8:** K- (*L-1316*, R.D., DUKE). **Site 9:** Dwarfed thalli, intergrown with *Cetraria arenaria*, K- (*L-92*, R.D., NY), K+ (*L-644*, R.D.). **Site 11:** Weakly K+ (*L-140*, R.D., NY). **Site 12:** Weakly K+ (*L-1342*, R.D., DUKE). **Site 13:** Large mats at base of bedrock outcrops, K- (*L-1346*, R.D., NYS, DUKE). **Site 14:** All K- (*L-1260*, R.D.; *L-1262*, R.D., DUKE; *L-1259*, R.D., NY, NYS, US, DUKE). **Site 15:** Terricolous at edge of oak woods, both K- (*L-388*, R.D., NY; *L-389*, R.D., CUP). Arctic-alpine/boreal.

This best known Reindeer Lichen is widespread in the Shawangunks. My series of specimens, although showing the characteristic bone-white or greyish-white color and morphology of *C. rangiferina*, failed to give definite K+ yellow spot test reactions in all but two cases, as noted above, even with a freshly mixed 20 percent aqueous KOH solution. These yielded significant amounts of atranorin, the compound that is responsible for the K+ yellow reaction, however, when examined with TLC (LaGreca annotations). Evans (1950:78) noted that "the podetia [of *C. rangiferina*] turn...yellow with K, but the color produced by the latter reagent may be obscured, owing to the large amount of fumarprotocetraric acid present. Atranorin, however, can readily be demonstrated [by microchemical crystal tests or chromatography]."

Cladina stygia (Fr.) Ahti, a very similar northern species with black-based podetia (Ahti & Hyvönen 1985), has not been found in the Shawangunks, but might be there in boggy areas or associated with the faults.

Cladina stellaris (Opiz) Brodo
(Alpine Reindeer Lichen)

Site 4: "Here at the edge [of the deep faults] once grew a quantity of the arctic and high alpine lichen *Cladonia alpestris* [(L.) Rabenh., a synonym], encouraged, no doubt, by the cool air rising from so many openings, but recent fires have carried off all but two or three small groups standing like little domed sponges among the more common species" (Nearing 1953b:104); Dirig (1992). Arctic-alpine/boreal.

I did not find this gorgeous lichen at Site 4 or elsewhere in the Shawangunks, despite careful searching.

Cladina submitis (A. Evans) Hale & W. Culb.
(Sprawling Reindeer Lichen)

Site 6: Robust, heavily wrinkled, repent thalli, intergrown with *Cladonia floridana* and *Cladonia uncialis* (*L-1292*, R.D., NY, NYS, US, DUKE, WISC). **Site 7:** Small thalli with thick, wrinkled bases, terricolous and sprawling, growing with *Cladina rangiferina* and *Cladonia dimorphoclada* (*L-1289*, R.D., DUKE, WISC); Kiviat (1988:62); Dirig (1992).

This is the first record of *Cladina submitis* from the Shawangunks, where it is disjunct from the Atlantic Coastal Plain. On eastern Long Island, New York (*L-2871*, R.D., NY, DUKE), and on Cape Cod, Massachusetts (*L-1293*, R.D., DUKE, MICH), the podetia of this Reindeer Lichen may reach 10 cm in length, looking much like miniature

leafless oak trees sprawled on the sand. Shawangunk specimens were less well developed, but the 4-cm-long podetia had the characteristic robust bases, wrinkling, and delicate, twisted tips, allowing identification in the field. They were growing very sparsely among mats of other Cladoniaceae that covered exposed quartzite slabs in the open dwarf pine plains near Maratanza Lake.

Occurrence of this lichen inland in New York is not without precedent: John W. Thomson found it in Westchester County, near Pound Ridge Reservation, Bedford village (*Thomson 1598*, US). And I have collected it on the Saratoga County sand plains in the upper Hudson River valley as well (*L-1079*, R.D., NY, NYS, US, WISC).

Cladina subtenuis (des Abb.) Hale & W. Culb.
(Reindeer Lichen)

Site 6: Terricolous (*L-1351*, R.D., DUKE; *L-1354*, R.D.; *L-1357*, R.D., DUKE, CANL). **Site 7:** Terricolous (*L-130*, R.D., DUKE; *L-1306*, R.D., NY, NYS, US, DUKE). **Site 8:** On exposed ledge (*L-1344*, R.D., NY, NYS). **Site 12:** On exposed bedrock (*L-1377*, R.D., NY, DUKE).

Apparently frequent on the Shawangunk ridge, although a species of southern affinity that reaches its northern limit in the Adirondack region.

Cladonia atlantica A. Evans
(Atlantic Lichen)

Site 2: Castle Creek Path, on edge of duff over quartzite (*Seischab & Bernard 2*, R.D., DUKE). **Site 7:** In windswept dwarf pine plains, terricolous (*L-89*, *L-1305*, both in R.D., NY, NYS). **Site 8:** On open ledge (*L-1345*, R.D., US, DUKE). **Site 12:** On steep cliff (*L-1378*, R.D., NY, DUKE). **Unspecified:** Dirig (1992).

An appropriately named Atlantic Coastal Plain disjunct. Seeming to be widely distributed on the ridge.

Cladonia cervicornis (Ach.) Flotow, ssp. *verticillata* (Hoffm.) Ahti
(Ladder Lichen)

Site 9: 1935, mixed with *C. rappii*, var. *exilior* (*Torrey s.n.*, NY). **Unspecified:** On thin earth [Torrey (1935:154), as *Cladonia verticillata* (Hoffm.) Schaerer].

Cladonia cristatella Tuck.
(British Soldiers, Red Crest Lichen)

Site 1: On boat wharf; NW of Log Cabin; High Point Rd.; N end of Fly Brook causeway; jct. of Stokes Trail with Maple Path—five obs. 1982-1983 (*Smiley & Huth*, MOHONK). **Site 7:** Terricolous (*L-1299*, R.D.). **Site 13:** In woodland (*L-1332*, R.D., NY).

Cladonia dimorphoclada Robb.
(Ledge Lichen)

Site 2: On duff over quartzite (*Seischab & Bernard 1*, R.D., DUKE). **Site 6:** Terricolous (*L-1353*, R.D., NY, NYS; *L-1358*, R.D., NY; *L-1359*, R.D., US). **Site 7:** In windswept dwarf pine plains (*L-87*, R.D., NY, CUP; *L-131*, R.D., DUKE; *L-1288*, R.D.; *L-1309*, R.D., DUKE). **Site 8:** Terricolous (*L-129*, R.D., NY).

This lichen is distinguished from *Cladonia uncialis* by the non-shiny, thick, inflated podetia with internal longitudinal ridges of medullary tissue. It is less widely distributed than that species on the Shawangunk ridge.

Cladonia floridana Vainio
(Florida Lichen)

Site 4: Terricolous (*L-1376*, R.D., US, DUKE). Site 6: Terricolous (*L-1290*, R.D.; *L-1352*, R.D., NY, NYS). Site 9: 1935 (*Torrey s.n.*, NY). Site 12: On steep cliff (*L-1380*, R.D., DUKE). Unspecified: R. H. Torrey letter quoted; "great quantities" at 670 m elev. (Smiley 1940:45); Brodo (1968:194, 271); Dirig (1992). Atlantic Coastal Plain disjunct.

Seeming to prefer the most exposed, windswept situations. This lichen ranges from Cape Cod, Massachusetts, to Florida along the Coastal Plain and Piedmont, with other inland stations in West Virginia, Ohio, and Kentucky (Thomson 1967:124).

Cladonia grayi G. K. Merr. ex Sandst.
(Mealy Goblet Lichen, Gray's Pyxie Cup)

Site 12: Terricolous on litter (*L-1381*, R.D., DUKE). Site 13: In woodland (*L-1347*, R.D., DUKE).

Cladonia pleurota (Florke) Schaerer
(Red-tipped Goblet Lichen)

Site 1: Old fields near Cedar Drive, 7 May 1935 (*Smiley MM-614*, MOHONK).

Cladonia pyxidata (L.) Hoffm.
(Goblet Lichen)

Site 9: Growing on *Pinus rigida*, *Juglans cinerea* L., *Ostrya virginiana* (Mill.) Koch., *Carpinus caroliniana*, *Betula alleghaniensis*, *B. lenta* L., *B. populifolia* Marsh., *Quercus alba* L.; *Q. rubra* L., var. *borealis* (Michx. f.) Farw.; *Q. montana* Willd., *Prunus serotina* Ehrh., *Acer rubrum*, *Kalmia latifolia* L., and *Fraxinus nigra* Marsh. (Brown 1946:54).

Cladonia rappii A. Evans, var. *exilior* (des Abbes) Ahti
(Slender Ladder Lichen)

Site 9: 1935, mixed with *C. cervicornis* ssp. *verticillata* (*Torrey s.n.*, NY). Atlantic Coastal Plain disjunct.

This characteristic pineland lichen (Nearing 1962a:58, Brodo 1968:186) used to be known as *C. calycantha* Delise ex Nyl.

Cladonia squamosa (Scop.) Hoffm.
(Funnel Lichen)

Site 8: On partly sunny ledge (*L-133*, R.D., NY). Site 9: 1935 (*Torrey s.n.*, NY); 5 September 1959 (*M. & H. Fleming s.n.*, NY). Unspecified: "On...thin earth" (Torrey 1935:154).

Cladonia strepsilis (Ach.) Vainio
(Twisted Lichen)

Site 7: On bare quartzite near lake shore, no podetia (*L-128*, R.D., NY). **Site 9:** 1935 (*Torrey s.n.*, NY); 21 September 1935 (*Anderson s.n.*, NY). **Unspecified:** on thin earth, "resistant to the numerous fires which are set by the blueberry pickers to cause new crops" (*Torrey 1935:154*).

Cladonia sulphurina (Michaux) Fr.

Site 4: August 1937 (*Torrey s.n.*, NY); Nearing's (1953b:103) report of *Cladonia deformis* (L.) Hoffm. from this site probably also refers to this species: "Along the northwest wall, where the sun strikes for a little while [each] day, ...cover[ing] the longer-fallen rocks, ...almost unknown so far south." **Site 8:** 5 September 1959 (*M. & H. Fleming s.n.*, NY). **Miscellaneous:** Sunken Gardens, Ellenville, 27 July 1924 (*Anderson s.n.*, NY). [Synonym: *Cladonia gonecha* (Ach.) Asah.] Arctic-alpine/boreal.

Cladonia uncialis (L.) Weber ex Wigg.
(Thorn Lichen)

Site 1: Humpty Dumpty Trail (Carriage Road) through tumbled talus (*L-3143*, R.D.). **Site 2:** Personal obs., 8 Aug. 1979. **Site 3:** On duff at brink of precipice (*L-526*, R.D., US). **Site 6:** (*L-1291*, *L-1360*, both in R.D.) **Site 7:** (*L-1297*, *L-1310*, both in R.D.). **Site 8:** (*L-124*, R.D., NY; *L-125*, R.D., NYS; *L-126*, R.D., US). **Site 9:** In windswept pine plains (*L-134*, R.D., NY). **Site 11:** Edge of open oak woods (*L-139*, R.D., DUKE). **Site 12:** On bare rock (*L-76*, R.D., NY; *L-1341*, R.D., NY). **Site 13:** Open oak woods (*L-1349*, R.D., NY; *L-1350*, R.D., NYS). **Site 14:** Terricolous (*L-1261*, R.D., NY). **Site 15:** Edge of oak woods (*L-387*, R.D., NY). **Unspecified:** "Everywhere on thin soil" (*Torrey 1935: 154*). Arctic-alpine/boreal.

This may be the most widespread terricolous Shawangunk lichen. Its shiny, polished look, deep yellow-green color, and much more slender branches distinguish it from *Cladonia dimorphoclada*.

Dermatocarpon miniatum (L.) Mann.
(Cliff Wafer)

Site 1: On limestone boulder N of Bonticou, 21 Nov. 1935 (*MM-645*, MOHONK); 1935 (*Anderson s.n.*, NY).

Usually found on limy substrates (see Part III).

Dimelaena oreina (Ach.) Norman
(Mountain Stud Lichen)

Site 1: On flat exposed rock, Sky Top, May 1935 (*Smiley 624*, MOHONK); on top of rock at prescribed burn #1, Hermit's Hut, a 7.5-cm-diameter, 1-cm-wide ring, with the center dead, and new growth on the inside of ring (*D. Smiley obs.*, MOHONK). **Site 7:** On quartzite (*L-123*, R.D.; *L-138*, R.D., NY); Dirig (1992). **Unspecified:** "The most common crustose lichen..., which is everywhere on the ice-polished Shawangunk quartzite, in dainty little islands or in large colonies probably centuries old" [*Torrey (1935:154)*, as *Rinodina oreina* (Ach.) Mass.]. Arctic-alpine/boreal.

This greenish-grey lichen, which is characteristically found on white quartzite, can be rather striking. Apothecia sparse; ascospores brown, ovoid, uniseptate (*L-138*). The "*Rinodina* sp." mentioned by

Smiley & George (1974:181) and Selender (1980:2) probably referred to *D. oreina*.

Flavoparmelia baltimorensis (Gyelnik & Foriss) Hale
(Baltimore Shield Lichen)

Site 1: Saxicolous on quartzite talus along trail bordering lake (L-3146, R.D.).

Flavoparmelia caperata (L.) Hale
(Wrinkled Shield Lichen)

Site 8: 0.6 m above ground on *Betula alleghaniensis* trunk, near "Moss Pool" (L-132, R.D.). Site 9: On *Juglans cinerea*, *Quercus rubra* var. *borealis*, *Q. montana*, and *Fraxinus americana* [Brown (1946:64), as *Parmelia caperata* (L.) Ach.].

Noted as a "dominant species on mountains" (Brown 1946:203).

Flavopunctelia flaventior (Stirton) Hale
(Golden-pitted Shield Lichen)

Site 2: On *Acer rubrum* trunk, Minnewaska day guest parking lot (L-1321, R.D., DUKE).

Graphis scripta (L.) Ach.
(Common Script Lichen)

Site 9: On bark of *Juglans nigra* L., *Carpinus caroliniana*, *Betula alleghaniensis*, *Quercus montana*, and *Acer saccharum* (Brown 1946:58).

Hypocenomyce anthracophila (Nyl.) P. James &
G. Schneider in G. Schneider
(Burn Lichen)

Site 1: At base of 60-cm-diameter *Pinus strobus* L. on cliffs, fertile (L-3142, R.D.).

Hypocenomyce scalaris (Ach. ex Liljeblad) M. Choisy
(Oyster Lichen)

Site 1: At base of *Pinus rigida* on cliffs (L-3141, R.D.). Site 2: At base of large *Tsuga canadensis* (L-1322, R.D., NY); on *Acer rubrum* (L-1324, NY, US); on 34-cm-dbh *P. rigida* (L-1325, R.D., NY). Site 6: On sheltered, lee side of 10-cm-diameter, dwarf, bonsai-like *P. rigida* at brink of cliff (L-1323, R.D., NY, NYS, US, DUKE).

This tiny squamulose lichen (C+ red, PD- spot test reactions) grows on bark, lignum, and charred wood (especially Pinaceae and *Acer*) in the dappled shade of humid edge habitats. It is widespread in northeastern North America in pine barrens and other open-canopied situations (Dirig 1990). *Hypocenomyce anthracophila* is very similar, but has smaller squamules, different chemistry (C-, PD+ red reactions), is often fertile, and appears to be rather rare in New York.

Hypogymnia physodes (L.) Nyl.
(Puffed Shield Lichen)

Site 1: On pine and other tree trunks, May 1935 (Anderson 608, MOHONK). Site 4: On *Tsuga canadensis* trunk (L-1314, R.D.); corticolous (L-1361, R.D., NYS). Site 8: On *Kalmia latifolia* (L-1327, R.D., NY). Site 9: On *Pinus rigida* (Brown & Muenscher 12, CUP, MICH); reported on *Pinus rigida* [as *Parmelia pertusa* (Schrank) Schaerer] and on

Quercus montana and *Fraxinus americana* [as *Parmelia physodes* (L.) Ach.] by Brown (1946:69-70). Arctic-alpine/boreal.

Icmadophila ericetorum (L.) Zahlbr.
(Heath Lichen)

Site 4: 27 July 1924 (*Anderson s.n.*, NY); 18 May 1941 (*McGrath 3103*, NY); 1937 (*Nearing s.n.*, NY); "Smearing dead logs with its blue-green film, against which the pinkish disks of the fruit give a gaudy, unpleasant effect. This belongs in the arctic, but comes southward on our higher mountains" [*Nearing* (1953b:104) as "*I. aeruginosum*" = *I. aeruginosa* (Scop.) Trevis.]. **Site 8:** 5 September 1959 (*M. & H. Fleming s.n.*, NY). Arctic-alpine/boreal.

Imshaugia aleurites (Ach.) S.F. Meyer
(Grizzly Shield Lichen)

Site 1: On pine trunk, May 1935 (*611*, MOHONK). **Site 7:** On dwarf *Pinus rigida* on bluff (*L-1311*, R.D., NY, NYS). **Site 12:** On *P. rigida* (*L-1340*, R.D., NY, NYS, US, DUKE, CANL). [Synonym: *Parmeliopsis aleurites* (Ach.) Nyl.] Arctic-alpine/boreal.

Imshaugia placorodia (Ach.) S. F. Meyer
(Plate Lichen)

Site 1: On trunks of pine trees, May 1935 (*Anderson MM-610*, MOHONK). **Site 9:** September 1935 (*Anderson s.n.*, NY). [Synonym: *Parmeliopsis placorodia* (Ach.) Nyl.]

Lasallia papulosa (Ach.) Llano
(Blistered Rock Tripe, Toadskin Lichen)

Site 1: Laurel Ledge Rd., May 1935 (*Smiley MM-637*, MOHONK); fertile, May 1935 (*Anderson MM-621*, MOHONK); red thalli, S of Humpty Dumpty Path, on conglomerate, 25 June 1972 (*Smiley s.n.*, MOHONK); on quartzite boulder (*L-3139*, R.D.); Friend [1936:103, as *Umbilicaria pustulata* (L.) Hoffm.]; Sept. 1972 (*621*, MOHONK); Smiley & George (1974:179, 181, 184). **Site 2:** Saxicolous (*L-1319*, R.D.); Selender (1980:2). **Site 4:** On rock (*L-1337*, R.D., NYS). **Site 5:** High Point, 1946 (*Nearing s.n.*, NY; Llano 1950:36). **Site 8:** On semi-shaded, slightly damp quartzite bedrock (*L-116*, *L-121*, both in R.D., NY); 13- and 15-cm-diameter, heavily fertile thalli (*L-1263*, *L-1264*, both in R.D.). **Site 11:** Shady oak woods, on quartzite bedrock (*L-103*, R.D., NY, CUP; *L-106*, *L-109*, both in R.D., NY); small brick-red thalli, in shade only (*L-110*, R.D., NY). **Site 12:** On *Pinus rigida* trunk base in partial sun (*L-77*, R.D.); on quartzite in full sun (*L-78*, *L-79*, both in R.D., NY). **Site 15:** On rock (*L-230*, R.D., NY; *L-231-b*, NY). **Unspecified:** Snyder & Beard (1981:13).

In the Shawangunks, the Toadskin Lichen is very common and frequently fertile, with younger thalli sometimes showing a deep red tinge on the upper cortex. It is rare to find this species on a woody substrate (*L-77*); hundreds of adjacent thalli were growing on bedrock.

Lasallia pensylvanica (Hoffm.) Llano
(Pennsylvania Rock Tripe)

Site 1: Eagle Cliff, Mohonk Lake, 1919 (*Britton s.n.*, Llano 1950:44); on steep rock faces, May 1935 (*Smiley MM-622*, MOHONK); Friend (1936:103, as *Umbilicaria pensylvanica* Hoffm.); Sept. 1972 (*622*, MOHONK); Smiley & George (1974:179,

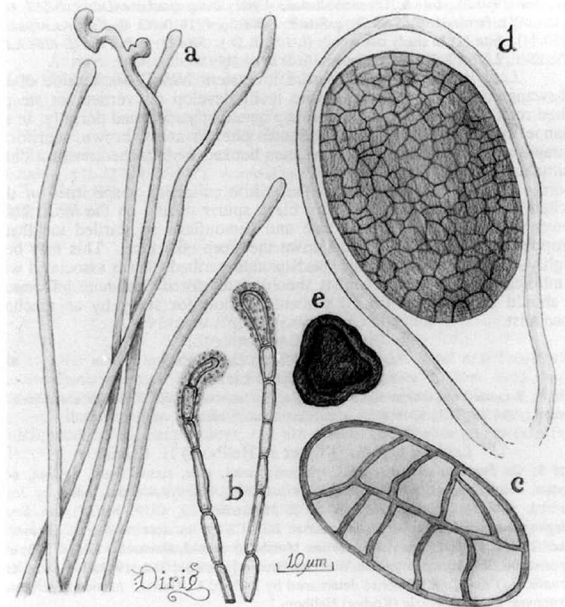


Figure 3: *Lasallia pensylvanica* (Hoffm.) Llano, hymenial structures and apothecium: a. Group of paraphysis apices. b. Two paraphysis apices with dark guttulate gel coats. c. Young ascospore showing early septation. d. Ascus apex containing single brown ascospore at a later stage of septation (mature free ascospores are opaque black). e. Apothecium surface and margin (x10). Parts a-d (x1100) drawn using a drawing tube from *Dirig L-113* (R.D., NY, CUP); a and d squash-mounted in Melzer's reagent, b and c squash-mounted in distilled water. Part e drawn freehand from *Dirig L-1265* (R.D.).

181); on boulders (*L-3140*, R.D.). **Site 2:** Along footpath around lake (*L-1318*, R.D.); Selender (1980:2). **Site 8:** On semi-shaded, slightly damp quartzite (*L-115*, *L-117*, both R.D., NY); fertile (*L-1265*, R.D.). **Site 9:** Saxicolous, 1910 (*G. B. Kaiser s.n.*, Llano 1950:44). **Site 11:** In shady oak woods (*L-101*, R.D.). **Site 12:** In full sun (*L-113*, R.D., NY, CUP; *L-114*, R.D., NY). Unspecified: Dirig (1992).

Lasallia pensylvanica is rare in eastern New York outside of the Shawangunks. The largest, fertile thalli develop on vertical or steeply tilted rock surfaces. Young thalli may be slightly reddened dorsally, in the manner of *L. papulosa* (*L-114*). Spores one per ascus, brown, muriform; paraphysis apices simple or sometimes hooked or branched, with a dark, guttulate gel coat (Fig. 3).

At Site 12 on 25 May 1976, while collecting a specimen of this lichen, I discovered a large, hairy black spider resting on the pitted black lower surface. The spider's size and camouflage so startled me that I dropped the thallus, which slid down the steep cliff face. This may be a highly specialized invertebrate, perhaps undescribed, that is associated with Umbilicariaceae. Lichenologists should watch for it elsewhere. If found, it should be collected (in 70 percent alcohol) for study by an arachnid specialist.

"*Lecanora subfusca* (L.) Ach."

(Common Stud Lichen)

Site 9: Reported on *Ostrya virginiana*, *Quercus montana*, and *Fraxinus americana* by Brown (1946:60, 163; 1948:463); identification uncertain—no vouchers found.

Lecidea helvola (Körber ex Hellbom) H. Olivier

Site 9: On *Fraxinus americana* L., apothecia small, pale, spores eight, hyaline, non-septate, long-ellipsoid, some with guttules, 15.6-20.0 x 3.5-4.4 μm , notes by Joyce Hedrick with MICH duplicate (*Brown & Muenscher 40*, CUP, MICH); on *Betula alleghaniensis* Britt. (*Brown & Muenscher 259*, CUP); on *Acer rubrum* L. (*Brown & Muenscher 260*, CUP); on *A. saccharum* Marsh. (*Brown & Muenscher 261*, CUP); also reported on *Carpinus caroliniana* Walt. by Brown [1946:61, 164; 1948:463, as *Lecidea vernalis* (L.) Ach.]. CUP series determined by Richard C. Harris. Arctic-alpine/boreal. [Synonym: *Biatora helvola* (Körber) Hellbom.]

Mycoblastus sanguinarius (L.) Norman

(Clot Lichen)

Site 4: 1937 (*Nearing s.n.*, NY); "A few specimens" (Lewis 1938:10). Arctic-alpine/boreal.

Ochrolechia pseudopallescens Brodo

Site 7: On dead branch of dwarf *Pinus rigida* (*L-1307*, R.D., CANL, PARATYPES).

This recently described species grows almost exclusively on conifer bark or lignum (Brodo 1991:755-758).

Parmelia neodiscordans Hale

Site 1: Abundant on siliceous rock cliffs around Mohonk Lake, especially near broad fissures and drainage lines, 4 May 1935; containing fumarprotocetraric acid (*Anderson s.n.*, NY).

A rare Appalachian species that also occurs in the Adirondacks (Hale 1987:30; R. C. Harris, letter, 23 November 1993).

Parmelia omphalodes (L.) Ach.

(Smoky Shield Lichen)

Site 8: In semi-shaded crevice of ice caves, on quartzite, containing atranorin and salazinic acid (*L-127*, R.D., NY). Arctic-alpine/boreal.

This lichen is characteristic of alpine boulders and talus slopes (Hale 1979:97).

Parmelia saxatilis (L.) Ach.

(Stane-Raw)

Unspecified: "Ice caves," no date (*Anderson s.n.*, NY). Arctic-alpine/boreal.

Peltigera leucophlebia (Nyl.) Gyelnik

(Studded Leather Lichen)

Site 1: Over mosses in hemlock woods, 5 May 1935 (*O. B. Smith 613*, MOHONK); Bonticou Pasture, on rock at edge of swamp, wet thallus green, 21 Nov. 1935 (*Smiley MM-644*, MOHONK). **Miscellaneous:** Cragmoor, 1 August 1936 (*Anderson s.n.*, NY).

I have usually found this species associated with limy substrates, which occur in adjacent valleys, but are rare in the Shawangunks (see Part III).

Phaeophyscia rubropulchra (Degel.) Moberg.

(Orange-pith Lichen)

Site 1: 1935 (*Anderson s.n.*, NY). **Site 9:** On *Juglans cinerea*, *Ostrya virginiana*, *Quercus rubra* var. *borealis*, *Acer saccharum*, and *Fraxinus americana* [Brown 1946:75, as *Physcia endochrysea* (Hampe) Nyl.]. **Miscellaneous:** Cragmoor, 1936 (*Anderson s.n.*, NY).

Physcia millegrana Degel.

(Fruitful Blister Lichen)

Site 1: On tree near incinerator, May 1935 (*Anderson s.n.*, NY); on 4-year-old *Juniperus virginiana* log in Mohonk boat house on pier (*L-3145*, R.D.).

Platismatia tuckermanii (Oakes) W. Culb. & C. Culb.

(Lettuce Lichen)

Site 7: On *Pinus rigida*, depauperate (*L-1296*, R.D., NY, NYS).

Pseudevernia consocians (Vainio) Hale & W. Culb.

(Sprout Lichen)

Site 1: On trunks of pine trees in open places, path along lower ridge, NE of Mohonk Lake, May 1935 (*Anderson 609*, MOHONK); **Site 4:** On *Pinus rigida* and *Tsuga canadensis* at brink of chasm (*L-1336*, R.D., NY, NYS, US, DUKE); on hemlocks and

birches (Nearing 1953b:102); Lewis (1938:10). **Site 9:** On *Pinus rigida* (Brown & Muenscher 44, CUP); Brown (1946:56, 1948:463). [In the literature reported under the name *Evernia furfuracea* (L.) Mann.]

Pycnothelia papillaria (Ehrh.) Dufour
(Nipple Lichen)

Site 1: Milbrook Mountain, 1935 (*D. Smiley MM-615*, MOHONK). **Site 2:** Personal obs., 8 Aug. 1979. **Site 4:** (*L-1374*, R.D.). **Site 6:** On exposed rocks (*L-1355*, R.D., US). **Site 7:** On quartzite (*L-88*, R.D.). **Site 8:** On boulder (*L-1343*, R.D., NY, NYS). **Site 12:** Terricolous (*L-1338*, R.D., NY). **Site 13:** In woodland (*L-1334*, R.D.). **Unspecified:** On thin soil [Torrey 1935:154, as *Cladonia papillaria* (Ehrh.) Hoffm.].

Common on disturbed soil in exposed sites, sometimes growing with *Baeomyces roseus*.

Rhizocarpon geographicum (L.) DC.
(Map Lichen)

Site 4: "In our region a rarity indeed,...found elsewhere above timberline in the White Mountains and Adirondacks, and everywhere in the far north" (Nearing 1953b:103). **Miscellaneous:** Ellenville, 27 July ?1924, psoromic acid strain (*Anderson s.n.*, NY). Arctic-alpine/boreal.

Sarcogyne clavus (DC. in Lam. & DC.) Krempelh.
(Rock Button, "Brownie's Buttons")

Site 1: Sky Top, growing beneath surface of rock in driest places, apothecia black, May 1935 (*623*, MOHONK); N. Lookout Rd., 27 Oct. 1935 (*Smiley MM-661*, MOHONK). [Synonym: *Biatorella clavus* (DC.) Th. Fr.]

Trapeliopsis granulosa (Hoffm.) Lumbsch
(Gray Earth Lichen)

Site 8: On disturbed soil on ledge in deep fault (*L-136*, R.D., MICH). **Site 9:** 1937 (*Nearing s.n.*, NY). [Synonym: *Lecidea granulosa* (Hoffm.) Ach.]

Tuckermannopsis oakesiana (Tuck.) Hale
(Oakes' Shield Lichen)

Site 8: On wet rocks (*L-137*, R.D., NY). [Synonym: *Cetraria oakesiana* Tuck.]

Tuckermannopsis sepincola (Ehrh.) Hale
(Chocolate Shield Lichen)

Site 4: August 1924 (*Anderson s.n.*, NY); "Draping the bark of small birches and the dead hemlock twigs with chocolate" [Nearing (1953b:104), as "*Cetraria saepincola*" = *C. sepincola* (Ehrh.) Ach.]. **Site 6:** Corticolous at bases of shrubs (*L-1317*, R.D., NY, NYS). **Site 8:** Corticolous on *Kalmia latifolia* in ice-filled fault (*L-1328*, R.D., NY). **Site 9:** 1935 (*Anderson s.n.*, NY). **Unspecified:** Nearing (1939:68, as *C. saepincola*). Arctic-alpine/boreal.

Umbilicaria mammulata (Ach.) Tuck.
(Smooth Rock Tripe)

Site 1: On nearly vertical cliff faces, Nov. 1935 (*Anderson MM-619*, MOHONK); on quartzite talus (*L-3154*, R.D.); Friend (1936:103, as *Umbilicaria Dillenii* Tuck.); Sept. 1972 (*619*, MOHONK); Smiley & George (1974:179, 184). **Site 2:** Selender (1980:2). **Site 8:** On semi-shaded quartzite, 17-cm-diameter thallus (*L-93*, R.D.); (*L-119*, *L-120*, *L-122*, all R.D., NY). **Site 11:** In shady oak woods (*L-102*, *L-107*, *L-108*, all in R.D., NY). **Site 15:** On sandstone bedrock (*L-232*, *L-233*, *L-234*, *L-235*, *L-236*, *L-237*, all in R.D., NY). **Unspecified:** Snyder & Beard (1981:13). **Miscellaneous:** Port Jervis, Shawangunk Mountains (*C.F. Austin 26*, NY; Llano 1950:134); Shingle Gully Ice Caves, "Grand Canyon," 1992 (*L. Leonardi 423-A*, NYS, CUP).

This species is very common in this mountain range, being less well developed at Site 15, on the western flank of the Shawangunk escarpment.

Umbilicaria muehlenbergii (Ach.) Tuck.
(Muhlenberg's Rock Tripe)

Site 1: Laurel Ledge Rd., May 1935 (*Smiley MM-636*, MOHONK); Sky Top, May 1935 (*MM-620*, MOHONK); personal observation, April 1992; Friend (1936:103); Sept. 1972 (*620*, MOHONK). **Site 2:** On top of sunlit quartzite boulder (*L-1320*, R.D.). **Site 5:** High Point, 1946 (*G.G. Nearing s.n.*, NY; Llano 1950:205). **Site 7:** On sandstone [*sic*], fertile (*L-1300*, R.D.); on quartzite (*L-118*, R.D., NY). **Site 9:** Torrey (1932b:160, as *Gyrophora Muehlenbergii* Ach.). **Site 12:** In full sun on steep cliff face (*L-111*, *L-112*, both R.D., NY; *L-1339*, in R.D., NYS). **Site 15:** On sandstone (*L-229*, R.D., NY, CUP; *L-231*, R.D., NY). **Unspecified:** "Common, as everywhere on this mountain, in the small form, an inch in diameter or less, perhaps due to the open, waterless conditions on the ice-planed ledges or the many boulders" (Torrey 1935:154, as *G. Muehlenbergii*).

The largest, most luxuriant thalli (5-7 cm in diameter) occur on vertical cliff faces, with much smaller ones (0.5-1+ cm in diameter) on the summit of the ridge where they must withstand a harsher microclimate. Torrey (1932b:160) reported an undescribed "small polyphyllus form," informally suggesting (with G. P. Anderson) the name "*Gyrophora Muehlenbergii*, var. *kittatinyense*" for it. This is probably the same entity as *Umbilicaria muehlenbergii* var. *alpina* Tuck., characterized as a "smaller, thicker and somewhat polyphylline [form]..., peculiar to the alpine zone of the highest mountains of eastern North America" (Llano 1950:201). Torrey (*loc. cit.*) further observed that "in places this lichen appears to have been devoured over large areas, by insects or animals, only the [umbilici] being left, but this did not kill [them], for all were sending out new squamulose processes." Field notes on Umbilicariaceae at The Mohonk Preserve document a noticeable loss in lichen cover on the cliffs at Mohonk Lake during the winters of 1977 and 1984. Bradley Snyder and Karl Beard, who made the earlier observations, pondered the role of mechanical damage—hail, wind, and wet snow—in rock tripe life history. Although invertebrate feeding is a possible explanation of Torrey's damaged thalli, harsh weather conditions might also have been responsible.

Usnea sp. [*U. strigosa* (Ach.) A. Eat. group]
(Beard Lichen)

Site 13: On *Quercus montana*; K-, P- reactions in white medulla; no isidia or soredia (*L-1331*, R.D.).

The chemistry of this specimen was studied at Duke University by LaGreca. It contained usnic acid and a "very interesting unidentified compound: Rf classes: (A)-1, (B)-3, (C)-2, H+ pale yellow-brown" [see Culberson & Ammann (1979) for interpretation of Rf classes]. The same compound was found in *W. L. Culberson 13,272* (*Usnea arizonica* Mot.) from Arizona, and in *Malachowski 1397-2* and *1398* (both *Usnea* sp.) from Michigan, all in DUKE. Identification of this specimen awaits further work on this large and confusing genus.

Vulpicida pinastri (Scop.) Mattsson & Lai
(Pine Lichen)

Site 4: "Draping the bark of small birches and the dead hemlock twigs with...lemon" [Nearing (1953b:104), as *Cetraria pinastri* (Scop.) Gray]. Site 9: 5 September 1959 (*M. & H. Fleming s.n.*, NY) [Synonym: *Tuckermannopsis pinastri* (Scop.) Hale]. Arctic-alpine/boreal.

Xanthoparmelia conspersa (Ehrh. ex Ach.) Hale
(Boulder Lichen)

Site 2: Slender [1980:2, as *Parmelia conspersa* (Ach.) Ach.]. Site 8: Saxicolous on quartzite (*L-1312*, R.D., NY).

Xanthoparmelia somloensis (Gyelnik) Hale
(Boulder Lichen)

Site 6: A 35-cm-diameter thallus, breaking up in the center, growing on the horizontal rim of a quartzite conglomerate bluff in full sun (*L-1330* in R.D., NY). Site 7: A 15-cm-diameter thallus on horizontal quartzite bedrock, at the edge of duff, in full sun near the NW shore of Maratanza Lake (*L-1329* in R.D., NY).

These loosely adnate specimens lack isidia or soredia; have a light brown lower surface with unbranched rhizines to 1 mm long; greyish yellow-green, shiny, and (to me) emaculate upper cortex; white medulla; identical chemistry (K+ yellow to red, C-, P+ orange reactions in the medulla; usnic and salazinic acids, probably constipatic acid, and another unidentified fatty acid—LaGreca annotations); and incipient apothecia of 0.3-1 mm diameter. They are morphologically quite different, however. *L-1329* has plane linear lobes 1-3 mm broad, closely matching *X. taractica* (Krempelh.) Hale as treated in Hale (1979:42-43); while *L-1330* has much smaller lobes 0.6-1 mm broad, the growing tips plane with older areas of the thallus closely convoluted. If interpreted as "maculate" (as Hale did), these specimens appear to fall within the variation of *X. somloensis* (Hale 1990:192-195).

Part III: Analysis of the Shawangunk Lichen Flora

The species reported herein undoubtedly represent but a fraction of the total lichen flora of the Shawangunks. Identification of several distributional patterns based on this preliminary information is possible, however, since they are already well known in the vascular flora or fauna. Habitat associations can also be summarized for the known species.

Arctic-alpine/Boreal Species

The Shawangunk faults harbor a number of lichens with Arctic-alpine or boreal affinities that can live at this latitude in the damp drafts of "air chilled by...buried accumulations of snow" (Nearing 1953b:103) that "remain in [the caves] in greater or less amount, and in some seasons ... are preserved entirely through the summer and autumn" (Darton 1894b:33). These habitats also experience reduced sunlight because of their depth and the shade resulting from fallen boulders and conifers growing inside or about the rim. These lichens of northern affinity can thrive at high elevations in southeastern New York, where they are apparent Pleistocene relicts, trapped in "habitat islands" that approximate the more northern conditions they now optimally inhabit.

Species occurring inside or at the mouths of the faults include *Hypogymnia physodes*, *Tuckermannopsis oakesiana*, *T. sepincola*, *Vulpucida pinastri*, *Pseudevernia consocians*, *Parmelia omphalodes*, *Arctoparmelia centrifuga*, *A. incurva*, *Cladonia sulphurina*, *C. squamosa*, *Cladina stellaris*, *Icmadophila ericetorum*, *Mycoblastus sanguinarius*, and *Rhizocarpon geographicum*. Other Shawangunk species of northern affinity that are not strictly Arctic-alpine/boreal are *Parmelia saxatilis*, *Lasallia pensylvanica*, *Cladonia uncialis*, *Cladina rangiferina*, *C. arbuscula*, and *Dimelaena oreina* (Brodo 1968, Thomson 1984).

Shawangunk vascular plants of similar affinities include *Rhododendron canadense* (L.) Torr., *Potentilla tridentata* Soland. ex Ait., *Gaultheria hispidula* (L.) Muhl. ex Bigel., *Juncus trifidus* L., *Minuartia groenlandica* (Retz.) Farw., and *Xyris montana* Ries (Britton 1884a, Torrey 1932b, Nearing 1953b, Domville & Dunbar 1970:2, Fernald 1970, Snyder & Beard 1981:13, Clemens 1990:15-16). The Common Raven (*Corvus corax* L.) is an animal with an analogous distribution (Andrle & Carroll 1988).

Torrey (1932a-b), Lewis (1938), Smiley (1939a, 1940), and Nearing (1953b) discussed these interesting habitats, which need to be much more thoroughly explored for lichens and other biota.

Species Disjunct from the Atlantic Coastal Plain

Another obvious but less exemplified distributional pattern of the Shawangunk flora is an Atlantic Coastal Plain disjunction. The best

known illustrations are *Corema conradii* (early refs. above; also Britton 1887, Pike 1892, Torrey 1932a, Smiley 1939a, 1940a; Smiley 1940; Nearing 1953a, 1962b), *Solidago puberula* Nutt. (Domville & Dunbar 1970:2), and the dwarf form of *Pinus rigida* (refs. above). Among the known lichens of the ridge, *Cladonia submitis*, *Cladonia atlantica*, *Cladonia floridana*, *Cladonia rappii* var. *exilior*, and *Cetraria arenaria* echo this pattern. Corey *et al.* (1992) reported the Peat Mosses *Sphagnum trinitense* C. Mull., *S. torreyanum* Sull., *S. flavicomans* (Card.) Warnst., *S. angermanicum* Melin, and *S. henryense* Warnst. as having similar distributions [see Andrus (1980) for distributional context]. The entire pine barrens and dwarf pine plains communities are disjunct from the Atlantic coast at this elevation. A similarly-distributed lepidopteran is the Sleepy Dusky Wing [*Erynnis brizo* (Boisduval & Le Conte)] (John F. Cryan, verbal comm.).

Britton (1884b, 1887) listed 25 additional vascular plants of coastal affinity that occur in the Kittatinny Mountains, the southern extension of the Shawangunk ridge. Further details of Kittatinny biota may be found in Torrey 1932b:159, Anderson (1935), Nearing (1953a-b), and Niering (1953).

Species Reaching their Northern Limit in the Shawangunks

A third distributional pattern of Shawangunk biota is southern affinity, with northern limits reached at or near this mountain ridge. South-facing, sun-baked cliffs and talus provide the warm conditions necessary for southern species to survive in the Shawangunks. *Cladonia atlantica* and *Cladonia floridana* are examples among lichens, and the Five-lined Skink [*Eumeces fasciatus* (L.)], Northern Copperhead [*Agkistrodon contortrix* (L.)], and the now extirpated Eastern Woodrat [*Neotoma floridana* (Ord)] among vertebrates. Snyder & Beard (1981:14) and Kiviat (1988:45-63) summarized further illustrations of this distributional tendency.

Substrate-associated Lichens

Substrate-associated species include Umbilicariaceae and *Dimelaena oreina* on acidic quartzite (Hale 1979:32); *Hypocenomyce scalaris*, *H. anthracophila*, *Ochrolechia pseudopallescens*, and often *Pseudevernia consocians*, *Imshaugia placododia*, and *Platismatia tuckermannii* on conifers (Brodo 1968:170, 1991; Culberson & Culberson 1968:551; Dirig 1990); and *Peltigera leucophlebia*, *Dermatocarpon miniatum*, *Baeomyces roseus*, and *Cetraria arenaria* on limy substrates (personal observations).

Limestone is rare in this region, occurring in the valleys southeast and northwest of the ridge (Eights 1836, Sweet & Secor 1940, Nearing 1953b, Domville & Dunbar 1970:2, Kiviat 1988). Limestone erratics rest on the ridge top in spots (see Smiley MM-65 under *D. miniatum* above), from which calcium carbonate may locally concentrate in perched wetlands

over many centuries of leaching. Friend (1936), Smiley (1939b), and Biedermann (1992) made reference to limy situations in the Shawangunks, or to vascular plants that are lime-associated.

Generally Distributed Species

These lichen species may be considered general in distribution at this latitude: *Hypocenomyce scalaris*, *Trapeliopsis granulosa*, *Baeomyces roseus*, *Cladonia cervicornis* ssp. *verticillata*, *C. cristatella*, *C. grayi*, *Pycnothelia papillaria*, *Candelaria concolor*, *Flavoparmelia caperata*, *Flavopunctelia flaventior*, *Physcia millegrana*, and *Graphis scripta*.

Lichen Habitat Associations

Pine Barrens [sites 1-2 (in part), 5-7, 9, and 12 in Fig. 1]: Lichens include *Hypocenomyce scalaris*, *H. anthracophila*, and *Imshaugia aleurites* on *Pinus rigida*, and *Baeomyces roseus* and *Pycnothelia papillaria* on disturbed soil. *Cetraria arenaria* and Cladoniaceae (*Cladina arbuscula*, *rangiferina*, *submitis*, and *subtenuis*; *Cladonia atlantica*, *cristatella*, *dimorphoclada*, *floridana*, *grayi*, *strepsilis*, and *uncialis*) dominate the terricolous niche. *Dimelaena oreina*, *Lasallia papulosa*, *L. pennsylvanica*, *Umbilicaria muehlenbergii*, and *Xanthoparmelia conspersa* grow on rock at these sites.

Dwarf Pine Plains (sites 6-9, Fig. 1): All species listed in the previous paragraph occur, with these additional: *Xanthoparmelia somloensis* on quartzite; *Lecanora subfusca*, *Ochrolechia pseudopallescens*, *Platismatia tuckermanii*, *Tuckermannopsis sepincola*, *Cetraria arenaria*, *Hypogymnia physodes*, *Graphis scripta*, and *Phaeophyscia rubropulchra* on dwarfed woody substrates.

Exposed Crags (Gertrude's Nose and Sam's Point, sites 3 and 9, respectively, Fig. 1): *Lecidea helvola*, *Flavoparmelia caperata*, *Cladonia cervicornis* ssp. *verticillata*, *C. floridana*, *C. pyxidata*, *C. rappii* var. *exilior*, *C. squamosa*, *C. strepsilis*, *C. uncialis*, *Cetraria arenaria*, *Cladina rangiferina*, *Baeomyces roseus*, *Bryoria furcellata*, *Graphis scripta*, *Imshaugia placododia*, *Lecanora subfusca*, *Phaeophyscia rubropulchra*, *Pseudevernia consocians*, *Trapeliopsis granulosa*, *Tuckermannopsis sepincola*, *Umbilicaria muehlenbergii*, and *Lasallia pennsylvanica* have been recorded.

Oak Woods (sites 10-15, Fig. 1): Slopes of the ridge have *Baeomyces roseus*, *Cladina rangiferina*, *Cladonia cristatella*, *C. grayi*, *C. uncialis*, *Pycnothelia papillaria*, *Dermatocarpon miniatum*, and all recorded Umbilicariaceae.

Faults (sites 4 and 8, Fig. 1): Lichen species of northern affinity recorded from these intriguing habitats are listed above under "Arctic-alpine/Boreal Species." These additional species have been collected there: *Cladonia atlantica*, *C. dimorphoclada*, *C. floridana*, *Cladina subtenuis*, *Lasallia papulosa*, *Pycnothelia papillaria*, *Flavoparmelia caperata*,

Trapeliopsis granulosa, *Umbilicaria mammulata*, and *Xanthoparmelia conspersa*.

For the convenience of future collectors, the Appendix lists all lichens collected at Sites 1-15 (Fig. 1).

Summary and Conclusions

The Shawangunk ridge provides widely contrasting habitats. Here are cool northwest-facing slopes and deep, humid faults sheltering year-long ice; open, sunny, windswept alpine summits with occasional fires and fog; and warm, sun-baked, southeast-facing cliffs and talus. Considering its latitudinal placement, it is not surprising to find northern elements near their southern limits juxtaposed with southern species approaching their northern borders in this steep, narrow mountain range where paradoxes abound.

More puzzling is the occurrence of pine barrens vegetation and its most extreme expression, dwarf pine plains, on the crest of this ridge; for in their finest form, these vegetation formations have otherwise developed on the Atlantic Coastal Plain. Although apparently antithetical, coastal sand and Shawangunk summits are alike in several important ways: They have a rocky base (sand is just pulverized quartz-rich or silicate rock) that is sun-baked and windswept due to open-canopied, fire-influenced vegetations growing on exposed landforms. Soils are thin, infertile, often acidic, and have very limited water-holding capacity. Cloud water and fog, frequent on mountains and beaches, are important sources of moisture for lichens; interestingly, Weathers & Likens (1992) stated that high elevations and coastal spots are where cloud water chemistry can best be studied, implying an atmospheric similarity in such places. Britton (1887), Nearing (1953a-b), and McIntosh (1959) further discussed the resemblance of this mountain ridge to sandy coastal sites.

The constantly windswept nature of beaches and mountain crests may be of vital importance in the dispersal of lichens that grow in these places. All of the recognized Shawangunk coastal disjuncts and southern-affinity lichens are terricolous, and employ fragmentation and wind-dissemination as their reproductive strategy. These species may depend on an open, windswept landscape for survival. A majority of the other Shawangunk lichens are sorediate or fragmentation-dispersed. The soredia of *Hypocenomyce scalaris* have been shown to be wind-dispersed (Dirig 1990:455), and it is likely that all other sorediate lichens have wind as one dispersal agent. Isidia are larger than soredia, but also are probably dispersed by winds; only *Flavoparmelia baltimorensis*, *Imshaugia aleurites*, and *Pseudevernia consocians* are isidiate among the known Shawangunk lichens, and these species grow in relatively sheltered situations. In fact, terricolous and saxicolous lichens predominate in the Shawangunk barrens and plains, probably in response to windswept conditions and occasional fires. Corticolous species generally occur away from the windy ridge top on more sheltered slopes and in the faults. Quartzite bedrock accounts for the frequency of saxicolous lichens in

Shawangunk pine barrens and plains, but these species are rare in lowland and coastal vegetations of this sort where the only available substrates are occasional glacial erratics.

Eisenberg (1992) placed deglaciation of the hard and tall Shawangunks at 2000-4000 years before surrounding areas, making them available for early recolonization. The propagules of coastal disjuncts may have blown or floated to the Shawangunks while glacial meltwaters were higher than today, become established, and persisted where conditions most closely approximated those of their primary habitats nearer the Atlantic. As the glaciers receded, many northern species survived in the cooler microclimates of the faults, hundreds of kilometers south of their present centers of distribution. Nearby *Sphagnum*-heath bogs, with shady, conifer-dominated borders and the high humidity and cooling effects of constant evaporation, serve as islands of habitat for similar assemblages of northern lichens, far to the south of their regular occurrence.

Thick fogs that frequently envelop the Shawangunks may now be having an adverse effect on its lichens (and other biota). Smiley & George (1974) hinted that air pollution might be responsible for a photographically documented decline in lichen cover on the cliffs at Mohonk Lake. In a study of Shawangunk cloud water chemistry, Weathers & Likens (1992) found that mean pH values of Mohonk clouds and rain were 3.5 and 4.0 respectively, reflecting "its proximity to emission sources in the New York-New Jersey metropolitan region." Soil acidification from such highly acidic precipitation may be partly responsible for a decline that has been documented since 1933 at Mohonk in the Yellow Lady's-Slipper (*Cypripedium calceolus* L.), a known calciphile (Biedermann 1992). To what extent has acid rain affected lichen substrates, and will species like *Cetraria arenaria* that prefer limy ledges inland disappear from the Shawangunks during the next few decades?

The earliest natural history accounts mentioned lichens in celebrating the grandeur of this region. James Eights (1836:146) wrote in his *Notes of a Pedestrian*:

The Shawangunk range, rising immediately from the edge of the [Delaware and Hudson] canal, soon attains an eminence, lofty indeed.... The... [cliff] surfaces, beneath, are all over bedecked with a luxuriant display of mosses, and lichens, varying as greatly in their species as they do in the variety of their peculiar tints. All of these when combined in one view, give to the scene an aspect which is at once strikingly wild, cragged, and pleasing to behold.

N. H. Darton, a geologist writing in *National Geographic Magazine* (1894b:24), repeated these impressions: "The surface of Shawangunk Mountain is nearly everywhere very rugged, and cliffs and rocky slopes abound. These consist of snow-white grits, more or less mantled with dark lichens, and are remarkably picturesque." Fortunately, thousands of hectares in this mountain range have been preserved in contiguous tracts controlled by various public and private agencies, offering accessible opportunities for further floristic and ecological studies of its conspicuous lichen flora. Historical and ongoing records and facilities already exist at The Mohonk Preserve to augment studies of lichen growth and decline, air

pollution, and vegetation. Considering some of the remarkable finds summarized in this paper, it is likely that others await discovery, especially in the dwarf pine plains and faults.

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*D. Smiley and D. Smiley Jr. are the same person.

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APPENDIX:

LICHEN SPECIES COLLECTED AT SITES 1-15 IN THE SHAWANGUNK MOUNTAINS

Site 1: *Baeomyces roseus*, *Candelaria concolor*, *Cetraria arenaria*, *C. culbersonii*, *Cladina rangiferina*, *Cladonia cristatella*, *C. pleurota*, *C. uncialis*, *Dermatocarpon miniatum*, *Dimelaena oreina*, *Flavoparmelia baltimorensis*, *Hypocenomyce anthracophila*, *H. scalaris*, *Hypogymnia physodes*, *Imshaugia aleurites*, *I. placodioides*, *Lasallia papulosa*, *L. pensylvanica*, *Parmelia neodiscordans*, *Peltigera leucophlebia*, *Phaeophyscia rubropulchra*, *Physcia millegrana*, *Pseudevernia consocians*, *Pycnothelia papillaria*, *Sarcogyne clavus*, *Umbilicaria mammulata*, *U. muehlenbergii*

Site 2: *Cetraria arenaria*, *Cladonia atlantica*, *C. dimorphoclada*, *C. uncialis*, *Flavopunctelia flaventior*, *Hypocenomyce scalaris*, *Lasallia papulosa*, *L. pensylvanica*, *Pycnothelia papillaria*, *Umbilicaria mammulata*, *U. muehlenbergii*, *Xanthoparmelia conspersa*

Site 3: *Cetraria arenaria*, *Cladina rangiferina*, *Cladonia uncialis*

Site 4: *Arctoparmelia centrifuga*, *A. incurva*, *Cladina rangiferina*, *C. stellaris*, *Cladonia floridana*, *C. sulphurina*, *Hypogymnia physodes*, *Icmadophila ericetorum*, *Lasallia papulosa*, *Mycoblastus sanguinarius*, *Pseudevernia consocians*, *Pycnothelia papillaria*, *Rhizocarpon geographicum*, *Tuckermannopsis sepincola*, *Vulpicida pinastri*

Site 5: *Baeomyces roseus*, *Cetraria arenaria*, *Lasallia papulosa*, *Umbilicaria muehlenbergii*

Site 6: *Baeomyces roseus*, *Cetraria arenaria*, *Cladina arbuscula*, *C. rangiferina*, *C. submitis*, *C. subtenuis*, *Cladonia dimorphoclada*, *C. floridana*, *C. uncialis*, *Hypocenomyce scalaris*, *Pycnothelia papillaria*, *Tuckermannopsis sepincola*, *Xanthoparmelia somloensis*

Site 7: *Cetraria arenaria*, *Cladina arbuscula*, *C. rangiferina*, *C. submitis*, *C. subtenuis*, *Cladonia atlantica*, *C. cristatella*, *C. dimorphoclada*, *C. strepsilis*, *C. uncialis*, *Dimelaena oreina*, *Imshaugia aleurites*, *Ochrolechia pseudopallescens*,

Platismatia tuckermanii, *Pycnothelia papillaria*, *Umbilicaria muehlenbergii*,
Xanthoparmelia somloensis

Site 8: *Arctoparmelia centrifuga*, *Cladina rangiferina*, *C. subtenuis*, *Cladonia atlantica*, *C. dimorphoclada*, *C. squamosa*, *C. sulphurina*, *C. uncialis*, *Flavoparmelia caperata*, *Hypogymnia physodes*, *Imshaugia ericetorum*, *Lasallia papulosa*, *L. pennsylvanica*, *Parmelia omphalodes*, *Pycnothelia papillaria*, *Trapelopsis granulosa*, *Tuckermannopsis oakesiana*, *T. sepincola*, *Umbilicaria mammulata*, *Vulpicida pinastri*, *Xanthoparmelia conspersa*

Site 9: *Baeomyces roseus*, *Bryoria furcellata*, *Cetraria arenaria*, *Cladina rangiferina*, *Cladonia cervicornis* ssp. *verticillata*, *C. floridana*, *C. pyxidata*, *C. rappii* var. *exilior*, *C. squamosa*, *C. strepsilis*, *C. uncialis*, *Flavoparmelia caperata*, *Graphis scripta*, *Hypogymnia physodes*, *Imshaugia placorodia*, *Lasallia pennsylvanica*, *Lecanora subfusca*, *Lecidea helvola*, *Phaeophyscia rubropulchra*, *Pseudevernia consocians*, *Trapelopsis granulosa*, *Tuckermannopsis sepincola*, *Umbilicaria muehlenbergii*

Site 10: *Baeomyces roseus*

Site 11: *Cladina rangiferina*, *Cladonia uncialis*, *Lasallia papulosa*, *L. pennsylvanica*, *Umbilicaria mammulata*

Site 12: *Baeomyces roseus*, *Cladina arbuscula*, *C. rangiferina*, *C. subtenuis*, *Cladonia atlantica*, *C. floridana*, *C. grayi*, *C. uncialis*, *Imshaugia aleurites*, *Lasallia papulosa*, *L. pennsylvanica*, *Pycnothelia papillaria*, *Umbilicaria muehlenbergii*

Site 13: *Baeomyces roseus*, *Cladina rangiferina*, *Cladonia cristatella*, *C. grayi*, *C. uncialis*, *Pycnothelia papillaria*, *Usnea* sp. (*U. strigosa* group)

Site 14: *Cladina rangiferina*, *Cladonia uncialis*

Site 15: *Baeomyces roseus*, *Cladina rangiferina*, *Cladonia uncialis*, *Lasallia papulosa*, *Umbilicaria mammulata*, *U. muehlenbergii*



BOOK REVIEWS

L. M. Kohn, Book Review Editor

The Boletes of North America: A compendium, by Ernst E. Both. Softcover, 140 x 216 mm, 436 pp, 1993. Special publication, The Buffalo Museum of Science, 1020 Humboldt Parkway, Buffalo, NY 14211. ISBN 3-443-51027-2. US \$10.- plus shipping and handling.

Boletes are a group of fleshy fungi whose charisma has amazed, astounded, and stymied many a professional and amateur mycologist. Many of us have experienced frustration at some time or another because the literature is outdated, widely scattered, or available to only a few specialists with access to large libraries. Now with the appearance of Both's compendium, a large audience can benefit from this up-to-date compilation on North American boletes (Mexico is excluded).

After a short introduction, the main body of the text consists of an annotated index of bolete species and infraspecific taxa arranged by epithet regardless of genus. The listing includes the basionym, literature citation, synonymy, and information on the type specimen if available. A short diagnosis follows with habitat and distribution information. A list of references to literature is next that will lead to primary sources as well as popular guides with decent illustrations. If pertinent, a commentary on the particular taxon can include discussion of synonymy. Some additional synonymy follows the main index which appeared too late to be incorporated into the main text. A commentary on *Aureoboletus* precedes the extensive bibliography and is followed by a glossary of epithets with the translated meaning in English and lastly, there is an index to species and subspecific taxa arranged alphabetically by genus.

The author explicitly states that this is neither a monograph nor does it deal with bolete classification. Particular preference for a classification scheme is not implied, rather we have a record of what has been done, by whom, when, and where. Keys and illustrations are absent but references to same are abundant. The compilation will save me hours of literature searching and will send me speedily to the appropriate references for more detailed observations. It will be the first source I look at when trying to ferret out information on North American boletes. The author is to be commended for producing such a timely and practical reference, and will be used heavily by anyone working with boletes.
Roy E. Halling, The New York Botanical Garden, Bronx, New York.

The Boletineae of Mexico and Central America IV. Beihefte zur Nova Hedwigia, Heft 105, by R. Singer, J. Garcia, and L. D. Gomez. Softcover, 240 x 170 mm, 62 pp with 13 plates (1 color), 1992. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, Johannesstrasse 3A, D-7000 Stuttgart 1, Germany (fax 0711-625005). US Agents: Lubrecht & Cramer Ltd, 38 County Route 48, Forestburgh, NY 12777 (tel. 914-794-8539). ISBN 3-443-51027-2. DM 70.

This is the fourth number in a continuing series to document the bolete mycota of Mexico and Central America. In particular, *Boletellus* and *Phylloboletellus* are the genera covered with 18 species of the former and one of the latter discussed. The classification scheme is that of Singer in his 4th edition of the **Agaricales in Modern Taxonomy**. By and large the genera possess ornamented basidiospores with longitudinal ridges or veins although a few taxa are admitted that have alveolate, reticulate or smooth basidiospores. Some of these few have been classified by other authors in genera such as *Austroboletus* and *Boletus*, but the authors detail features such as spore print color, chemistry, and other anatomical characters that would align the few with *Boletellus*.

There is a short summary and introduction followed by the taxonomic treatment, literature cited, and illustrations, one of which is a color plate of *Boletellus jalapensis*. All but two taxa [*Boletellus coccineus* (= *B. ananas*) and *B. betula*] are fully described including discussions of distributions, mycorrhizal associations where known, and relationships to other taxa. Two descriptions of the rare *Phylloboletellus chloephorus* are given for comparison of the two known populations in Argentina and Mexico. The dichotomous key seems to work although in order to reach *B. russellii* satisfactorily, one must assume that it does not have an unusually elongated stipe (which it does in my experience). Typographical errors are sufficient enough to be distracting, but hardly affect the scientific content. One nomenclatural oddity surrounds the typification of *Boletus coccineus* Fr. where the nomenclatural type is designated as a plate from Charles Plumier's **Traite de Fougères de la'Amérique**. Yet, the authors designate a recently collected specimen from Nuevo Leon, Mexico as a lectotype.

Overall, the publication is a useful and functional documentation of *Boletellus* and *Phylloboletellus* from Central America and Mexico and will serve those who are interested in these boletes. Roy E. Halling, *The New York Botanical Garden, Bronx, New York*.

Les amanitopsis d'Europe (Genre Amanita, Agaricales, Fungi). Synthèse critique de la littérature. Opera Botanica Belgica 5: 128, by A. Fraiture. Softcover, 293 x 205 mm, 128 pp, 1993. National Botanic Garden of Belgium, Domein van Bouchout, B-1860 Meise, Belgium (fax 32-2-2701567) ISBN 90-72619-09-9. BeF 830.- (approximately \$26 U.S.) including postage.

In the past, identification of an agaric as an *Amanitopsis* was, to some of us, almost equivalent to a species identification, as *A. vaginata* or one of its varieties. However, this casual oversimplification masked the nomenclatural and taxonomic difficulties of the many specific epithets that have been applied to members of this common and conspicuous group. For the nonspecialist, this book represents a significant step in unravelling the tangled web of synonyms, species concepts, and the ranges of morphological variation associated with these names, at least with respect to the taxa occurring in Europe and North Africa. It is important to note that this book is based on a synthesis by the author of predominantly European literature (as is stated in the title), and is not based on a study of specimens, including the types of the taxa treated. It is as a synthesis that this book is most valuable, by bringing together the scattered publications of type studies and critical species concepts, and the author refers the reader to these original publications and selected descriptions for further study. Naturally, one wishes that all of the required type studies were published before such a synthesis was attempted. In North America, R.E. Tulloss has been making such detailed studies of specimens, including the types of many names originating in Europe, and his work is frequently cited.

This book includes a summary in French and English, a discussion of the morphological taxonomic characters used, an overview of classifications by Bas, Bon, Corner and Singer, dichotomous and synoptic keys and descriptions to 23 species, and references to an additional 2 species of *Amanita* in which exannulate forms could be confused with members of *Amanitopsis*. The author explains in the summary that the name *Amanitopsis* is being used not as a generic name but as a common name for the exannulate species of *Amanita*. Only in the discussion of Bon's classification scheme does one find information about the nomenclatural status of the generic name *Amanitopsis* Roze. Since its conserved lectotype is *A. vaginata* (Bull.: Fr.) Roze, it is a typonym of *Amanita* section *Vaginatae* (Fr.) Quelet. Because the work is based on a literature survey and not personal studies of specimens, the descriptions are detailed and extensive for some species, but somewhat abbreviated in others. Microscopic characters beyond spore sizes are not consistently provided, there are no illustrations of any microscopic features, and only habit sketches for 16 of the 25 taxa treated. The lengthy lists of synonymy and misapplications, and discussions of these in a series of 80 notes that follow individual species descriptions, are most useful in arriving at an understanding of species names in this group. Information on the habitats of the species treated, including associated trees, is especially welcome. The volume ends with an extensive list of references and an index to names cited. For its careful production and modest cost, this book is to be recommended to agaricologists both amateur and professional. *Greg Thorn, Michigan State University, East Lansing, Michigan.*

British Fungus Flora 7. Cortinariaceae p.p. by R. Watling, N. M. Gregory, and P. D. Orton. Softcover, 245 x 155 mm, iv + 132 pp, 1993. Royal Botanic Garden, Inverleith Row, Edinburgh EH3 5LR, UK (fax 031-5520382). ISBN 1-872291-09-0. £10.- plus £1.50 postage within UK, £2.50 postage outside UK.

This small, handy volume is the seventh in a series intended as a source of information for dedicated amateur and professional mycologists interested in the larger fungi of the British Isles. This volume treats the 75 known British species of *Galerina*, *Leucocortinarius*, *Phaeocollybia*, *Phaeogalera*, *Phaeolepiota*, *Phaeomarasmius*, *Pleuroflammula*, *Rozites*, *Stagnicola* (by Watling and Gregory), and *Gymnopilus* (by Orton). Included with it is the **Colour Identification Chart**, originally published in 1969 and issued together with the introduction to this series. The book begins with a selected list of references, followed by the keys, descriptions, and illustrations. The keys are good; they are simply and clearly written and workable. The descriptions are likewise generally very good, complete and clearly written. Exceptions are those of species with only old or doubtful records in Britain, such as *Gymnopilus picreus*; one wonders how difficult it would have been to provide the information on whether the specimens of this species that are reported to be in Kew have smooth or rough spores. The information given on habitat, although welcome, is disappointing in its lack of detail. As the authors mention, more careful observations on the bryophytes among which *Galerina* species grow should be made, since there are indications of specificity in these associations. Surprisingly, there is no mention in the species descriptions of the deadly toxins associated with *Galerina autumnalis* or the *Galerina unicolor* group. There is a refreshing lack of new species or new combinations, although the authors note that additional species remain to be confirmed from the British Isles. The line drawings are rather schematic, but adequate for the species illustrated (66 %).

The only negative comment is a minor one that is true for other volumes in the series, that the author citations for the species treated are inconsistent and occasionally incorrect. The author of the basionym and whether or not that name is sanctioned by Fries are frequently not indicated in the species headings. An example is *Gymnopilus junonius* (Fr.: Fr.) Orton, more commonly known as *G. spectabilis* (Weinm.: Fr.) Singer. If one accepts Orton's synonymy of *Agaricus junonius* with this taxon the name chosen by Orton appears to be correct, but not for the reasons given. Orton states that *Agaricus spectabilis* Fries (1828) is preoccupied by *A. spectabilis* Weinmann (1824), but Fries attributed the name *A. spectabilis* to Weinmann. If one accepts Orton's synonymy of *A. spectabilis* Weinmann with *Phaeolepiota aurea* (and not with this taxon), then the correct name of these two is clearly *A. junonius*. But even if *A. spectabilis* and *A. junonius* are considered to be synonyms (as many other authors have felt), the latter is still correct, because it is the prior, sanctioned name. Although this series is not intended as a technical

monograph, it would still be desirable to have confidence that the chosen names and author citations are correct. This small misgiving aside, I have no hesitation in recommending that others follow me in adding this volume to their shelves. *Greg Thorn, Michigan State University, East Lansing, Michigan.*

A monograph of *Marasmius*, *Collybia* and related genera in Europe. Part 1: *Marasmius*, *Setulipes*, and *Marasmiellus* (Libri Botanici, vol 8), by V. Antonín and M. E. Noordeloos. Soft cover, 240 X 170 mm, 229 pp with 62 figs, 1993. IHW-Verlag, Bert-Brecht-Str. 18, D-85 386 Eching bei München, Germany (fax 49-86-3192257). ISBN 3-9803083-5-9. DM 98.-

This monograph on European marasmioid and collybioid fungi, the first of two parts, treats the genera *Marasmius*, *Setulipes* and *Marasmiellus*. Part two, now in preparation, will cover the genera *Collybia*, *Chaetocalathus*, *Crinipellis* and *Micromphale*. Part one of the treatise begins with a well-written history of the classification of *Marasmius* and *Collybia* sensu lato, beginning with Fries (1821) and culminating with a discussion of contemporary circumscriptions. Five tables are presented that outline the infrageneric classifications of Fries (1838 – *Marasmius*; 1854 – *Collybia*), Quélet (1888 – *Marasmius*), Bataille (1919 – *Marasmius*), and Kühner (1933, 1935 – *Marasmius*). For this monograph, the authors follow Kühner's infrageneric delimitation of *Marasmius* (with modifications and amendments by Singer, Jansen & Noordeloos, Desjardin, and Antonín & Noordeloos), and Singer's (1973) classification of *Marasmiellus*. A discussion of taxonomically informative macro- and micromorphological features, and a short glossary of pertinent terms follow the historical account.

European taxa of marasmioid fungi accepted by the authors include 42 species (plus 2 varieties) of *Marasmius* distributed among six sections, 2 species of *Setulipes*, and 15 species (plus 3 varieties) of *Marasmiellus* distributed among six sections. A key to the genera included in Parts 1 and 2 is not provided. However, a key to the sections of *Marasmius*, and keys to the species of *Marasmius*, *Setulipes* and *Marasmiellus* are presented. Full descriptions, and illustrations of basidiomata and salient micromorphological features are presented for each taxon. In addition, 15 color plates of uncommonly photographed species are provided. For each taxon, the authors have included supplementary data on selected icones and literature, ecology, distribution, an extensive list of specimens examined, and a commentary on diagnostic features, phenetically similar taxa, and nomenclatural and taxonomic problems. An accounting of excluded and insufficiently known taxa follows the enumeration of species. The volume ends with German translations of the keys and abbreviated descriptions of each taxon.

The monograph is an excellent and thorough treatment of European marasmioid fungi written by two agaricologists who are fully versed in contemporary systematics of this group of important saprotrophic fungi. Their species concepts are based on data generated through the examination of all extant type specimens as well as hundreds of herbarium specimens and fresh material. The authors are especially commended for their efforts to stabilize the taxonomy of the European representatives by designating lectotypes, neotypes and iconotypes where necessary and appropriate. An unfortunate oversight was the failure to include in the bibliography all papers cited in the text. This is an important publication that is invaluable to all specialists on marasmioid fungi, and is beneficial to all who are interested in agaric taxonomy. *Dennis E. Desjardin, Department of Biology, San Francisco State University, San Francisco, California.*

Tribes Cystodermateae Sing. and Leucocoprineae Sing. of the CIS and Baltic States (Libri Botanici, vol 9), by S. P. Wasser. Soft cover, 240 X 170 mm, 105 pp., 1993. IHW-Verlag, Bert-Brecht-Str. 18, D-85 386 Eching. ISBN 3-9803083-6-7. DM 78.-.

This is the second book by Wasser to treat members of the Agaricaceae from the Commonwealth of Independent States and Baltic States (the former Soviet Union). The first book, **Tribe Agariceae Pat. of the Soviet Union** (Koeltz Sci. Books), published in 1989, covered the dark-spored members of the family. In this second installment, the author focuses on the tribes Cystodermateae and Leucocoprineae. A third and final volume, now in preparation, will treat tribe Lepioteae. Wasser cites the current lack of consensus concerning the delimitations of taxa at all ranks in the Agaricaceae. He notes that contemporary authors subdivide the family into anywhere from 2 to 23 genera. For this monograph, the author follows Singer's (1986) classification, with a few emendations. Tribe Cystodermateae is represented in the region by the genera *Phaeolepiota* (1 sp.), *Cystoderma* (10 spp.), and *Squamanita* (2 spp.), while the tribe Leucocoprineae is represented by the genera *Chlorophyllum* (1 sp.), *Leucocoprinus* (7 spp.), *Leucoagaricus* (5 spp.), and *Macrolepiota* (7 spp.). There is a minimal introduction and description of research methods, and the bulk of the treatment is an enumeration of species. There is no key to the tribes, but dichotomous keys to genera and species are provided. Somewhat superficial characters are emphasized in the key to genera of the tribe Leucocoprineae, such as mobile vs. immobile annulus, and thin-fleshy fragile basidiomata vs. thick-fleshy, medium to large basidiomata. Although generic delimitations and intergeneric comparisons are clearly documented in the commentaries following generic circumscriptions, I wish some of the more diagnostic features were incorporated into the key. A quick glance at the list of synonyms for any of a number of species clearly shows the historical confusion in generic delimitations.

Many species at some time in their history have been placed in *Lepiota*, *Leucocoprinus* and *Leucoagaricus*. Unfortunately, the keys provided in this monograph do not help to resolve the confusion.

Full descriptions are presented for each taxon, and excellent line drawings of basidiomata and micromorphological features are included for many taxa. Additionally, beautiful watercolor plates of 28 taxa are provided. Data on ecology, general distributions, and phenetically similar taxa are provided also, as is a German translation of the keys. Taxa currently reported from the former Soviet Union are not the only species treated in this monograph. If the author suspected that a species might eventually be found in the territory, a full description is provided. It is unfortunate that the author did not include these supplemental species in the keys. Doing so would have made the monograph much more user-friendly, especially for those attempting to identify specimens collected from ecologically similar regions of the world. This monograph is a valuable addition to the literature on the Agaricaceae, and an indispensable resource for anyone interested in these commonly collected, ecologically and economically important fungi. *Dennis E. Desjardin, Department of Biology, San Francisco State University, San Francisco, California.*

EDITORS NOTE: IHW Verlag has issued a reprint (1993) of **Compendium of Soil Fungi, Vol. I-II**, by K. H. Domsch, W. Gams, and T.-H. Anderson. ISBN 3-9803083-8-3. DM 298.-

British Truffles: A Revision of British Hypogeous Fungi, by D. M. Pegler, B. M. Spooner, and T. W. K. Young. Softcover, 244 x 155 mm, vii + 216 pp. Kew Scientific Publications, The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AE, England (fax 081-332-5278). ISBN 0-947643-39-7. £19.50 + 15% postage and handling.

As anyone who has joined a British Mycological Society foray will attest, British hypogean fungi are enthusiastically sought by amateur and professional alike. This is only the second treatment of British hypogean fungi since the first, in 1954. After a useful introduction that includes information on collecting these often inconspicuous fungi, chapters treat the zygomycotan "Pea Truffles" (T. W. K. Young), the ascomycotan "True Truffles" (B. M. Spooner), and the basidiomycotan "False Truffles" (D. M. Pegler) and "Anamorphic Truffles". Dichotomous keys are provided to species, all known species are described complete with extensive British collection records, and illustrated by line drawings and half-tone SEM photo micrographs. References are complete and up-to-date. Twelve water colour illustrations by Lorna Minton and a glossary complete this attractive volume. Highly recommended to students of hypogeous fungi; anyone interested in finding and identifying truffles will welcome **British Truffles**. *L.M.K.*

ERRATA, VOLUME FIFTY-ONE

The page that follows is a replacement for page eighty-three (83) of the article "Study of *Trametes dickinsii* Berk. *sensu aucts.*, a synonym of *Daedalea quercina*." by Anjali Roy and S. Pal, *Mycotaxon* 51 (April-June): 81-89. 1994. Another page was erroneously substituted for page 83 during preparation of the volume.

**NOTICE: SECOND LATIN AMERICAN
CONGRESS OF MYCOLOGY**

The Second Latin American Congress of Mycology will be held at the Institute of Tropical Medicine "Pedro Kouri" in Havana in October 1996. The Congress will be held under the auspices of the Latin American Association of Mycology and other national and international entities. There will be oral and poster presentations and sessions on *Biotechnology, Ecology, Ethnomycology, Phytopathology, Industrial Mycology, Medical Mycology, and Taxonomy, as well as other topics.*

If you are interested in participating or obtaining more information contact:

Dr. Miguel Rodriguez, Pres. ALM
National Botanical Garden
Carretera del Rocio km 3 1/2
C. P. 19230 Calabazar, Boyeros
Ciudad de la Habana
CUBA

Indicate your name, address, institution, telephone number, email address and area of interest.

**NOTICE: NEW EDITION OF A WORK
BY ELIAS MAGNUS FRIES**

E. FRIES - *Sveriges ätliga och giftiga Svampar**
Die Speise- und Giftpilze Schwedens
The Edible and Poisonous Mushrooms of Sweden

Edited and revised by Dr. N. Arnold, translated by Inger Ludwig and Dr. M. Fischer; ca. 220 pages, 93 color plates, size 21 x 29.7 cm, date of publication August 1994. (DM 248.--).

The new edition of *Sveriges ätliga och giftiga svampar* makes available one of the most important volumes by last century's great mycologist **Elias Magnus Fries**. Originally published in Swedish in 10 fascicles between 1860 and 1866, it remained widely unknown. Now including English and German translations in common with the original text, this volume is accessible to a broader public. The 93 color plates are reproduced accurately in slightly reduced size. The remarks of E. M. Fries comprise description, delimitation to related taxa as well as usefulness of the portrayed taxon. Available through:

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