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CONTENTS

[Contents continued overleaf]

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[Contents continued from front cover]

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CHECKLIST AND HOST INDEX OF WOOD-INHABITING FUNGI OF ALASKA

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Abstract: In this study of 754 collections of wood-inhabiting fungi in Alaska, we report 254 species of wood-inhabiting fungi, mostly in the Corticiaceae *sensu lato* and Polyporaceae *sensu lato*. One hundred fifty-one of these are new records for the state of Alaska, and nine are new records for North America. A host index to fungi collected is included. Also included is a list of fungi previously reported from Alaska not collected in this study. This survey provides a baseline study for fungi in old growth forests of Alaska.

Key words: Alaska fungi, checklist, Corticiaceae, Polyporaceae, wood-inhabiting fungi

In the last 50 years, the demand for timber and timber products has greatly escalated, while at the same time allowable logging has decreased. The net result of reduction in permitted logging in the lower 48 states is an increase of logging in areas of Alaska that contain the few major tracts of remaining old growth forests in the United States. This increased harvesting would be expected to cause changes in the composition of the mycota of the logged areas. Unfortunately, these changes are difficult to document because of a lack of baseline studies on the fungal species composition of stable old growth in Alaska. To begin attainment of the necessary baseline information for further ecological and systematic studies, one of us (HHB) has collected extensively in the Anchorage area and Kenai Peninsula, largely in the Chugach National Forest, for four seasons, a one-day trip to Denali National Park, one week in the interior on a float plane trip, and an additional season in the islands of the Tongass National Forest near Juneau.

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[1] Maintained at Madison, WI, in cooperation with the University of Wisconsin-Madison

Although there are numerous reports on agarics and other large fleshy fungi from Alaska, the wood-inhabiting fungi, especially in the Aphyllophorales, have been under-collected and under-reported. Previous work on the wood-inhabiting fungi of Alaska has been scant, with fewer than forty publications that mention distributions of these fungi in the state (see Appendix) . Fewer than ten of the publications deal exclusively with Alaskan fungi. David Farr of the National Fungus Collection in Beltsville, Maryland has generously provided us with a list based on Farr *et al.* (1989) that catalogs 176 wood-inhabiting basidiomycete species from Alaska reported from these publications.

One striking aspect is the relatively small number of host tree species in a given area; most areas have fewer than 10 species of trees. Different areas, of course, have their own tree species compositions, but the collective number of kinds of hosts is relatively small; there are only 33 species that reach tree size in all of Alaska (Viereck and Little, 1972). For example, the old growth forest of the Kenai Peninsula in the Chugach National Forest consists of very few tree species, mostly *Picea glauca* (Moench) Voss [white spruce], *Picea sitchensis* (Bong.) Carr. [sitka spruce], their natural hybrid *Picea x lutzii* Little [Lutz spruce], *Tsuga heterophylla* (Raf.) Sarg. [western hemlock], *Tsuga mertensiana* (Bong.) Carr. [mountain hemlock], and an assortment of shrubby *Salix*, *Betula*, and *Alnus* species. Also locally abundant are *Populus trichocarpa* Torr. et Gray [black cottonwood] and *Populus tremuloides* Michx. [trembling aspen]. In comparison, the forests of southeastern Alaska, in the Tongass National Forest near Juneau, consist mostly of *Tsuga heterophylla*, *Picea sitchensis*, *Pinus contorta* Dougl. var. *contorta* Dougl. [shore pine], *Sambucus callicarpa* Greene [red elder] and several shrubby *Salix*, *Betula*, and *Alnus* species. A host index follows the collection data.

There has been increasing interest in the influence of down wood on the health of the forests and ecosystem management (Maser and Trappe 1984, Maser *et al.*, 1988; Larson, 1992). The fungi we have collected and listed here, especially those in the Corticiaceae *s.l.*, are the main decomposers of wood in these forests, gradually returning nutrients to the soil over the course of several hundred years. The importance of this interaction of downed wood and fungi in the ecosystem has been vastly underrated.

In this study of 754 collections, we report 254 species of wood-inhabiting fungi from Alaska. Based on Conners (1967), Ginns (1986), Farr *et al.* (1989), and Ginns and Lefebvre (1993), as well as the literature in Appendix 1, 151 (approximately 60%) of these species were previously unreported from Alaska. Seventeen of these species have not been recorded in the United States, and nine are new reports from North America. In addition, approximately 20 new species will be described in later publications. Gilbertson and Ryvarden (1986, 1987) report 81 species of polypores occurring in Alaska. We report 39 of these species plus an additional 12 species. Ginns and Lefevbre (1993) list 93 species of corticioid fungi from Alaska. Our collections include 46 of these species, plus an additional 120 species. Farr *et al.* (1989) report 176 basidiomycete species from Alaska. Our collection includes 66 of these fungi. Additional species of fungi from Alaska included in these three publications, as well as the publications of Baxter (1947, 1950), Baxter and Warner (1942) and Baxter and Wadsworth (1939), and not in our collections are listed in Appendix 2.

Although there are some differences in hosts, the Alaskan mycota is similar to that of North Europe and Siberia. The reporting of many of these species from Alaska extends their distribution ranges and significantly contributes to the presumed circumboreal, circumpolar, or Pacific Northwest distribution patterns for these fungi.

MATERIALS AND METHODS

Collecting and culturing techniques were as described in Gilbertson and Ryvarden (1986). All specimens and cultures are deposited at the Center for Forest Mycology Research (CFMR). Collections were made at the following sites in 1988, 1989, 1990, and 1991:

Kenai Peninsula, September 1988
    Russian River Ferry, 12 IX 88
    Trail Lakes Campground, S of Moose Pass, 13 IX 88
    Broadview Guard Station, 13 IX 88
    Mile 12 Seward Highway, 14 IX 88
    Golden Fin Lake, N of Seward, 14 IX 88
    E Fork Creek at Seward Highway, 15 IX 88

Kenai Peninsula, August-September 1989
    Mile 40 Sterling Highway, 28 VIII 89
    Mile 10 Seward Highway, 29 VIII 89
    Broadview Guard Station, Sterling Highway, 29 VIII 89
    Exit Glacier, near Seward, 29 VIII 89
    Trail River Campground, 29 VIII 89
    Three Rivers Campground, 29 VIII 89
    Oilwell Road, 5 mi E of Ninilchik, 30 VIII 89
    Oilwell Road, 4 mi E of Ninilchik, 31 VIII 89
    Tustamena Lake, 31 VIII 89
    Mile 60 Seward Highway, 6 IX 89
    Hope Road at Seward Highway, 6 IX 89

Eagle River, August 1989
    Keith Reynold's home, Eagle River, 27 VIII 89
    Chugach State Park, near Eagle River, 4 IX 89
    Eaglewood, Eagle River, 4 IX 89

Anchorage, July 1990
    McHugh Creek Wayside, Chugach State Park near Anchorage, 3 VII 90
    Elmendorf Airforce Base, Anchorage, 3 VII 90

Interior of Alaska, July 1990

Peters Creek Trail, Peters Creek, 4 VII 90
S end Turnagain Arm, Portage, 5 VII 90
E end Turnagain Arm, Portage, 5 VII 90
Denali National Park Headquarters, 7 VII 90
Mile 13 Denali National Park Rd., 7 VII 90
N of Peterson Creek, S of Girdwood, 9 VII 90
Virgin Creek, Girdwood, 9 VII 90
Tebay Lake, Chugach Mountains, 10 VII 90
near Chandalar Creek, Porcupine River., 12 VII 90
Millers Camp N of Eagle, Yukon River., 12 VII 90
S shore Walker Lake, NW of Bettles, 14 VII 90
Clarence Lake Inlet, Upper Susitna River, 15 VII 90
Clarence Lake Inlet, NW of Lake Louise, 16 VII 90

Kenai Peninsula, July 1990

S end Johnson Pass Trail, Chugach National Forest, 18 VII 90
Johnson Creek Trail at Trail Lake, Kenai Peninsula, 18 VII 90

Tongass National Forest (Southeastern Alaska), July-August 1991

Todd, Chichagof Island, 22 VII 91
Hawk Inlet, Admiralty Island, 22 VII 91
Saook Bay, Baronov Island, 22 VII 91
Trapp Bay, Chichagof Island, 22 VII 91
Taku Harbor, 23 VII 91
Duncan Canal, Kupreanof Island, 23 VII 91
Port Alexander, Mitkof Island, 23 VII 91
Thayer Lake, Admiralty Island, 23 VII 91
Kadake Bay, Kuiu Island, 24 VII 91
Glass Peninsula near Twin Point, Admiralty Island, 24 VII 91
Hood Bay, W side Admiralty Island, 24 VII 91
Hood Bay, Admiralty Island, 24 VII 91
Gambier Bay, Admiralty Island, 24 VII 91
Security Bay, Kuiu Island, 24 VII 91
Murder Cove, S tip Admiralty Island, 24 VII 91
Mole Harbor, Admiralty Island, 24 VII 91
Echo Cove, 40 mi N of Juneau, 25 VII 91
Patterson Bay, Chichagof Island, 25 VII 91
Port Frederick near Halibut Island, Chichagof Island, 25 VII 91
N arm Hoonah Sound, Chichagof Island, 25 VII 91
Neka Bay, Chichagof Island, 25 VII 91
Pavlof Harbor, Chichagof Island, 25 VII 91
Sheep Creek Trail, S of Juneau, 28 VII 91
Mile 12 N Douglas Highway, 29 VII 91
Mendenhall Glacier, Loop Trail, Juneau, 30 VII 91
Mendenhall Glacier, Juneau, 31 VII 91
Switzer Trail, Juneau, 1 VIII 91

Mendenhall Glacier, W Glacier Trail, Juneau, 2 VIII 91
Yankee Basin Trail, 5 VIII 91
Eagle Crest Road, 2 mi from lodge, Douglas Island, 6 VIII 91
Eagle Crest Road at Douglas Island, 6 VIII 91
John Muir Cabin, Auke Bay, 7 VIII 91
Aukenu Trail, 7 VIII 91
Lena Beach, 7 VIII 91
Spaulding Trail, Auke Bay, 8 VIII 91
Fish Creek Trail, Douglas Island, 9 VIII 91

Kenai Peninsula, August 1991
Broadview Guard Station,Kenai Lake, Chugach NF, 15 VIII 91
Stariski State Recreation Area, N of Homer, 16 VIII 91
Anchor Point Rec. Area, Halibut Campground, 18-19 VIII 91
Cooper Creek Campground, Cooper Landing, 20 VIII 91

Based on Conners (1967), Ginns (1986), Farr *et al.* (1989), and Ginns and Lefebvre (1993), as well as the literature in the appendix, species in the list below and preceded by the following notations indicate new distributions: * new to Alaska, # new to the United States, @ new to North America. Numbers followed by the following codes (-sp= multispore culture, -T = basidiome tissue culture) indicate that a culture of the collection has been deposited at the Center for Forest Mycology Research (CFMR). Abbreviations included in collection site data are as follows:

AFB	Air Force Base	Mt	Mountain
Cg	Campground	N	north
Cr	Creek	NF	National Forest
Gl	Glacier	NP	National Park
diam	diameter	Pt	Point
E	east	R	River
GS	Guard Station	Rd	Road
Hwy	Highway	RecA	Recreation Area
HQ	Headquarters	S	south
I	Island	-sp	multispore culture
KP	Kenai Peninsula	St	State
L	Lake	-T	tissue culture
Lnd	Landing	Tr	Trail
mi	mile	W	west

Wood-inhabiting fungi of Alaska

* ***Acanthophysium cerrusatum* (Bres.) Boid.**
Picea, fire killed, Mile 40 Sterling Hwy, KP, 1989, HHB-12618
Populus tremuloides down branch, Denali NP, 1990, HHB-13204-sp

Acanthophysium lividocoeruleum (P.Karst.) Boid.
Picea glauca log, Chugach St Park, Eagle River, 1989, HHB-12829-sp

* **_Acanthophysium spiniger_ (Rog. et Lemke) Parm.**
Picea sitchensis log, Mile 10 Seward Hwy, KP, 1989, HHB-12672
Tsuga mertensiana, E end Turnagain arm, Portage, 1990, HHB-13118-sp

Acanthophysium weirii (Burt) Parm.
Picea lutzii, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13362
Picea sitchensis or *Tsuga heterophylla* stump, Aukenu Tr, 1991, HHB-14012
P. sitchensis down branches, Mile 10 Seward Hwy, KP, 1989, HHB-12675, HHB-12678-sp, HHB-12680-sp
P. sitchensis?, E end Turnagain Arm, Portage, 1990, HHB-13131, HHB-13132

Albatrellus ovinus (Fr.) Murr.
Picea x lutzii, Broadview GS, Sterling Hwy, KP, 1989, HHB-12707

Aleurocystidellum subcruentatum (Berk. et Curt.) Lemke
Picea sitchensis live bark, Eagle Crest Rd at Douglas I, Tongass NF, 1991, HHB-13980-sp, HHB-13973
P. sitchensis snag, Lena Beach, Tongass NF, 1991, HHB-13984-sp, HHB-13997
P. sitchensis, E end Turnagain Arm, Portage, 1990, HHB-13135-sp
P. sitchensis log off ground, N of Peterson Cr, S of Girdwood, 1990, HHB-13258
P. sitchensis, trunk live tree, Todd, Chichagof I, Tongass NF, 1991, HHB-13661-sp
P. sitchensis dead, Mendenhall Gl, Juneau, 1991, HHB-13893
P. sitchensis, dead branches of live tree, Stariski St RecA, N of Homer, KP, 1991, HHB-14110
P. sitchensis live bark, Anchor Pt RecA, Halibut Cg, KP, 1991, HHB-14113, HHB-14120-s

* **_Aleurodiscus amorphus_ (Pers.:Fr.) J. Schroet.**
Picea sitchensis, small recently dead, Mendenhall Gl, W Glacier Tr, 1991, HHB-13890

* **_Aleurodiscus penicillatus_ Burt**
Picea sitchensis branch, Mendenhall Gl, Juneau, 1991, HHB-13878
Picea sitchensis, dead branch live tree, Anchor Pt RecA, Halibut Cg, KP, 1991, HHB-14115, HHB-14112
Picea sitchensis, dead branch live tree, Stariski St RecA, N of Homer, KP, 1991, HHB-14108, HHB-14109
Picea sitchensis dead branch live tree, Sheep Cr Tr, S of Juneau, Tongass NF, 1991, HHB-13777
Picea sitchensis, dead branch live tree, Virgin Cr, Girdwood, 1990, HHB-13223, HHB-13236, HHB-13244, HHB-13245
Picea sitchensis dead branch live tree, Neka Bay, Chichagof I, Tongass NF, 1991, HHB-13767 cont'd--->

Picea sitchensis, Exit Gl, near Seward, KP, 1989, HHB-12689-sp
Picea sitchensis live, Anchor Pt RecA, KP, 1991, HHB-14121
Picea sitchensis, Mendenhall Gl, Juneau, 1991, HHB-13822
Picea sitchensis small diam dead standing, Mendenhall Gl, W Glacier Tr, 1991, HHB-13902; dead branch live tree, HHB-13896, HHB-13900, HHB-13901
Tsuga heterophylla, dead branch live tree, Echo Cove, 40 mi N of Juneau, Tongass NF, 1991, HHB-13751, HHB-13748
Tsuga heterophylla down twig, Echo Cove, 40 mi N of Juneau, Tongass NF, 1991, HHB-13747
Tsuga mertensiana, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13369

Amphinema byssoides (Fr.) J. Erikss.

Alnus sinuata, Yankee Basin Tr, Tongass NF, 28 mi N of Juneau, 1991, HHB-13939
Alnus, well-decayed stem, N of Peterson Cr, S of Girdwood, 1990, HHB-13264
Picea glauca down, Denali NP HQ, 1990, HHB-13194
P. glauca, E Fork Cr at Seward Hwy, KP, 1988, HHB-12496
P. glauca, Elmendorf AFB, Anchorage, 1990, HHB-13055-sp
P. glauca log, Chugach St Park, Eagle River, 1989, HHB-12814
P. glauca stump, Broadview GS, Kenai L, KP, Chugach NF, 1990, HHB-13331
Picea x lutzii branch, Mile 60 Seward Hwy, KP, 1989, HHB-12848
Picea x lutzii log, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13367
Picea x lutzii, Russian River Ferry, KP, 1988, HHB-12394, HHB-12370
Picea mariana log, Mile 13 Denali NP Rd, 1990, HHB-13170, HHB-13167, HHB-13172
Picea sitchensis base of dead, Mendenhall Gl, W Glacier Tr, Tongass NF, 1991, HHB-13891
P. sitchensis, down branch, Neka Bay, Chichagof I, Tongass NF, 1991, HHB-13764
P. sitchensis down twigs, Mendenhall Gl, W Glacier Tr, Juneau, 1991, HHB-13915-sp, HHB-13918
P. sitchensis down, Virgin Cr, Girdwood, 1990, HHB-13231, HHB-13227
P. sitchensis log, Yankee Basin Tr, Tongass NF, 1991, HHB-13920
P. sitchensis well-decayed trunk, Port Frederick near Halibut I, Chichagof I, Tongass NF, 1991, HHB-13769
Populus tremuloides, Elmendorf AFB, Anchorage, 1990, HHB-13060, HHB-13081
Populus trichocarpa log, Cooper Cr Cg, Cooper Landing, KP, 1991, HHB-14153
Salix debris, Mile 13 Denali NP Rd, 1990, HHB-13175, HHB-13179, HHB-13178, HHB-13181
Salix, Elmendorf AFB, Anchorage, 1990, HHB-13084
Tsuga heterophylla or *Picea sitchensis* log, Yankee Basin Tr, N of Juneau, Tongass NF, 1991, HHB-13934
Tsuga heterophylla? log, Yankee Basin Tr, N of Juneau, Tongass NF, 1991, HHB-13927
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13128
Tsuga, well-decayed stump, Golden Fin L, N of Seward, KP, 1988, HHB-12452

* **Amylocorticium cebennense (Bourd.) Pouz.**
Picea sitchensis, Todd, Chichagof I, Tongass NF, 1991, HHB-13660

* **Amylocorticium subincarnatum (Peck) Pouz.**
Picea glauca, Broadview GS, Kenai L, KP, Chugach NF, 1990, HHB-13339

*# **Amylocorticium subsulphureum (Karst.) Pouz.**
Tsuga heterophylla log, Mile 12 N Douglas Hwy, Tongass NF, 1991, HHB-13817-sp

Amylocystis lapponicus (Rom.) Singer
Picea x lutzii, S end of Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13400-sp

Anomoporia bombycina (Fr.) Pouz.
Picea x lutzii, Russian River Ferry, KP, 1988, HHB-12389

Antrodia albida (Fr.) Donk
Picea log, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14092
Salix snag, Anchor Pt RecA, KP, 1991, HHB-14146

Antrodia albobrunnea (Rom.) Ryv.
Picea sitchensis log, Eagle Crest Rd, Douglas I, Tongass NF, 1991, HHB-13976

* **Antrodia carbonica (Overh.) Gilbn. et Ryv.**
Picea x lutzii, Johnson Cr Tr at Trail L, KP, 1990, HHB-13356

Antrodia heteromorpha (Fr.) Donk
Picea x lutzii, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14074
Picea x lutzii stump, Cooper Cr Cg, Cooper Landing, KP, 1991, HHB-14162-T
Populus trichocarpa stump, Stariski St RecA, 20 mi N of Homer, KP, 1991, HHB-14107
Tsuga heterophylla, porcupine scar live tree, Eagle Crest Rd, Douglas I,Tongass NF, 1991, HHB-13977-T

Antrodia sinuosa (Pers.:Fr.) Karst.
Picea x lutzii log, Mile 60 Seward Hwy, KP, 1989, HHB-12857
Tsuga, Hope Rd at Seward Hwy, KP, 1989, HHB-12878-sp

Antrodia sitchensis (Baxt.) Gilbn. et Ryv.
Picea glauca log, E Fork Cr at Seward Hwy, KP, 1988, HHB-12513
Picea x lutzii, Three Rivers Cg, KP, 1989, HHB-12661-sp
Picea x lutzii, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13363

Asterodon ferruginosa Pat.
Picea glauca log, Elmendorf AFB, Anchorage, 1990, HHB-13090-sp
Tsuga mertensiana, S end Turnagain Arm, Portage, 1990, HHB-13155

*#@ ***Athelia acrospora* Jülich**
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13408

* ***Athelia arachnoidea* (Berk.) Jülich**
Populus trichocarpa stump, Cooper Cr Cg, Cooper Landing, KP, 1991, HHB-14156

* ***Athelia bombacina* Pers.**
Picea mariana stump, Tustamena L, KP, 1989, HHB-12771
Picea sitchensis, Exit Gl,near Seward, KP, 1989, HHB-12702
Pinus contorta var. *contorta* Eagle Crest Rd, Douglas I, Tongass NF, 1991, HHB-13963

* ***Athelia coprophila* (Wakef.) Jülich**
Alnus sinuata down branch, Yankee Basin Tr, 28 mi N of Juneau, Tongass NF, 1991, HHB-13942

* ***Athelia decipiens* (v.Höhn. et Litsch) J. Erikss.**
Picea x lutzii, Oilwell Rd, 5 mi E of Ninilchik, KP, 1989, HHB-12709-sp
Tsuga heterophylla, Hawk Inlet, Admiralty I, Tongass NF, 1991, HHB-13651

* ***Athelia fibulata* M.P. Christ.**
Picea x lutzii down branch, S end Johnson Pass Tr, KP, Chugach NF, 1990, HHB-13406
Picea sitchensis log, Exit Gl, near Seward, KP, 1989, HHB-1268

*# ***Atheliopsis glaucina* (Bourd. et Galz.) Parm.**
Betula papyrifera log, Mile 60 Seward Hwy, KP, 1989, HHB-12843

* ***Basidioradulum radulum* (Fr.) Nobles**
Alnus or *Salix* log, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14097

***Bjerkandera adusta* (Willd.:Fr.) Karst.**
Alnus sinuata, dead part live tree, Stariski St RecA, N of Homer, KP, 1991, HHB-14100
Populus or *Betula* log, Chugach St Park, Eagle River, 1989, HHB-12842
Populus tremuloides, Elmendorf AFB, Anchorage, 1990, HHB-13072-sp
Populus trichocarpa, Chugach St Park,Eagle 1989, HHB-12826-sp

***Botryobasidium botryosum* (Bres.) J. Erikss.**
Picea x lutzii dead root collar, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13420
Picea sitchensis fallen branch, 10 mi N of Seward, Seward Hwy, KP, 1989, HHB-12671
Tsuga heterophylla log, Switzer Tr, Juneau, 1991, HHB-13885
T. heterophylla, Taku Harbor, Tongass NF, 1991, HHB-13685

* **_Botryobasidium candicans_ J. Erikss.**
Picea x lutzii, Russian River Ferry, KP, 1988, HHB-12364
Tsuga heterophylla log, Switzer Tr, Juneau, 1991, HHB-13887
T. heterophylla or *Picea sitchensis* log, Lena Beach, Tongass NF, 1991, HHB-13987
Tsuga mertensiana log, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13364

* **_Botryobasidium danicum_ J. Erikss. et Hjortst.**
Picea sitchensis or *Tsuga heterophylla*, Mile 12 N Douglas Hwy, Tongass NF, 1991, HHB-13798

* **_Botryobasidium laeve_ (J. Erikss.) Parm.**
Pinus contorta var. *contorta*, Eagle Crest, Tongass NF, 1991, HHB-13958, HHB-13970
Populus trichocarpa log, Anchor Pt RecA, KP, 1991, HHB-14132

* **_Botryobasidium subcoronatum_ (v.Höhn. et Litsch.) Donk**
Picea log, Trail Lake Cg,S of Moose 1988, HHB-12431
Tsuga heterophylla down well-decayed log, Echo Cove, 40 mi N of Juneau, Tongass NF, 1991, HHB-13750
T. heterophylla log, Spaulding Tr, Auke Bay, Tongass NF, 1991, HHB-14021

* **_Botryohypochnus isabellinus_ (Fr.) J. Erikss.**
Betula kenaiaca, Russian River Ferry, KP, 1988, HHB-12380
Picea sitchensis, Trapp Bay, Chichagof I, 1991, HHB-13675

* **_Bourdotia caesio-cinerea_ (v.Höhn. et Litsch.) Bourd. et Galz.**
Picea mariana dead root crown, Mile 13 Denali NP Rd, 1990, HHB-13187

Bourdotia eyrei (Wakef.) Bourd. et Galz.
Populus trichocarpa log, Cooper Cr Cg, Cooper Lnd,KP, 1991, HHB-14152

*#@ **_Byssocorticium lutescens_ J. Erikss. et Ryv.**
Pinus contorta var. *contorta*?, Eagle Crest, Douglas I, Tongass NF, 1991, HHB-13959

* **_Calocera cornea_ (Batsch.:Fr.) Fr.**
Alnus sinuata, Mendenhall Gl, W Glacier Tr, Juneau, 1991, HHB-13838, HHB-13917
Tsuga heterophylla or *Picea sitchensis*, Trapp Bay, Chichagof I, Tongass NF, 1991, HHB-13679-sp

* **_Calocera viscosa_ (Pers.:Fr.) Fr.**
Picea log, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12733-sp

Ceraceomerulius serpens (Fr.) J. Erikss. et Ryv.
Picea mariana log, Tustamena L, KP, 1989, HHB-12769-sp-T
Picea mariana, decayed root crown, Mile 13 Denali NP Rd, 1990, HHB-13189
Populus tremuloides, Elmendorf AFB, 1990, HHB-13075A, HHB-13064
Tsuga mertensiana, E end Turnagain arm, Portage, 1990, HHB-13152, HHB-13154

* **_Ceraceomyces borealis_ (Rom.) J. Erikss.**
Tsuga heterophylla log, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14048

* **_Ceraceomyces tessulatus_, (Cooke) Jülich**
Betula log, Mile 60 Seward Hwy, KP, 1989, HHB-12854
Betula log, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12720
Picea sitchensis? log, Golden Fin L, N of Seward, KP, 1988, HHB-12457
Tsuga, Hope Rd at Seward Hwy, KP, 1989, HHB-12882

* **_Ceriporiopsis pannocincta_ (Rom.) Gilbn. et Ryv.**
Populus tremuloides log, Eaglewood, Eagle River, 1989, HHB-12806
P. tremuloides, Elmendorf AFB, Anchorage, 1990, HHB-13066

Cerrena unicolor (Bull.:Fr.) Murr.
Betula snag, Chugach St Park, Eagle River, 1989, HHB-12822-T

Chaetoderma luna (Rog. et Jacks.) Parm.
Conifer (undet.), Aukenu Tr, Tongass NF, 1991, HHB-14011
Picea glauca, Chugach St Park, Eagle River, 1989, HHB-12836-sp
Picea mariana log, Mile 13 Denali NP Rd, 1990, HHB-13171-sp
Picea sitchensis down branch, Mile 10 Seward Hwy, KP, 1989, HHB-12673
P. sitchensis, Eagle Crest Rd at stream 2 mi, below lodge, Douglas I, Tongass NF, 1991, HHB-13975
P. sitchensis, Mile 12 Seward Hwy, KP, 1988, HHB-12475
Pinus contorta var. *contorta*, John Muir Cabin, Auke Bay, Tongass NF, 1991, HHB-14010-T-sp
Tsuga heterophylla down branch, Patterson Bay, Chichagof I, Tongass NF, 1991, HHB-13757
T. heterophylla or *P. sitchensis* log, Yankee Basin Tr, N of Juneau, Tongass NF, 1991, HHB-13943
T. heterophylla or *P. sitchensis* branch, N arm Hoonah Sound, Chichagof I, Tongass NF, 1991, HHB-13760
T. heterophylla well-decayed log, Hood Bay, Admiralty I, Tongass NF, 1991, HHB-13742
T. heterophylla? log, Yankee Basin Tr, 28 mi N of Juneau, Tongass NF, 1991, HHB-13928, HHB-13924
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13137-sp

Cheimonophyllum candidissimum (Berk. et Curt.) Singer
Populus trichocarpa twigs, Exit Gl, near Seward, KP, 1989, HHB-12698-sp

* ***Chlorociboria aeruginascens*** **(Nyl.) Kanouse**
Betula, Mile 40 Sterling Hwy, KP, 1989, HHB-12640

Chondrostereum purpureum **(Fr.) Pouz.**
Populus trichocarpa, Broadview GS, Cooper Landing, KP, 1990, HHB-13333-sp, HHB-13334-sp

* ***Coniophora arida*** **(Fr.) Karst.**
Picea x lutzii down branch, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13403
Picea x lutzii, Trail Lakes Cg, S.of Moose Pass, KP, Chugach NF, 1988, HHB-12407
Picea mariana stump, Tustamena L, 1989, HHB-12765
Picea sitchensis well-decayed log, Virgin Cr,Girdwood, 1990, HHB-13239
Tsuga heterophylla or *Picea sitchensis*, Trapp Bay, Chichagof I, Tongass NF, 1991, HHB-13682

* ***Coniophora olivacea*** **(Fr.:Fr.) Karst.**
Picea x lutzii dead root, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13402
Picea x lutzii down, Trail Lakes Cg S. of Moose Pass, KP, 1988, HHB-12434
Picea x lutzii log, Three Rivers Cg, KP, 1989, HHB-12659
Picea mariana log, Mile 13 Denali NP Rd, 1990, HHB-13182
Tsuga heterophylla down trunk, Kadake Bay, Kuiu I, Tongass NF, 19901, HHB-13725
Tsuga mertensiana, E end Turnagain arm, Portage, 1990, HHB-13141

Coniophora puteana **(Schum.:Fr.) Karst.**
Betula papyrifera, Eaglewood, Eagle River, 1989, HHB-12786
Picea glauca stump, Broadview GS, Kenai L, KP, Chugach NF, 1990, HHB-13336
Picea x lutzii log, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13398

* ***Crepidotus phaseoliformis*** **Hesler et A.H. Smith**
Betula down twig, Oilwell Rd 5 mi E of Ninilchik, KP, 1989, HHB-12748-sp

Crustoderma dryinum **(Berk. et Curt.) Parm.**
Picea glauca well-decayed log, Tebay L, Chugach Mt, 1990, HHB-13266

Cylindrobasidium albulum **(Atk. et Burt) J. Erikss et Hjortst.**
Picea x lutzii down branch,S end Johnson Pass Tr,Chugach NF, KP, 1990, HHB-13411

Cylindrobasidium laeve **(Pers.:Fr.) Chamuris**
Populus tremuloides, Chugach St Park, Eagle River, 1989, HHB-12828-sp

Cyphellopsis anomala (Pers.:Fr.) Donk

Alnus, Broadview GS, Kenai L, KP, Chugach NF, 1990, HHB-13341-sp, HHB-13530

Populus trichocarpa log, Anchor Pt RecA, KP, 1991, HHB-14127

Cytidia salicina (Fr.) Burt

Alnus sinuata down branch, Mendenhall Gl, Juneau, 1991, HHB-13823-T

Betula nana, Clarence L inlet, Upper Susitna R, 1990, HHB-13330-sp

Salix snag, Anchor Pt RecA, KP, 1991, HHB-14142, HHB-14138

* **_Dacrymyces chrysospermus_ Berk. et Curt.**

Picea dead, Hope Rd at Seward Hwy, KP, 1989, HHB-12881-sp

Picea x lutzii log, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12732

Dacrymyces deliquescens (Bull.) Duby

Picea sitchensis or *Tsuga heterophylla* old log, Trapp Bay, Chichagof I, Tongass NF, 1991, HHB-13678

* **_Dacrymyces minor_ Peck**

Betula, S shore Walker L, NW of Bettles, 1990, HHB-13309, HHB-13315

Picea sitchensis, dead branch of live tree, Sheep Cr Tr, S of Juneau, Tongass NF, 1991, HHB-13778

Pinus contorta var. *contorta*, N Douglas Hwy, Tongass NF, 1991, HHB-13818-sp

Populus trichocarpa Yankee Basin Tr, Tongass NF, 28 mi N of Juneau, 1991, HHB-13952

* **_Dacrymyces tortus_ Fr.**

Pinus contorta var. *contorta*, Eagle Crest Rd, Douglas I, Tongass NF. 1991, HHB-13967

* **_Dendrothele incrustans_ (Lemke) Lemke**

Tsuga mertensiana dead branches live tree, Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13370

T. mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13136

T. mertensiana, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13368

Diplomitoporus crustulinus (Bres.) Dom.

Picea log, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12734-sp

Tsuga heterophylla, Saook Bay, Baronov I, Tongass NF, 1991, HHB-13670

T. heterophylla well-decayed log, Thayer L, Admiralty I, Tongass NF, 1991, HHB-13746

Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13161

Diplomitoporus lindbladii (Berk.) Gilbn. et Ryv.

Picea x lutzii, Oilwell Rd, 5 mi E of Ninilchik, KP, 1989, HHB-12711-sp

Tsuga heterophylla log, Spaulding Tr, Auke Bay, Tongass NF, 1991, HHB-14025

Echinodontium tinctorium (Ell. et Ev.) Ell. et Ev.
Tsuga, Hope Rd at Seward Hwy, KP, 1989, HHB-12866-T
Tsuga mertensiana live, E end Turnagain arm, Portage, 1990, HHB-13144
T. mertensiana, Trail Lakes Cg, S of Moose Pass, KP, 1988, HHB-12450, HHB-12451

* **_Encoelia furfuraceum_ (Roth.:Pers.) Karst.**
Alnus, Broadview GS, Cooper Landing, Kenai L,KP, 1990, HHB-13347-sp

* **_Exidia repanda_ Fr.**
Betula, S shore Walker L, NW of Bettles, 1990, HHB-13301, HHB-13304, HHB-13317

* **_Exidiopsis laccata_ (Bourd. et Galz.) Luck-Allen**
Salix, Mendenhall Gl, Loop Tr, Juneau, 1991, HHB-13826

Fibricium rude (Karst.) Jülich
Alnus dead, Broadview GS, KP, 1988, HHB-12445
Betula papyrifera log, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13430
Populus tremuloides, Trail Lakes Cg, KP, 1988, HHB-12418

* **_Fibulomyces mutabilis_ (Bres.) Jülich**
Picea glauca down tip, Denali NP HQ, 1990, HHB-13197
Picea x lutzii down branch, S end Johnson Pass Tr, Chugach N.F.,KP, 1990, HHB-13428-sp

Fomes fomentarius (L.:Fr.) Kickx.
Betula snag, Chugach St Park, Eagle River, 1989, HHB-12823

Fomitopsis pinicola (Swartz:Fr.) Karst.
Tsuga heterophylla, base of live, Eagle Crest Rd, Douglas I, Tongass NF, 1991, HHB-13982
Tsuga heterophylla log, Fish Cr, Douglas I, Tongass NF, 1991, HHB-14032
Tsuga heterophylla or *Picea sitchensis* log, Lena Beach, Tongass NF, 1991, HHB-13999
Tsuga mertensiana snag, E end Turnagain arm, Portage, 1990, HHB-13140

* **_Galerina stylifera_ (Atk.) A.H. Smith et Singer**
Betula papyrifera, Mile 60 Seward Highway, KP, 1989, HHB-12845-sp

Ganoderma applanatum (Pers.) Pat.
Alnus sinuata dead, Gambier Bay, Admiralty I, Tongass NF, 1991, HHB-13720
Populus tremuloides live, Chugach St Park, Eagle River, 1989, HHB-12825
Tsuga heterophylla down trunk, Kadake Bay, Kuiu I, Tongass NF, 1991, HHB-13724

Gloeocystidiellum citrinum (Pers.) Donk
Tsuga mertensiana well-decayed log, Virgin Cr, Girdwood, 1990, HHB-13234

* **Gloeocystidiellum convolvens (Karst.) Donk**
Betula nana?, Peters Cr Tr, Peters Cr, 1990, HHB-13108-sp
conifer, Oilwell Rd 4 mi E of Ninilchik, KP, 1989, HHB-12746A
Populus tremuloides, Elmendorf 1990, HHB-13075-sp

* **Gloeocystidiellum furfuraceum (Bres.) Donk**
Picea mariana stump, Tustamena L, KP, 1989, HHB-12759

Gloeocystidiellum karstenii (Bourd. et Galz.) Donk
Populus tremuloides, Elmendorf 1990, HHB-13073-sp

Gloeocystidiellum leucoxanthum (Bres.) Boid.
Alnus, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14061
Alnus down, S of Peterson Cr, N of Girdwood, 1990, HHB-13259-sp
Alnus, N of Peterson Cr, S of Girdwood, 1990, HHB-13248
Alnus sinuata dead branch, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14168
A. sinuata, Mendenhall Gl, Juneau, 1991, HHB-13871
Betula nana?, Peters Cr Tr, Peters Cr, 1990, HHB-13109
Populus trichocarpa branch, Anchor Pt RecA, Halibut Cg, KP, 1991, HHB-14125
Salix, Anchor Pt RecA, Halibut Cg, KP, 1991, HHB-14114
Salix dead branch, Tebay L, Chugach Mt, 1990, HHB-13281, HHB-13282-sp
Salix, Mile 13 Denali NP Rd, 1990, HHB-13166-sp

Gloeocystidiellum luridum (Bres.) Boid.
Alnus? down branch, N of Peterson Cr, S of Girdwood, 1990, HHB-13261

Gloeophyllum sepiarium (Wulff.:Fr.) Karst.
Picea log, Mile 40 Sterling Hwy, KP, 1989, HHB-12626-sp
Picea x lutzii, Cooper Cr Cg,Cooper Lnd, KP, 1991, HHB-14159-T
Picea mariana log, Tustamena L, KP, 1989, HHB-12768

Grandinia abieticola (Bourd. et Galz.) Jülich
Betula papyrifera log, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13394
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13150

* **Grandinia alienata (Parm.) Jülich**
Populus tremuloides, Elmendorf AFB, Anchorage, 1990, HHB-13067
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13164

*#@ **Grandinia altaica Parm. (Jülich)**
Betula down branch, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12746
Betula papyrifera log, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13388

* **_Grandinia alutacea_ (Fr.) Jülich**
Picea glauca, Elmendorf AFB, Anchorage, 1990, HHB-13087-sp

* **_Grandinia alutaria_ (Burt) Jülich**
Betula down branch, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12745
Picea log, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14081
Picea x lutzii log, Mile 40 Sterling Hwy, KP, 1989, HHB-12634
Picea x lutzii, yellow stringy rot, Cooper Cr Cg, Cooper Lnd, KP, 1991, HHB-14161
Sambucus callicarpa, Mendenhall Gl, Juneau, 1991, HHB-13839

* **_Grandinia arguta_ (Fr.) Jülich**
Alnus, Peters Cr Tr, Peters Cr, 1990, HHB-13114
Betula log, Hope Rd at Seward Hwy, KP, 1989, HHB-12873-sp, HHB-12873-T
Picea sitchensis down, Mendenhall Gl, W Gl Tr, 1991, HHB-13911
P. sitchensis log, Mile 60 Seward Hwy, KP, 1989, HHB-12681
P. sitchensis well-decayed log, Glass Pen. near Twin Pt, Admiralty I, Tongass NF, 1991, HHB-13710
Salix dead branch, Mile 40 Sterling Hwy, KP, 1989, HHB-12633
Salix, Millers Camp N of Eagle, Yukon R, 1990, HHB-13292

Grandinia aspera (Fr.) Jülich =_Grandinia granulosa_ (Pers.:Fr.) Jülich
Alnus sinuata log, Mendenhall Gl, W Glacier Tr, Juneau, 1991, HHB-13907
Picea x lutzii log, Mile 60 Seward Hwy, KP, 1989, HHB-12850
Picea x lutzii log, Mile 40 Sterling Hwy, KP, 1989, HHB-12625
Picea x lutzii, Trail Lakes Cg, S of Moose Pass, KP, 1988, HHB-12413, HHB-12415
Picea mariana stump, Tustamena L, KP, 1989, HHB-12770
Picea sitchensis down branches, Mendenhall Gl, W Glacier Tr, 1991, HHB-13903
P. sitchensis, Mile 12 Seward Hwy, KP, 1988, HHB-12478
Salix stump, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14086
Tsuga heterophylla, bark of wet log, Security Bay, Kuiu I, Tongass NF, 1991, HHB-13727
T. heterophylla branch, Spaulding Tr, Auke Bay, Tongass NF, 1991, HHB-14015
T. heterophylla fallen branch, Kadake Bay,Kuiu I, Tongass NF, 1991, HHB-13723
T. heterophylla log, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14040
T. heterophylla, small diam snag, Mendenhall Gl, Juneau, 1991, HHB-13845
T. heterophylla, Switzer Tr, Juneau, 1991, HHB-13886
Tsuga heterophylla or _Picea sitchensis_ log, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14051
Vaccinum down branch, Mile 12 N Douglas Hwy, Tongass NF, 1991, HHB-13813

* **_Grandinia barba-jovis_ (Bull.:Fr.) Jülich**
Alnus down trunk, S. end of Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13416-sp
Alnus sinuata or _Salix_, Mendenhall Gl, Loop Tr, Juneau, 1991, HHB-13834 --->

Alnus sinuata stump, Sheep Cr Tr, S of Juneau, Tongass NF, 1991, HHB-13788
Betula log, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13393
Betula papyrifera, S end Johnson Pass Tr, Chugach NF, 1990, HHB-13412
Populus trichocarpa, Yankee Basin Tr, 28 mi N of Juneau, Tongass NF, 1991, HHB-13954
Salix sp?, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14069

* **Grandinia breviseta (Karst.) Jülich**
Alnus sinuata, Spaulding Tr, Auke Bay, Tongass NF, 1991, HHB-14006-sp
Picea x lutzii log, Three Rive Cg, KP, 1989, HHB-12655
Picea sitchensis dead branch, Mendenhall Gl, W Glacier Tr, Juneau, 1991, HHB-13895, HHB-13898
Tsuga heterophylla down branch, Security Bay,Kuiu I, Tongass NF, 1991, HHB-13728
T. heterophylla snag, Spaulding Tr Auke Bay, Tongass NF, 1991, HHB-14019
T. heterophylla or *P. sitchensis* log, Mendenhall Gl, Loop Tr, Juneau, 1991, HHB-13849
T. heterophylla or *P. sitchensis* log, Lena Beach, Tongass NF, 1991, HHB-13988
Vaccinum, Mile 12 N Douglas Hwy, Tongass NF, 1991, HHB-13809

*#@ **Grandinia cineracea (Bourd. et Galz.) Jülich**
Picea log & *Veluticeps*, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14091
Vaccinum, Mile 12 N Douglas Hwy, Douglas I, Tongass NF, 1991, HHB-13810

Grandinia crustosa (Fr.) J. Erikss.
Alnus, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14066, HHB-14089, HHB-14094
Alnus down branch, N of Peterson Cr, S of Girdwood, 1990, HHB-13252
Alnus, Peters Cr Tr, Peters Cr, 1990, HHB-13100-sp, HHB-13103
Betula papyrifera down branch, S. end Johnson Pass Tr, Chugach NF, 1990, HHB-13392-sp
Salix, Mile 13 Denali NP Rd, 1990, HHB-13173-sp
Salix trunk dead, Tebay L, Chugach Mt, 1990, HHB-13280
Salix?, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14071

* **Grandinia floccosa (Bourd. et Galz.) Jülich**
Picea log, 4 mi E of Ninilchik, KP, 1989, HHB-12716-sp

* **Grandinia pallidula (Bres.) Jülich**
Tsuga heterophylla log, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14046-sp

* ***Grandinia pruni* (Lasch) Jülich**

Alnus, McHugh Cr Wayside, Chugach St Park Anchorage, 1990, HHB-13095-sp
Oplopanax horridus, Lena Beach, Tongass NF, 1991, HHB-13991
Pinus contorta var. *contorta*, John Muir Cabin, Auke Bay, Tongass NF, 1991, HHB-14009

***Grandinia quercina* (Fr.) J. Erikss.**

Alnus, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14062
Alnus down branch, N of Peterson Cr, S of Girdwood, 1990, HHB-13251
Alnus, Peters Cr Tr, Peters Cr, 1990, HHB-13097-sp, HHB-13104-sp, HHB-13117-sp
Betula nana, Clarence L Inlet, NW of L 1990, HHB-13326-sp
Populus tremuloides, Elmendorf AFB, Anchorage, 1990, HHB-13079
Tsuga mertensiana, dead branch live tree, Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13372

* ***Grandinia spathulata* (Schrad.:Fr.) Jülich**

Populus trichocarpa, Broadview GS Kenai L Cooper Landing, KP, 1990, HHB-13335

* ***Grandinia subalutacea* (Karst.) Jülich**

Alnus sinuata, well-decayed log, Pavlof Harbor, Chichagof I, Tongass NF, 1991, HHB-13752
Picea x lutzii trunk, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13424
Tsuga heterophylla down branch, Murder Cove, S tip Admiralty I, Tongass NF, 1991, HHB-13732

***Hapalopilus nidulans* (Fr.) Karst.**

Alnus, N of Peterson Cr, S of Girdwood, 1990, HHB-13246-sp

* ***Hapalopilus salmonicolor* (Berk. et Curt.) Pouz.**

Picea x lutzii, Oilwell Rd 5 mi E of Ninilchik, KP, 1989, HHB-12714-sp

***Hericium ramosum* (Bull.ex Mérat) Letell.**

Betula papyrifera, wounded live tree, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12735-sp
Populus trichocarpa log, Exit Gl, near Seward, KP, 1989, HHB-12700-sp

* ***Heteroporus biennis* (Bull.:Fr.) Laz.**

conifer stump, unknown, near Juneau, 1991, HHB-13856

***Heterotextus luteus* (Bres.) McNabb**

Picea sitchensis, N of Peterson Cr S of Girdwood, 1990, HHB-13255
Picea sitchensis or *Tsuga mertensiana* down twig, Virgin Cr, Girdwood, 1990, HHB-13243-sp cont'd ---->

Tsuga heterophylla down branch, Mile 12 N Douglas Hwy, Tongass NF, 1991, HHB-13812

T. heterophylla down twigs, Trapp Bay, Chichagof I, Tongass NF, 1991, HHB-13680

***Hygrophoropsis aurantiaca* (Wulf.:Fr.) Maire**

soil and brown-rotted wood, Chugach St Park, Eagle River, 1989, HHB-12841-T

***Hymenochaete tabacina* (Sow.:Fr.) Lév.**

Salix, Mile 40 Sterling Hwy, KP, 1989, HHB-12628-sp

* ***Hyphoderma argillaceum* (Bres.) Donk**

Tsuga heterophylla or *Picea sitchensis* log, Yankee Basin Tr, N of Juneau, Tongass NF, 1991, HHB-13932

* ***Hyphoderma litschaueri* (Burt) J. Erikss. et Strid**

Betula shrub, Tebay L, Chugach Mt, 1990, HHB-13269-sp

* ***Hyphoderma medioburiense* (Burt) Donk**

Hardwood, E end Turnagain Arm, Portage, 1990, HHB-13126

* ***Hyphoderma obtusiforme* J. Erikss. et Strid**

Alnus down branch, S end of Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13415-sp

Salix debris, Mile 13 Denali NP Rd, 1990, HHB-13177-sp

* ***Hyphoderma praetermissum* (Karst) J. Erikss. et Strid**

Alnus sinuata, Mole Harbor, Admiralty I, Tongass NF, 1991, HHB-13715-sp

Picea mariana log, Mile 13 Denali NP Rd, 1990, HHB-13185

Picea sitchensis log, Anchor Pt RecA, KP, 1991, HHB-14119

Populus tremuloides log, Denali NP, 1990, HHB-13206

Tsuga heterophylla or *Picea sitchensis* log, Yankee Basin Tr, N of Juneau, Tongass NF, 1991, HHB-13946

* ***Hyphoderma sambuci* (Pers.) Jülich**

Picea x lutzii, Trail Lakes Cg, S of Moose Pass, KP, 1988, HHB-12425

Picea sitchensis down branch, Mendenhall Gl, W Glacier Tr, Juneau, 1991, HHB-13906

Populus trichocarpa log, Anchor Pt RecA, KP, 1991, HHB-14126

Salix?, Millers Camp N of Eagle, Yukon R, 1990, HHB-13290-sp

Sambucus callicarpa, Gambier Bay, Admiralty I, Tongass NF, 1991, HHB-13716, HHB-13719

S. callicarpa, Lena Beach, Tongass NF, 1991, HHB-13993, HHB-13998

S. callicarpa, Mendenhall Gl, Loop Tr, Juneau, 1991, HHB-13853, HHB-13830

S. callicarpa, Sheep Cr Tr, S of Juneau, Tongass NF, 1991, HHB-13784, 13796

S. callicarpa, Stariski St RecA, 20 mi N of Homer, KP, 1991, HHB-14099

Hyphoderma setigerum (Fr.) Donk

Alnus, McHugh Cr Wayside, Chugach St Park, 1990, HHB-13091-sp, HHB-13093
Alnus sinuata down, Pavlof Harbor, Chichagof I, Tongass NF, 1991, HHB-13754-sp
A. sinuata, Mendenhall Gl, Juneau, 1991, HHB-13828
Betula papyrifera down branch, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13383
Betula, S shore Walker L, NW of Bettles, 1990, HHB-13308
Betula standing snag, Broadview GS, Kenai L, Chugach NF, 1991, HHB-14088
Sambucus callicarpa, Sheep Cr Tr, S of Juneau, Tongass NF, 1991, HHB-13786

* **_Hyphoderma sibiricum_ (Parm.) J. Erikss. et Strid**

Picea x lutzii log, Mile 40 Sterling Hwy, KP, 1989, HHB-12636-sp
Salix, Millers Camp, N of Eagle, Yukon R, 1990, HHB-13289-sp
Tsuga heterophylla log, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14041

*#@ **_Hyphoderma subdefinitum_ J. Erikss. et Strid**

Picea mariana stump, Tustamena L, KP, 1989, HHB-12755-sp

* **_Hyphodermella corrugata_ (Fr.) J. Erikss. et Ryv.**

Alnus, Millers Camp, N of Eagle, Yukon R, 1990, HHB-13284-sp, 13287-sp

Hypholoma sublateritium (Fr.) Quél.

Betula papyrifera log, Three Rivers Cg, KP, 1989, HHB-12658

Hypochnicium bombycinum (Sommerf.:Fr.) J. Erikss.

Alnus sinuata or *Populus trichocarpa*, Mendenhall Gl, Juneau, 1991, HHB-13873
Alnus, Taku Harbor, Tongass NF, 1991, HHB-13689
Salix, dead branch, big tree, Mile 40 Sterling Hwy, KP, 1989, HHB-12631-sp

* **_Hypochnicium detriticum_ (Bourd. et Galz.) J. Erikss. et Ryv.**

Picea sitchensis down, Port Frederick near Halibut I, Chichagof I, Tongass NF, 1991, HHB-13771
Populus trichocarpa down branch, Anchor Pt RecA, KP, 1991, HHB-14134

* **_Hypochnicium eichleri_ (Bres.) J. Erikss. et Ryv.**

Betula log, Anchor Pt RecA, Anchor Pt, KP, 1991, HHB-14112

* **_Hypochnicium lundellii_ (Bourd.) J. Erikss.**

Picea x lutzii log, Mile 60 Seward Hwy, KP, 1989, HHB-12847

* **_Hypochnicium polonense_ (Bres.) Strid**

Alnus dead branch, Eaglewood, Eagle River, 1989, HHB-12802
Populus trichocarpa, Chugach St Park, Eagle River, 1989, HHB-12839

* ***Hypochnicium sphaerosporum* (v.Höhn. et Litsch.) J. Erikss.**
Picea x lutzii, Hope Rd at Seward Hwy, KP, , 1990, HHB-12870, HHB-12879
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13119

***Hypsizygus tessulatus* (Bull.:Fr.) Singer**
Betula kenaiaca, Russian River Ferry, KP, 1988, HHB-12384

***Inonotus tomentosus* (Fr.) S.C. Teng**
Picea x lutzii, under, Russian River Ferry, KP, 1988, HHB-12371, HHB-13281
Picea x lutzii, Cooper Cr Canyon, Cooper Landing, KP , HHB-14163-T

***Ischnoderma resinosum* (Fr.) Karst.**
Tsuga mertensiana log, Virgin Cr, Girdwood, 1990, HHB-13235

* ***Lachnella alboviolascens* (Alb. et Schw.:Fr.)Fr.**
Sambucus callicarpa, Sheep Cr Tr, S of Juneau, Tongass NF, 1991, HHB-13783

* ***Laeticorticium roseum* (Fr.) Donk**
Populus trichocarpa, Broadview GS, Kenai L, KP, 1991, HHB-14166

* ***Lentinellus omphalodes* (Fr.) Karst.**
Betula log, Mile 60 Seward Hwy, KP, 1989, HHB-12856
Salix, dead part live branch, Mile 40 Sterling Hwy, KP, 1989, HHB-12629-sp
Salix snag, Trail River Cg, KP, 1989, HHB-12664-sp
Salix snag, Tustamena L, KP, 1989, HHB-12760-sp

***Lentinellus ursinus* (Fr.) Kühn.**
Populus trichocarpa, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12743

* ***Leptosporomyces galzinii* (Bourd.) Jülich**
Picea mariana, near Chandalar Cr, Porcupine R, 1990, HHB-13296

* ***Leptosporomyces raunkerii* (M.P. Christ.) Jülich**
Picea sitchensis well-decayed log, Port Frederick near Halibut I, Chichagof I, Tongass NF, 1991, HHB-13768

***Leucogyrophana mollusca* (Fr.) Parm.**
Picea glauca log, East Fork Cr at Seward 1988, HHB-12500
Picea x lutzii, Russian River Ferry, KP, 1988, HHB-12367
Picea mariana log, Tustamena L, KP, 1989, HHB-12763, HHB-12767
Picea sitchensis well-decayed log, N of Peterson Cr, S of Girdwood, 1990, HHB-13260

* ***Leucogyrophana romellii* J. Ginns**
Picea x lutzii log, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13399
Tsuga heterophylla log, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14043

* ***Lycoperdon perlatum* Pers.**
well-decayed wood, Mendenhall Gl, Juneau, 1991, HHB-13860-sp

* ***Melzericium udicolum* (Bourd.) Hauerslev.**
Alnus sinuata, Mendenhall Gl, Juneau, 1991, HHB-13837
Alnus, Taku Harbor, S of Juneau, Tongass NF, 1991, HHB-13688
Sambucus callicarpa, Sheep Cr Tr, S of Juneau, Tongass NF, 1991, HHB-13787
Tsuga mertensiana, down twigs, Virgin Cr, Girdwood, 1990, HHB-13212

* ***Merismodes fasciculatus* (Schw.) Donk**
Alnus, Broadview GS, Cooper Landing, Kenai L, KP, 1990, HHB-13342

* ***Odonticium romellii* (Lund.) Parm.**
Pinus contorta var. *contorta*?, N Douglas Hwy, Douglas I, Tongass NF, 1991, HHB-13820

***Oxyporus corticola* (Fr.) Ryv.**
Picea, Oilwell Rd, 4 mi E of Ninilchik,KP, 1989, HHB-12731-sp

***Paxillus involutus* (Batsch.:Fr.) Fr.**
Picea x lutzii stump, Three Rivers Cg, KP, 1989, HHB-12660

***Peniophora aurantiaca* (Bres.) v.Höhn. et Litsch.**
Alnus, Peters Cr Tr, Peters Cr, 1990, HHB-13096-sp
Alnus sinuata, dead branch live tree, Sheep Cr Tr, S of Juneau, Tongass NF, 1991, HHB-13797
Betula down stem, Stariski St RecA, 20 mi N of Homer, KP, 1991, HHB-14105
Salix, dead, Mendenhall Gl, Juneau, 1991, HHB-13821

* ***Peniophora cinerea* (Fr.) Cooke**
Betula, S shore of Walker L, NW of Bettles, 1990, HHB-13310-sp

***Peniophora incarnata* (Fr.) Karst.**
Alnus sinuata, Mendenhall Gl, Juneau, 1991, HHB-13857

* ***Peniophora nuda* (Fr.) Bres.**
Betula, S shore of Walker L, NW of Bettles, 1990, HHB-13305-sp

***Peniophora polygonia* (Fr.) Bourd. et Galz.**
Populus tremuloides, Elmendorf AFB, Anchorage, 1990, HHB-13057-sp, HHB-13061-sp
P. tremuloides, S shore Walker L, NW of Bettles, 1990, HHB-13300
P. tremuloides snag, Broadview GS, Kenai L, Chugach NF, 1991, HHB-14080

***Peniophora violaceolivida* (Sommerf.) Massee**
Alnus, Peters Cr Tr, Peters Cr, 1990, HHB-13116-sp

* **_Perenniporia tenuis_ (Schw.) Ryv. var. _tenuis_ (Schw.) Ryv.**
Populus trichocarpa snag, Yankee Basin Tr, N of Juneau, Tongass NF, 1991, HHB-13953

* **_Phanerochaete burtii_ (Rom.) Parm.**
Alnus, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14065

Phanerochaete gigantea (Fr.:Fr.) Rattan
Picea x lutzii log, Trail Rivers Cg, KP, 1989, HHB-12652-sp
Picea sitchensis, Yankee Basin Tr, 28 mi N of Juneau, Tongass NF, 1991, HHB-13950

Phanerochaete laevis (Pers.:Fr.) J. Erikss.
Picea sitchensis, well-decayed log, Mendenhall Gl, Juneau, 1991, HHB-13866

* **_Phanerochaete rimosa_ (Cooke) Burds.**
Oplopanax horridus, Lena Beach, Tongass NF, 1991, HHB-13992-sp

* **_Phanerochaete sanguinea_ (Fr.) Pouz.**
Tsuga heterophylla or *Picea sitchensis* log, Switzer Tr, Juneau, 1991, HHB-13883

Phanerochaete sordida (Karst.) J. Erikss. et Ryv.
Alnus, Millers Camp north of Eagle, Yukon R, 1990, HHB-13285, HHB-13288-sp
Betula papyrifera log, Eaglewood, Eagle River, 1989, HHB-12793-sp
Picea x lutzii, Mile 60 Seward Hwy, KP, 1989, HHB-12852-sp
Picea sitchensis well-decayed log, Pavlov Harbor, Chichagof I, Tongass NF, 1991, HHB-13753
Populus tremuloides, Elmendorf AFB, 1990, HHB-13076-sp, HHB-13078-sp
P. tremuloides log, Denali NP, 1990, HHB-13207-sp

* **_Phanerochaete velutina_ (DC.:Fr.) Karst.**
Alnus log, Broadview GS, Kenai L, Chugach NF, 1991, HHB-14095
Populus tremuloides,Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14167

Phellinus chrysoloma (Fr.) Donk
Picea mariana down trunk, Tustamena L, KP, 1989, HHB-12766-sp

Phellinus ferreus (Pers.) Bourd. et Galz.
Alnus, Broadview GS, Kenai L, KP, Cooper Lnd, 1988, HHB-12442; 1990, HHB-13345
Alnus down branch, Virgin Cr, Girdwood, 1990, HHB-13241
Alnus sinuata log, Sheep Cr Tr, S of Juneau, Tongass NF, 1991, HHB-13782
Betula papyrifera log, Eaglewood, Eagle River, 1989, HHB-12783-sp
Picea x lutzii log, Trail River Cg, KP, 1989, HHB-12650
Picea x lutzii, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13359
Picea sitchensis? log, Aukenu Tr, Tongass NF, 1991, HHB-14014 cont'd --->

Tsuga mertensiana, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13373
Vaccinum, Mile 12 N Douglas Hwy, Douglas I, Tongass NF, 1991, HHB-13811

Phellinus igniarius **(L.:Fr.) Quél.**
Alnus snag, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14077
Betula live, Broadview GS Kenai L, KP, Chugach NF, 1991, HHB-14067
Betula papyrifera live, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13377
B. papyrifera live, Russian River Ferry, KP, 1988, HHB-12401
B. papyrifera, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12726-sp
Betula papyrifera var. *Kenaica*, Mile 40 Sterling Hwy, KP, 1989, HHB-12617-T
Betula stump, Trail Lakes Cg, S of Moose Pass, KP, 1988, HHB-12423

* ***Phellinus laevigatus*** **(Fr.) Bourd. et Galz.**
Alnus sinuata, Sheep Cr Tr, S of Juneau, Tongass NF, 1991, HHB-13794
Betula papyrifera log, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13389
Betula, Peters Cr Tr, Peters Cr, 1990, HHB-13111-sp

Phellinus nigrolimitatus **(Rom.) Bourd. et Galz.**
Salix? log, Tebay L, Chugach Mt, HHB-13277
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13159

Phellinus pini **(Brot.:Fr.) A. Ames**
Tsuga heterophylla live, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14038
T. heterophylla log, recently fallen, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14034
T. heterophylla snag, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14035
Tsuga heterophylla, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14059
T. mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13125
T. mertensiana log, Virgin Cr, Girdwood, 1990, HHB-13240

Phellinus viticola **(Schw.:Fr.) Donk**
Alnus, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14063, HHB-14098
Alnus, down well-decayed log, N of Peterson Cr, S of Girdwood, 1990, HHB-13250
Alnus, McHugh Cr Wayside, Chugach St Park, Anchorage, 1990, HHB-13092
Alnus, Peters Cr Tr, Peters Cr, 1990, HHB-13098
Alnus snag, N of Peterson Cr, S of Girdwood, 1990, HHB-13249
Betula stump, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14068
Picea mariana log, Tustamena L, KP, 1989, HHB-12761

*#@ ***Phlebia firma*** **J. Erikss. et Hjortst.**
Picea sitchensis, Virgin Cr, Girdwood, 1990, HHB-13210-sp

* ***Phlebia lilascens*** **(Bourd.) J. Erikss. et Hjortst.**
Picea sitchensis log, Mile 10 Seward Hwy, 1989, HHB-12679-sp

*#@ ***Phlebia lindtneri* (Pilát) Parm.**
Salix, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14073

* ***Phlebia subserialis* (Bourd. et Galz.) Donk**
Picea glauca, Chugach St Park, Eagle 1989, HHB-12837-sp

* ***Phlebiella christiansenii* (Parm.) Larss. et Hjortst.**
Tsuga mertensiana, E end Turnagain arm, Portage, 1990, HHB-13149

*#@ ***Phlebiella fibrillosa* (Hallenb.) Larss. et Hjortst.**
Picea x lutzii down branch, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13409

* ***Phlebiella grisella* (Bourd.) Larss. et Hjortst.**
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13124

*# ***Phlebiella insperata* (Jacks.) Ginns et Lefebvre**
Picea x lutzii down branch, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13410

* ***Phlebiella pseudotsugae* (Burt) Larss. et Hjortst.**
Tsuga heterophylla log, Spaulding Tr, Auke Bay, Tongass NF, 1991, HHB-14022

***Phlebiella vaga* (Fr.) Karst.**
Alnus log well-decayed log, N of Peterson Cr, S of Girdwood, 1990, HHB-13262
Betula log, Hope Rd at Seward Hwy, KP, 1989, HHB-12872
Betula nana, Clarence L Inlet, NW of L Louise, 1990, HHB-13325
Picea x lutzii log, well-decayed log, Three Rivers Cg, KP, 1989, HHB-12666
Picea x lutzii log, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13379
Picea x lutzii, Trail Lakes Cg, S of Moose Pass, KP, 1988, HHB-12422
Picea mariana stump, Tustamena L, KP, 1989, HHB-12754
Pinus contorta var. *contorta*, Eagle Crest Rd Douglas I, Tongass NF, 1991, HHB-13969
Tsuga heterophylla down, Patterson Bay, Chichagof I, Tongass NF, 1991, HHB-13759
T. heterophylla down branch, Murder Cove, S tip Admiralty I, Tongass NF, 1991, HHB-13734
T. heterophylla? log, Yankee Basin Tr, 28 mi N of Juneau, Tongass NF, 1991, HHB-13925

* ***Pholiota albocrenulata* (Peck) Sacc.**
Betula live tree, Oilwell Rd, 4 mi E of 1989, HHB-12749-sp

* ***Pholiota alnicola* (Fr.) Singer**
Betula papyrifera snag, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12736-T

* ***Pholiota curvipes* (Fr.) Quél.**
Betula papyrifera, base of live, Trail River Cg, KP, 1989, HHB-12648A-sp

* ***Pholiota limonella* (Peck) Sacc.**
Betula papyrifera base, Eaglewood, Eagle River, 1989, HHB-12811-sp
B. papyrifera, K Reynolds home, Eagle River, 1989, HHB-11272-T
B. papyrifera live, near Keith Reynolds' home, Eagle River, 1989, HHB-12648
B. papyrifera stump, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12721-sp

* ***Pholiota rigidipes* Peck**
Betula papyrifera snag, Oilwell Rd 4 mi E of Ninilchik, KP, 1989, HHB-12777-sp-T

* ***Pholiota squarrosa* (Fr.) Kummer**
Betula papyrifera snag, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12737-sp-T

* ***Pholiota terrestris* Overh.**
near *Picea x lutzii*, Roadside near Cooper Cr Cg,KP, 1988, HHB-12404
Soil near *Alnus* and *Picea*, Three Rivers Cg, KP, 1989, HHB-12668-sp-T

* ***Piloderma bicolor* (Peck) Jülich**
Picea x lutzii dead root, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13421
Picea x lutzii stump, well-decayed/burned, Mile 40 Sterling Hwy, KP, 1989, HHB-12619
Picea mariana log, Tustamena L, KP, 1989, HHB-12753, HHB-12764
Salix low branch, Elmendorf AFB, Anchorage, 1990, HHB-13059
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13143

***Pleurocybella porrigens* (Pers.:Fr.) Singer**
Picea sitchensis down, Exit Gl,near Seward, KP, 1989, HHB-12699-T
P. sitchensis log, Golden Fin L, N of Seward, KP, 1988, HHB-12462

***Pleurotus ostreatus* (Jacq.:Fr.) Quél.**
Betula, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12750-sp
Populus tremuloides stump, Eaglewood, Eagle 1989, HHB-12797-T

***Plicatura nivea* (Fr.) Karst.**
Alnus, Russian River Ferry, KP, 1988, HHB-12406-sp
Alnus, Eaglewood, Eagle River, 1989, HHB-12782

***Plicaturopsis crispa* (Fr.) Reid**
Betula papyrifera down branch, Eaglewood, Eagle River, 1989, HHB-12787

* ***Polyporus brumalis* Pers.:Fr.**
Betula, Oilwell Rd 4 mi E of Ninilchik,KP, 1989, HHB-12725-sp

***Polyporus elegans* Bull.:Fr.**
Alnus sinuata stump, Mendenhall Gl, Juneau, 1991, HHB-13854, HHB-13877
Salix ?, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14072-sp

***Polyporus melanopus* Fr.**
Picea sitchensis roots, Mendenhall Gl, Juneau, 1991, HHB-13864

***Polyporus varius* Fr.**
Alnus, Broadview GS, Cooper Lnd, Kenai L, KP, 1990, HHB-13355-sp
Alnus sinuata, Trap Bay, Chichagof I, Tongass NF, 1991, HHB-13674-T
Salix trunk, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14084

***Postia caesia* (Schrad.:Fr.) Karst.**
Alnus sinuata down branch,Yankee Basin Tr, 28 mi N of Juneau, Tongass NF, 1991, HHB-13941
Picea glauca, Chugach St Park, Eagle River, 1989, HHB-12815
Picea x lutzii, Broadview GS, KP, 1988, HHB-12443
Populus tremuloides dead trunk, Eaglewood, Eagle River, 1989, HHB-12805
Tsuga heterophylla down branch, Murder Cove, Admiralty I, Tongass NF, 1991, HHB-13735
T. heterophylla, Mendenhall Gl, Loop Tr, Juneau, 1991, HHB-13844

***Postia fragilis* (Fr.) Jülich**
Picea x lutzii log, Three Rivers Cg, KP, 1989, HHB-12654-T
Tsuga, Hope Rd at Seward Hwy, KP, 1989, HHB-12877-T

***Postia mappa* (Overh. et Lowe) M.J. Larsen et Lombard**
Picea glauca, Elmendorf AFB, Anchorage, 1990, HHB-13070-sp

* ***Postia perdelicata* (Murr.) M.J. Larsen et Lombard**
Alnus sinuata log, Mendenhall Gl, Juneau, 1991, HHB-13868-T
A. sinuata well-decayed log, Sheep Cr Tr, S of Juneau, Tongass NF, 1991, HHB-13781
Betula branch, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14078-T
Betula snag, Eaglewood, Eagle River, 1989, HHB-12809-T

* ***Postia stiptica* (Pers.:Fr.) Jülich**
Tsuga heterophylla scar live tree, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14031-T

* ***Postia undosa* (Peck) Jülich**
Picea x lutzii down, Trail Lakes Cg, KP, 1988, HHB-12411

Pseudohydnum gelatinosum (Scop.:Fr.) Karst.
Picea sitchensis and *Populus trichocarpa*, Exit Gl, near Seward, 1989, HHB-12683

* **_Pseudomerulius aureus_ (Fr.) Jülich**
Tsuga heterophylla or *Picea sitchensis* log, Spaulding Tr, Auke Bay, Tongass NF, 1991, HHB-14027-sp

* **_Pseudotomentella humicola_ M.J. Larsen**
Alnus trunk well-decayed, N of Peterson Cr, S of Girdwood, 1990, HHB-13263

Pycnoporellus alboluteus (Ell. et Ev.) Kotl. et Pouz.
Picea glauca log, Chugach St Park, Eagle River, 1989, HHB-12816-sp
Picea sitchensis well-decayed log, Mile 12 Seward Hwy, KP, 1988, HHB-12490

* **_Ramaricium flavomarginatum_ (Burt) Ginns**
Picea sitchensis log, Exit Gl, near Seward, 1989, HHB-12690-sp

* **_Resinicium bicolor_ (Fr.) Parm.**
Oplopanax horridus, Lena Beach, Tongass NF, 1991, HHB-13995

* **_Resinicium furfuraceum_ (Bres.) Parm.**
Picea x lutzii log, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13381
Picea sitchensis or *Tsuga heterophylla* log, Spaulding Tr, Auke Bay, Tongass NF, 1991, HHB-14008
P. sitchensis or *T. heterophylla*, Aukenu Tr, Chugach NF, 1991, HHB-14013
Picea sitchensis, Saook Bay, Baronov I, Tongass NF, 1991, HHB-13671
Tsuga heterophylla log, Mile 12 N Douglas Hwy, Douglas I, Tongass NF, 1991, HHB-13802, HHB-13803
T. heterophylla stump, Spaulding Tr, Auke Bay, Tongass NF, 1991, HHB-14018
T. heterophylla or *P. sitchensis* log, Spaulding Tr, Auke Bay, Tongass NF, 1991, HHB-14007

Rigidoporus crocatus (Pat.) Ryv.
Picea sitchensis log, Lena Beach, Tongass NF, 1991, HHB-14000
Tsuga heterophylla, Port Alexander, Mitkof I, 1991, HHB-13692

* **_Schizopora paradoxa_ (Fr.) Donk**
Alnus dead branches, Eaglewood, Eagle River, 1989, HHB-12803-sp
Alnus, Peters Cr Tr, Peters Cr, 1990, HHB-13101-sp
Populus tremuloides, Elmendorf AFB, Anchorage, 1990, HHB-13071

Sebacina cinerea Bres.
Alnus sinuata down, Cooper Cr Cg, Cooper Lnd, KP, 1991, HHB-14150

* **_Sistotrema brinkmannii_ (Bres.) J. Erikss.**
Picea x lutzii, Russian River Ferry, KP, 1988, HHB-12372

*# **_Sistotrema farinacea_ Hallenb.**

Alnus sinuata twig, Pavlov Harbor, Chichagof I, Tongass NF, 1991, HHB-13755-sp

Pinus contorta var. *contorta*, Eagle Crest Rd Douglas I, Tongass NF, 1991, HHB-13964

Sistotrema muscicola (Pers.) Lundell

Tsuga heterophylla log, Yankee Basin Tr, 28 mi N of Juneau, Tongass NF, 1991, HHB-13947

T. heterophylla or *Picea sitchensis* log, Yankee Basin Tr, N of Juneau, Tongass NF, 1991, HHB-13937

*# **_Sistotrema oblongisporum_ M.P. Christ. et Hauersl.**

Betula papyrifera log, S end Johnson Pass Tr, Chugach N.F. KP, 1990, HHB-13426-sp

Picea sitchensis? stump, Yankee Basin Tr, Tongass NF, 1991, HHB-13931

*# **_Sistotrema porulosum_ Hallenb.**

Alnus sinuata, Mendenhall Gl, Juneau, 1991, HHB-13858

* **_Sphaerobasidium minutum_ (J. Erikss.) Oberw.:Jülich**

Tsuga heterophylla log, Switzer Cr, Juneau, 1991, HHB-13884

* **_Steccherinum fimbriatum_ (Pers.:Fr.) Liberta**

Alnus sinuata, Cooper Cr Cg, Cooper Lnd, KP, 1991, HHB-14149

Steccherinum ochraceum (Pers. apud Gmel.: Fr.) S.F. Gray

Populus tremuloides down branch, Denali NP, 1990, HHB-13202-sp

Populus trichocarpa, Peters Cr Tr, Peters Cr, 1990, HHB-13110-sp

Stereum rugosum (Pers.:Fr.) Fr.

Alnus, Eaglewood, Eagle River, 1989, HHB-12781

Alnus, Peters Cr Tr, Peters Cr, 1990, HHB-13113-sp

Alnus snag, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13390-sp

Alnus sinuata, dead branch live tree, Stariski St RecA, N of Homer, KP, 1991, HHB-14101

A. sinuata, Mendenhall Gl, Juneau, 1991, HHB-13852

Betula nana, Clarence L inlet, NW of L Louise, 1990, HHB-13324

Betula, S shore Walker L, NW of Bettles, 1990, HHB-13303-sp

Betula twigs, Mile 40 Seward Hwy, KP, 1989, HHB-12635

Salix down branch, Broadview GS, KP, Chugach NF, 1991, HHB-14083

Vaccinum down branch, Mile 12 N Douglas Hwy, Tongass NF, 1991, HHB-13816

Stereum sanguinolentum (Alb. et Schw.:Fr.) Fr.

Picea glauca down tip, Denali NP, 1990, HHB-13196-sp

Picea x lutzii stump, Three Rivers 1989, HHB-12656-sp

Picea sitchensis log, Mendenhall Gl, W Glacier Tr, Juneau, 1991, HHB-13910-sp -->

P. sitchensis log off ground, N of Peterson Cr, S of Girdwood, 1990, HHB-13257
P. sitchensis log, Exit Gl, near Seward, KP, 1989, HHB-12688-sp
P. sitchensis, wound of dead standing, Lena Beach, Tongass NF, 1991, HHB-13983
Tsuga heterophylla, live, porcupine scarred, Port Alexander, Mitkof I, Tongass NF, 1991, HHB-13693
Tsuga, Hope Rd at Seward Hwy, KP, 1989, HHB-12865-sp, HHB-12869
Tsuga mertensiana dead branch of live tree, Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13371-sp, HHB-13376-sp

* ***Subulicystidium longisporium* (Pat.) Parm.**
Alnus sinuata, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14056
Alnus sinuata, Mendenhall Gl, Juneau, 1991, HHB-13870
Tsuga heterophylla down bark, Mendenhall Gl, Juneau, 1991, HHB-13846

***Thelephora terrestris* Fr.**
Picea stump, well-decayed, Trail R Cg, KP, 1989, HHB-12651
Tsuga heterophylla, sphagnum under, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14036

* ***Tomentella bryophila* (Pers.) M.J. Larsen**
Picea glauca, Broadview GS, Kenai L, KP, Chugach NF, 1990, HHB-13350
Picea sitchensis log, Yankee Basin Tr, 28 mi N of Juneau, Tongass NF, 1991, HHB-13921

* ***Tomentella ramosissima* (Berk. et Curt.) Wakef.**
Tsuga heterophylla or *Picea sitchensis*, Mole Harbor, Admiralty I, Tongass NF, 1991, HHB-13714

*# ***Tomentella subalpina* M.J. Larsen**
Populus, well-decayed log, Cooper Cr Cg, Cooper Landing, , 1991, HHB-14151

* ***Tomentella umbrinospora* M.J. Larsen**
Betula log, Hope Rd at Seward Hwy, KP, 1989, HHB-12875-sp

* ***Tomentellopsis echinospora* (Ell.) Hjortst.**
Picea x lutzii, Russian River Ferry, KP, 1988, HHB-12368

* ***Trametes cervina* (Schw.) Bres.**
Picea glauca, Broadview GS, Cooper Lnd, Kenai L, KP, 1990, HHB-13353-sp
Picea x lutzii, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13358-sp

***Trametes hirsuta* (Wulff.:Fr.) Pilát**
Betula papyrifera, Eaglewood, Eagle River, 1989, HHB-12790

***Trametes ochracea* (Pers.) Gilbn. et Ryv.**
Populus tremuloides log, Tustamena L, KP, 1989, HHB-12758

Trametes pubescens (Schum.:Fr.) Pilát
Betula papyrifera down branch, Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13429-sp

Trametes suaveolens L.:Fr.
Populus log, 1609 Eagle River Rd, Eagle 1991, HHB-14170-T
P. trichocarpa, Chugach St Park, Eagle River, 1989, HHB-12827, HHB-12840-T

Trametes trogii Berk.
Picea glauca, East Fork Cr at Seward 1988, HHB-12505

Trechispora confinis (Bourd. et Galz.) Liberta
Populus tremuloides, Elmendorf AFB, Anchorage, 1990, HHB-13062-sp

* **_Trechispora farinacea_ (Pers.:Fr.) Liberta**
Picea x lutzii dead roots, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13422
Picea sitchensis well-decayed log, Hood Bay, W side Admiralty I, Tongass NF, 1991, HHB-13740
Tsuga heterophylla down log, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14042
T. heterophylla or *P. sitchensis* log, Lena Beach, Tongass NF, 1991, HHB-13986

* **_Trechispora microspora_ (Karst.) Liberta**
Picea x lutzii, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13366, HHB-13395
Tsuga mertensiana? log, Virgin Cr, Girdwood, 1990, HHB-13229

Trechispora mollusca (Pers.:Fr.) Liberta
Picea sitchensis log, Virgin Cr, Girdwood, 1990, HHB-13226
P. sitchensis, Todd, Chichagof I, Tongass NF, 1991, HHB-13667
Tsuga heterophylla or *P. sitchensis* log, Lena Beach, Tongass NF, 1991, HHB-13996

*# **_Trechispora stellulata_ (Bourd. et Galz.) Liberta**
Betula log, Broadview GS, Kenai L, KP, Chugach NF, 1991, HHB-14079
Picea x lutzii, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13361
Tsuga heterophylla or *Picea sitchensis* log, Lena Beach, Tongass NF, 1991, HHB-13989
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13121

* **_Tremella fuciformis_ Berk.**
Betula log, Hope Rd at Seward Hwy, KP, 1989, HHB-12876-sp

* ***Tremella mesenterica* Fr.**

Alnus sinuata down branch, Sheep Cr Tr, S of Juneau, Tongass NF, 1991, HHB-13795
Populus trichocarpa log, Anchor Pt RecA, Halibut Cg, KP, 1991, HHB-14128

***Trichaptum abietinum* (Dicks.:Fr.) Ryv.**

Picea glauca down top, Denali NP HQ, 1990, HHB-13198
Picea x lutzii, Mile 60 Seward Hwy, KP, 1989, HHB-12858
Picea x lutzii, Russian River Ferry, KP, 1988, HHB-12385
Picea x lutzii, Trail Lakes Cg, S of Moose Pass, KP, 1988, HHB-12429
Picea sitchensis, Golden Fin L, N of Seward, KP, 1988, HHB-12467
P. sitchensis stump, Mile 10 Seward Hwy, KP, 1989, HHB-12677
P. sitchensis or *Tsuga heterophylla*, Mile 12 N Douglas Hwy, Tongass NF, 1991, HHB-13799-sp
T. heterophylla log, Fish Cr, Douglas I, Tongass NF, 1991, HHB-14033

* ***Trichoderma harzianum* Rifai**

Picea glauca log, Denali NP HQ, 1990, HHB-13192
Populus tremuloides down branch, Denali NP HQ, 1990, HHB-13203
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13160

* ***Tubulicrinis accedens* (Bourd. et Galz.) Donk**

Picea x lutzii stump, Mile 40 Sterling 1989, HHB-12623-sp
Picea glauca well-decayed log,Tebay L, Chugach Mt, 1990, HHB-13267

* ***Tubulicrinis angustus* (Rog. et Weres.) Donk**

Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13148

* ***Tubulicrinis borealis* J. Erikss.**

Betula, S shore Walker L, NW of Bettles, 1990, HHB-13307
Picea glauca stump, Broadview GS, Kenai L, KP, Chugach NF, 1990, HHB-13338
Picea x lutzii, Russian River Ferry, KP, 1988, HHB-12390
Picea sitchensis?, Exit Gl, near Seward, KP, 1989, HHB-12687

* ***Tubulicrinis effugiens* (Bourd. et Galz.) Oberw.**

Tsuga heterophylla, well-decayed log, Murder Cove, Admiralty I, Tongass NF, 1991, HHB-13736

* ***Tubulicrinis gracillimus* (Rog. et Jacks.) G.H. Cunn.**

Betula log, Anchor Pt RecA, Anchor Pt, KP, 1991, HHB-14118
Betula, S shore Walker L, NW of Bettles, 1990, HHB-13312
Betula nana, Clarence L Inlet, NW of L 1990, HHB-13321-sp, HHB-13321-sp, HHB-13323-sp, HHB-13328-sp
Betula papyrifera, Broadview GS Cooper Lnd, Kenai L, KP, 1990, HHB-13352
Menziesia, Security Bay, Kuiu I, Tongass NF, 1991, HHB-13729
Picea glauca log, Chugach St Park, Eagle River, 1989, HHB-12830 cont'd --->

P. glauca stump, Broadview GS, Cooper Lnd, Kenai L,. KP, 1990, HHB-13332
Picea x lutzii down branch, Johnson Pass Tr, Chugach N.F., KP, 1990, HHB-13404-sp
Picea x lutzii, Russian River Ferry, KP, 1988, HHB-12391
Picea sitchensis, dead branch live tree, Mendenhall Gl, W Glacier Tr, 1991, HHB-13897, HHB-13899, HHB-13912
P. sitchensis, Mendenhall Gl, Juneau, 1991, HHB-13861
P. sitchensis, dead branch, Mendenhall Gl, W Glacier Tr, Juneau, 1991, HHB-13905, HHB-13908
P. sitchensis, dead branch live tree, Virgin Cr, Girdwood, 1990, HHB-13237, HHB-13242
P. sitchensis, dead branch live tree, Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13382
P. sitchensis, down branch, Anchor Pt RecA, KP, 1991, HHB-14124
P. sitchensis or *Tsuga heterophylla*, down branch, Switzer Tr, Juneau, 1991, HHB-13879
Salix dead branch, Tebay L, Chugach Mt, 1990, HHB-13265, HHB-13283
Salix debris, Mile 13 Denali NP Rd, 1990, HHB-13174, HHB-13176, HHB-13180, HHB-13199
Tsuga heterophylla down branch, Eagle Crest Rd, Douglas I, Tongass NF, 1991, HHB-13978
T. heterophylla down branch, Spaulding Tr, Auke Bay, Tongass NF, 1991, HHB-14016
T. heterophylla down branches, Kadake Bay, Kuiu I, Tongass NF, 1991, HHB-13726
T. heterophylla down branch, Mile 12 N Douglas Hwy, Tongass NF, 1991, HHB-13800
T. heterophylla, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14037
T. heterophylla, well-decayed log, Switzer Tr, Juneau, 1991, HHB-13881
T. heterophylla?, Hawk Inlet, Admiralty I, Tongass NF, 1991, HHB-13653
T. heterophylla?, Hawk Inlet, Admiralty I, Tongass NF, 1991, HHB-13650
T. heterophylla or *P. sitchensis* down, Thayer L, Admiralty I, Tongass NF, 1991, HHB-13743
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13134, HHB-13146
Tsuga mertensiana, S end Turnagain Arm, Portage, 1990, HHB-13123

*** *Tubulicrinis regificus* (Jacks. et Deard.) Donk**
Betula papyrifera down branch, S end Johnson Pass Tr, Chugach NF, KP, 1990, HHB-13413

***#@ *Tubulicrinis sororius* (Bourd. et Galz.) Oberw.**
Tsuga heterophylla down branch, Patterson Bay, Chichagof I, Tongass NF, 1991, HHB-13756
T. heterophylla or *Picea sitchensis* down, N arm Hoonah Sound, Chichagof I, Tongass NF, 1991, HHB-13761

* ***Tubulicrinis subulatus* (Bourd. et Galz.) Donk**
Picea glauca, Broadview GS, Cooper Lnd, Kenai L, KP, 1990, HHB-13349
Picea x lutzii, S end Johnson Pass Tr, Chugach NF KP, 1990, HHB-13360
Picea sitchensis down, Virgin Cr, Girdwood, 1990, HHB-13225
Tsuga heterophylla, Mile 12 N Douglas Hwy, Tongass NF, 1991, HHB-13807
T. heterophylla or *P. sitchensis* log, Yankee Basin Tr, N of Juneau, Tongass NF, 1991, HHB-13936

* ***Tulasnella allantospora* Wakef. et Pearson**
Tsuga heterophylla log, Fish Cr Tr, Douglas I, Tongass NF, 1991, HHB-14054-sp
Betula log, East Fork Cr at Seward Hwy, KP, 1988, HHB-12522

* ***Tulasnella bifrons* Bourd. et Galz.**
Alnus sinuata or *Salix*, Mendenhall Gl, Loop Tr, Juneau, 1991, HHB-13835

* ***Tulasnella fuscoviolacea* Bres.**
Picea sitchensis, bark down branches, Mile 12 Seward Hwy, KP, 1988, HHB-12483

* ***Tulasnella violea* (Quél.) Bourd. et Galz.**
Betula log, Mile 60 Seward Hwy, KP, 1989, HHB-12844
Alnus sinuata, Mendenhall Gl, Loop Tr, Juneau, 1991, HHB-13840

* ***Typhula setipes* (Greveille) Berthier**
Epilobium (fireweed) stems, Oilwell Rd, 4 mi E of Ninilchik, KP, 1989, HHB-12747-sp

***Tyromyces chioneus* (Fr.) Karst.**
Betula papyrifera dead branch, Mile 40 Sterling Hwy, KP, 1989, HHB-12627-sp

* ***Vararia investiens* (Schw.) Karst.**
Betula, S shore Walker L, NW of Bettles, 1990, HHB-13306
Picea x lutzii, Russian River Ferry, KP, 1988, HHB-12362

***Veluticeps abietina* (Pers.:Fr.) Hjortst. et Tell.**
Alnus sinuata, Hawk Inlet, Admiralty I, Tongass NF, 1991, HHB-13649-sp
Picea log, Broadview GS, Kenai L, Chugach NF, 1991, HHB-14090, HHB-14093
Picea x lutzii log, Mile 40 Sterling Hwy, KP, 1989, HHB-12622-sp
Picea x lutzii, Mile 60 Seward Hwy, KP, 1989, HHB-12862-sp
Picea x lutzii, Russian River Ferry, KP, 1988, HHB-12363
Picea mariana log, Tustamena L, KP, 1989, HHB-12773, HHB-12774
Picea sitchensis log, Mile 10 Seward Hwy, KP, 1989, HHB-12676
P. sitchensis, N of Peterson Cr, S of 1990, HHB-13256
P. sitchensis?, Golden Fin L, N of Seward, 1988, HHB-12456
P. sitchensis, Todd, Chichagof I, Tongass NF, 1991, HHB-13663-sp
Tsuga heterophylla, down branch, Spaulding Tr, Auke Bay, Tongass NF, 1991, HHB-14017 cont'd --->

T. heterophylla or *P. sitchensis* log, Eagle Crest Rd, Douglas I, Tongass NF, 1991, HHB-13981-sp
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13120, HHB-13133

* **_Xenasma pruinosum_ (Pat.) Donk**
Tsuga mertensiana, E end Turnagain Arm, Portage, 1990, HHB-13142

Xeromphalina campanella (Bat.:Fr.) Kühn. et Maire
Picea x lutzii, Hope Rd at Seward Hwy, KP, 1989, HHB-12864-sp

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Host index of wood-inhabiting fungi of Alaska

--includes only fungi listed in this report

Alnus sinuata (Reg.) Rydb.
Amphinema byssoides, Athelia coprophila, Bjerkandera adusta, Calocera cornea, Cytidia salicina, Ganoderma applanatum, Gloeocystidiellum leucoxanthum, Grandinia aspera, Grandinia barba-jovis, Grandinia breviseta, Grandinia subalutacea, Hyphoderma praetermissum, Hyphoderma setigerum, Hypochnicium bombycinum, Melzericium udicolum, Peniophora aurantiaca, Peniophora incarnata, Phellinus ferreus, Phellinus laevigatus, Polyporus elegans, Polyporus varius, Postia caesia, Postia perdelicata, Sebacina cinerea, Sistotrema farinacea, Sistotrema porulosum, Steccherinum fimbriatum, Stereum rugosum, Subulicystidium longisporium, Tremella mesenterica, Tulasnella biformis, Tulasnella violea, Veluticeps abietina

Alnus *sp.*
Amphinema byssoides, Basidioradulum radulum, Encoelia furfuraceum, Fibricium rude, Gloeocystidiellum leucoxanthum, Gloeocystidiellum luridum, Grandinia arguta, Grandinia barba-jovis, Grandinia crustosa, Grandinia pruni, Grandinia quercina, Hapalopilus nidulans, Hyphoderma obtusiforme, Hyphoderma setigerum, Hyphodermella corrugata, Hypochnicium bombycinum, Hypochnicium polonense, Melzericium udicolum, Merismodes anomala, Merismodes fasciculatus, Peniophora aurantiaca, Peniophora violaceolivida, Phanerochaete burtii, Phanerochaete sordida, Phanerochaete velutina, Phellinus ferreus, Phellinus viticola, Phlebiella vaga, Plicatura nivea, Polyporus varius, Pseudotomentella humicola, Schizopora paradoxa, Stereum rugosum

Betula nana L.
Cytidia salicina, Gloeocystidiellum convolvens, Gloeocystidiellum leucoxanthum Grandinia quercina, Phlebiella vaga, Stereum rugosum, Tubulicrinis gracillimus

Betula papyrifera **Marsh.**
Atheliopsis glaucina, Coniophora puteana, Fibricium rude, Galerina stylifera, Grandinia abieticola, Grandinia altaica, Grandinia barba-jovis, Grandinia crustosa, Hericium ramosum, Hyphoderma setigerum, Hypholoma sublateritium, Phanerochaete sordida, Phellinus ferreus, Phellinus igniarius, Phellinus laevigatus, Pholiota alnicola, Pholiota curvipes, Pholiota limonella, Pholiota rigidipes, Pholiota squarrosa, Plicaturopsis crispa, Sistotrema oblongisporum, Trametes hirsuta, Trametes pubescens, Tubulicrinis gracillimus, Tubulicrinis regificus, Tyromyces chioneus

Betula *sp.*
Cerrena unicolor, Chlorocibora aeruginascens, Crepidotus phaseoliformis, Cudonia circinans, Dacrymyces minor, Exidia repanda, Fomes fomentarius, Grandinia altaica, Grandinia arguta, Grandinia barba-jovis, Hyphoderma litschaueri, Hyphoderma setigerum, Hypochnicium eichleri, Hypsizygus tessulatus, Lentinellus omphalodes, Peniophora aurantiaca, Peniophora cinerea, Peniophora nuda, Phellinus igniarius, Phellinus laevigatus, Phellinus viticola, Phlebiella vaga, Pholiota albocrenulata, Pleurotus ostreatus, Polyporus brumalis, Postia perdelicata, Stereum rugosum, Tomentella umbrinospora, Trechispora stellulata, Tremella fuciformis, Tubulicrinis borealis, Tubulicrinis gracillimus, Tulasnella allantospora, Tulasnella violea, Vararia investiens

Epilobium (fireweed)
Typhula setipes

Menziesia ferruginea **Sm.**
Tubulicrinis gracillimus

Oplopanax horridus **(Sm.) Miq.**
Grandinia pruni, Phanerochaete rimosa, Resinicium bicolor

Picea glauca **(Moench) Voss**
Acanthophysium lividocaeruleum, Amphinema byssoides, Amylocorticium subincarnata, Antrodia sitchensis, Asterodon ferruginosa, Chaetoderma luna, Coniophora puteana, Crustoderma dryinum, Fibulomyces mutabilis, Grandinia alutacea, Leucogyrophana mollusca, Phlebia subserialis, Postia caesia, Postia mappa, Pycnoporellus alboluteus, Stereum sanguinolentum, Tomentella bryophila, Trametes cervina, Trametes trogii, Trichaptum abietinum, Trichoderma harzianum, Tubulicrinis accedens, Tubulicrinis borealis, Tubulicrinis gracillimus, Tubulicrinis subulatus

Picea x lutzii
Acanthophysium weirii, Albatrellus ovinus, Amphinema byssoides, Amylocystis lapponicus, Anomoporia bombycina, Antrodia carbonica, Antrodia heteromorpha, Antrodia sinuosa, Antrodia sitchensis, Athelia decipiens, Athelia fibulata, Botryobasidium botryosum, Botryobasidium candicans, Coniophora arida,

Coniophora olivacea, Coniophora puteana, Cylindrobasidium albulum, Dacrymyces chrysospermus, Diplomitoporus lindbladii, Fibulomyces mutabilis, Gloeophyllum sepiarium, Grandinia alutaria, Grandinia aspera, Grandinia breviseta, Grandinia subalutacea, Hapalopilus salmonicolor, Hyphoderma sambuci, Hyphoderma sibiricum, Hypochnicium lundellii, Hypochnicium sphaerosporum, Inonotus tomentosus, Leucogyrophana mollusca, Leucogyrophana romellii, Paxillus involutus, Phanerochaete gigantea, Phanerochaete sordida, Phellinus ferreus, Phlebiella fibrillosa, Phlebiella insperata, Phlebiella vaga, Pholiota terrestris, Piloderma bicolor, Postia caesia, Postia fragilis, Postia undosa, Resinicium furfuraceum, Sistotrema brinkmannii, Stereum sanguinolentum, Tomentellopsis echinospora, Trametes cervina, Trechispora farinacea, Trechispora microspora, Trechispora stellulata, Trichaptum abietinum, Tubulicrinis accedens, Tubulicrinis borealis, Tubulicrinis gracillimus, Tubulicrinis subulatus, Vararia investiens, Veluticeps abietina, Xeromphalina campanella

***Picea mariana* (Mill.) B.S.P.**
Amphinema byssoides, Athelia bombacina, Bourdotia caesio-cinerea, Ceraceomerulius serpens, Chaetoderma luna, Coniophora arida, Coniophora olivacea, Gloeocystidiellum furfuraceum, Gloeophyllum sepiarium, Grandinia aspera, Hyphoderma praetermissum, Hyphoderma subdefinitum, Leptosporomyces galzinii, Leucogyrophana mollusca, Phellinus chrysoloma, Phellinus viticola, Phlebiella vaga, Piloderma bicolor, Veluticeps abietina

***Picea sitchensis* (Bong,) Carr.**
Acanthophysium spiniger, Acanthophysium weirii, Aleurocystidellum subcruentatum, Aleurodiscus amorphus, Aleurodiscus penicillatus, Amphinema byssoides, Amylocorticium cebennense, Antrodia albobrunnea, Athelia bombacina, Athelia fibulata, Botryobasidium botryosum, Botryobasidium danicum, Botryohypochnus isabellinus, Ceraceomyces tessulatus, Chaetoderma luna, Coniophora arida, Dacrymyces delequescens, Dacrymyces minor, Grandinia arguta, *Grandinia aspera, Grandinia breviseta, Heterotextus luteus, Hyphoderma* praetermissum, Hyphoderma sambuci, Hypochnicium detriticum, Leptosporomyces raunkerii, Leucogyrophana mollusca, Phanerochaete gigantea, Phanerochaete laevis, Phanerochaete sanguinea, Phanerochaete sordida, Phellinus ferreus, Phlebia firma, Phlebia lilascens, Pleurocybella porrigens, Polyporus melanopus, Pseudohydnum gelatinosum, Pycnoporellus alboluteus, Ramaricium flavomarginatum, Resinicium furfuraceum, Rigidoporus crocatus, Sistotrema oblongisporum, Stereum sanguinolentum, Tomentella bryophila, Trechispora farinacea, Trechispora mollusca, Trichaptum abietinum, Tubulicrinis borealis, Tubulicrinis gracillimus, Tubulicrinis subulatus, Tulasnella fuscoviolacea, Veluticeps abietina

Picea* *sp.
Aleurodiscus cerrusatus, Antrodia albida, Botryobasidium subcoronatum, Calocera viscosa, Dacrymyces chrysospermus, Diplomitoporus crustulinus, Gloeophyllum sepiarium, Grandinia alutaria, Grandinia floccosa, Oxyporus corticola, Thelephora terrestris, Veluticeps abietina

Pinus contorta **Dougl. var. *contorta***
Athelia bombacina, Botryobasidium laeve, Byssocorticium lutescens, Chaetoderma luna, Dacrymyces minor, Dacrymyces tortus, Grandinia pruni, Odonticium romellii, Phlebiella vaga, Sistotrema farinacea

Populus tremuloides **Michx.**
Acanthophysium cerrusatus, Amphinema byssoides, Bjerkandera adusta, Ceraceomerulius serpens, Ceriporiopsis pannocincta, Cylindrobasidium laeve, Fibricium rude, Ganoderma applanatum, Gloeocystidiellum convolvens, Gloeocystidiellum karstenii, Grandinia alienata, Grandinia quercina, Hyphoderma praetermissum, Peniophora polygonia, Phanerochaete sordida, Phanerochaete velutina, Pleurotus ostreatus, Postia caesia, Schizopora paradoxa, Steccherinum ochraceum, Trametes ochracea, Trechispora confinis, Trichoderma harzianum

Populus trichocarpa **Torr. & Gray**
Amphinema byssoides, Antrodia heteromorpha, Athelia arachnoidea, Bjerkandera adusta, Botryobasidium laeve, Bourdotia eyeri, Cheimonophyllum candidissimum, Chondrostereum purpureum, Cyphellopsis anomala, Dacrymyces minor, Gloeocystidiellum leucoxanthum, Grandinia barba-jovis, Grandinia spathulata, Hericium ramosum, Hyphoderma sambuci, Hypochnicium detriticum, Hypochnicium polonense, Laeticorticium roseum, Lentinellus ursinus, Perenniporia tenuis var. tenuis, Pseudohydnum gelatinosum, Steccherinum ochraceum, Trametes suaveolens, Tremella mesenterica

Salix *sp.*
Amphinema byssoides, Antrodia albida, Cytidia salicina, Exidiopsis laccata, Gloeocystidiellum leucoxanthum, Grandinia arguta, Grandinia aspera, Grandinia barba-jovis, Grandinia crustosa, Hymenochaete tabacina, Hyphoderma obtusiforme, Hyphoderma sambuci, Hyphoderma sibiricum, Hypochnicium bombycinum, Lentinellus omphalodes, Peniophora aurantiaca, Phellinus nigrolimitatus, Phlebia lindtneri, Piloderma bicolor, Polyporus elegans, Polyporus varius, Stereum rugosum, Tubulicrinis gracillimus

Sambucus callicarpa **Greene.**
Grandinia alutaria, Hyphoderma sambuci, Hyphoderma setigerum, Lachnella alboviolascens, Melzericium udicolum

Tsuga heterophylla **(Raf.) Sarg.**
Aleurodiscus penicillatus, Amphinema byssoides, Amylocorticium subsulphureum, Antrodia heteromorpha, Athelia decipiens, Botryobasidium botryosum, Botryobasidium candicans, Botryobasidium subcoronatum, Calocera cornea, Ceraceomyces borealis, Chaetoderma luna, Coniophora arida, Coniophora olivacea, Diplomitoporus crustulinus, Diplomitoporus lindbladii, Fomitopsis pinicola, Ganoderma applanatum, Grandinia aspera, Grandinia breviseta, Grandinia pallidula, Grandinia subalutacea, Heterotextus luteus, Hyphoderma argillaceum, Hyphoderma praetermissum, Hyphoderma sibiricum, Leucogyrophana romellii, Phanerochaete

sanguinea, Phellinus pini, Phlebiella pseudotsugae, Phlebiella vaga, Postia caesia, Postia stiptica, Pseudomerulius aureus, Resinicium furfuraceum, Rigidoporus crocatus, Sistotrema muscicola, Sphaerobasidium minutum, Stereum sanguinolentum, Subulicystidium longisporum, Thelephora terrestris, Tomentella ramosissima, Trechispora farinacea, Trechispora mollusca, Trechispora stellulata, Trichaptum abietinum, Tubulicrinis effugiens, Tubulicrinis gracillimus, Tubulicrinis sororius, Tubulicrinis subulatus, Tulasnella allantospora, Veluticeps abietina

***Tsuga mertensiana* (Bong.) Carr.**
Acanthophysium spiniger, Acanthophysium weirii, Aleurodiscus penicillatus, Amphinema byssoides, Asterodon ferruginosa, Athelia acrospora, Botryobasidium candicans, Ceraceomyces serpens, Chaetoderma luna, Coniophora olivacea, Dendrothele incrustans, Diplomitoporus crustulinus, Echinodontium tinctorium, Fomitopsis pinicola, Gloeocystidiellum citrinum, Grandinia abieticola, Grandinia alienata, Grandinia quercina, Hypochnicium sphaerosporum, Ischnoderma resinosum, Melzericium udicolum, Phellinus ferreus, Phellinus nigrolimitatus, Phellinus pini, Phlebiella christiansenii, Phlebiella grisella, Piloderma bicolor, Stereum sanguinolentum, Trechispora microspora, Trechispora stellulata, Trichoderma harzianum, Tubulicrinis angustus, Tubulicrinis gracillimus, Veluticeps abietina Xenasma pruinosum

***Tsuga** sp.*
Antrodia sinuosa, Ceraceomyces tessulatus, Echinodontium tinctorium, Postia fragilis, Stereum sanguinolentum

***Vaccinum** sp.*
Grandinia aspera, Grandinia breviseta, Grandinia cineracea, Phellinus ferreus, Stereum rugosum

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Appendix 2. Wood-inhabiting fungi reported from Alaska in selected references, but not collected in this study.

F --Farr *et al.* (1989)
G&R --Gilbertson and Ryvarden (1986, 1987)
G&L --Ginns and Lefevbre (1993)
B --Baxter (1947, 1950), Baxter and Warner (1942) or Baxter and Wadsworth (1939)

Amylostereum chailetii (Pers.:Fr.) Boid. **G&L**
Antrodia crassa (Karst.) Ryv. **F, G&R, B**
Antrodia odora (Peck ex Sacc.) Gilbn. et Ryv. **F, G&R**
Antrodia serialis (Fr.:Fr.) Donk **F, G&R, B**
Antrodia variiformis (Peck) Donk **F, G&R, B**
Antrodia xantha (Fr.:Fr.) Ryv. **F, G&R, B**
Armillaria mellea (Vahl.:Fr.) Kummer **F**
Athelia neuhoffii (Bres.) Donk **F, G&L**
Auricularia auricula-judae (Bull.:Fr.) Wettst. **G&L**
Auriculariopsis ampla (Lév.) Maire **F, G&L, B**
Bondarzewia montana (Quél.) Singer **F**
Botryobasidium pruinatum (Bres.) J. Erikss. **F, G&L**
Botryobasidium vagum (Berk. & Curt.) D.P. Rogers **F, G&L**
Ceriporia excelsa (Lund.) Parm. **G&R**
Ceriporia purpurea (Fr.:Fr.) Donk **F**
Ceriporia reticulata (Pers.:Fr.) Dom. **F**
Ceriporia viridans (Berk. et Br.) Donk **G&R**
Ceriporiopsis aneirina (Sommerf.:Fr.) Dom. **F, G&R, B**
Ceriporiopsis mucida (Pers.:Fr.) Gilbn. et Ryv. **G&R**
Cerocorticium hiemale (Laurila) Jülich et Stalpers **F**
Climacocystis borealis (Fr.:Fr.) Kotl. et Pouz. **F, G&R**
Collybia acervata (Fr.:Fr.) Kummer **F**
Coprinus martinii J.Favre ex P.D. Orton **F**
Coprinus psychromorbidus Redhead et J. Traquair **F**
Cylindrobasidium corrugum (Burt) J.Ginns **F, G&L**
Dacrymyces dictyosporus G.W. Martin **G&L**
Dacrymyces stillatus Nees:Fr. **G&L**
Dacryobolus karstenii (Bres.) Oberw. ex Parm. **F, G&L**
Daedaleopsis confragosa (Bolt.:Fr.) J.Schroet. **F, B**
Datronia mollis (Sommerf.:Fr.) Donk **F, G&R**
Datronia scutellata (Schw.) Gilbn. et Ryv. **F**
Datronia stereoides (Fr.:Fr.) Ryv. **F, G&R, B**
Dentipellis dissita (Berk. et Cooke) Maas G. **B**

Dentipellis fragilis (Per.:Fr.) Donk **F, G&L**
Dichomitus squalens (Karst.) D.Reid **F, G&R, B**
Diplomitoporus lenis (Karst.) Gilbn. et Ryv. **F, G&R**
Eichleriella deglubens (Berk. et Broome) D.Reid **F, G&L**
Exidia glandulosa Fr.:Fr. **F, G&L**
Exidia saccharina Alb. et Schw.:Fr. **G&L**
Exidiopsis calcea (Pers.) K.Wells **F, B, G&L**
Fibulomyces septentrionalis (J.Erikss.) Jülich **F**
Flammulina velutipes (Curtis:Fr.) Singer **F**
Fomitopsis officinalis (Villars:Fr.) Bond. et Singer **F, G&R**
Fomitopsis rosea (Alb. et Schw.:Fr.) Karst. **F, B**
Ganoderma oregonense Murr. **F**
Globulicium hiemale (Laurila) Hjortst. **G&L**
Gloeocystidiellum karstenii (Bourd. et Galz.) Donk **F, G&L**
Gloeocystidiellum ochraceum (Fr.:Fr.) Donk **F, G&L, B**
Gloeocystidiellum porosum (Berk. & Curt.) Donk **F, G&L**
Gloeophyllum odoratum (Wulf.:Fr.) Imazeki **F, B**
Gloeophyllum protractum (Fr.) Imaz. **G&R**
Gloeoporus dichrous (Fr.:Fr.) Bres. **F**
Grandinia stenospora (Karst.) Jülich **F**
Helicobasidium brebissonii (Desm.) Donk **G&L**
Hericium abietis (Weir ex Hubert) K.A.Harrison **F, G&L**
Hericium coralloides (Scop.:Fr.) S.F. Gray **F, G&L**
Heterobasidion annosum (Fr.:Fr.) Bref. **F, G&R, B**
Hymenochaete agglutinans Ellis **F, B**
Hymenochaete corrugata (Fr.) Lév. **G&L**
Hymenochaete tenuis Peck **F, G&L**
Ischnoderma benzoinum (Vahl:Fr.) Karst. **B**
Inonotus cuticularis (Bull.:Fr.) Karst. **G&R**
Inonotus radiatus (Sow.:Fr.) Karst. **F, G&R, B**
Kavinia alboviridis (Morg.) Gilbn. et Budn. **B**
Kuehneromyces mutabilis (Schaeff.:Fr.) Singer et A.H. Smith **F**
Laetiporus sulphureus (Bull.:Fr.) Murr. **F, G&R, B**
Laurilia sulcata (Burt) Pouz. **F, G&L, B**
Lentinus strigosus (Schw.:Fr.) Fr. **F**
Lenzites betulina (L.:Fr.) Fr. **F, B**
Leucogyrophana mollusca (Fr.:Fr.) Pouz. **F, G&L**
Leucogyrophana pinastri (Fr.:Fr.) Ginns et Weres. **F, G&L**
Marasmiellus filopes (Peck) Redhead **F**
Marasmius epidryas Kühn. **F**
Meruliopsis ambiguus (Berk.) Ginns **G&L**
Meruliopsis corium (Fr.:Fr.) Ginns **F, G&L, B**
Meruliopsis taxicola (Pers.) Bond. **F**
Micromphale perforans (Hoffm.:Fr.) Singer **F**
Neolentinus kauffmanii (A.H. Smith) Redhead et Ginns **F**
Nidula candida (Peck) V.S. White **F**

Oxyporus cuneatus (Murr.) Aoshima **F, G&R**
Peniophora borealis (Peck) Burt **G&L**
Peniophora rufa (Fr.:Fr.) Boid. **F, G&L, B**
Perenniporia subacida (Peck) Donk **F, G&R, B**
Perenniporia tenuis (Schw.) Ryv. var. *pulchella* (Schw.) Gilbn. et Ryv. **G&R**
Phaeolus schweinitzii (Fr.:Fr.) Pat. **F, G&R, B**
Phanerochaete carnosa (Burt) Parm. **F, G&L**
Phellinus ferrugineofuscus (Karst.) Bourd. **F, G&R, B**
Phellinus ferruginosus (Schrad.:Fr.) Pat. **F, G&R, B**
Phellinus gilvus (Schw.) Pat. **B**
Phellinus hartigii (Allesch. et Schnabl) Pat. **G&R**
Phellinus nigricans (Fr.:Fr.) Karst. **F, B**
Phellinus punctatus (Fr.) Pil. **F, G&R, B**
Phellinus robustus (Karst.) Bourd. et Galz. **F**
Phellinus tremulae (Bond.) Bond. et Boriss. **G&R**
Phellinus weirii (Murr.) Gilbn. **F**
Phlebia albida Post **G&L**
Phlebia radiata Fr. **G&L**
Pholiota adiposa (Fr.:Fr.) Kummer **F, B**
Pholiota populnea (Pers.:Fr.) Kuyper et Tjall.-Beukers **F**
Pholiota squarrosoides (Peck) Sacc. **F**
Physiosporinus sanguinolentus (Alb. et Schw.:Fr.) Pil. **G&R**
Physiosporinus vitreus (Pers.:Fr.) Karst. **G&R**
Piptoporus betulinus (Bull.:Fr.) Karst. **F, G&R, B**
Polyporus badius (Pers.) Schw. **F, G&R**
Polyporus mori (Pollini:Fr.) Fr. **F**
Postia balsamea (Peck) Jülich **F**
Postia leucospongia (Cke. et Harkn.) Jülich **G&R**
Postia placenta (Fr.) M.J. Larsen et Lomb. **F**
Pycnoporellus fulgens (Fr.) Donk **F**
Pycnoporus cinnabarinus (Jacq.:Fr.) Karst. **G&R**
Scytinostroma arachnoideum (Peck) Gilbn. **F, G&L**
Scytinostroma galactinum (Fr.) Donk **F, G&L**
Scytinostroma portentosum (Berk. & Curt.) Donk **F, G&L**
Scytinostromella nannfeldtii (J.Erikss) G.Freeman et R.Petersen **F, G&L**
Sebacina arctica Y. Kobayasi **G&L**
Serpula lacrimans var. *lacrimans* (Jacq.:Fr.) Schroet. **G&L**
Sistotrema raduloides (Karst.) Donk **F, G&L**
Skeletocutis amorpha (Fr.:Fr.) Kotl. et Pouz. **F**
Skeletocutis subincarnata (Peck) J. Keller **F, G&R**
Spongipellis delectans (Peck) Murr. **G&R**
Steccherinum alaskense Lindsey et Gilbn. **F, G&L**
Stereum gausapatum (Fr.:Fr.) Fr. **F, G&L**
Stereum hirsutum (Willd.:Fr.) S.F. Gray **F, G&L, B**
Strobilurus occidentalis V.Wells et P.Kempton **F**
Tapinella panuoides (Batsch:Fr.) E.J. Gilbert **F**

Thanatephorus cucumeris (A.B.Frank) Donk **F, G&L**
Thelephora anthocephala var. *anthocephala* Bull.:Fr. **G&L**
Thelephora caryophyllea Fr.:Fr. **F, G&L**
Tomentellina fibrosa (Berk. & Curt.) M.J. Larsen **F, G&L, B**
Trametes versicolor (L.:Fr.) Pil. **F, G&R, B**
Trechispora cohaerens (Schw.) Jülich et Stalpers **F**
Trechispora mollusca (Pers.:Fr.) Liberta **G&R**
Trichaptum biforme (Fr.) Ryv. **F, G&R, B**
Trichaptum laricinum (Karst.) Ryv. **G&R**
Trichaptum subchartaceum (Murr.) Ryv. **G&R**
Tricholomopsis rutilans (Schaeff.:Fr.) Singer **F**
Typhula incarnata Fr. **F**
Typhula uncialis (Grev.) Berth. **F**
Veluticeps fimbriata (Ellis et Ev.) Nakas. **G&L**

MYCOTAXON

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SCANNING ELECTRON MICROSCOPIC OBSERVATIONS ON A NEW RECORD OF *DICTYOCHAETA DAPHNIOIDES*

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Abstract

A new record for Africa of *Dictyochaeta daphnioides* is reported. Its conidiogenesis, observed by means of SEM, is described and discussed.

To date 69 species have been described in *Codinaea* Maire and *Dictyochaeta* Spegazzini, the generic name taken up by Gamundi *et al.* (1977) in preference to the later *Codinaea*. Of these species, 59 have been described in or transferred to *Dictyochaeta*, while another 10 still remain in *Codinaea*. Kuthubutheen & Nawawi (1991e) provided a key to the species in these two genera.

Among the new species of *Dictyochaeta*, several have been recently described by Kuthubutheen (1987a; 1987b) and Kuthubutheen & Nawawi (1990; 1991a; 1991b; 1991c; 1991d) from Malaysia. During mycological studies carried out in the Tai National Park (Ivory Coast), a strain belonging to *Dictyochaeta daphnioides* Kuthubutheen & Nawawi (1991a) was isolated from undetermined leaf litter. It was examined by SEM in order to clarify conidial production and detachment.

Materials and Methods

A strain of *D. daphnioides* (IMI 358908) was isolated from an undetermined leaf fragment (IMI 358907) collected in the forest litter of the Tai National Park (Ivory Coast) by A. Rambelli on 11 March 1992.

Specimens for scanning electron microscopy (SEM) were cut from a pure culture on mycological agar in Petri dishes and fixed in 5% glutaraldehyde in 0.2 M sodium phosphate buffer (pH 7,2) and post-fixed in 1% OsO_4 in 0.2 M cacodylate buffer (pH 7,2). Dehydration was performed in a graded acetone series, after which the material was critical-point dried, mounted, coated with gold (800 Å) and then observed with a Jeol Jsm 5200 scanning electron microscope.

Results

This collection represents a new record of the species for Africa and the first record of *Dictyochaeta daphnioides* since the original description. The African isolate agrees with the type, reported by the authors from Malaysia (Bukit Rengit Forest Reserve, Pahang) in essential features and differs from it only in having slightly shorter conidiophores (up to 170 µm) and conidia (9.5-12.0 µm), and conidiogenous cells which are sometimes geniculate.

Observation by SEM shows smooth conidiophore and conidium surfaces surrounded by an irregular layer of mucilage (Fig. 1 a). Each conidiogenous cell produces several denticles (Figs. 1 b, c). The conidia are produced from the interior of the conidiogenous cell (Figs. 2 a, b) and are at first surrounded by mucilaginous material continuous with the apex of the conidiogenous cell (Figs. 1 d, e). This mucilaginous material progressively dissolves; at first some residues remain attached to the apical setula and to the base of the conidium (Fig. 1 a). Later, an enlarged collarette, continuous with the external wall of the denticle, becomes visible at the base of the conidium, presumably as the mucilage dissolves (Figs. 2 a, b). With conidial secession the enlarged collarette often secedes as well, remaining attached to the base of the conidium (Fig. 2 d), leaving a tubular to somewhat cylindrical denticle (Fig. 1 b). The detachment of the collarette occurs at a point where the denticle is particularly thin (Fig. 2 e). Sometimes the collarette remains on the conidiogenous cell (Fig. 2 c).

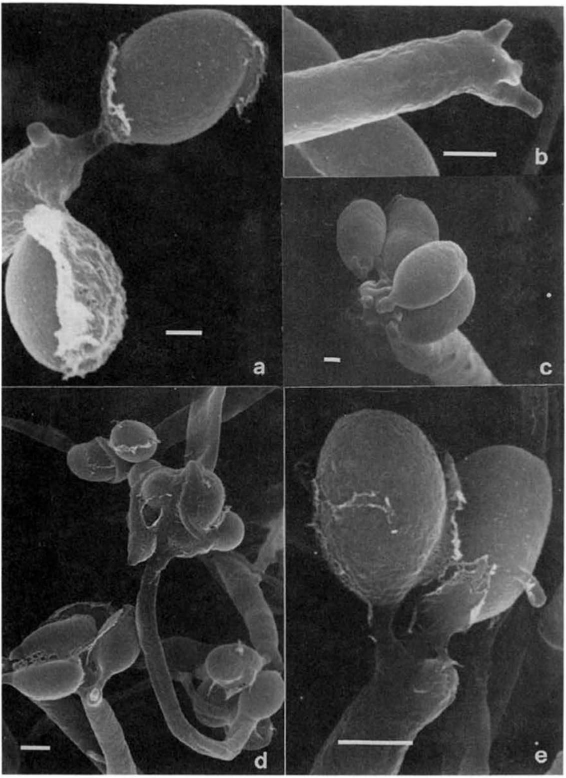

Fig. 1 - *Dictyochaeta daphnioides*: a) smooth conidiophores and conidia with mucilaginous residues (bar = 2 μm); b, c) conidiogenous cells with several denticles (bar = 2 μm); d, e) mucilaginous covers (bar = 4 μm).

Discussion

The African isolate, observed by means of SEM, show: conidiophores and conidia which are quite smooth, as was observed b) means of light microscopy and as originally described for the Malaysian strain (Kuthubutheen & Nawawi, 1991a) .

Conidiogenous cells are polyphialidic; the described mechanism of collarette breaking and detachment is very characteristic and seems to indicate the production of only one spore from each conidiogenous locus. Kuthubutheen & Nawawi (1991a) described *D. daphnioides* with *collarettes tubular to somewhat cylindrical* and with conidia *papillate at the basal end*. On the basis of what was observed by means of SEM, the papillate conidial bases could be due to the detached collarettes that remain attached to the conidia leaving tubular denticles on the conidiogenous cells.

The presence of papillate conidia is also reported for *D. aliformis* Kuthubutheen & Nawawi (1991a), *D. tumidospora* Kuthubutheen & Nawawi (1991a), and *D. guadalcanalensis* (Matsushima) Kuthubutheen & Nawawi (1991d) and it is clear that SEM observations would be useful to confirm if a similar mechanism is operating. Conidiophores with *collars easily coming off* are reported and illustrated for *D. triseptata* (Matsushima) Castañeda (Matsushima, 1993). Finally, a collarette detachment could be supposed also for *D. querna* Kirk (1982) described by the author with *collarettes infundibuliform* but illustrated with conidiogenous cells bearing several conidiogenous loci mainly lacking in collarettes.

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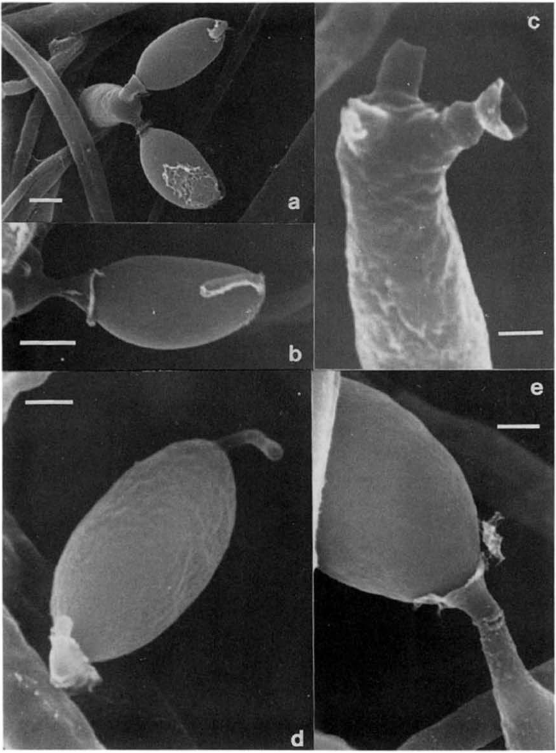

Fig. 2 - *Dictyochaeta daphnioides*: a, b) conidia discharged from enlarged collarettes (bar = 3 µm); c) collarette at the apex of a conidiogenous cell (bar = 1 µm); d) conidium with the attached collarette (bar = 1 µm); e) collarette detachment (bar = 2 µm).

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STUDIES ON KERATINOPHILIC FUNGI. IV. *BIFIDOCARPUS*, A NEW GENUS OF THE EUROTIALES

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ABSTRACT

Bifidocarpus cubensis *gen. et sp.nov.* a keratinophilic fungus from Cuban soil, is described and illustrated. It is characterized by white ascomata with a hyphal peridium bearing typical forked appendages and by the small reniform to allantoid ascospores. ***Bifidocarpus*** is compared with other genera of the Eurotiales. It is treated in the Onygenaceae.

RESUMEN

Se describe e ilustra un nuevo hongo queratinofílico, ***Bifidocarpus cubensis*** *gen. et sp.nov.*, aislado del suelo de Cuba. Las características más representativas del mismo son sus ascomas de color blanco con un peridio hifal con apéndices ramificados en forma dicotómica y ascosporas pequeñas y arriñonadas. Se discute la posición taxonómica de ***Bifidocarpus*** dentro de los Eurotiales. Se considera perteneciente a la familia Onygenaceae.

During a survey of the keratinophilic fungi in Cuba an interesting fungus was recovered which differs from the known species of the Eurotiales. We believe it represents a new genus, which is described below.

Bifidocarpus Cano, Guarro et Castañeda, *gen. nov.*
Etym. ***Bifido-*** refering to the bifid branches of the ascoma appendages.

Ascomata *discreta vel confluentia, superficialia, plus minusve globosa, alba cum hyphis peridialis filiformis, anastamosantibus, septatis et appendicibus dichotomis praedita.* ***Appendices*** *ramosae, repetite dichotomae, pilosae ornamentae, hyalinae.* ***Asci*** *globosi vel subglobosi, hyalini, evanescenti, octospori.* ***Paraphyses*** *nullae.* ***Ascosporae*** *subreniformes usque allantoideae, hyalinae, tenuituniceatae, unicellulares, laeves.* ***Anamorphosis*** *ignotis.*

Species typica: ***Bifidocarpus cubensis*** Cano, Guarro et Castañeda *sp.nov.*

Ascomata discrete often confluent, more or less globose, white, with a brownish central part, peridium composed of anastomosing and dichotomously branched hyphae forming a loose reticulum; **appendages** short and dichotomously branched, with blunt apices, ornamented with numerous short, fine hairs. **Asci** globose to subglobose, hyaline, evanescent, 8-spored. **Ascospores** slightly reniform to allantoid, hyaline, smooth. **Anamorph** not formed.

Type species: ***Bifidocarpus cubensis*** Cano, Guarro et Castañeda *sp.nov.*

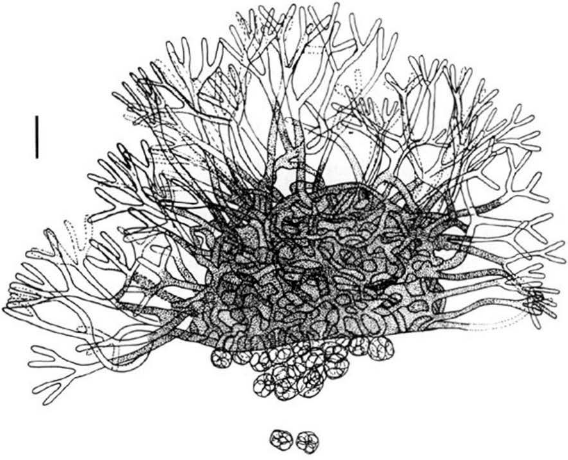

Fig.1.- ***Bifidocarpus cubensis*** (FMR 4194). (bar= 10 µm).

Bifidocarpus cubensis Cano, Guarro et Castañeda, *sp. nov*. (Fig. 1-3)

Etym. ***cubensis*** refers to the country in which the sample was collected

Ascomata *discreta vel confluentia, superficialia, plus minusve globosa, alba, 70-150 µm diam, cum hyphis peridialis filiformis, anastomosantibus, septatis, 1-1,5 µm latis et appendicibus dichotomis praedita.* ***Appendices*** *ramosae, repetite dichotomae, pilosae ornamentae, hyalinae, 15-30 µm longae.* ***Asci*** *globosi vel subglobosi, hyalini, evanescenti, octospori, 4-5 x 3-4 µm.* ***Paraphyses*** *nullae.* ***Ascosporae*** *subreniformes usque allantoideae, hyalinae, tenuitunicatae, unicellulares, laeves, 2-2.5 x 1.5-1.7 µm.* ***Anamorphosis*** *ignotis.*

Holotypus siccus et lyophilisatus: *ex solo, in collectione fungorum IMI 356298, Egham, Britannia deposita est. Isotypus:* FMR 4194.

Colonies on oat-meal agar very restricted, reaching 3-8 mm diam. in 14 days at 25°C, white, superficial mycelium dense, flat, velvety, margin regular, reverse uncoloured. On Bacto Emerson YpSs agar (Difco), colonies have the same pattern of growth but the reverse is yellowish brown. We were unable to obtain fertile cultures of this fungus on all the artificial media tried. Fertile ascomata develop only on sterile soil to which horse hair was added.

Vegetative hyphae hyaline, septate, wall smooth, 1-1.5 µm wide. **Ascomata**

discrete, often confluent, more or less globose, white, centre brownish, 70-150 µm diam., peridium with dichotomous, anastomosing hyphae; **peridial hyphae** abundant, 1-1.5 µm wide, wall with numerous short thin filaments, septate, anastomosing and dichotomously branching hyphae forming a loose reticulum; **appendages** frequently septate, dichotomously branched, with blunt apices, ornamented with numerous short, fine hairs, 15-30 µm long. **Asci** globose to subglobose, hyaline, evanescent, 8-spored, 4-5 x 3-4 µm. **Ascospores** subreniform to allantoid, hyaline, smooth, 2-2.5 x 1.5-1.7 µm. **Anamorph** unknown. Slightly keratinolytic.

No growth at 37°C. Sensitive to 0.04% actidione.

Material examined (dried and lyophilized): FMR 4194, forest soil, Varadero, Cuba, 12 March, 1992, J. Cano.

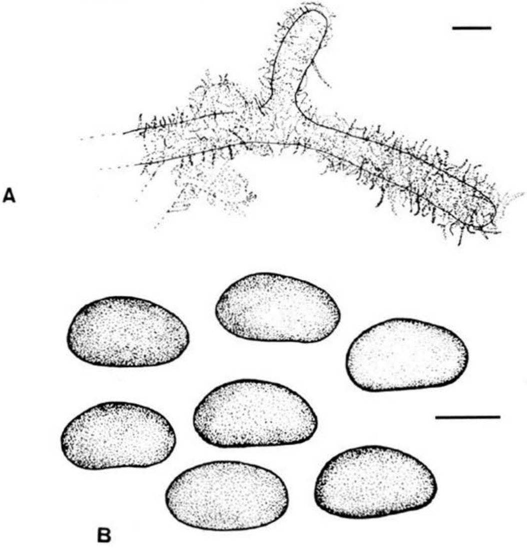

Fig.2.- ***Bifidocarpus cubensis*** (FMR 4194). **A**, Peridial hyphae (bar= 2 µm). **B**, Ascospores (bar= 1 µm).

The taxonomic placement of this new fungus is controversial because its main characteristics do not completely fit those of any of the established families in the Eurotiales (Arx, 1987; Currah, 1985). It could be tentatively included in the Onygenaceae *sensu* von Arx. Their small, hyaline and reniform ascospores make this fungus unique in that family. ***Renispora*** Sigler et Carmichael also have reniform ascospores but these are pigmented and pitted, and in addition it has a typical ***Chrysosporium*** anamorph. ***Onygena corvina*** Albertini et Schweinitz also bears ascospores with some similarities (cylindrical and often curved) to those of ***Bifidocarpus***, but these are bigger (6-8 x 2.5-

3.5 µm) and the ascomata have a distinct stipe.

This fungus is only known from one strain isolated by the "hair baiting method". It could mean that it is very rare, but tropical soil fungi are practically still unexplored, and it is probable that more extensive surveys in Africa, Asia and South America would show that some of the known fungi are more widespread than we actually think. In our studies of tropical soils we have found new strains of keratinophilic fungi considered as rare only because a few isolates existed, as was the case with some species of ***Ascocalvatia, Spiromastix, Gymnoascus***, etc.

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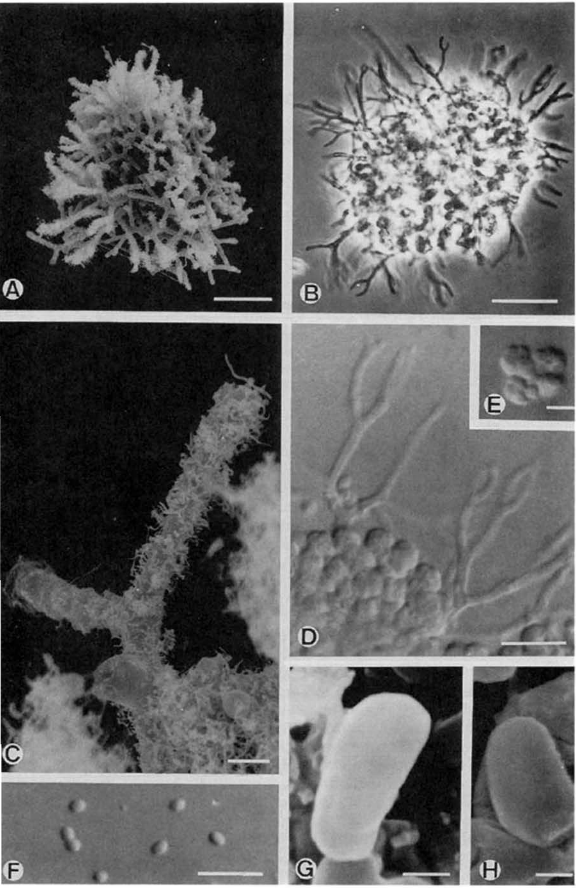
Fig. 3. ***Bifidocarpus cubensis*** (FMR 4194). **A**,**B**, Ascoma (A, bar= 20 µm; B, bar= 30 µm). C, Peridial hyphae (bar= 2 µm). **D**, Asci and peridial hyphae (bar= 10 µm). **E**, Asci (bar= 5 µm). **F**, **G**,**H**, Ascospores (F, bar= 10 µm; G,H, bar= 0.5 µm).


A
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CULTURE MORPHOLOGY OF CREPIDOTUS SPECIES

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Abstract

The culture morphology of 9 taxa of *Crepidotus* (Crepidotaceae, Agaricales) is described as developed on three different media (malt extract agar MEA, potato dextrose agar PDA, chemically defined medium PiNL). Diagnostic characters of greatest value include growth rate, color and texture of tissue-type and occurrence of differentiated elements. Stalpers' species code was determined for each species.

Introduction

The genus *Crepidotus* includes species with pleurotoid fruit-bodies with small to medium sized caps which may be white or coloured, fibrillose to tomentose or glabrous, with lamellae radiating from a lateral or eccentric attachment point and with spores whose spore deposit ranges from clay colour to snuff brown or cinnamon. Spore shape, size and ornamentation in combination with size and shape of cheilocystidia are most important distinctive characters for species recognition (Senn-Irlet, in press). Most *Crepidotus* species are saprophytes on rotten wood, more rarely they fruit on dead plant debris or other substrates. No study sofar has ever included morphological characters of the mycelium.

The importance of culture morphology in taxonomy of Basidiomycetes has gained main importance in wood-rotting fungi (Nobles, 1948; Stalpers, 1978), where documentation of culture features is now considered essential in species description. Culture features helped to clarify generic delimitations in the Agaricales (eg. Redhead & Ginns,1985).

The potential value of culture characters in taxonomy of Agaricales has never been opposed, on the contrary several authors stress the importance of such characters (Pantidou et al., 1983; Singer,1975). Nevertheless, up to date such studies are still rare. Recent investigations include *Collybia* (Vilgalys & Miller, 1983), *Lyophyllum* p.p. (Moncalvo et al., 1989), *Marasmius* (Desjardin, 1990), *Mycena* (Treu & Agerer, 1990), *Pholiota* (Jacobsson, 1989), ectomycorrhizal fungi (Hutchison, L.J., 1991)

The research documented here was designed to answer the following questions: Does culture morphology support the contemporary delimitations of *Crepidotus* species (Senn-Irlet, in press)? Are there specific characters that strengthen species concepts and faciliate separation of closely related species? Can *Crepidotus* species be recognized on cultural characteres alone?

Material and methods

Suspensions of spores in sterile water or in liquid media were spread onto the agar surface of a petri dish. Spore germination took place within 3 to 8 weeks. The obtained heterocaryotic mycelia were screened for nuclei by staining either by carmin aceto acid (siderophilic reaction see Clémençon, 1978) or by DAPI using fluorescence microscopy.
Three different culture media were used regularly, one occasionally:
PDA: potato/dextrose agar (commercial product, Merck 10130)
MEA: malt-extract agar (commercial product, Merck 5398)
PiNL (chemically defined medium): $(NH_4)_2H_4O_6$ (0.94 g/l) K_2PO_4 (0.037 g/l), KCl (0.031 g/l), $MgCl_2 \cdot 6H_2O$,(0.030 g/l), $CaCl_2 \cdot 6\ H_2O$, (0.0132 g/l), micronutrients (total 0.74 g/10 ml) $MnCl_2 \cdot 4\ H_2O$, H_3BO_3, $ZnCl_2 \cdot 2\ H_2O$, $Na_2MoO_4 \cdot 2\ H_2O$, $NiCl \cdot 6\ H_20$; Fe^{III}NaEDTA , succinate buffer, pH 5.5, 0.2M (10 ml/l); maltose D (5 g/l), glucose D (10 g/l), thiamine HCl (0.1 ml/l); gelose Agar-Agar (15 g/l).
YPSS/2: glucose D (7.5 g), yeast extract (2 g), $K_2HPO_4 \cdot 3H_2O$ (0.5 g), $MgS0_4 \cdot 7\ H_2O$ (0.25 g), gelose Agar-Agar (15 g/l).
The cultures are stored in the culture collection of Departement of Systematic Botany in Lausanne. The original specimens are kept in the herbarium (LAU).

Spot tests for presence or absence of laccase, tyrosinase and peroxidase were performed on 28 days old culture of all isolates grown on PDA, MEA and PiNL using substrate-specific reagents (see Marr, 1979, 1984). 5 replicates were placed in a separate petri dish and the reactions were recorded at 5, 10, 30 minutes, 2 and 24 hours. The intensity of the reaction was classified in 3 categories. A reaction is recorded as negative if no colour changes have been noted at any time observed. With syringaldazine for detecting laccase, a positive reaction took always place within the first 30 minutes whereas weak positive reactions with L-tyrosine detecting tyrosinase took place only after 24 hours. With p-cresol, which reacts in presence of undefined phenoloxydases, positive reactions were occasionally observed immediately but in most cases within 4 hours.

The growth rate indicated refer to the radius of the radiating mycelia.

Results

All isolates on solid agar media formed both submerged and appressed to raised mycelia. Grown simultaneously under equal conditions in numerous test series during the investigation period each species showed an individual growth rate (Table 2), which did not significantly change. However, in all species observed growth rate was fastest after the first inoculation.

Table 1: Isolates of *Crepidotus* species in culture studies.

Without further indications the localities are situated in Switzerland.

species name coll. no	substrate	locality	date
subgenus *Crepidotus*			
mollis			
89/195	stump of *Fraxinus*	Jura, Develier	28.IX.1989
91/149	lying *Fagus*-trunk	Berne Brienz	24.IX.1991
91/226	stump of deciduous tree	France, Boulogne	18.X.1991
92/57	lying *Fagus*-trunk	Berne, Giessbach	24.IV.1992
calolepis			
90/154	lying trunk of deciduous tree	Canada, Alb., Banff	26.VII.1990
subgenus *Dochmiopus*			
section *Dochmiopus*			
applanatus var. applanatus			
89/197	lying trunk	Jura, Caquerelle	28.IX.1989
crocophyllus			
BRNO	*Fraxinus*	Czechia, Lanzhot	10.X.1990
cesatii var. cesatii			
91/198	*Fagus*-twig	Berne, Belp	8.X.1991
92/265	*Salix*-twig	Berne, Belp	1.X.1992
cesatii var. subsphaerosporus			
89/173	twig of *Picea*	Berne, Gurnigel,	6.IX.1989
92/279	lying *Picea* trunk	Berne, Habkern	14.IV.1992
variabilis			
91/197	*Fagus* -twig	Berne, Bremgartenwald	7.X.1991
91/247	*Fagus* -twigs and litter	France, Desvres	17.X.1991
section *Crepidotellae*			
luteolus			
91/195	on dead *Urtica* culm	Berne,Bremgartenwald	7.X.1991
subverrucisporus			
91/151	*Salix*-twig	Berne, Brienz	24.IX.1991
92/264	*Alnus*-twig	Berne, Belp	1.X.1992

Different light conditions, i.e permanent dark in the incubator, permanent daylight conditions in the culture room as well as normal diurnal light changes did not affect the growth rate in a significant way. Nevertheless, a tendency towards a faster growth in permanent daylight conditions has been observed (Table 2).

Fruit-bodies never developed, yet, earliest stages - noduli- have been observed several times. Fruit-bodies in cultures have been obtained by Russel (1978).

Fastest growth was observed between 20 °and 25° C, yet growth was still possible for all species at 10 °C but stopped at temperatures >30 °C.

There was little variation in culture morphology between different isolates of a given species on a given medium. In other words this study indicates rather consistent characters for cultures at given controlled conditions.

The culture media clearly affected the morphology of the isolates. MEA grown isolates revealed very little variation. In contrast PDA grown isolates revealed distinct morphologies such as culture mat colouration and culture mat tissue.

The Bavendamm-test (1928) with which white-rot can be detected by growing the fungus on media containing small amounts of gallic or tannic acid showed in all species examined the same result: the growth was very weak to almost zero but a dark diffusion zone under the fungus appeared. Therefore all Crepidoti examined produce a laccase, which is confirmed by spot tests of syringaldazine (see Table 3). However the presence of tyrosinase could not be proved for *C. calolepis*.

Conventional reagents for microscopy of higher fungi (Melzer' reagent, cresyl bue, cotton blue, congo red, KOH, sudanIII , patent blue) displayed no special reactions. The cell walls remain acyanophilous, the cytoplasma inamyloid, KOH did not evoke colour changes, sudan III and patent blue showed no reaction at all.

No specific smells were noted.

No remarkable differences could be observed between the different strains of one species.

Micromorphological characters (Figs. 1-3, 5)

Expect of *C. calolepis* whose mycelium is very poorly differentiated, all other *Crepidotus* species displayed characteristic micromorphological features in their mycelia such as diverticulate hyphae in the submerged mycelia, ampullate (allocysts sensu Stalpers, 1978) or almost moniliform intercalary cells in the aerial mycelium and cystidia-like terminal swellings (Fig. 1 d). Features which proved to be specific include textura intricata (for *C. calolepis*), textura epidermoidea (for *C. crocophyllus* and *C. subverrucisporus*, see Figs. 2b and 3b) and intracellular pigments (for *C. crocophyllus*).

Rhizomorphs have not been observed in any species, but strands of 2-4 parallel or twisted hyphae are abundant in several species.

Arthroconidia have not been found.

Hyphal cells in all parts of the mycelium are binuclear.

Table 2: Mean growth rates (mm· d^{-1}) of 9 *Crepidotus* species on petri dishes.

light and temperpature conditions	permanent light conditions 20°; n=3				various light conditions, 18-25°; n= 3-30
period	1 th week	2nd week	3 rd week	4 th week	4 th week
applanatus					
PiNL	0	0.45	0.57	0.78	0.35-0.7
PDA	0	0.23	0.28	0.26	0.25-0.53
MEA	0	0.30	0.24	0.35	0.2-0.35
calolepis					
PiNL	0.5	1.05	1.04	0.56	0.67-1.5
PDA	1.57	1.21	1.09	1	0.78-1.03
MEA	1.43	1.25	1.2	1.17	0.42-0.60
cesatii var. *cesatii*					
PiNL	1.07	0.93	0.88	0.92	1.42
PDA	1.14	1.32	1.48	1.35	1.17-1.35
MEA	1.57	1.89	2	>1.5	0.32-1.17
cesatii var. *subsp.*					
PiNL	0	0.53	0.52	0.75	0.61-0.85
PDA	0	0.35	0.33	0.28	0.17-0.28
MEA	0	0.42	0.42	0.42	0.21-0.39
crocophyllus					
PiNL	0.9	1.35	1.57	1.46	0.96-1.46
PDA	0.43	0.35	0.33	0.30	0.39-1.17
MEA	0.5	0.71	0.85	1.10	1-1.5
luteolus					
PiNL	1.25	1.28	1.66	1.57	1.57
PDA	1.85	1.86	1.95	>1.5	>1.5
MEA	1.71	1.75	1.66	1.48	0.82->1.5
mollis					
PiNL	1.07	1.46	1.64	1.37	0.6-0.85
PDA	0.6	0.71	0.69	0.71	0.71-1.46
MEA	0.71	1.14	1.23	1.23	1.14-1.42
subverrucisporus					
PiNL	1.64	2.14	2.04	>1.5	>1.5
PDA	1.57	1.64	1.5	1.28	1.21-1.53
MEA	1.64	1.5	1.5	1.37	1.2->1.5
variabilis					
PiNL	1.78	1.82	1.64	1.39	1.28-1.53
PDA	1.57	1.64	1.5	1.28	0.71-1.46
MEA	1.5	1.78	1.73	1.48	1.39-1.53

Table 3. Results of spot tests for important extracellular enzymes involved in wood decomposing: p-cresol for phenoloxydases, L-tyrosine for tyrosinase and syringaldazine exclusively for laccase. All observations in pure cultures after 28 days.

+ = weak reaction, ++ positive reaction, +++ strong positive reaction
- = no reaction noted

	phenol oxydases-			tyro-sinase			laccase		
	PiNL	PDA	MEA	PiNL	PDA	MEA	PiNL	PDA	MEA
applanatus	+	+	+	+++	+++	+	++	+++	+
calolepis	-	-	-	-	-	-	+	+	+
cesatii cesatii	++	+	+++	+	+	++	+++	+	+++
cesatii subsp	++	++	+++	+	++	+++	+++	+++	+++
crocophyllus	++	+	+++	+++	+	++	+++	+	+++
luteolus	+++	+++	+++	-	+++	+	++	+++	++
mollis	+++	+	+++	++	+++	+	++	++	++
subverrucisporus	-	++	+	++	+	-	++	+	+
variabilis	++	+++	++	++	++	+	+	+	+++

Description of culture morphology

Crepidotus applanatus (Pers.) Kummer var. *applanatus*
characteristics: slow to medium growth, aerial mycelium white to dirty cream, formation of stephanocysts in the aerial mycelium.

Macromorphology
PiNL: advancing zone appressed, silky to downy, sometimes with long radiating straight hyphae; hyphae hyaline. Aerial mycelium subfelty to felty, white; reverse white.
PDA: advancing zone appressed to subfelty without single radiating precursory hyphae, white; hyphae hyaline. Aerial mycelium pellicular to subfelty, glossy, cream to dirty ochraceous; reverse cream to ochraceous.
MEA: advancing zone pellicular to felty without single radiating precursory hyphae, cream, hyphae hyaline. Aerial mycelium felty, slightly zonate cream to apricot; reverse cream, grooved.

Micromorphology
Advancing zone of 1.5-2 µm wide, cylindric, straight hyphae, infrequently branched, on PiNL with very long terminal cells. Aerial mycelium composed of 2-4 µm wide, abundantly branched,thin-walled hyphae, with

numerous segments of inflated, 6-20 µm wide cells, with clusters of 8-10 µm wide stephanocysts with 12-24 small teeth sitting on 15-30 x 4-6 µm large intercalary basal cells (see Senn-Irlet & Scheidegger, 1994); erect terminal cells tapering or rarely clavate, up to 60 x 6-10 µm. Submerged hyphae frequently branched, often flexuose, contorted or diverticulate, thin-walled. Clamps rare.

Crepidotus calolepis (Fr.) Karsten var. *calolepis*
characteristics: growth rate medium, aerial mycelium white, felty, clamps absent, all hyphae rather undifferentiated, weak phenoloxydase reactions, no tyrosinase.

Macromorphology
PiNL: advancing zone appressed, sometimes raised with a wollen bulge. Aerial mycelium granular to farinaceous, faintly zonate, white, around inoculum plug sometimes brownish; reverse white to cream, below inoculum plug darkened.
PDA: advancing zone appressed to raised, downy, hyphae hyaline. Aerial mycelium silky to felty, often glossy, white, around inoculum plug sometimes dirty brown; reverse white to darkened.
MEA: advancing zone narrow, appressed, hyphae hyaline. Aerial mycelium felty, faintly zonate, sometimes grooved, cream; reverse cream, with radial grooves.

Micromorphology
Advancing zone of 2-3.5 µm wide, cylindric, long-celled hyphae, subterminal cell sparsely branched. Aerial mycelium of felty zones with interwoven, sparsely branched cylindric hyphae with scattered small knob-like excrescences, at times slightly flexuose and forming a loose textura intricata; inflated up to 5 µm wide plasmatic cells (monilioid hyphae) rare; erect, cystidia-like terminal cells mostly absent; strands of 2-4 parallel or twisted hyphae abundant. Submerged hyphae loose, 2-3 µm wide, distinctly branched, terminal cells blunt, cylindric. On MEA the felty mycelium did not form a conspicuous textura intricata, whereas such a structure was formed on PDA. Clamps absent.

Crepidotus cesatii (Rab.) Sacc. var. *cesatii*
characteristics: growth rate medium, aerial mycelium felty to plumose, white, terminal cells numerous, cystidia-like.

Macromorphology
PiNL: advancing zone appressed to raised, hyphae hyaline. Aerial mycelium felty, thin, appressed, white; reverse white.
PDA: advancing zone raised, hyphae hyaline. Aerial mycelium subfelty to velvety, white; reverse dense, cream-apricot.
MEA: Advancing zone narrow and dense, raised, hyphae hyaline. Aerial mycelium felty to floccose, zonate, around inoculum plug sometimes grooved, white; reverse dense cream-yellowish, grooved.

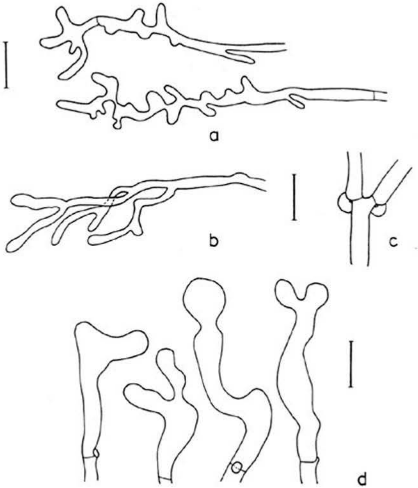

Figure 1: Micromorphological characters of axenic cultures of *Crepidotus*: a = diverticulate hyphae (from C. *mollis)* b = staghorn-like hyphae (from C. *calolepis)* , c = clamp connections (from C. *cesatii* var. *subsphaerosporus*) d = cystidia-like terminal cells (from C. *luteolus*) bar = 10µm

Micromorphology
Advancing zone of 2-4 µm wide, cylindric often flexuose hyphae, terminal cell up to 90 µm long, subterminal cell branched; isoplerous cells present. Aerial mycelium of 2.5-5 µm wide, cylindric radiating hyphae, densely branched, plasmatic up to 11 µm wide swollen cells (physalohyphae, monilioid hyphae) present; granular plasmatic cells abundant; terminal cystidia-like elements, 25-60 x 6-10 µm, clavate and flexuose-lageniform respectively; strands of 2-6, twisted narrow hyphae may be present. Submerged mycelium dense, hyphae frequently branched; cystidia-like terminal cells present. Clamps abundant.

Crepidotus cesatii (Rab.) Sacc. var. *subsphaerosporus* (J. Lange) Senn-Irlet
characteristics: growth rate slow, aerial mycelium felty, white, terminal cells numerous, cystidia-like.

Macromorphology
PiNL: advancing zone appressed to raised, hyphae hyaline. Aerial mycelium felty to velvety, faintly zonate, white; reverse white.
PDA: advancing zone raised, narrow, hyphae hyaline. Aerial mycelium velvety, cream; reverse cream.
MEA: advancing zone narrowly appressed, hyphae hyaline. Aerial mycelium velvety, isolates granular, at times grooved, faintly zonate, cream; reverse cream-apricot.

Micromorphology
Advancing zone of 1.8-2.5 µm wide, cylindric hyphae; terminal cell straight and regularily clamped, subterminal cell branched and often with 1 to 3, up to 10 µm long finger-like excrescences. Aerial mycelium of 2.8-4 µm wide, cylindric, abundantly branched hyphae; granular plasmatic up to 8 µm wide swollen cells present (monilioid hyphae); cystidia-like erect terminal swellings 30-40 x 5-10 µm clavate and flexuose; hyphal strands of 2-6, 1.5-2.5 µm wide cylindric twisted hyphae present. Submerged mycelium dense, mostly short-branched with many cystidia-like terminal swellings. Clamps abundant.

Crepidotus crocophyllus (Berk.) Sacc.
characteristics: rapid growth, aerial mycelium crustose, brownish; hyphae with yellow brownish intracellular pigment forming textura epidermoidea.

Macromorphology
PiNL: advancing zone appressed, fimbriate, hyphae hyaline. Aerial mycelium plumose to floccose, faintly zonate, around inoculum plug crustose, white, at times yellowish; reverse yellow.
PDA: advancing zone appressed or submerged, hyphae cream. Aerial mycelium felty forming a dense mat, cream, around inoculum plug yellow-brown crustose; reverse orange.
MEA: advancing zone broad, appressed. Aerial mycelium felty to loosely floccose or sometimes plumose, faintly zonate, white, reverse orange.

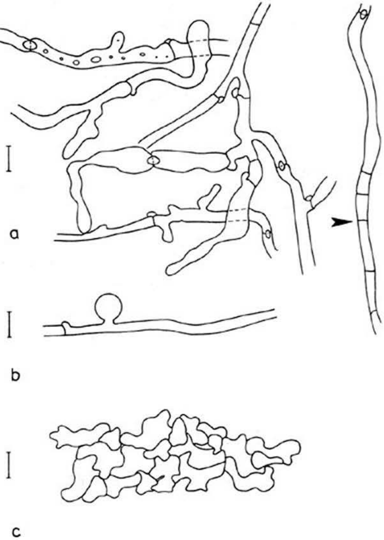

Figure 2: Micromorphological characters of axenic cultures of *Crepidotus crocophyllus*
a = aerial mycelium with hyphae with granular content and with secundary septae (arrowhead), b = hyphae with globose swelling, c = textura epidermoidea with interlocking hyphae.
bar = 10µm

Micromorphology
Advancing zone submerged, hyphae hyaline. Aerial mycelium of 3-5 µm wide, abundantly branched hyphae with many plasmatic cells; scattered main hyphae slightly thick-walled; erect terminal cells cystidia-like, clavate, flexuose and often sligthly monilioid, 27-39 (-76) µm; around inoculum plug textura epidermoidea (see Fig. 2b) with interlocking jig-jaw like cells; old cultures with isoplerous (= "oleiferous") hyphae which stain yellow in KOH and numerous secundary septae; intracelllular pigment yellow to yellow-brown, dissolving in KOH and forming small granules in the whole microscopic preparation. Submerged hyphae regularly branched, with 3-4 µm wide, straight or rarely flexuose hyphae; terminal segments often diverticulate to staghorn-like. Clamps abundant but not at all septae.

Crepidotus luteolus (Lamb.) Sacc.
characteristics: very rapid growth, aerial mycelium pale lemon on MEA, zonate, felty to floccose; terminal cells cystidia-like.

Macromorphology
PiNL: advancing zone appressed to raised, hyphae hyaline. Aerial mycelium felty to distinctly plumose, zonate, white; reverse white.
PDA: advancing zone appressed to raised, hyphae hyaline. Aerial mycelium felty to floccose, faintly zonate, white to cream; reverse white.
MEA: advancing zone appressed, hyphae hyaline. Aerial mycelium felty, faintly zonate, sometimes with exudation droplets (water), sometimes radially grooved, pale lemon to pale yellow at least in parts, towards the margin whitish: reverse yellow-brown, grooved around inoculum plug.

Micromorphology
Advancing zone of 2-3 µm wide, radially spreading cylindric hyphae with tapering ends; terminal cells always clamped; branching behind subterminal cell. Aerial mycelium of 2-4 µm wide, abundantly branched, thin-walled hyphae with several segments of inflated cells, i.e. monilioid hyphae; terminal swellings cystidia-like, 30-55 x 5-10 µm, cylindric to lageniform, flexuose and sometimes branched or capitate (Fig. 1d). Submerged hyphae abundantly branched, often diverticulate to staghorn-like, cystidia-like terminal elements present. Clamps abundant.

Crepidotus mollis (Schaeff.: Fr.) Staude
characteristics: rapid growth; aerial mycelium white, plumose, floccose; clamps absent.

Macromorphology
PiNL: advancing zone appressed to raised, hyphae hyaline. Aerial mycelium floccose to distinctly plumose, often fan-like, zonate or not, pure white, reverse white.
PDA: advancing zone appressed to raised, hyphae hyaline. Aerial mycelium felty around inoculum plug, floccose to plumose towards the margins, sometimes zonate, pure white; reverse white.

MEA: advancing zone appressed, hyphae hyaline. Aerial mycelium felty, granular to plumose, faintly zonate, sometimes with exudation droplets (water), pure white; reverse white to cream.

Micromorphology
Advancing zone of 1.5-2.5 µm wide, cylindric, straight, long hyphae; subterminal cell at times branched or with scattered small knob-like excrescences. Aerial mycelium of densely packed 1.5-3 µm wide, cylindrical, thin-walled abundantly branched hyphae, never forming a distinct plectenchymatous crust, with scattered segments with short excrescences, at times with coiled isoplerous hyphae (as fig. 25-26 in Hutchison, 1991); ampullate or slightly monilioid up to 8 µm wide segments are very rare; terminal cells erect, cylindrical, tapering or occasionally cystidia-like, 24-50 x 3-6 x 2-3 µm, lageniform, hyaline and thin-walled. Submerged mycelium densely branched, scattered with ampullate cells and often with staghorn-like hyphae (see Fig. 1b) or diverticulate segments (Fig. 1a). Older mycelium exhibit segments which are interpreted as secundary septae.with very short, 5-10 µm long cells. Isoplerous hyphae may be observed in older cultures, too. Clamps always absent.
On a newly tested other culture medium (YPSS/2) small red bulbs were formed, which proved to be true sclerotia with an outermost layer of interlocking thick-walled hyphae.

Crepidotus subverrucisporus Pilát
characteristics: very rapid growth, aerial mycelium cream, crustose, plumose, zonate.

Macromorphology
PiNL: advancing zone appressed, hyphae hyaline. Aerial mycelium floccose, faintly zonate, around inoculum plug crustose, white; reverse white.
PDA: advancing zone appressed, hyphae hyaline. Aerial mycelium floccose to wolly, towards the margin plumose, narrowly zonate, cream to straw-yellow, often yellow spotted.
MEA: advancing zone appressed, hyphae hyaline. Aerial mycelium felty, dense, towards the margin plunose, below inoculum plug grooved, often with colourless droplets; reverse apricot.

Micromorphology
Advancing zone of 2-3.5 µm wide, straight, cylindrical hyphae with tapering or blunt ends, branched behind the subterminal cell only. Aerial mycelium of 2-4 µm wide, abundantly branched hyphae, with scattered hyphal swellings or with one or two short excrescences per cell, up to 20 x 3µm; terminal cells either rather long, undifferentiated, cylindrical and slightly flexuose, up to 65 x 6 µm or more cystidia-like i.e. narrowly lageniform and often angled in the upper part and/or slightly flexuose, 20-45 x 5-8 µm, or occasionally small and sphaeropedunculate, up to 12 µm wide; around the inoculation plug the crustose layer consists of a textura epidermoidea with interlocking jig-jaw like cells (Fig. 3 b). Submerged hyphae abundantly branched, at times flexuose or ampullate, with terminal swellings similar to those of the aerial mycelium or with diverticulate

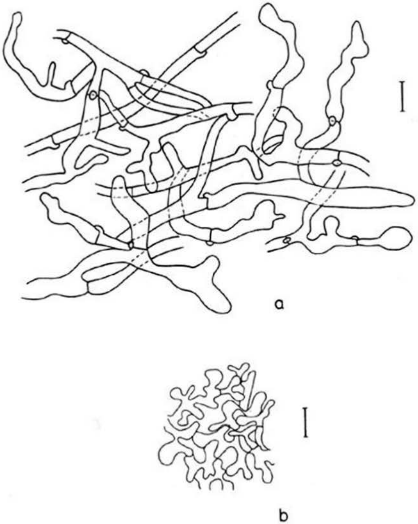

Figure 3: Micromorphological characters of axenic cultures of *Crepidotus subverrucisporus*,
a = aerial mycelium b = textura epidermoidea with interlocking hyphae.
bar = 10µm

terminal segments. Clamps frequent almost at all septae; secundary septae may be present in older cultures

Crepidotus variabilis (Pers.: Fr.) Kummer var. *variabilis*
characteristics: rapid growth, aerial mycelium white or yellow-spotted, granular to felty.

Macromorphology
PiNL: advancing zone appressed to fimbriate, hyphae hyaline. Aerial mycelium floccose, granulate, white; reverse white.
PDA: advancing zone appressed, hyphae hyaline. Aerial mycelium felty, faintly zonate, white; reverse pale orange, apricot.
MEA: advancing zone appressed, hyphae hyaline. Aerial mycelium felty, loose, white; reverse pale orange, apricot.

Micromorphology
Advancing zone of 3-5 µm wide, cylindrical hyphae with tapering ends, abundantly branched behind the subterminal cell, scattered with slightly thick-walled hyaline hyphae. Aerial mycelium of loosely interwoven, 4-6 µm wide hyphae with often slightly thick-walled and very long cells; thin-walled 2-4 µm wide hyphae abundantly branched, occasionally with few short excrescences; cystidia-like terminal swellings 15-32 x 3-4.5 µm, cylindrical and flexuose or slightly moniliform. Submerged mycelium loose, at times with strands of 2-5, 4-6 µm wide hyphe: terminal cells often staghorn-like or diverticulate. In older cultures segments of short, clampless cells which are interpreted as secundary septae are present. In old cultures of MEA globose, terminal or intercalary, slightly thick-walled cells of 15-25 µm diam. with refractive content have been observed, which are interpreted as chlamydospores by several authors (e.g. Jacobsson, 1989). Clamps abundant but not at all septae.

Discussion

All isolates on solid agar media formed both submerged and appressed to raised mycelia. All species showed an characteristic growth rate and constant micromorphological characters. However several micromorphological characters are dependant on a given culture medium (especially PDA), an observation which is in accordance with other studies (e.g. Pantidou et al., 1983; Desjardin 1990). This study makes clear that *Crepidotus* species can be classified by characters of the vegetative part alone (see Table 4). (Micro-)morphological characters which have been observed previously with *Marasmius* (Desjardin, 1990) such as diverticulate hyphae, staghorn-like hyphae, crusts consisting of textura epidermoidea and cystidia-like terminal cells have been observed too. The general micromorphological aspects of most *Crepidotus* species in culture are similar to those described and illustrated by Jacobsson (1989) from *Pholiota*.

Table 4. Stalpers code (1978) for 9 European *Crepidotus* species.

in brackets: character not always present

C. *applanatus*: 2, 10, 13, 15 (0), 25, 30 (1) 31(1), 40 (1), 44, 52, 53, (61), 75 (2), 77(1), 79 (2), 89 (1), 95(2), 98(2)
C. *calolepis*: 9, 12, 13, 15(0), 18 (1), 19 (1), 25, 30 (2), 39 (0), 52, 53, 79, 89 (2), 95 (2), 98 (2)
C. *cesatii var. cesatii* : 2, 9, 12, 13, 15(0), 19, 22, 25, 26, 29 (1), 30 (2), 44, 52, 53, 65(1), 75 (2), 89 (2), 95(2), 98(2)
C.*cesatii var. subsphaerosporus*: 2, 10, 12,13, 15(0), 18, 25, 26, 29 (1), 30(2), 44, 52, 53, (61), 75(2), 78(2), 90, 95(2), 98(2)
C. *crocophyllus*: 2, 9, 12, 13, 15(1), 19,23, 25, 28, 31, 32, 38, 44, 53, (61), 64, 67, 75(2), 89(2), 95(2), 98(2)
C. *luteolus*: 2, 9, 13, 15(0), 22, 29, 30, (35), 44, (61), 72, 75, 89, 91, 95, 98,
C. *mollis*: 2, 9, 13, 15(1), 19, 23, 25, 29, 30(2), 39(0), 52, (61), 75(2), 79, 89,(2), 95(2), 98(2)
C. *subverrucisporus*: 2, 8, 13, 15(0), 19, 23, 25, 29, 30, 31, 35, 38, 44, 52, 53, (61), 64, 75(2), 78(2), 89(2), 95(2), 98(2),
C. *variabilis*: 2, 9, 13, 15(0), 19, 25, 29, 30, 35, 44, 48, 52, (61), 75(2), 78(2), 89, 91, 95(2), 98(2),

Obvious vegetative reproductive structures such as arthroconidia have not been observed. Chlamydospore-like structures, i.e. irregular or moniliform swellings with refractive bodies but without thickened walls have been observed in several species e.g. C. *variabilis* and C. *crocophyllus* However, like Jacobsson (1989) no release of these chlamydospore-like cells could be observed, which makes the interpretation as chlamydospores very doubtful, allocyst sensu Stalpers (1978) seems to be the better, more neutral, term for these structures. A special case of a vegetative reproductive structure was found in C. *applanatus* where the observed stephanocysts (Senn-Irlet & Scheidegger, 1994) may be interpreted as reproductive propagules. Sclerotia have been observed only once: C. *mollis* growing on a new culture medium (YPSS/2) produced on the agar surface in the presence of bacteria small red bulbs which proved to be sclerotia.

Clamp connections were formed in all species of which the basidiomes are characterized by this feature except C. *applanatus*, where the basidiomes exhibit abundant clamp connections but where they are extremely rare on the mycelium.

Many of the characters observed in the mycelia grown on more or less artificial culture media, such as stephanocysts in *Crepidotus applanatus*, textura epidermidea in C. *crocophyllus* and scattered thick-walled hyphae in C. *variabilis*, could be observed also on small wooden sticks of various decayed wood which served as the sole nutrient basis in a large size petri dish. These observations support the assumption that the same morphologies may be observed in the field too.

Field observations of *Crepidotus* species causing white rot could be confirmed by different spot tests indicating the presence of laccase and tyrosinase. According to Harkin et al (1974) and Marr (1979) syringdaldazine may be the best test reagent for detecting total active laccase, and L-tyrosinase or p-cresol the better reagents for detecting total active tyrosinase. All species except *C. calolepis*, showed strong laccase activity as well as tyrosinase activity. In the classification of Marr (1979) *C. calolepis* is best placed in group II, the "laccase-only" specimens, where e.g.*Trametes versicolor* is to be found. In this classification all other *Crepidotus* species are placed in group I, i.e. the group which consists of species containing both laccase and tyrosinase.

As has been noticed before by Hutchison (1990) these spot tests and especially the intensivity of the reaction proved to be dependent of the culture medium. This fact hampers comparisons with similar studies, especially if quantitatvie aspects should be taken into account. Therefore only general statements on absence or presence of specific enzymes can be used in comparative studies.

Acknowledgement

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FASCIATISPORA LIGNICOLA SP. NOV. (AMPHISPHAERIACEAE, ASCOMYCOTINA) FROM DRIFT MANGROVE WOOD

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Abstract

A new ascomycetous fungus *Fasciatispora lignicola* is described from driftwood of the mangrove *Rhizophora apiculata* and unidentified driftwood at Kuala Selangor and Morib, Malaysia. The species is compared with the type species *F. nypae* Hyde.

Introduction

Investigations of the mycota of mangroves and their role in the decomposition of lignocellulose (Jones and Hyde, 1988; Jones and Kuthubutheen, 1989; Tan, Leong and Jones, 1989; Leong, Tan and Jones, 1991; Jones, 1993) revealed the existence of a new ascomycete. In this paper a new species in the genus *Fasciatispora* is described.

Taxonomy

Fasciatispora lignicola Alias, Jones & Kuthub. sp. nov. Figs. 1-5.

Ascocarpi 80-110 x 100-150 µm, in ligno vel cortice immersi, parvi, globosi, solitarii vel gregarii, periphysati, ostiolati, pallide brunnei vel brunnei. Peridium angustum. Paraphyses 0.8-2.2 µm, latae, septatae, ramosae, longitudino ascorum excedentibus. Asci 73-93 x 6.6-9.0 µm ($\bar{x}$ = 79.4 x 6 µm, n = 26), cylindrici, unitunicati, octospori, pedunculati, crassitunicati, cum apparatu apicali, reactione Melzeri coeruleo-colorata. Ascosporae 8.4-14.9 x 3.9-7.5 µm ($\bar{x}$ = 12.1 x 5.6 µm, n = 52), uniseriatae, ellipsoideae, unicellulares, laeves, brunneae vel fuscae, cum zona centrali pallidiora, exappendiculatae.

Ascomata 80-110 µm high x 100-150 µm wide, immersed in wood or bark, small, globose, solitary or gregarious, base flattened and poorly developed, epapillate, periphysate, ostiolate, and pale to dark brown in colour. Peridium a thin layer. Paraphyses present, 0.8-2.2 µm thick, septate, branched and longer than the asci. Asci 73-91 x 6.6-9.1 µm ($\bar{x}$ = 79.4 x 6 µm; n = 26), cylindrical, unitunicate, eight-spored, thick-walled, pedunculate with an apical apparatus staining blue in Melzer's reagent. Ascospores 8.4-14.9 x 3.9-7.5 µm ($\bar{x}$ = 12.1 x 5.6 µm; n = 52), uniseptate, young spores fusiform becoming ellipsoid at maturity, one-celled, dark brown, smooth walled, with a central pallid band, non-appendaged.

DISTRIBUTION:	Straits of Malacca.
ETYMOLOGY:	from the Latin *lignicola*, in reference to its growth on woody tissue of mangroves.
HOLOTYPE:	Straits of Malacca, Malaysia, Morib. I.M.I. 359655, on intertidal *Rhizophora apiculata* Blume. 4 December, 1991, collected by Siti Aisyah Alias.
HABITAT:	on mangrove wood, brackish (17-27°/₀₀), saprobic.

OTHER COLLECTIONS: on *Rhizophora apiculata* Blume collected at Morib mangrove stand, Malaysia, 12 December 1991; unidentified driftwood in *Bruguiera* zone, Kuala Selangor (mid tide), Malaysia 4 April 1992, salinity 13-14°/₀₀.

Discussion

Hyde (1991) described *Fasciatispora*, a genus placed in the Amphisphaeriaceae with *Fasciatispora nypae* as the type species. The fungus is characterised by having unicellular brown ascospores with a unique central pallid band (Hyde, 1991). *Fasciatispora lignicola* was found to differ from *F. nypae* in a number of respects: the ascospore measurements are smaller (8.4-14.9 x 3.9-7.5; 11.6-17 x 5.6-7.1); it is found on wood and not on the woody tissue of *Nypa fruticans*; no polar appendages to the ascospores were observed; and *F. lignicola* lacks a stroma. These features are regarded as sufficient to warrant the description of a new species.

Fasciatispora lignicola was recorded on 2 occasions out of 242 samples of drift and mangrove wood collected from Morib and on one occasion on 220 samples collected in Kuala Selangor. These two sites had muddy shores and the fungus occurs at salinities ranging from 13-27°/$_{oo}$. This indicates that the fungus can tolerate a wide range of salinities.

Acknowledgements

It is a pleasure to acknowledge the help of Dr K.D. Hyde in the identification of this species and for reviewing the manuscript. E.B.G. Jones is grateful to the British Council and the University of Malaya for travelling funds to visit Malaysia and to the Natural Environment Research Council for research grant GR3/7122. Siti Aisyah Alias is grateful for the award of a research fellowship by the University of Malaya. We thank Mr C. Derrick for photographic assistance.

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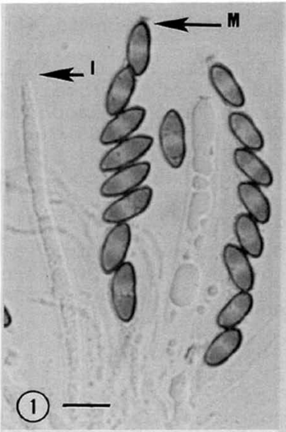
Legends

Figs. 1-5. *Fasciatispora lignicola.*
Figs. 1-2. Immature (I) and mature (M) asci and paraphyses (P); Figs. 3-4. Close-up of ascus tip; Fig. 5. Ascospores, unicellular, with a central pallid ban and smooth-walled. All figures to the same scale, bar = 10 µm.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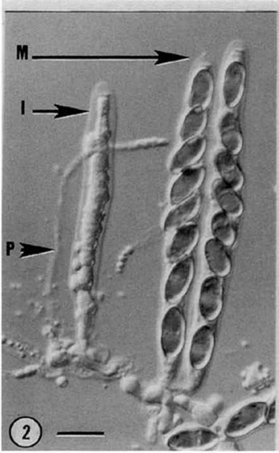
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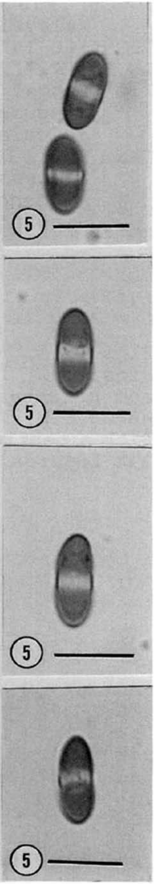
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TWO NEW COPROPHILOUS DISCOMYCETES (PEZIZALES) FROM TAIWAN

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ABSTRACT

Two new species of coprophilous discomycetes (Pezizales) are described from Taiwan. *Coprotus uncinatus* is characterized by hooked paraphyses, and *Thecotheus formosanus* by verruculous and apiculate ascospores.

Keywords: Discomycetes, Pezizales, Taiwan.

INTRODUCTION

During investigations of the coprophilous fungal flora of Taiwan, an undescribed species each of *Coprotus* Korf & Kimbr. and *Thecotheus* Boud. were collected. North American specis of *Coprotus* was revised by Kimbrough *et al.* (1972). Subsequently, a number of species were added to this genus from various localities (Bell & Kimbrough 1973, Jeng & Krug 1977, Thind *et al.* 1978, Gibson & Kimbrough 1980, Gené *et al.* 1993). After the publication of North American species of *Thecotheus* (Kimbrough 1969), additional species of *Thecotheus* were described (Pfister 1972, 1981, Kaushal 1980, Krug & Khan 1987, Gené *et al.* 1993, Wang & Kimbrough 1993). Since these two recent collections appear to differ from all known species, they are described as new species.

Coprotus uncinatus Wang, sp. nov. Figs. 1,3 & 4

Apothecia alba vel luteola, discoidea, 0.5-0.7 mm diam; margo fimbriatus. Excipulum ectale textura globosa vel angularis, cellulae 10-20 x 12.5-20 µm; excipulum medullare textuis globosa vel angularis, cellulae 5-10 µm diam. Asci octospori, cylindracei, J-, 125-150 x 12.5-17.5 µm. Ascosporae ellipsoideae, laeves, 14-16 x 7.5-10 µm, "de Bary bubble" praeditae. Paraphyses graciles, simplices vel ramosae, apices uncinatae, 2-3 µm diam.

Holotypus: Taiwan. Pingtung: Kangtzu, on cow dung, June 3,1993, Y.Z. Wang F0740 (National Museum of Natural Science, R.O.C.).
Etymology: Latinized from *uncinate*, referring to the hooked paraphyses.

Apothecia white to pale yellow, discoid, constricted below, 0.5-0.7 mm diam; margin fimbriate. Ectal excipulum of a *textura globulosa* to *angularis*, cells 10-20 x 12.5-20 µm; medullary excipulum composed of small polygonal cells, 5-10 µm diam. Asci cylindrical, eight-spored, J-, 125-150 x 12.5-17.5 µm. Ascospores ellipsoid, smooth, 14-16 x 7.5-10 µm, each with a de Bary bubble when mature. Paraphyses slender, simple or branched, tips hooked, 2-3 µm diam.

Coprotus uncinatus is characterized by slender, tip-hooked, and sometimes coiled paraphyses. It is similar to *C. ochraceus* (Cr. & Cr.) Larsen in having apothecia with raised margin, and similar sized asci and ascospores, but the apothecia of the latter are larger and the paraphyses tips are enlarged. *C. glaucellus* (Rehm) Kimbrough also has hooked paraphyses, however the asci and ascospores are smaller (7.5-9.0 x 4.5-5.5 µm, Kimbrough *et al*. 1972).

Habitat: on cow dung.
Specimen examined: see type.

Thecotheus formosanus Wang, sp. nov. Figs. 2 & 5

Apothecia dispersa, primo subglobosa et alba, inmaturitate cupuliformes et brunneola,

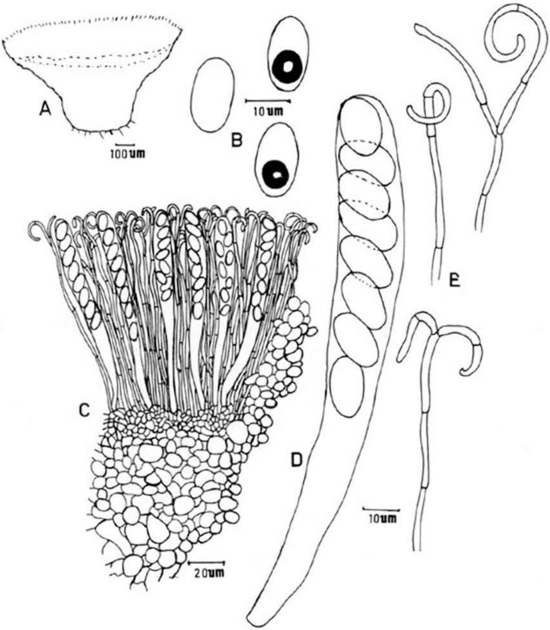

Fig. 1. *Coprotus uncinatus* A. An apothecium. B. Three ascospores. C. Cross section of an apothecium. D. An ascus. E. Three paraphyses tips.

0.5-1 X 0.2-1.2 mm. Excipulum ectale textura globosa vel angularis 10-45 µm diam, ad marginem cellularum bulborum compositum, 10-15 µm in diam; excipulum medullare cum tuxturis intricatis, hyphae 2-5 µm diam, Asci octospori, cylindracei, J+, 150-250 x 12.5-17.5 µm. Ascosporae ellipsoidae, 18-20 x 7.5-9 µm verruculosa, apiculataes, apiculi hemisphaerici, 1-1.5 x 2-3 µm. Paraphyses, filiformes 2-3 µm diam, vel apice leviter inflati, 4-7.5 µm diam.

Holotypus: Taiwan. Pingtung Co., Kangtzu, on cow dung, May 11,1993, Y.Z. Wang F0744 (National Museum of Natural Science R.O.C.).
Etymology: Latinized from *formosa,* referring to the old name of Taiwan.

Apothecia scattered, at first subglobose and white, becoming cupulate and tan, 0.5-1 X 0.2-1.2 mm, without margin. Ectal-excipulum of a *textura globulosa* to *angularis*, cells 10-45 µm diam; marginal hyphae terminating into globose tips, 10-15 µm diam; medullary excipulum of a textura intricata, hyphae 2-5 µm diam. Asci cylindrical, 150-250 x 12.5-17.5 µm, eight-spored, J+, operculum indistinct. Ascospores ellipsoid, 18-20 x 7.5-9 µm, slightly asymmetrical, verruculous; warts less than 0.5 µm in diam, with or sometimes without apiculi at two ends of the spores, apiculi hemispherical, 1-1.5 x 2-3 µm, surrounded with a gelatinous sheath. Paraphyses two types, one type filiform 2-3 µm, the second type enlarged at the apex, 4-7.5 µm diam.

Thecotheus formosanus is characterized by apiculate and verruculous ascospores. *T. apiculatus* Kimbrough also has apiculate ascospores, but which are smooth and the apiculi are narrower. *T. harasisus* Gené et al has larger (23-28 x 12-13.5 µm) and warty (4.5-6.5 µm diam.) ascospores.

Habitat: on cow dung.
Specimens examined: Taiwan. Pingtung Co: Kangtzu, on cow dung, June 8,1993, Y.Z. Wang F0739 (N.M.N.S.) and holotype.

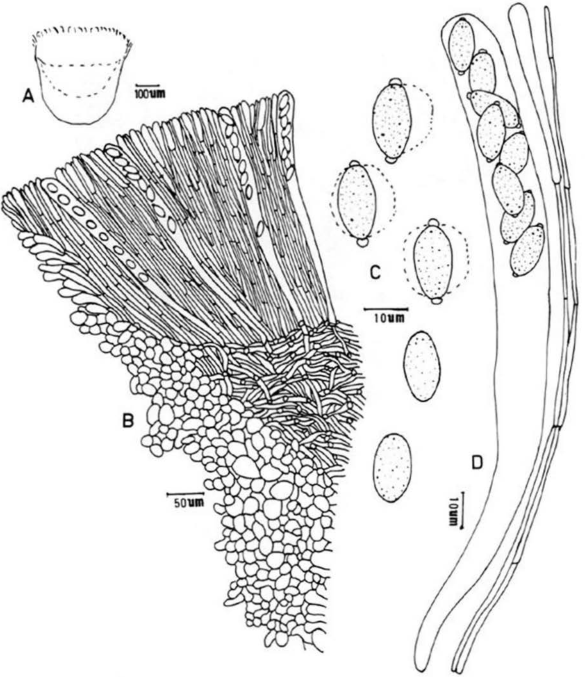

Fig. 2. *Thecotheus formosanus* A. An apothecium. B. Cross section of an apothecium. C. Five ascospores; upper three with apiculi and the other two without apiculi. D. An ascus and two paraphyses tips.

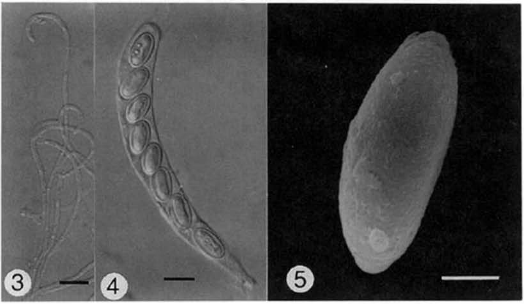

Fig. 3-4. *Coprotus uncinatus* (Holotype). 3. A paraphysis tip, scale bar = 10 µm. 4. An ascus, scale bar = 10 µm. Fig. 5. *Thecotheus formosanus* (Holotype). An ascospore (SEM), scale bar= 3 µm.

ACKNOWLEDGEMENT

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MYCOTAXON

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EDMUNDMASONIA GAMUNDIAE SP. NOV. A NEW HYPHOMYCETE FROM TIERRA DEL FUEGO (ARGENTINA)

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SUMMARY

A new species of **Edmundmasonia** Subram., **E. gamundiae**, is illustrated and described from **Nothofagus** sp. decaying bark collected in Tierra del Fuego, Argentina.

Exsiccata are available at the Spegazzini Institute (LPS).

Furthering our research on lignicolous **Hyphomycetes** from Tierra del Fuego (Argentina) a new species, namely **Edmundmasonia gamundiae**, is herein described from observations on natural media. This fungus was initially disposed in **Brachysporiella** Batista. Subsequent analysis of the material showed that it fits better with the concept of **Edmundmasonia** discussed by Holubová-Jechová (1983). Rao and De Hoog (1986) considered that there were not fundamental differences between **Dendryphiosphaeria** and the type species of **Brachisporiella, B. gayana** Bat. Hughes (1978) also regarded **Edmundmansonia** Subram. with light conidiogenous cells in more or less drepanoid arrangement, as a synonym of **Brachisporiella**. We agree in some way with Rao and De Hoog (op.cit.) since they are reluctant to lump all Brachisporiella-like organisms into a single genus, and maintain **Dendryphiosphaeria** as conceived by Lunghini & Rambelli (1978), and **Edmundmansonia**, in the Holubová-Jechobá concept.

Edmundmasonia gamundiae *Arambarri & Godeas sp. nov.*

<u>Hyphae</u> basales brunneae vel atrobrunneae, septatae ramosae, 2-5 um latae, stromata parvula formantes. <u>Conidiophora</u> singularia, erecta, recta, ramosa, septata, brunnea vel atro-brunnea, crassitunicata, laevia, 150-300 um longa ad basim 7-10 um lata, ad apicem 5-6 um lata. <u>Cellulae conidiogenae</u> terminales et laterales, monotreticeae, ampulliformes ad apicem truncatae, aseptatae, brunneae, crassitunicatae, 5-12 um longae, 2.5-3.5 um latae interdum

per proliferationes percurrentes vel sympodiales, saepe faciliter secedentes. Conidia obovoidea, 3-septata, brunnea, crassitunicata, laevia, 31-36 um longa, cellulam apicalem 12-14um lata, cellulam basalem 2-3 um lata, pallidora et tenuitunicata, cum cicatrice basali prominente planaque, usque 1.8 um lata, conidia faciliter secedentibus.
Holotypus: ARGENTINA, Provincia Tierra del Fuego, Departamento Ushuaia, Lago Roca, leg. A.M.Arambarri, 3-93, in Herb. LPS 45266 conservatus est.

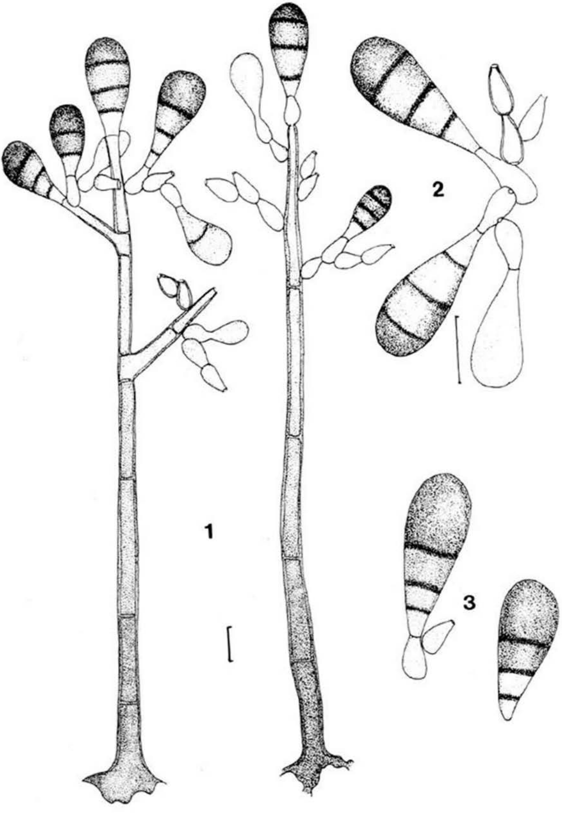
Etimology: In honour of the Argentine mycologist Dr. Irma J. Gamundí.

Mycelium composed of branched, septate hyphae ,2-5 um wide, thick-walled, aggregated and forming small stromata. Conidiophores macronematous, mononematous, erect, straight, branched, septate, brown to dark brown, thick-walled, smooth, 150-300 um long, 7-10 um wide towards the base and 5-6 um wide at the apex. Conidiogenous cells monotretic, ampulliform, brown, thick-walled, aseptate, narrow at the truncate tip, 5-12 um long, 2.5-3.5 um wide, sometimes proliferating percurrently and sympodially forming a short and branched chain. Conidia obovoid, 3-septate, brown, thick-walled, smooth, 31-36 um long, their apical cell being the widest, 12-14 um wide, narrow below and tapering to the obconical basal cell, 3-7 um wide, with a prominent basal, flat scar, up to 1.8-2 um wide, conidia dark-brown becoming paler towards the base.

This species clearly belongs to the genus **Edmundmasonia** described by Subramanian (1958). At present, four other species: **E. pulchra** Subram., **E. bulbosa** D.Rao and P.R.Rao (1964), **E. villosa** Hol.-Jech. (1983), **E. biseptata** Hol.-Jech. (1983) are referred to this genus.

The differences between **Brachysporiella**, **Dendryphiosphaeria** and **Edmundmasonia** are based on the arrangement of the conidiogenous cells and the conidial ontogeny. In **Brachysporiella**, the conidiogenous cells have proliferation percurrent and holoblastic ontogeny, while in **Dendryphiosphaeria** and **Edmundmasonia** they may have percurrent and sympodial proliferations. In **Dendryphiosphaeria** the conidiogenesis is phialidic, not tretic as it was suggested firstly by Holubová-Jechová (1983) and we have observed tretic ontogeny in our collection.

Edmundmasonia gamundiae. 1. General aspect of the conidiophore. 2. Conidiogenous cells and conidia. 3. Conidia.
Bars indicate 15 um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These concepts can be summarized these concepts as follows :

A.- Conidiogenous cells with percurrent proliferations. Conidial ontogeny holoblastic.

BRACHYSPORIELLA

A'.- Conidiogenous cells with percurrent and sympodial proliferations.

B.- Conidial ontogeny enteroblastic tretic

EDMUNDMASONIA

B'.- Conidial ontogeny enteroblastic phialidic

BRACHYSPORIELLA

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MYCOTAXON

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MENISPORA FUEGIANA SP. NOV. A NEW HYPHOMYCETE FROM TIERRA DEL FUEGO (ARGENTINA).

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SUMMARY

Menispora fuegiana a new species of dematiaceous Hyphomycete, found on decaying bark, in Tierra del Fuego, Argentina, is proposed.

Exsiccata are available at the Spegazzini Institute (LPS).

An undescribed **Hyphomycete** belonging to the genus ***Menispora*** Persoon was found in decaying bark of **Nothofagus** sp. in Tierra del Fuego (Argentina), Nothofagus forest.

The morphological characteristics were drawn from material in nature. Every attempt at cultivation on standard media proved unsuccessful.

Menispora fuegiana Arambarri et Godeas sp. nov.

Mycelium ex hyphis ramosis, septatis, pallide-brunneis, laevibus, 1,5-2 um lat., compositum. Setae basis versus rectae, apicem versus sinuatae singulariter orientes vel 2-3 aggregatae basim versus brunneae vel atrobrunneae, apicem versus rotundatum, subhyalinae, crasse tunicatae, usque ad 140 um supra basim 3-3.5 um gradatim, subhyalinae, usque ad 1.4-2 um lat. angustatae. Conidiophora recta, singulariter orientia vel 2-4 aggregata cum seta consociata basim versus brunnea, apicem versus pallide brunnea, 3-4 septata, 70-75 um long., 4.5-5 um lat. Phialides plus minusve cylindricae, 20-25 um long, 4.5 um lat., cun um collum laterale ferentes. Phialosporae hyalinae, 0-2 septatae, curvatae, 22-27 um x 2.1-2.7 um, in capitulum mucosum, incoloratum productae.
Holotypus: ARGENTINA, Tierra del Fuego, departamento Ushuaia, Paso Garibaldi, leg. A. Godeas, 3/93, ad ligno putrido Nothofagus sp.

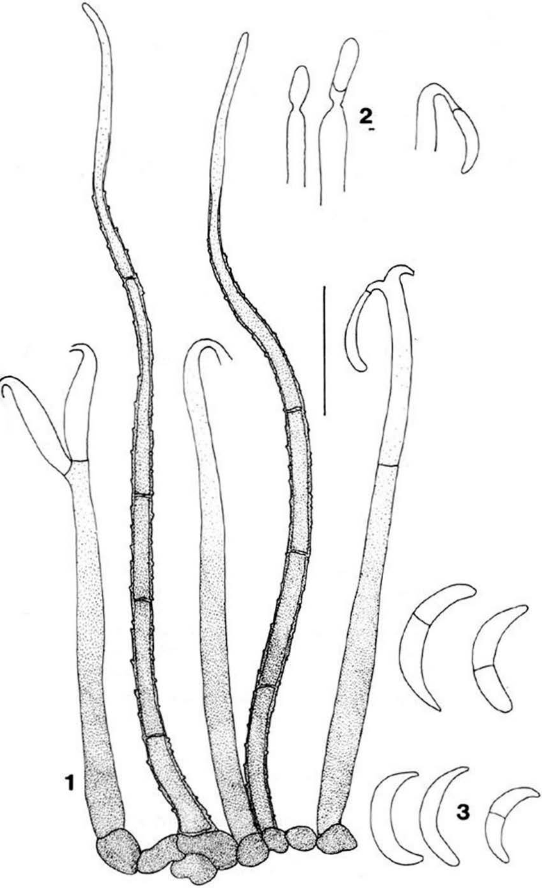
Etymology: *fuegiana* in relation to the place where it was found.

Mycelium composed of branched, septate, subhyaline to brown hyphae, 1.5-2 um wide. Setae distinct from conidiophores, straight to sinuous, unbranched, scattered or in groups of 2 or 3, with small warts and brown at the base, smooth and paler towards the apex, regularly septate up to 140 um long, 3-3.5 um wide and 1.4-2 um at the apex. Conidiophores macronematous, mononematous, erect, straight, unbranched, arising in number of 2 to 4 at the base of the seta, brown at the base pale brown to subhyaline towards the apex, 3-4 septate, 70-75 um long, 4.5-5 um wide. Conidiogenous cells mono or polyphialidic, terminal, 1 or 2 at the end of the conidiophore, discrete, with a long collarete, which may be recurved during production of the conidia, sometimes with sympodial proliferation. Collarete cylindrical, 3-4 um long, 1.5-2 um wide. Conidia aggregate in slimy masses, hyaline, smooth, 0-2 septate, curved, without setulae, 22-27 um x 2.1-2.7 um.

Our species can be placed in the genus **Menispora** specially taking into account the morphology of the conidia that is curved and the conidiogenous cell with long recurved collarete. Among the species of this genus, our species is closely related with **M. britannica** and **M. uncinata** since they have the conidiogenous cell integrated to the conidiophore and also they have sympodial proliferations and independant setiform structures. Arambarri & Cabello (1989) curried out a numerical studies of some phialidic genera of Hyphomycetes and found that **M. britannica** and **M. uncinata** differed of the other species of **Menispora** for the above mencioned characters.

On the other hand our species resemble in some aspects the conidiogenous cell of some species of **Cylindrotrichum** such as **C. menisporoides** Cabello & Arambarri, and **C. probosciophorum** (DiCosmo, Berch & Kendrick) Arambarri & Cabello, specially for the long collarete, that is reçurved after the conidiogenesis and in this aspect it is more similar to **C. menisporoides** (Arambarri, Cabello and Cazau 1991), but it belongs to a different genus on account of the morphology of the conidia. The closest species is **M. britannica** (Ellis) Kirk (Kirk 1985), but has different conidia ; they are 0-septate and setulate at both ends in **M. britannica**, for all these reasons **M. fuegiana** could integrate this group of **Menispora** species.

MENISPORA FUEGIANA 1.-Conidiophores and setae, 2.-Cellula conidiogenae, 3.- Conidia.
Bars indicate 20 um.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MYCOTAXON

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GLOMUS CLARUM (GLOMALES, ZYGOMYCETES), A NEW VESICULAR–ARBUSCULAR FUNGUS TO POLAND

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Abstract

Morphological features of spores of *Glomus clarum* Nicol. & Schenck are described and illustrated. This fungus was isolated from the root zone of *Ammophila arenaria* Link colonizing maritime sand dune soils and then propagated in pot cultures with *Sorghum sudanense* (Piper) Staph. *Glomus clarum* forms hyaline to pale yellow spores with three walls, an evanescent outermost wall adherent to two laminated walls. This fungus occurred only in one of over 500 soil samples examined coming from 143 localities of Poland. *Glomus clarum* was for the first time found in Poland and probably is a new fungus to Europe.

Key Words: Glomales, *Glomus clarum*, occurrence, Poland

Introduction

Glomus clarum Nicol. & Schenck has originally been described as forming hyaline to yellow spores with two walls, an outer 5–20 µm thick wall and an inner 2–9 µm thick wall consisting of two to five layers

(Nicolson and Schenck, 1979). According to Schenck and Perez (1990), the spore wall structure of *G. clarum* is composed of a unit outer wall and a laminated inner wall. Morton (1989, pers. comm.) found *G. clarum* spores to possess three walls, a mucilagenous evanescent outer wall staining pink to red in Melzer's reagent and two adherent laminated walls.

Examination of a soil sample recovered from the root zone of *Ammophila arenaria* Link colonizing maritime sand dune soils adjacent to Świnoujscie, Poland revealed spores of *G. clarum*. The aim of this paper is to describe and illustrate these spores as well as to present the distribution of *G. clarum* in the world.

Materials and methods

Soils were collected from around plant roots and then refrigerated until processing. Spores were extracted by wet sieving and decanting (Gerdemann and Nicolson, 1963). Spores were propagated in 500 cm^3 pot cultures containing an autoclaved soil:sand mixture (1:3, v/v) as the pot medium. The inoculum consisted of ca 200 field–collected spores that were placed in a hole at a depth of 5 cm. The potting medium was then seeded with *Sorghum sudanense* (Piper) Staph. Plants were grown in a greenhouse at 18–30°C with 12 h photoperiod (combined incandescent and cool white fluorescent light) and watered twice a week. Pot cultures were harvested after five months, spores extracted, roots stained (Phillips and Hayman, 1970) and examined for the presence of mycorrhizae. About 100 and 20 pot–collected spores were mounted in polyvinyl alcohol/lactic acid/glycerol, PVLG (Koske and Tessier, 1983) and a mixture of PVLG and Melzer's reagent (1:1, v/v), respectively. Wall description and terminology follow those suggested by Walker (1983). Spore colour was examined under a dissecting microscope on freshly collected specimens immersed in water. Colours are from Kornerup and Wanscher (1983). Specimens have been preserved in PVLG and deposited in the Department of Plant Pathology (DPP), Academy of Agriculture, Szczecin, Poland. Spelling of scientific names is according to Walker and Trappe (1993). Classification is that of Morton and Benny (1990).

Description and discussion

Glomus clarum Nicol. & Schenck

Figs. 1–4.

Spores formed singly or in loose clusters in the soil on a thin–walled, coenocytic to sparsely septate subtending hypha; hyaline to pale yellow (2A3); globose to subglobose; (70–) 106 (–150) µm diam; sometimes irregular; 90–100 x 140–180 µm.

Spore wall structure of three walls (1–3) in one group (A). Wall 1 evanescent, hyaline, (0.3–) 0.6 (–0.9) µm thick before disintegration, closely adherent to wall 2, staining pinkish white (8A2) in Melzer's reagent, usually sloughed in mature spores. Wall 2 laminated, smooth, hyaline, (2.5–) 5.8 (–11.0) µm thick. Wall 3 laminated, smooth, hyaline to pale yellow (2A3), (2.9–) 5.9 (–10.0) µm thick.

Subtending hypha hyaline to pale yellow (2A3); straight or recurved; funnel–shaped; (11.3–) 13.3 (–15.7) µm diam at the spore base. Wall of subtending hypha hyaline to pale yellow (2A3), (5.7–) 6.6 (–8.6) µm thick at the spore base; continuous with spore walls 2 and 3.

Pore 1.0–4.8 µm wide, occluded by a curved septum continuous with the innermost lamina of spore wall 3. Spore contents of hyaline oil droplets.

COLLECTION EXAMINED. POLAND, Świnoujście, under *Ammophila arenaria* Link, 22 Sept. 1992, *Błaszkowski, J. 1933–1940* (DPP).

OTHER MATERIALS EXAMINED. U.S.A. WEST VIRGINIA: Morgantown, under pot–cultured *S. sudanense*, 2 Feb. 1987, *Morton, J. B. T190* (DPP).

DISTRIBUTION AND HABITAT. *Glomus clarum* was found only in one of over 500 soil samples examined coming from 143 localities of Poland. This species was associated with roots of *A. arenaria* colonizing maritime sand dune soils adjacent to Świnoujście. The spore density of *G. clarum* in the soil sample harbouring this fungus was 62 in 100 g dry soil. The proportion of spores of this species in the spore population of all arbuscular fungi recovered was 34.6%. The fungus accompanying *G. clarum* was *Glomus* 100, an undescribed species.

Glomus clarum has earlier been found in cultivated and uncultivated soils of Florida, Kansas, Kentucky, West Virginia, U.S.A. (Day et al., 1987; Hetrick and Bloom, 1983; Miller et al., 1985; Morton, 1985; Nicolson and Schenck, 1979; Schenck and Kinloch, 1980; Schenck and Smith, 1981), Colombia, South America (Schenck et al., 1984; Sieverding, 1989), Adelaide, South Australia (McGee, 1986), Singapore (Louis and Lim, 1988) and in soils of maritime dunes and shores of Québec, New Brunswick, New Scotia, Canada (Dalpé, 1989), and Madras, India (Mohankumar et al., 1988). This suggests that this species is physiologically and genetically adapted to different environmental conditions (Stahl et al., 1988), although examination of the occurrence of arbuscular fungi in 158 cultivated sites of Poland did not reveal *G. coronatum* spores (Błaszkowski, 1993). This paper for the first time reports the occurrence of *G. clarum* in Europe.

MYCORRHIZAL ASSOCIATIONS. *Glomus clarum* was associated in the field with vesicular–arbuscular mycorrhizae of *A. arenaria*. This species formed vesicular–arbuscular mycorrhizae in pot cultures with *S. sudanense*.

Glomus clarum is easily recognizable by its distinctive spore wall structure. The evanescent wall 1 tightly adheres to wall 2. It usually is absent in field–collected spores. This wall swells and somewhat detaches in spores stored in lactic acid for a few days, becoming more visible. Additionally, the dextrinoid reaction of wall 1 in Melzer's reagent improves its recognition. The laminae of wall 2 are very thin and tightly adherent to each other. Hence, wall 2 resembles a unit wall. Examination

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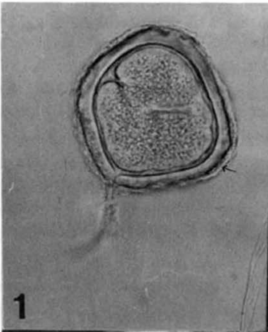
Figs. 1–4. *Glomus clarum.* 1. Intact spore in lactic acid, the swollen evanescent wall 1 is arrowed, bright–field microscopy, x424. 2. Spore with tightly adherent wall 1 (arrow), differential interference contrast (DIC), x896. 3. Surface of spore wall 1, DIC, x1724. 4. Cross–section of spore wall at subtending hypha occluded by a septum (s), numbers indicate spore wall arrangement, DIC, x1724.



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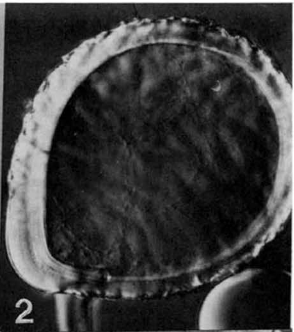

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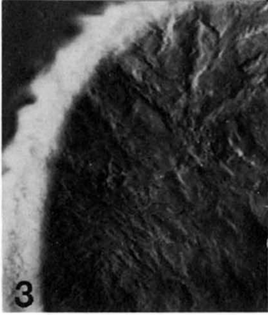

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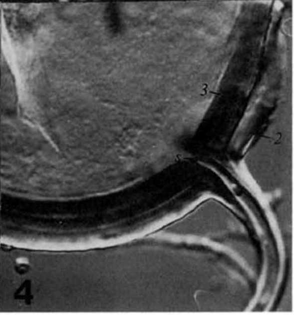

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of spores under a light microscope equipped with Nomarski interference optics reveals the laminated nature of this wall. However, the swell of the laminae and their decomposition in spores stored in lactic acid for a few weeks suggest that the composition of wall 2 differs from that of typical laminated wall. This wall may mistakenly be considered an evanescent wall. Recognition of the presence of the laminated wall 3 improves its pigmentation and separation from wall 2 in crushed spores.

At the spore base, the subtending hypha is composed of two walls continuous with spore walls 2 and 3, a hyaline outer wall and a coloured inner wall. However, the inner wall rapidly diminishes. Therefore, the colour of the whole subtending hypha quickly changes from pale yellow to hyaline.

When examined under a dissecting microscope, spores of *G. clarum* most resemble in colour, shape, and appearance those of *G. caledonium* (Nicol. & Gerd.) Trappe & Gerd., *G. etunicatum* Becker & Gerd., *G. halonatum* Rose & Trappe, and *G. lamellosum* Dalpé, Koske & Tews. Spores of these species are brightly coloured and have a thick hyaline outer wall (Becker and Gerdemann, 1977; Dalpé et al., 1992; Gerdemann and Trappe, 1974; Rose and Trappe, 1980).

Based on the properties of the spore wall structure, *G. clarum* is most closely related to *G. lamellosum*. Walls 2 and 3 of *G. clarum* spores are similar in the nature and colour to walls 1 and 2 of *G. lamellosum* spores. However, the latter species forms an additional membranous innermost wall that is absent in *G. clarum* spores. According to Rose and Trappe (1980), the outer wall of mature spores of *G. halonatum* is 8–12(–20) μm thick, hyaline, amorphous and roughened. Thus, this wall is reminiscent of wall 2 of *G. clarum* spores. However, the laminated inner wall of *G. halonatum* spores is darker (brown vs. hyaline to pale yellow in *G. clarum*) and ornamented with short, crowded spines projecting into the hyaline outer wall (vs. smooth in *G. clarum* spores). The features separating spores of *G. clarum* from those of *G. caledonium* and *G. etunicatum* are the number and nature of spore walls. Spores of *G. clarum* are three–walled, whereas those of the latter two species are two–walled. The structural wall in all these species is of the laminated wall type, but the contiguous outer walls of spores of *G. caledonium* and *G. etunicatum* are a unit wall and an evanescent wall, respectively.

According to Morton et al. (1992), *G. manihotis* Howeler, Sieverding & Schenck should be synonymized with *G. clarum*, because the small difference in spore colour between the two species is an insufficient feature to establish a new species taxon.

Acknowledgement

I would like to thank Dr. J. B. Morton, West Virginia University, for providing some specimens of *Glomus clarum* and an anonymous reviewer for the valuable comments on this manuscript. This research was financially supported in part by The Committee of Scientific Researches, grant no. 5.0271.91.01.

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MYCOTAXON

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TOMENTELLA OLIGOFIBULA SP. NOV. (APHYLLOPHORALES, THELEPHORACEAE S. STR.), FROM THE CANARY ISLANDS

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ABSTRACT

A new species, *Tomentella oligofibula*, from the Canary Islands, is characterized by infrequent occurrence of clamp connections and basidiospores with echinuli that are frequently bifurcate.

Key words: Fungi, scanning electron microscopy.

INTRODUCTION

During continuing and ongoing studies of the fungal flora of the Canary Islands, one of us (E. Beltrán Tejera) collected a specimen of *Tomentella* that proved to be an undescribed species. *Tomentella oligofibula* is described herein.

MATERIALS AND METHODS

Data on microscopic characteristics were obtained from small portions of the basidiocarp squash-mounted in 5 percent KOH (w/v) and stained with 1 percent Phloxine B (w/v), Melzer's reagent (Melzer, 1924) or lactophenol cotton blue (Johansen, 1940). Material for scanning electron microscopy was rehydrated in 10 percent KOH for 5 minutes, followed by sequential dehydration in 25, 50, 75, and 95 percent ethanol for 5 minutes at each concentration, and 100 percent ethanol for two changes at 5 minutes each, critical point dried, and gold coated. Micrographs were taken with a Hitachi S530 scanning electron microscope at an accelerating voltage of 25 kV. Capital letters used to designate herbaria are those of Holmgren et al. (1981). Color designations are of Munsell (1929-1942).

Tomentella oligofibula M. J. Larsen, E. Beltrán-Tejera et J. L. Rodríguez-Armas, **sp. nov.** Figs. 1-5

(Etymology: From **oligo** (Gr. comp., few) and **fibula** (L., n., clamp connection of fungal hyphae).

Basidioma effuso, brunneo; hyphis subiculis 3-5 µm diam, oligofibulis, leviter vel incrustatis; basidiis 35-40 x 6-7 µm; basidiosporis 5.5-6.5 (-7.5) µm lastis, irregularis vel lobatis.

***Holotypus:** habitat in reliquiis lignosis ex Myrica faya Ait. (Fayo-Ericion arboreae), in loco dicto Reserva de la Biosfera "El Canal y Los Tiles," ad 1350 m supra mare, Junonia major (Insula La Palma dicta), Islas Canarias, leg E. Beltrán Tejera, 2-XII.1989. In Herbario TFC Mic. n$^{\circ}$ 5122 conservatus est (Isotypus in Herbario CFMR).*

Basidioma effuse, occurring in small patches: fertile area continuous, smooth at 10x, pale to dull brown (near 7.5 YR/4); margin farinaceous to arachnoid, narrow, paler than the fertile area; subiculum extremely thin to appearing absent, somewhat darker than the fertile area. **Subicular hyphae** 3-5 µm diam, simple-septate with infrequent clamp connections, thin to somewhat thick-walled, wall thickening frequently irregular, sometimes with a fine rod-like encrusting material, tan to pale brown; **subhymenial hyphae** 2.5-4 µm diam, simple-septate with infrequent clamp connections; **basidia** 35-40 x 6-7 µm, 4-sterigmate, simple-septate at the base or infrequently with clamp connections, some parts infrequently blue to bluish green in KOH; **basidiospores** 5.5-6.5 (-7.5) µm across, irregular to lobed, echinulate with the echinuli frequently bifurcate, pale brown.

Remarks: *Tomentella oligofibula* is characterized by the infrequent occurrence of clamp connections throughout the structure of the basidioma and nature of basidiospore ornamentation, which is frequently bifurcate. It is best placed in the section *Brunneolae* (Bourd. et Galz.) Donk (Larsen, 1974). Basidiospores of *Tomentella oligofibula* are superficially similar to those of *Tomentella radiosa* (Karst.) Rick and *Tomentella schmoranzeri* (Bres.) M. Lars., where echinuli also become bifurcate. However, the size range of the spore body of these two species of 7.5-11.5 µm is much greater than that of *Tomentella oligofibula*. *Tomentellastrum cinereo-umbrinum* (Bres.) M. Lars. shares the characteristic with *Tomentella oligofibula* of possessing few clamp connections. However, the basidiospores of *Tomentellastrum cinereo-umbrinum* are much larger, being 9-10 (-10.5) µm across. The large spores and rare to mostly absent clamp connections are characteristic for *Tomentellastrum* (Larsen, 1981).

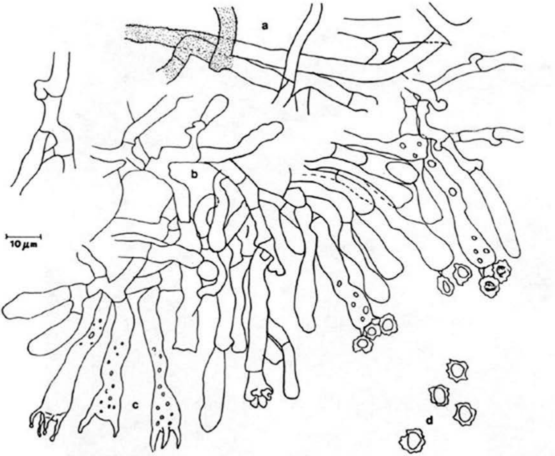

Fig. 1. Microscopic characteristics of *Tomentella oligofibula*. a: subicular hyphae; b: subhymenial hyphae; c: basidia; d: basidiospores (from holotype).

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Ms. R. Rentmeester of the Center for Forest Mycology Research. We gratefully acknowledge for taking the scanning electron micrographs and for preparation of figures. This work has been partly subsidized by one research grant proposal of the Ministerio de Educación y Ciencias of the Spanish Government [PB-87/1004 (DGICYT)].

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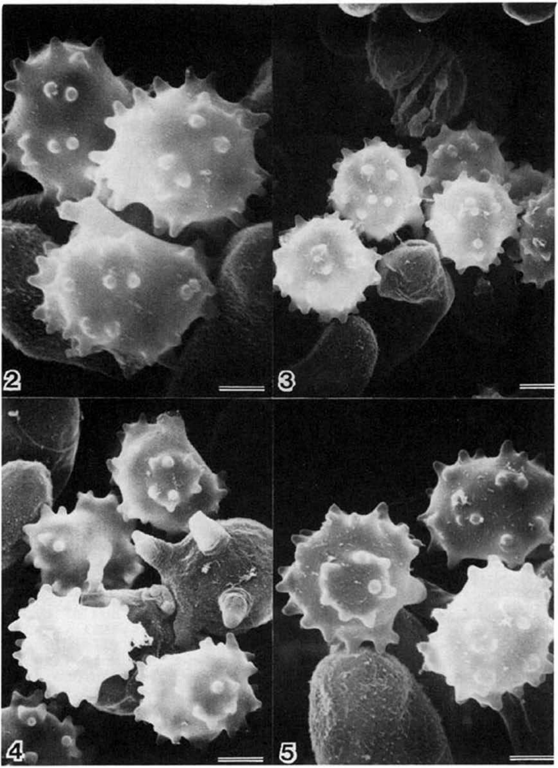

Figs. 2-5. Scanning electron micrographs of basidiospores of *Tomentella oligofibula*. Note the bifurcation of some of the echinuli (Scale bars = 1 μm ; from holotype).

MYCOTAXON

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A NEW SPECIES OF *DACTYLARIA* FROM CHINA

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During a survey of nematode-trapping fungi in the orchard soils from Xinjiang Autonomous Region, a *Dactylaria* species with short and erect conidiophores and fusiform conidia was observed and isolated. After study of the fungus and literature survey (De Hoog, 1985; Tzean & Chen, 1991; Upadhyal & Mankau, 1991), we believe the fungus to be hitherto undescribed. Herein we describe the fungus as a new species and compare it with the somewhat similar species, *D. irregularis* and *D. fusiformis*.

Dactylaria xinjiangensis **sp. nov.(Fig. 1)**

Coloniis in extracto granorum zeae mayodis cum agaro agar albidis. Mycelium sparsum, hyphis sterilibus incoloratis, septatis. Conidiophora adscendentia ad erecta, basi dilute brunnea, cylindrica, 0-5 septata, 23.5-34.0-44.5 µm longa, basi 2.5-3.4-4.7 µm crassa, sursum leniter attenuata, apice circa 2.0-2.5-3.0 crassa, in parte superiore tenuitunicata, subhyalina, cylindrica et paulo angustata, irregularia vel expansa, ad 14 denticulos conidiiferos habent. Conidia hyalina, fusiformia, 34.6-43.1-54.3 µm longa, latissima 2.0-2.6-3.7 µm in parte media, 3-7, praecipue 5 septata.

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[1] corresponding author

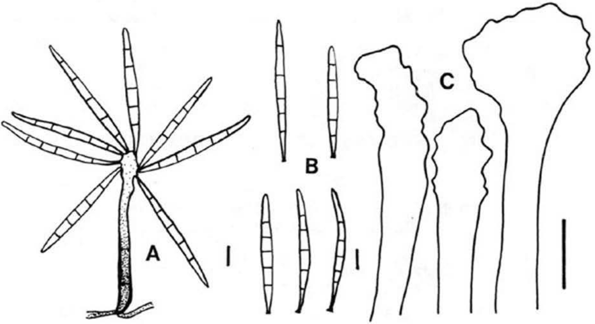

Fig. 1 *Dactylaria xinjiangensis*. A) condiophore and conidia; B) conidia, C) apical portion of condiophore. Bar=5 µm.

Habitat in pomarium soli, Urumchi, Xinjiang, 21-IX-1991, Xiu-yin Wu, XJ146-3, Typus HMAS 67040.

Colonies on Difco CMA whitish or pale brown, slow-growing extending a diam. of 4-5 cm within two weeks at 25°C, producing spare aerial mycelium. Conidiophores erect, pale brown at the base, cylindrical, 23.5-34.0-44.5 µm long, 2.5-3.4-4.7 µm wide at the base and 2.0-2.6-3.7 µm at the tip, apical portion cylindrical, irregular or broadening, with up to 14 blunt conidium-bearing denticles. Conidia hyaline, fusiform, straight or slightly curved, 3-7-septate, mainly 5-septate, 34.6-43.1-54.3 x 2.0-2.6-3.7 µm.

The fungus was isolated from the orchard soil of Urumchi, Xinjiang Autonomous Region. The type specimen is deposited in the Herbarium Mycologicum, Instituti Microbiologici, Academiae Sinicae (HMAS 67040).

Dactylaria xinjingensis resembles most closely *Dactylaria fusiformis* Shearer et Crane (Shearer & Crane, 1971) in conidial shape, but *D. fusiformis* has a broadening apical portion of conidiophores and conidia mainly 3-septate (Shearer & Crane, 1971) or 3-4(-6)-septate (Onifri & Zucconi, 1984) while the new species has a cylindrical, irregular or sometimes broadening apical portion of conidiophore and mainly 5-septate conidia. *D. xinjiangensis* also resembles *D. irregularis*, the distinctions between them are that the conidiophores of *D. irregularis* are not broadening at the apical portion and its conidia are not curved, 1-6 septate and narrower (1.8 μm).

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MYCOTAXON

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A CHECKLIST OF MYXOMYCETES OF THE MEDITERRANEAN COUNTRIES

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ABSTRACT

This checklist attempts to sinthesize the currently available chorological, taxonomic and nomenclatural information on 421 species of myxomycetes cited from countries bordering the Mediterranean sea. Species names are listed with synonyms used in Mediterranean literature, an updated nomenclature, and distribution by regions within.

RESUMEN

Se presenta una checklist que intenta sintetizar la información corológica, taxonómica y nomenclatural de 421 especies de Myxomycetes citadas de los paises que bordean el mar Mediterráneo. Se realiza una puesta al día de su nomenclatura y de su distribución por regiones. Los nombres de las especies se ordenan alfabéticamente y van acompañados de los sinónimos empleados en la literatura mediterránea.

INTRODUCTION

Current knowledge of the world myxomycete flora is far from complete or precise. As opposed to some well surveyed countries or regions such as the Netherlands (Nannenga-Bremekamp, 1974, 1979, 1983), United Kingdom (Ing, 1968, 1980, 1982), Finland (Härkönen, 1979, 1989), Germany (Neubert, 1980; 1985, Neubert & Baumann, 1986, 1987; Neubert et al., 1989, 1990, 1991, 1992), Austria (Nowotny, 1983, 1986, 1987, 1989, 1990, 1991, 1992a, 1992b, 1993), Japan (Yamamoto, 1988), Hawaii Islands (Eliasson, 1991), some of the United States (e.g. Kowalski, 1966, 1967; Blackwell & Gilbertson, 1980; Mitchel et al., 1980; Whitney, 1982; Stephenson, 1982, 1984, 1985)and Neotropical areas (e.g. Braun & Keller, 1976, 1986; Keller & Braun, 1977; Farr, 1976), there are others, such as the Mediterranean countries with very few exceptions (e.g. Faurel et al., 1964; Cochet, 1977; Cochet & Bozonnet; 1980, 1984; Lado, 1991, 1993), which have barely been explored and lack publications synthesizing the available taxonomic and phytogeographic information.

In order to correct these deficiences we have compiled the present checklist. It was not conceived as a simple catalogue, but rather as a computerized database, open to additions or corrections, and represents an effort to bring together all chorological, taxonomic and nomenclatural information on Myxomycetes from countries encircling the Mediterranean. For data presentation we follow the format described by Greuter et al. (1984), due to its simplicity and clarity. The checklist is basically intended to be a species listing including synonyms used in Mediterranean literature, an updated nomenclature, and distribution by areas.

We point out that the information may not be equally accurate for all the taxa treated herein, as it pretends to reflect our present state of knowledge and the main areas in need of research. We also point out that although we could have included a complete reference to types, Mediterranean herbaria, ecological notes and citations to pertinent literature, we have opted for a checklist which, still being rigorous, could be completed in reasonable time in order to render it as a working tool for the scientific community. Its degree of acceptance may encourage further completions.

CRITERIA FOLLOWED

The taxa are arranged alphabetically by genera and species. The generic treatment follows Martin et al. (1983) with some modifications proposed by Nannenga-Bremekamp (1967) for some members of the Stemonitales. Species are those accepted by Martin & Alexopoulos (1969) and Nannenga-Bremekamp (1991). Infraspecific taxa have not been considered, due to the inconsistency of distinctive characters in many of the cases. We thus hope to avoid error and imprecision. We have nevertheless compiled varieties cited in Mediterranean literature at hand, but without considering their distribution.

With regard to nomenclature, all species names adopted in some of the consulted sources have been compiled and verified, or they have otherwise been annotated as "*non vidi*". Orthographic variants and transcriptional errors have been corrected. The accepted names appear in bold characters, and basionyms [basion.] and synonym from Mediterranean texts in italics.

Author names, sites and years of publication are stated. We have found useful the works of Rostafinsky (1874, 1875, 1876), Lister (1894, 1911, 1925), Martin & Alexopoulos (1969) for pre-1968 taxa, and Nannenga-Bremekamp (1991) and *Index* *of Fungi* for later ones. Author names preceded by "*ex*" have been included. Following the Botanical Code of Nomenclature (1988), in the case of more than two authors, the first one is followed by "*et al.*" Author abbreviations are given according to Brummitt & Powell (1992), and when not included there in, we procede by analogy. Book titles are abbreviated as in Stafleu & Cowan (1976, 1979, 1981, 1983, 1985, 1986, 1988), and those of periodicals, as given in Bridson & Smith (1991).

Names of difficult interpretation or attributed to taxa of dubious identity come under "*Excluded or doubtful names*". They are followed by the literature citation of the author who uses the name, plus another reference, generally Martin & Alexopoulos (1969), where more data on their identity are to be found.

SOURCES OF INFORMATION

The sources of information are arranged by countries, and they include larger floras and catalogues as well as more restricted ones with valuable information. We have ignored only those citing accepted synonyms.

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GEOGRAPHIC AREA COVERED

The area covered is a well defined biogeographic unit limited to countries bordering the Mediterranean sea as well as Portugal and Jordania. The area has been divided according to practical criteria into sixteen regions which largely conform to political circumscriptions (Fig. 1). They are designated with the 3-letter code of Hollis & Brummitt (1992). We have without exception included records from islands under their countries, hence the Balearic Islands are under Spain, Corsica under France, Sardinia and Sicilia under Italy, and the Aegean Islands under Greece. Malta has been placed under Italy, the Asiatic and European regions of Turkey are treated as one, and Sinai has been included under Palestine. We point out that these decisions do not reflect any political views of the author. Abbreviations used herein are listed below.

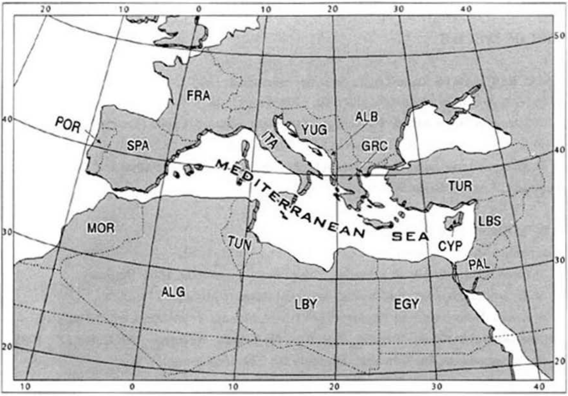

Fig. 1. Geographic area

ALB	Albania
ALG	Algeria
CYP	Cyprus
EGY	Egypt
FRA	France (inc. the Channel Islands, Corsica and Monaco)
GRC	Greece (inc. the Aegean Islands)
ITA	Italy (inc. Malta, San Marino, Sardinia, Sicily and Vatican)
LBS	Lebanon and Syria
LBY	Lybia
MOR	Morocco (inc. Ceuta and Melilla)
PAL	Palestine (Israel, Jordan and Sinai)
POR	Portugal
SPA	Spain (inc. Andorra, the Balearic Islands and Gibraltar)
TUN	Tunis
TUR	Turkey (inc. European territory)
YUG	Yugoslavia

Regions are tabulated clockwise from Portugal to Morocco. Plus and minus signs denote presence or absence of a species in any particular region. A query means doubt as to its presence due generally to imprecision by its author or collector. The figures for number of species by region given at the end of the table highlights priority for further study, not at all a poor myxomycete flora. We hope that the present work will contribute to a more complete understanding of this flora and will be a useful starting point for updates and more detailed studies.

LIST OF SPECIES

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR
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-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+
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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR
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-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR
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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR
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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

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POR SPA FRA ITA YUG ALB GRC TUR CYP LBS PAL EGY LBY TUN ALG MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR
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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR
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POR SPA FRA ITA YUG ALB GRC TUR CYP LBS PAL EGY LBY TUN ALG MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR
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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR
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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR
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POR SPA FRA ITA YUG ALB GRC TUR CYP LBS PAL EGY LBY TUN ALG MOR

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POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR
+	+	+	-	-	-	+	+	-	-	-	-	-	-	-	+
+	+	+	+	-	-	+	+	-	-	+	-	-	+	+	+
-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-
+	+	+	+	-	-	+	+	-	-	+	-	-	+	+	-
+	+	+	-	-	-	-	-	-	-	+	-	-	-	+	-
+	+	+	+	-	-	+	-	-	-	-	-	-	-	-	+
-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
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-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-
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+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

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TOTAL 421

POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR
-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
-	+	+	+	-	-	+	-	-	-	-	-	-	-	+	+
+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
151	269	339	164	1	0	60	80	9	0	86	0	3	35	71	117
POR	SPA	FRA	ITA	YUG	ALB	GRC	TUR	CYP	LBS	PAL	EGY	LBY	TUN	ALG	MOR

EXCLUDED OR DOUBTFUL NAMES

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Didymium cyanescens Fr., Symb. Gasteromyc. 19. 1818 [see Martin & Alexopoulos (1969: 384)].

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A NEW SPECIES OF MONOCHAETIA (COELOMYCETES) FROM CHINA

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A new species of *Monochaetia* is described. It is characterized by simple, eustromatic conidiomata and (3-) 4 (-5) euseptate holoblastic conidia with prominent septa and brown median cells, hyaline end and apical cells directly developing into a simple cellular appendage. It is compared with similar taxa.

Monochaetia nodosporella G.C.Zhao & Li Nan, sp. nov. (Figs 1-3)

Conidiomata eustromatica, dissita, complanata, canescentia, peltata, demum atro-brunnea, immersa, unilocularia, 136-476 μm lata; ostiolo sed a rima circumambienti dehiscenti. *Conidiophora* cylindrica, septata, hyalina vel fuscula, ramosa ex cellulae interioribus basali conidiomatis enascentia, 5.0-25.0 x 2.5-4.3 μm longa; cellulae conidiogenae discretae vel in conidiophoris incorporatae, determinatae vel indeterminatae, cylindricae vel ampulliformes, terminatae vel acropleurogenae, hyalinae vel pallidae, laeves, 4.7-9.3 x 2.5-3.8 μ m, raro ter percurrenter prolificantes. *Conidia* holoblastica arcuata, (3-) 4 (-5) euseptata, (2-) 3 (-4) cellulae medianae atro-brunneae, nodosae ampliata super septatam, 14.0-17.4 x 7.0 - 9.4 μ m; cellula apicalis et basalis recta orta in appendice una, subhyalina, simplicia, cellulosa; apicalis (12.0) 17.5 - 38.8 (52.5) μ m long; basalis 18.9-31.3 μm long.

Habitat: in foliis vivis *Castanopsis delavayi* Franch., Binchuan, provincia Yunnan, Sina, G.C. Zhao, Sheng et Li, XI 1988. Holotypus HSFC 880132 (isotypus IMI 359913), paratypus HSFC 88015 consevatur.

Conidiomata eustromatic, immersed and subepidermal, separate, complanate, peltate, canous, later peltate and when dehisced dark brown, unilocular; 136-476 μ m wide; comprised of thin walled textura angularis; ostiole absent, dehiscence by circumambient rupture. *Conidiophores* cylindrical, hyaline, to pale brown, smooth, septate, branched, 5.0-25.0 x 2.6-4.3 μ m long; conidiogenous cells discrete or integrated, terminal or acropleurogenous, cylindrical to ampulliform, hyaline, smooth, determinate or indeterminate, 4.7 - 9.3 x 2.5 - 3.8 μ m, occasionally proliferating percurrently. *Conidia* holoblastic, luniform arcuate, (3-) 4 (-5) euseptate, periclinal wall collapsed between the septa, with median (2) 3 (4) cells brown to dark brown, 14.0 - 17.4 x 7.0 - 9.4 μm, cell hyaline at base and apex and directly developed to become a simple, unbranched, hyaline, cellular appendage, apical (12.0) 17.5 - 38.8 (52.5) μm long, basal 18.9 - 31.3 μ m long, occasionally short branched.

Two taxa similar to *M. nodosporella* have been described previously but they differ in appendage and conidial characters: - *M. pinicola* Dearn. (Guba, 1961) (= *Toxosporium camptospermum* (Peck) Maubl.) and *M. hysteriiformis* (Berkeley & Curtis) Guba (Guba, 1961; Nag Raj, 1993). *Toxosporium camptospermum* was shown by Sutton (1975) to have 5 septate conidia in which the median septum was black-banded (Sutton, 1986). *M. hysteriformis* differs in having verruculose rather than smooth median cells and in the much shorter apical and basal appendages. The conidia of *M. nodosporella* are remarkable for their extremely smooth and nodular swelling at the septa. Most appendages are appreciably longer than the longest recorded in either *T. camptospermum* or *M. hysteriiformis* (Fig. 3). Therefore *M. nodosporella* is not close to either of these and appendage and conidial characters do not approach those of any previously known taxon.

Specimens examined: On living leaves of *Castanopsis delavayi* Franch.; Collected by G.C. Zhao, Sheng & Li, 1988, from high mountain forest, levels 2600 - 3000m, south Yunnan, Binchuan, Yunnan, China; Deposited in Plant Pathology Herbarium of Southwest Forestry College (HSFC) ; Kunming, Yunnan, China (HSFC 880132 holotype (IMI 359913, isotype), 880157 paratype).

I am grateful to Dr Brian C. Sutton for his guidance.

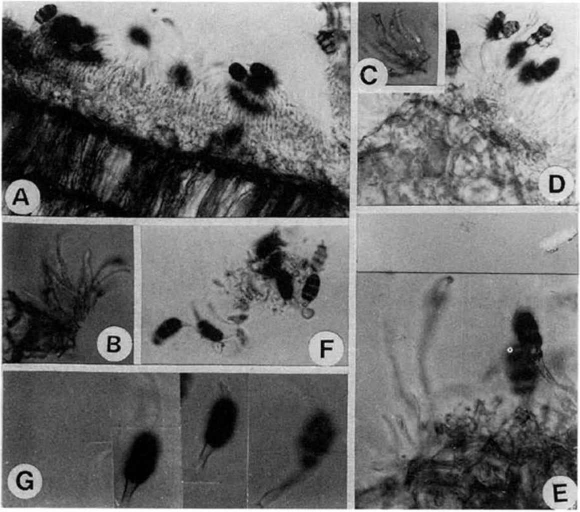

Fig. 1. *Monochaetia nodosporella* sp. nov. A. Vertical section of a conidioma; B-C. Conidiophores and conidiogenous cells; D-E. Conidiogenous cells, conidiophores and developing conidia; F. Conidia; G. Basal cellular appendage and conidiogenous cell of development. (A-D, F, X112; E,G, X200).

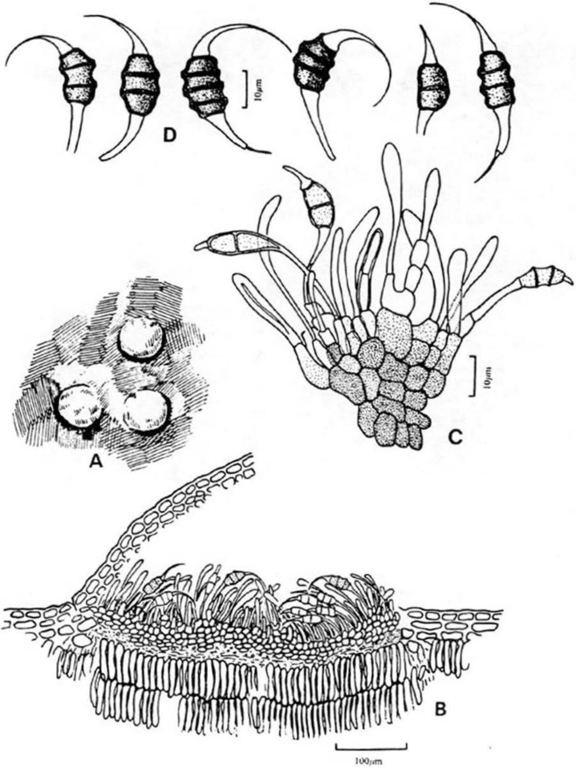

Fig. 2: *Monochaetia nodosporella.* A. Morphology of conidiomata on leaves. B. Vertical section of a conidioma. C. Conidiophores, conidiogenous cells and developing conidia. D. Conidia.

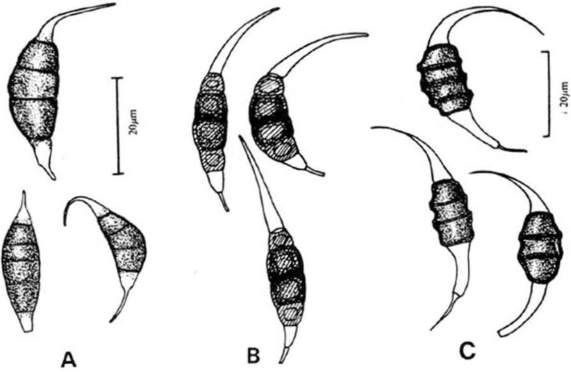

Fig. 3. Comparison of conidial features of *M. hysteriiformis*, *T. camptospermum* and *M. nodosporella*.
A. *M. hysteriiformis*; B. *T. camptospermum*; C. *M. nodosporella*.

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MYCOTAXON

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New record of *Ceratopycnidium baccharidicola* (endophyte on *Baccharis coridifolia*) in Brazil

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SUMMARY

From two populations of *B.coridifolia* near Santa María (Rio Grande do Sul, Brazil), *Ceratopycnidium baccharidicola* Bertoni & Cabral was isolated. It is recorded for the first time from Brazil and the second record of the species.

INTRODUCTION

Baccharis coridifolia, "mio-mio" o "romerillo", causes toxic episodes in cattle in Southern Brazil, Uruguay and Northern Argentina, and is a major economic problem in this area of the world (Habermehl et al., 1984). It has been suggested that macrocyclic trichothecenes are responsible for the toxicity of *B.coridifolia* (Habermehl et al., 1985). These metabolites: roridins A,D,E and verrucarins A,J are exactly the same toxins typically produced by cultures of *Myrothecium verrucaria* and *Myrothecium roridinum.* These **mycotoxins** were isolated from healthy plants, and plants in which **electron microscopy** examination for fungal endophytes was negative (Jarvis et al.,1988; 1989).

Ceratopycnidium baccharidicola was isolated as an endophyte by surface-sterilization and culturing, of *Baccharis coridifolia* plants, from three localities of Argentina: Magdalena (Buenos Aires province), Gualeguaychú and Campo Baggio (Entre Ríos province) (Bertoni & Cabral, 1991). So populations of *B.coridifolia* in Southern Brazil were investigated in a similar way.

MATERIAL and METHODS

Samples were taken from two populations of *Baccharis coridifolia* from Rio Grande do Sul. One was 22 km from Santa Maria in the small road to Rosario do Sul (Darcia Leal Nascimento´s farm). The other, 47 km from Sta.María (Sucesión Viterbo Borges´ farm).

Ten plants were sampled from each site. Three twigs and fifteen leaves were selected from each plant and washed in tap water. These were surface-sterilized with sequential washing in 50% ethanol for 1 min.; in commercial NaOCl-water, 2:1, for 3-5 min and finally rinsed in 50% ethanol for 1 min.

Three segments from each twig and one of each leaf were selected at random for culturing. Segments were transferred to Petri dishes containing 2% water agar and incubated at room temperature in daylight. After 15-30 days of post-culture, the endophytes were isolated on 2% malt extract agar.

RESULTS

Endophytes were found in both populations mentioned above. *C.baccharidicola* was found in both.

The genus *Ceratopycnidium* was introduced by Maublanc (1907) to accommodate a single species *C.citricola* from Brazzaville, Congo. *C.baccharidicola* is the second species of the genus, originally from Argentine plants of *B.coridifolia* (Bertoni & Cabral, 1991). It is distinghished from *C.citricola* by the morphology and size of the conidiomata.

The strains of *C.baccharidicola* from Brazilian *B.coridifolia* plants were similar to those found in the Argentine populations.

Specimens examined: Living culture as BAFC cult.484, isolated from *B.coridifolia* in Brazil, Rio Grande do Sul, 22 km from Santa María, april 1991. BAFC cult.485, ibid. BAFC cult.486, ibid, 47 km from Santa María.

CONCLUSIONS

This is the first time that *C. baccharidicola* was found on plants of *Baccharis coridifolia* from Brazil and the second record of the species. The presence of this fungus in populations of *B.coridifolia* of Argentina and Brazil suggests that this endophyte could be common on that plant.

ACKNOWLEDGEMENTS

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A NEW SPECIES OF *MYXOTRICHUM* WITH AN *OIDIODENDRON* ANAMORPH

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ABSTRACT

Myxotrichum arcticum, a new species with an *Oidiodendron* anamorph, is described and illustrated from Alaskan forest soil. It differs from others by having ascomata with very short, spine-like appendages which are never uncinate and which are similar to the peridial hyphae, and by having a unique *Oidiodendron* anamorph.

Key Words: *Myxotrichum*, *Oidiodendron*, ascomycete,
Myxotrichaceae, taxonomy, soil fungus.

During the past several years, soil and other natural substrates from Japan and overseas have been screened for producers of metabolites useful to the pharmaceutical industry. Meanwhile, a culture representing *Myxotrichum* Kunze was isolated from Alaskan forest soil in 1992. Since this fungus does not fit any hitherto described species of the genus, it is proposed as a new species.

MATERIALS AND METHODS

Strains. The isolate, BF 40000, examined in this study. The strain is maintained as living culture in the Tsukuba Research Institute, Banyu Pharmaceutical Co., Ltd., Tsukuba-shi, Japan. For a comparison, *Myxotrichum stipitatum* (Lindfors) Orr et Kuehn strain NHL 2962, collected from cultivated soil at the date palm plantation, near Basrah, Iraq, July 1983, was used.

Media. Cultures were grown in the dark, on several media including: phytone yeast extract (PYE) (Carmichael, 1962), yeast-starch (YpSs) (Emerson, 1941), oatmeal (OA), and cellulose agars. Distinct growth on the cellulose agar, composed of 10 g powdered cellulose, 1 g NH_4NO_3, 0.5 g K_2HPO_4, 0.5 g $MgSO_4 \cdot 7H_2O$, and 20 g agar per liter of infusion from 1 kg soil (Udagawa, 1960), was recorded as indicating cellulolytic ability. Colors designated are from the Kornerup and Wanscher (1978) color standard and the Rayner (1970) color chart, and are referred to with the letters M and R, respectively.

Scanning electron microscopy. Scanning electron microscopy (SEM) was performed using a Hitachi Model S-4100 SEM. For SEM, ascospores were fixed in 0.5% osmium tetroxide, dehydrated in a graded alcohol series, critical-point dried, and sputter coated with platinum-palladium.

Ubiquinone analysis. Extraction, purification and determination of ubiquinone from the liquid culture (a medium composed of 5 g malt extract, 3 g yeast extract, and 30 g glucose per liter of distilled water) of the strain by high-performance liquid chromatography were carried out as described by Kuraishi et al. (1985).

RESULTS AND DISCUSSION

Myxotrichum arcticum Udagawa, Uchiyama et Kamiya, sp.nov.
Figs. 1-3

Coloniae in agaro farinae avenaceae ad 15°C tarde crescentes, 10-12 mm diam in dies 21 attingentes, planae, ex coacto mycelio tenui constantes, velutinae, griseo-fulvae, abundantibus ascomatibus formantes, dein dilute flavae vel primulinae; conidiogenesis moderata vel abundans, viridi-grisea; reversum viridi-griseum vel olivaceo-griseum.

Ascomata superficialia, saepe confluentia, globosa vel subglobosa, 100-250 µm diam, primum flava et in centro alba, ad maturiatem griseo-nigra; hyphae peridii valde olivaceo-brunneae, incrassatae, septatae, 1.5-2(-2.5) µm diam, leves vel saepe asperulatae, ramosae et anastomosantes, reticulum formantes; appendices spiniformes, atrobrunneae, apicem versus pallescentes, rigidae, septatae, rectae vel flexae, 30-50 × 1.5-2.5 µm, incrassatae, asperulatae, plerumque simplices vel interdum ramosae cum 2-3 ramulis, apice acutae vel obtuse rotundatae. Asci 8-spori, subglobosi vel ovoidei, 8-10 × 7-9 µm, brevistipitati, evanescentes. Ascosporae hyalinae, fusiformes, 4-6 × 1.5-2 µm, utrinque plus minusve

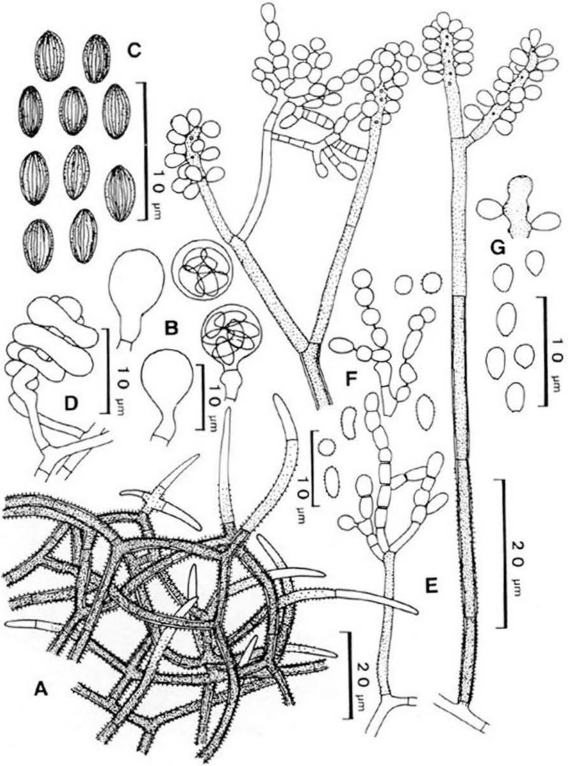

Fig. 1. *Myxotrichum arcticum*, BF 40000.
A. Peridial hyphae with appendages. B. Asci. C. Ascospores. D. Ascomatal initial. E. Conidiophores and conidiogenous cells. F. Connected and free intercalary conidia. G. Terminal conidia and their formation.

acuminatae, leviter striatae. Status anamorphus: *Oidiodendron* sp.

Ubiquinonum majus: Q-9.

Holotypus BF 40000, colonia exsiccata in cultura ex solo sylva, Alaska, USA, 18.viii.1992, a S. Uchiyama et S. Kamiya isolata et ea collectione fungorum, Musei et Instituti Historiae Naturalis Chiba (CBM) conservata.

Etymology: Latin, *arcticus*=from arctic regions, referring to the type locality.

Anamorphosis: *Oidiodendron* sp.

Conidiophora erecta, ex mycelio basali vel hyphis aeriis oriunda, simplicia vel saepe ramosa; stipites 30-450 × 1.5-2(-2.5) µm, dilute brunnei vel atrobrunnei, septati, incrassati, leves vel inferne grosse asperulati, in summo hyphas fertiles ramosas incorporati. Cellulae conidiogenae in conidiophora incorporatae, terminales, determinatae, hyalinae, cylindraceae, in catenas conidiorum proferentes, ad maturiatem effractae. Conidiophora interdum in partem fertilem geniculatum 10-35 × 1.5-3 µm terminantia, ex quibus cellulae conidiogenae dense confertae formantia; cellulae conidiogenae breves, in conidia terminalia singularia effectae. Conidia terminalia hyalina vel dilute brunnea, subglobosa vel ovoidea, 2-3 × 1.5-2 µm, ad basim truncata, levia. Conidia intercalaria hyalina vel dilute brunnea, globosa, subglobosa, ovoidea vel ellipsoidea, saepe utrinque truncata, 2.5-4(-4.5) × 1.5-2.5 µm, levia vel subtiliter asperulata.

Holotypus BF 40000, loc. cit.

Colonies on PYE growing restrictedly, attaining a diam of 16-18 mm in 14 days at 25°C, velvety, strongly wrinkled, consisting of a close-textured basal felt, Dull Green (M. 28D3); ascomata not produced; conidiogenesis moderate to heavy; exudate and soluble pigment present, brownish; reverse Greyish Brown (M. 7F3). Colonies on YpSs agar growing very restrictedly, attaining a diam of 9-10 mm in 21 days at 25°C, raised centrally, consisting of a thin basal felt, Orange White (M. 5A2) or Buff (R); ascomata not produced; conidiogenesis sparse, inconspicuous; reverse uncolored or faintly Pale Yellow (M. 4A3). Colonies on OA growing restrictedly, attaining a diam of 13-15 mm in 14 days at 25°C, plane, consisting of a thin basal felt, with surface appearing almost velvety or somewhat floccose, Dull Green to Greenish Grey (M. 29D5-26E2; R); margin thin, submerged; ascomata not produced; conidiogenesis abundant; soluble pigment present, Light Brown (M. 7D4) or Fawn (R); reverse Dark Brown (M. 6F5) or Dark Brick (R). Colonies on OA at 15°C growing less rapidly than at 25°C, attaining a diam of 10-12 mm in 21 days, plane, consisting of a thin basal felt, with surface appearing velvety, Greyish Yellow (M. 1B3), developing abundant ascomata within 28 days as a fairly

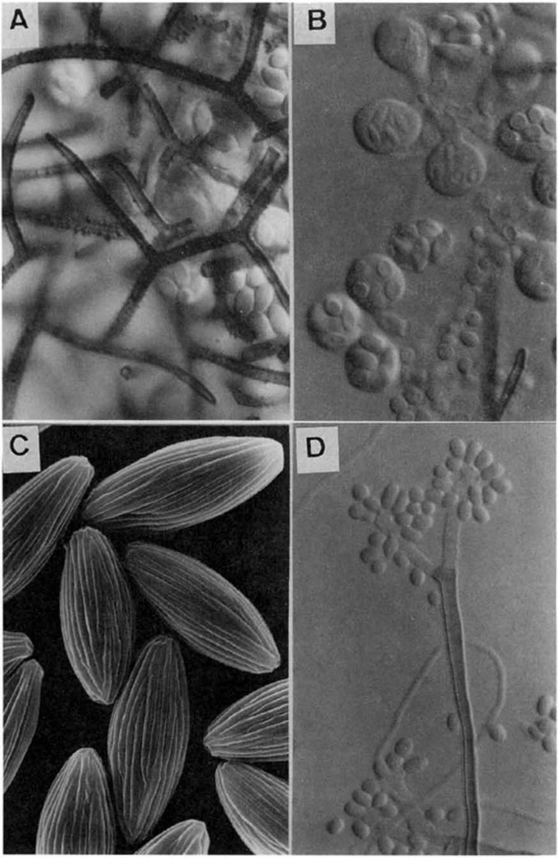

Fig. 2. *Myxotrichum arcticum*, BF 40000. A. Peridial hyphae with appendages, x900. B. Asci x1260. C. Ascospores (SEM) x7200. D. Conidiogenous cells and conidia x1260.

dense layer in colony center, becoming Pale Yellow (M. 1A3) or Primrose (R); conidiogenesis moderate to abundant, intermixed with the ascomata, Greenish Grey (M. 26E2; R); soluble pigment slightly brownish; reverse Greenish Grey (M. 27F2) or Olivaceous Grey (R).

Ascomata superficial, often confluent, globose to subglobose, 100-250 µm diam excl. appendages, at first yellow with a white centrum, becoming grayish black at maturity. Peridial hyphae dark olivaceous brown, thick-walled, septate, 1.5-2(-2.5) µm diam, smooth to often asperulate, not swollen at the nodes, branched and anastomosed, forming a reticulum, ending in spine-like appendages. Appendages dark brown, paling toward the apex, rigid, septate, straight or bent, 30-50 µm long, 1.5-2.5 µm diam at the middle, thick-walled, asperulate, slightly extending beyond the peridium proper, mostly unbranched or sometimes branched in two or three branchlets, terminating in a pointed or bluntly rounded end. Asci hyaline, 8-spored, subglobose to ovoid, 8-10 × 7-9 µm, short-stipitate (stipes up to 5-8 µm long), evanescent. Ascospores hyaline, fusiform, 4-6 × 1.5-2 µm, more or less acuminate at both ends, faintly striate. Ascomatal initials appeared as the formation of paired gametangial hyphae which arise from different aerial hyphae as side branches, consisting of club-shaped hyphal cell up to 15 µm long and 3 µm diam, around which another hypha coils tightly several times.

Conidiophores macronematous, mononematous, erect, arising from basal mycelium or aerial hyphae, simple or more often branched into several trunks; stipes 30-450 × 1.5-2(-2.5) µm, pale brown to dark brown, septate, thick-walled, smooth or coarsely roughened at lower part, branched in the upper region to produce fertile hyphae or giving rise directly to a hyaline apical portion crowded with short conidium-bearing segments. Conidiogenous cells integrated, terminal on branches or on conidiophores, determinate, hyaline, cylindrical, fragmenting to form conidial chains, at maturity broken out. Conidiophores sometimes terminating in a geniculate fertile portion measuring 10-35 × 1.5-3 µm, from which short conidiogenous cells are densely produced as a lateral branch, developing into single terminal conidia. Terminal conidia hyaline to pale brown, subglobose to ovoid, 2-3 × 1.5-2 µm, with a truncate base, smooth-walled. Intercalary conidia hyaline to pale brown, variable in shape, globose, subglobose, ovoid or ellipsoidal, often with truncate ends, 2.5-4(-4.5) × 1.5-2.5 µm, with walls smooth to finely roughened, connectives occasionally visible between the conidia.

Cellulolytic.

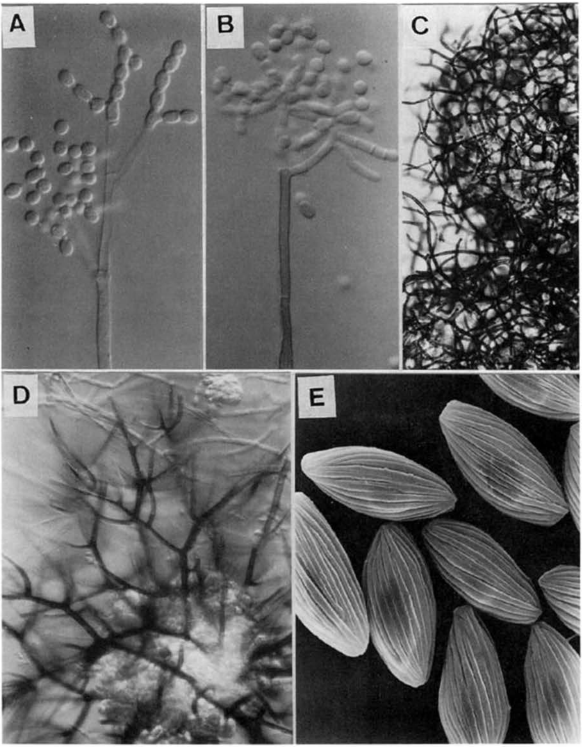

Fig. 3. *Myxotrichum arcticum*, BF 40000 (A-C) and *M. stipitatum*, NHL 2962 (D, E).

A, B. Conidiogenous cells and conidia, × 1000. C. Ascoma wall and appendages, × 250. D. Ascoma wall with appendages, × 500. E. Ascospores (SEM), × 6500.

Major ubiquinone: Q-9.

At 37°C, growth is nil.

Specimen examined: a dried culture isolated from forest soil, along George Parks Highway road, Willow, north of Wasilla, Alaska, USA, 18 August 1992, BF 40000, holotype. The type specimen is deposited in the Natural History Museum and Institute, Chiba, Japan (CBM).

Myxotrichum arcticum is quite distinct from all other species of the genus with the possible exception of *M. bicolor* (Ehrenberg) Fries (Orr et al., 1963; Currah, 1985). In both species ascomata form only short appendages which are not sharply distinguished from peridial hyphae. However, *M. bicolor* is a lichenicolous member of the genus and distinctly differs from this species in its larger ascospores (e.g. 3-6 × 8-14 μm). *Myxotrichum stipitatum* is somewhat similar to this species in the formation of rather short spine-like appendages, which are never uncinate stipitate asci and nearly equal ascospores. A comparison of the branching appearance between the ascoma appendages of both fungi serves to indicate that *M. arcticum* and *M. stipitatum* are distinct (Figs. 2, 3).

Two species of the genus *Oidiodendron*, *O. chlamydosporicum* Morrall and *O. scytaloides* W. Gams et Söderström, are characterized by production of arthroconidia and pigmented chlamydospores (Barron, 1962; Morrall, 1968; Tokumasu, 1973; Sigler and Carmichael, 1976; Gams and Söderström, 1983). *Oidiodendron periconioides* Morrall is characterized by another variation of conidial development, because its fertile hyphae are swollen into series of irregular oval-shaped vesicles, each of which differentiate into a conidium, distinguishing *O. periconioides* from other species (Morrall, 1968). Recently, more detailed observation on the unusual process of conidiogenesis in *O. periconioides* was made by Currah et al. (1993). The *Oidiodendron* anamorph of *M. arcticum*, in having minimized conidiogenous cells on the geniculate tips of conidiophores, somewhat resembles *O. periconioides* but there are no vesicle-like swellings.

In the Myxotrichaceae, *Myxotrichum cancellatum* Phillips, *M. stipitatum* (Lindfors) Orr et Kuehn, *Pseudogymnoascus roseus* Raillo and *Gymnostellatospora japonica* Udagawa, Uchiyama et Kamiya had the Q-10(H_2) system (Kuraishi et al., 1991; Udagawa et al., 1993), but the new species was Q-9 as the major ubiquinone system. Discussion on the significance of the distribution of ubiquinone systems in the Myxotrichaceae should be made only after determination of ubiquinone types in most of the remaining species.

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PETROMYCES MURICATUS, A NEW SPECIES WITH AN *ASPERGILLUS* ANAMORPH

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ABSTRACT

A new species of *Petromyces* (Ascomycetes: Trichocomaceae) is described and illustrated as *P. muricatus*. It is characterized by pale yellow to flesh colored ascostromata, oblate ascospores with a low equatorial rim and spinulose surfaces, and an *Aspergillus* anamorph belonging to the section *Circumdati* of the subgenus *Circumdati* (=*A. ochraceus* group). The holotype was isolated from grassland soil in the Philippines.

Key Words: ascomycete, Trichocomaceae, *Petromyces muricatus*, *Aspergillus muricatus*, taxonomy, soil fungus, the Philippines.

An interesting *Aspergillus* which produced abundant pale yellow to flesh colored sclerotioid bodies was recently isolated from grassland soil from the Philippines. Light yellow conidial heads with biseriate aspergilla produced in a dense stand over the surface of the colonies on potato-dextrose agar (PDA) indicated that this fungus belongs in the section *Circumdati* of the subgenus *Circumdati* (=the *Aspergillus ochraceus* group after Raper and Fennell (1965)). During the 3 months' observation period, the sclerotioid bodies could be seen to contain one to two ascomata in which ascospores mature very slowly in cultures on half strength PDA. The ascosporic species of the *A. ochraceus* group was later transferred to the genus *Petromyces* as a new teleomorphic species, *P. alliaceus* Malloch et Cain (Malloch and Cain, 1972). The ascospores of our fungus were oblate with a low equatorial rim and spinulose on the convex surfaces. Since no species of *Petromyces* have been described with ascospores of this ornamentation type, it is here described as a new species.

The cultures were grown in the dark, on several media including: Czapek agar, Czapek-yeast extract agar (CYA) (Klich and Pitt, 1988), malt extract agar (MEA), oatmeal agar and half strength PDA. Colors designated in capitals are from the Kornerup and Wanscher (1978) color standard and Rayner (1970) color chart, and are referred to with the letters M and R, respectively. The spores were examined by scanning electron microscopy (SEM), a Hitachi Model S-4100. For SEM, spores were fixed in 0.5% osmium tetroxide, dehydrated in a graded alcohol series, critical-point dried, and sputter coated with platinum-palladium. Extraction, purification, and determination of ubiquinones from the liquid cultures (a medium composed of 5 g malt extract, 3 g yeast extract, and 30 g glucose per liter of distilled water) of the fungus by high-performance liquid chromatography were carried out as described by Kuraishi et al. (1985).

Petromyces muricatus Udagawa, Uchiyama et Kamiya, sp.nov. (Figs. 1, 2)

Coloniae in agaro "Czapek-yeast extract" (CYA) effusae, floccosae, radiatim sulcatae, compactae, luteolae vel roseo-bubalinae vel carneae; ascostromata tarde formantia; conidiogenesis ad centrum abundans; reversum dilute aurantiacum vel luteolum. Coloniae in agaro maltoso (MEA) paulo effusae, floccosae, ex mycelio basali coacto tenuiter constantes; ascostromata dispersa, alba vel luteola vel bubalina; conidiogenesis limitata; reversum incoloratum vel dilute aurantiacum vel luteolum. Coloniae in agaro decocto tuberorum (half strength PDA) paulo effusae, floccosae, pro parte maxima planae, ex mycelio basali coacto tenuiter constantes; ascostromata ad centrum abundantia, ex hyphis aeriis et capitulis conidicis laxe obtecta, luteola vel straminea; conidiogenesis sparsa vel profusa; reversum dilute aurantiacum vel salmoneum et agar similaris.

Ascostromata dispersa vel saepe confluentia, luteola vel carnea, sclerotioidea, globosa vel subglobosa vel interdum elongata, 400-600 µm diam, 1-2 ascomatibus continentia, multistrata; stratum externum ex cellulis luteolis globosis vel plus minusve angularibus incrassatis 6-16 µm diam compositum. Ascomata non-ostiolata, globosa vel subglobosa, 155-300 µm diam, tarde maturescentia;

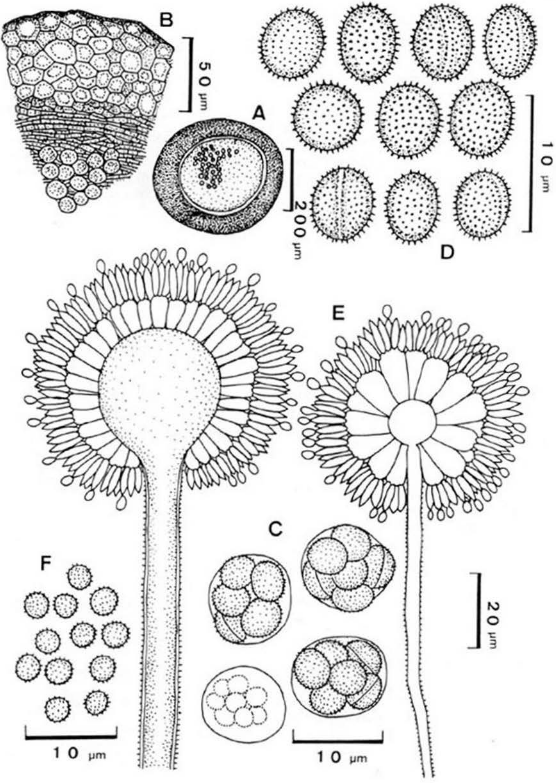

Fig. 1. *Petromyces muricatus*, BF 42515.
A. Ascostroma containing an ascoma (section). B. A portion of a stroma (section). C. Asci. D. Ascospores. E. Aspergilla. F. Conidia.

peridium tenue, ex cellulis hypharum compositum. Asci singulariter portati, 8-spori, subglobosi vel ovoidei, 10-14 × 8-10 μm, evanescentes. Ascosporae hyalinae, oblatae, in ambitu subglobosae vel late ellipsoideae, cum labro aequatorio praeditae, (4.5-)4.8-5.5 × (3.5-)4-4.8 μm, spinulosae. Status anamorphus: *Aspergillus muricatus*.

Ubiquinonum majus: Q-10(H_2).

Holotypus BF 42515, colonia exsiccata in cultura ex solo gramine, Laguna, Los Banos, in Philippinis, 22.ii.1993, a S. Uchiyama et S. Kamiya isolata et ea collectione fungorum, Musei et Instituti Historiae Naturalis Chiba (CBM) conservata.

Etymology: Latin, *muricatus*= covered with prickles, referring to the ascospore ornamentation.

Anamorphosis: *Aspergillus muricatus* Udagawa, Uchiyama et Kamiya, anam. nov.

Capitula conidica radiantia, dein secendentia, luteola, usque 300-500 μm diam. Conidiophora plerumque ex mycelio basali oriunda; stipites plus minusve sinuolati, luteoli, 300-2000(-5000) × 4-10 μm, incrassati, manifeste asperati; vesiculae globosae vel subglobosae, (15-)20-40 μm diam, in toto fertiles. Aspergilla biseriata; metulae (7.5-)10-18(-22) × (3.5-)5-8 μm; phialides cylindricae, 7.5-10 × 2-2.5 μm. Conidia hyalina, globosa vel subglobosa, 2.5-3 μm diam, lobato-reticulata. Status teleomorphus: *Petromyces muricatus*.

Holotytus BF 42515, loc, cit.

Colonies on Czapek agar growing rather restrictedly, attaining a diam of 14-16 mm in 7 days at 25°C, more or less floccose, consisting of a thin mycelial felt, Light Yellow (M. 4A4) or Straw (R); ascostromata slowly developing, not affecting the colony appearance; conidiogenesis profuse; reverse Light Yellow (M. 4A4) or Pale Luteous (R). Colonies on CYA growing rapidly, attaining a diam 45-50 mm in 7 days at 25°C, floccose, rather radially sulcate, consisting of a compact white mycelial felt, at first White, then becoming Light Yellow (M. 4A4) or Rosy Buff to Flesh (R); ascostromata slowly developing; conidiogenesis

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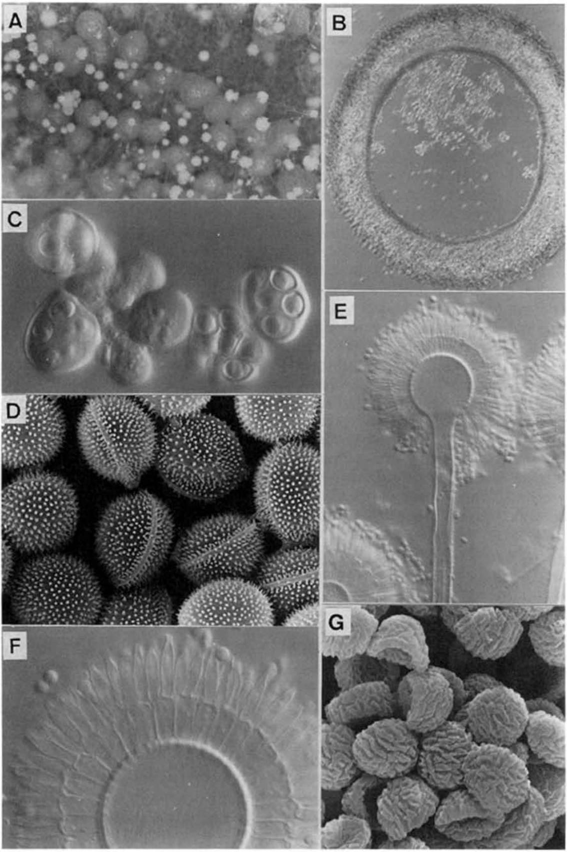
Fig. 2. *Petromyces muricatus*, BF 42515.
A. Ascostromata and conidial heads on half strength PDA in surface view, × 10. B. Ascostroma containing an ascoma (section), × 100. C. Asci, × 1400. D. Ascospores (SEM), × 3500. E. Aspergillum, × 400. F. Metulae and phialides, × 1000. G. Conidia (SEM), × 5000.


A
B
C
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G

abundant in the central area and scattered in the submarginal zones; margins broad, thin; exudate clear; odor musty; reverse Light Orange (M. 5A4) or Pale Luteous (R), with surrounding agar colored in the same shades. Colonies on MEA growing rather rapidly, attaining a diam of 40-48 mm in 7 days at 25°C, floccose, consisting of a thin mycelial felt, producing scattered ascostromata, White to Pale Yellow (M. 4A3) or Buff (R); conidiogenesis limited; exudate scattered, clear; reverse uncolored to Light Orang (M. 5A5) or Pale Luteous (R) . Colonies on half strength PDA growing rather rapidly, attaining a diam of 46-48 mm in 7 days at 25°C and rather slowly at 30°C, floccose, mostly plane, raised at center up to 4-5 mm high, consisting of a thin mycelial felt enmeshing abundant ascostromata at center, loosely covered by aerial hyphae and conidial heads, Pale Yellow (M. 4A3) or Straw (R); conidiogenesis sparse to profuse; margins entire, narrow; exudate clear; odor indistinct; reverse and agar Pale Orange (M. 5A3) or Salmon (R).

Ascostromata developing as irregular masses of swollen hyphae, scattered or often confluent in a layer, Pale Yellow or Flesh (R), sclerotioid, globose to subglobose or sometimes elongate, 400-600 µm in diam, containing 1-2 ascomata, multi-layered; outer layer consisting of pale yellow, globose to rather angular, thick-walled cells measuring 6-16 µm in diam; inner layer of hyaline, angular, rather thin-walled cells measuring 10-22 µm in diam. Ascomata non-ostiolate, globose to subglobose, 155-300 µm in diam, maturing slowly from the center outwards after 6 weeks (on half strength PDA at 30°C) or more; peridium about 5-6 µm thick, consisting of a compact hyphal tissue. Asci irregularly disposed on the ascogenous hyphae, borne singly from croziers, 8-spored, subglobose to ovoid, 10-14 × 8-10 µm, evanescent. Ascospores hyaline, oblate, subglobose to broadly ellipsoidal in face view, with a low equatorial rim, (4.5-)4.8-5.5 × (3.5-)4-4.8 µm, spinulose on the convex surfaces.

Conidial heads radiate, splitting into 3-4 columns in age, Light Yellow (R), up to 300-500 µm in diam. Conidiophores mostly arising from the basal mycelium; stipes more or less sinuous, pale yellowish, 300-2000(-5000) × 4-10 µm, with walls thick and distinctly roughened; vesicles globose to subglobose, (15-)20-40 µm in diam, fertile over the entire surface. Aspergilla biseriate; metulae variable in size, (7.5-)10-18(-22) × (3.5-)5-8 µm, more or less widening upward; phialides cylindrical, 7.5-10 × 2-2.5 µm. Conidia hyaline, globose to subglobose, 2.5-3 µm in diam, with walls lobate-reticulate (under SEM). Diminutive conidiophores present.

Major ubiquinone: Q-10(H_2).

At 37°C, growth is somewhat reduced, but ascostromata production is increased.

Specimen examined: BF 42515 (holotype), in dried culture isolated from grassland soil, Laguna, College of Agriculture, University of the Philippines at Los Banos, the Philippines, Feb. 22, 1993. The holotype has been deposited with the Natural History Museum and Institute, Chiba, Japan.

Petromyces muricatus becomes the third species of the *A. ochraceus* group known to produce a sclerenchymatous stroma bearing one to several ascomata (Malloch and Cain, 1972; Tewari, 1985). The type species, *P. alliaceus*, is characterized by non-ostiolate ascomata produced within a black stroma, and hyaline, oblate ascospores with a thin equatorial furrow or very low crests and smooth convex surfaces (Raper and Fennell, 1965; Malloch and Cain, 1972; Subramanian and Rajendran, 1981; Horie et al., 1993). Ascus and ascospore development is extremely slow or the stromata may remain abortive. The *Aspergillus* anamorph is characterized by tan-colored conidial heads, biseriate aspergilla with a globose to pyriform vesicle, and subglobose to ovoid, smooth-walled (micro-tuberculate under SEM) conidia (Raper and Fennell, 1965; Christensen, 1982; Klich and Pitt, 1988; Horie et al., 1993). It was recently transferred to the *A. wentii* group by Kozakiewicz (1989), due to the common characters of micro-tuberculate conidia, two series of conidiogenous cells and, ecologically, inhabitation of soil.

The second species, *P. albertensis*, is morphologically so similar to the type species that reliable separation becomes difficult. Only one notable character in *P. albertensis* is the irregular-shaped, indeterminately growing stromata.

Petromyces muricatus can be easily distinguished from these known species by the pale yellow to flesh colored ascostromata, fewer (usually one, sometimes two in number) ascomata in the ascostroma, smaller ascospores with spinulose convex surfaces, and light yellow conidial heads. The anamorph of *P. muricatus* clearly belongs to the section *Circumdati* of the subgenus *Circumdati* (Gams et al., 1985). The ornamentation of the conidia of the fungus might be interpreted to indicate a relationship to the species of the lobate-reticulate category in this section (Kozakiewicz, 1989). Among the species, the fungus somewhat resembles *A. sclerotiorum* Huber and *A. sulphureus* (Fres.) Wehmer in certain macroscopic and microscopic features. Besides the development of sclerotioid bodies to the ascostromata, the fungus differs from both species of *Aspergillus* in having light color in the colony reverse on MEA, longer conidiophores and larger metulae.

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MYCOTAXON

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A SECOND SPECIES OF *ASCOTRICHA* WITH NON-OSTIOLATE ASCOMATA

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ABSTRACT

A new species of *Ascotricha* (Ascomycetes: Xylariaceae) is described and illustrated as *A. novae-caledoniae*. It is characterized by non-ostiolate ascomata with a translucent peridium, a few branched short ascomatal hairs, clavate asci, discoid ascospores, and the absence of an anamorph. The holotype was isolated from forest soil in New Caledonia.

Key Words: *Ascotricha*, cleistothecial ascomycete, Xylariaceae, taxonomy, soil fungus

A member of the genus *Ascotricha* with non-ostiolate ascomata was isolated during a continuing survey of soil-borne ascomycetes as producers of secondary metabolites useful to the pharmaceutical industry. This species is considered to be sufficiently different from all previously described taxa of the genus to warrant its description as a new species (Hawksworth, 1971; Kulshreshtha et al., 1977; Udagawa et al., 1994).

Ascotricha novae-caledoniae Udagawa, Uchiyama et Kamiya, sp. nov. Figs. 1, 2

Coloniae in agaro "potato-carrot" aliquanto effusae, floccosae, planae vel aliquot zonatae, ex mycelio basali coacto tenuiter constantes, atroturchesiae vel turchesio-griseae vel viridi-griseae, ascomatibus abundantibus et hyphis aeriis laxe formantes; reversum incoloratum, deinde ad centrum dilute flavum vel roseo-bubalinum.

Ascomata superficialia vel interdum immersa, dispersa, non-ostiolata, hyalina, globosa vel subglobosa, 80-200 µm diam, in dimidio superiore pilosa; pili rigidi, 10-15, valde olivaceo-brunnei, flexuosi vel plus minusve geniculati, simplices vel 1-3 irregulariter ramosi, cum ramis (cellulis ampulliformibus) hyalinis instructi, 20-80 × 2.5-4 µm, incrassati, leves vel subtiliter asperati, septati, gradatim angustati, ad apicem cellula ampulliformi hyalina formantes; cellulae ampulliformes 9-24 × 2.5-6 µm; peridium 7.5-12.5 µm crassum, hyalinum vel parum brunneum, translucens, pseudoparenchymatum, multi-stratum; stratum externum hyalinum vel parum brunneum, ex "textura epidermoidea" compositum; strata interina hyalina, ex cellulis angularis 7.5-12.5 × 5-7.5 µm composita. Asci 8-spori, clavati, 30-42.5 × (7-)9-12 µm, brevi-stipitati, evanescentes; paraphyses nullae. Ascosporae vero biseriatae, primum hyalinae, postremo valde olivaceo-brunneae, discoideae, 6-7 × 5.5-7 × 3-3.5 µm, leves, fissura germinali aequatoria paratae.

Mycelio ex hyphis hyalinis, ramosis, saepe anastomosantibus, septatis, levibus, 1-2.5 µm diam composito. Conidia nulla.

Holotypus BF44360, colonia exsiccata in cultura ex solo silva, Poindimie, Prov. Nord, in Nova Caledonia, 17.vi.1993, a S. Uchiyama et S. Kamiya isolata et ea collectione fungorum, Musei et Instituti Historiae Naturalis Chiba (CBM) conservata.

Etymology: Latinized from the name New Caledonia, referring to the country of the type locality.

Colonies on potato-carrot agar (PCA) growing rather rapidly, attaining a diam of 20-23 mm in 12 days at 25°C, floccose, plane or somewhat zonate, consisting of a thin basal felt, Dark Turquoise to Turquoise Grey (M. 24F3-E2, after Kornerup and Wanscher, 1978) or Greenish Grey (Rayner, 1970), producing abundant ascomata on the felt, which are loosely covered by aerial hyphae; reverse uncoloured, later becoming Pale Yellow (M. 4A3) or Rosy Buff (R) in the centre. Colonies on oatmeal agar growing as on PCA, floccose, radially sulcate, consisting of a rather tough basal felt, Greenish Grey (M. 30D2) or Pale Olivaceous Grey (R), producing moderate ascomata on the felt; reverse Light Yellow (M. 4A4) or Pale Luteous (R). Colonies on cellulose agar growing rather restrictedly, very thin, vegetative mycelium submerged, producing abundant ascomata as black dots on the agar surface or into the substratum; reverse uncoloured.

Ascomata superficial or sometimes immersed, scattered, non-ostiolate, hyaline but appearing nearly black from the mass of

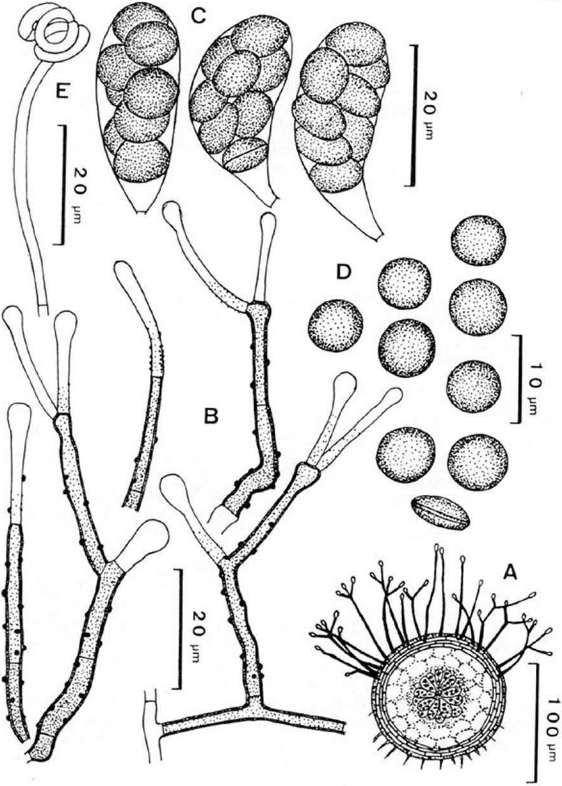

Fig. 1. *Ascotricha novae-caledoniae*, BF 44360.
A. Ascoma; B. Ascomatal hairs; C. Asci; D. Ascospores; E. Ascomatal initial.

ascospores after maturing within 14 days, globose to subglobose, 80-200 µm diam, ornamented with about 10-15 short hairs arising from the upper part; ascomatal hairs rigid, dark olivaceous brown, flexuous to somewhat geniculate, simple or irregularly branched 1-3 times with hyaline ampulliform cells, 20-80 µm long, 2.5-4 µm diam near the base, thick-walled, smooth or finely roughened, septate, gradually tapering and paling above to a hyaline ampulliform cell; ampulliform cells 9-24 × 2.5-6 µm; peridium 7.5-12.5 µm thick, hyaline to slightly brown, translucent, pseudoparenchymatous, multi-layered; outer layer hyaline to more or less pale brown, of textura epidermoidea, and inner layers of hyaline, angular cells measuring 7.5-12.5 × 5-7.5 µm. Asci 8-spored, clavate, 30-42.5 × (7-)9-12 µm (p. sp. 22.5-35 µm long), short-stipitate (up to 4-6 µm long), thin-walled, without apical structures, formed in irregular fascicles, evanescent; paraphyses not observed. Ascospores biseriate (uniseriate in side view), at first hyaline, becoming dark olivaceous brown, discoid, 6-7 × 5.5-7 × 3-3.5 µm, smooth-walled, with an equatorial germ slit measuring ca 5.5-6.5 µm long.

Mycelium consisting of hyaline, branched, often anastomosed, septate, smooth-walled, 1-2.5 µm diam hyphae. Ascomatal initials consisting of a small coiled ascogonium which originates as stalk cells from a hypha, soon becoming surrounded by hyphae arising from the neighbouring hyphae. Ampulliform branches which resemble the ornamental ascomatal hairs scattered on the basal mycelium, similar to those of *Ascotricha guamensis* Ames (Ames, 1951), but conidia not observed on the branches.

At 37°C, growth is nil.

Specimen examined: BF44360 (holotype), in dried culture isolated from forest soil, Pic d'Amoa near Tieti, Poindimie, Prov. Nord, New Caledonia, 17 June 1993, by S. Uchiyama and S. Kamiya. The holotype has been deposited with the Natural History Museum and Institute, Chiba, Japan (CBM).

Ascotricha novae-caledoniae becomes the second species of the genus known to produce non-ostiolate ascomata, with few hairs and clavate asci (Udagawa et al., 1994). The two species of *Ascotricha* with non-ostiolate ascomata can be distinguished from one another because *A. novae-caledoniae* produces ascomata with a translucent wall, with 10-15 short (up to 80 µm in length) and often 1-3 times branched hairs, discoid ascospores, and it does not produce an anamorph. *Ascotricha distans* Udagawa, Uchiyama et Kamiya (Udagawa et al., 1994) forms dark ascomata which are clothed with two types of hairs consisting of a few, long (up to 1000 µm), whip-like ones and short, seta-like, often diminished ones, ovoid to ellipsoidal ascospores, and an anamorph belonging

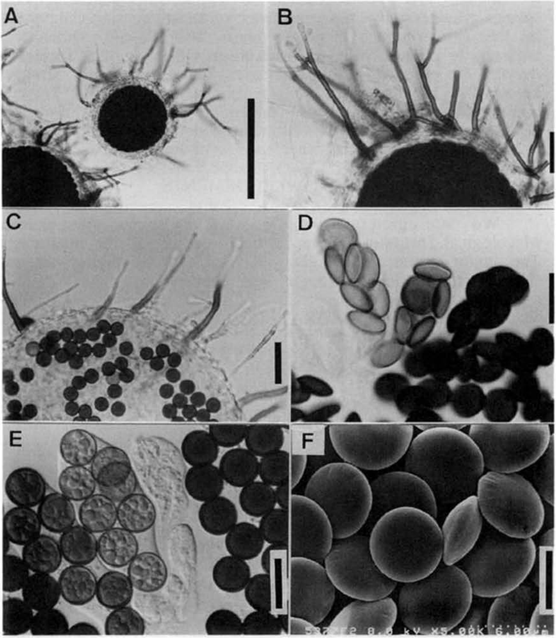

Fig. 2. *Ascotricha novae-caledoniae*, BF 44360.
A. Ascoma (Bar= 100 µm); B, C. Ascomatal hairs (Bars= 20 µm); D. Asci (Bar= 10 µm); E. Asci and ascospores (Bar= 10 µm); F. Ascospores, SEM (Bar= 5 µm).

to *Dicyma*. The asci appear to be similar in both cleistothecial species of *Ascotricha*. Like the asci of most cleistothecial species in the Sordariaceae, they are short and clavate, showing a tendency to produce biseriate ascospores. Other ostiolate species of *Ascotricha* produce cylindrical asci and uniseriately arranged ascospores (Hawksworth, 1971; Kulshreshtha et al., 1977). Two unusual characters of *A. novae-caledoniae*, viz. the translucent wall of the ascomata and the short inconspicuous ascomatal hairs, are clearly exclusive from the other species of *Ascotricha*.

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MYCOTAXON

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ASCOSPORE SHEATHS OF SOME COCCOMYCES, HYPODERMA, AND LOPHODERMIUM SPECIES (RHYTISMATACEAE)

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ABSTRACT

Ascospores surrounded by a gelatinous sheath' is generally considered to be one of the family characteristics of the Rhytismataceae, yet the form of the sheath has been little studied. Selected species of Rhytismataceae are illustrated to show some of the variation in the occurrence and shape of ascospore sheaths in the family. In some cases the structure and shape of the gelatinous sheaths or caps may be taxonomically useful at the species level, in other cases at higher taxonomic levels.

INTRODUCTION

Sheathed ascospores are found in most members of the Rhytismataceae, and are usually listed as characteristic of the family (Darker 1967, Sherwood 1980, Hawksworth et al. 1983). Many publications describe the sheaths in general terms, such as "narrow" or "well developed", and illustrate them as a vague line of dots surrounding the spores (e.g. Johnston 1989a). Some authors have noted variation in the shape of the sheaths in different species (e.g. Sherwood 1980, Spooner 1990). Cannon & Minter (1983) and Minter & Cannon (1984) illustrated sheaths of different shapes and thicknesses for several species, including what appeared to be a sheath with two layers in *Bifusella superba* Cannon & Minter. In an unpublished masters degree thesis dated September 1980, Liliane Petrini described for the first time the complex nature of the sheaths associated with the ascospores of many Poaceae-inhabiting *Lophodermium* species. These spores have a firm gelatinous cap at each end, in addition to a looser, gelatinous sheath surrounding the entire spore. Petrini noted that this may not have been observed previously because the sheaths dissolve in the commonly used mountant KOH, and because phase contrast or interference contrast optics are needed to see the caps and sheaths clearly.

Baral (1992) illustrated the effect that mounting medium can have on the appearance of ascospore sheaths, using members of the Leotiales as examples, and also discussed differences seen in freshly collected and living specimens as against herbarium material.

This paper describes ascospore sheaths from species of *Coccomyces* de Notaris, *Hypoderma* de Notaris and *Lophodermium* Chevallier when mounted in water and examined using phase contrast or interference contrast optics. Most specimens were examined from dried herbarium material, but fresh collections of a few species from New Zealand were included for comparative purposes.

METHODS

Fresh material was examined on the day it was collected. The hymenium was removed from ascomata and teased out in a drop of water on a microscope slide. Some ascomata released large numbers of ascospores immediately, and these were examined under both interference and phase contrast optics.

All species examined from fresh collections were also examined from herbarium specimens. Individual ascomata were slowly rehydrated while still attached to the leaf, using drops of water carried on the end of a scalpel. Once rehydrated the hymenium was removed and placed in a drop of water on a microscope slide. As with living material some ascomata, or ascomata from some collections, released ascospores more readily than others, and spores from such ascomata were used for the ascospore sheath descriptions. Additional species were examined from herbarium material alone.

Fresh material examined:

Coccomyces globosus Johnston. New Zealand: Auckland, Waitakere Ranges, on *Nestegis lanceolata*, coll. P R Johnston, 2.vi.1993 (PDD 62293).

Coccomyces limitatus (Berkeley & Curtis) Saccardo. *ibid.*, on *Knightia excelsa* (collection not kept).

Coccomyces radiatus Sherwood. *ibid.*, on *Rubus cissoides* (PDD 62294).

Hypoderma campanulatum Johnston. Coromandel, Mt Moehau, on *Dracophyllum pyrimidale*, coll. R E Beever, 8.ix.1993 (PDD 62435).

Hypoderma cordylines Johnston. Auckland, Waitakere Ranges, on *Cordyline australis*, coll. P R Johnston 2.vi.1993 (PDD 62439).

Lophodermium agathidis Minter & Hettige. *ibid.*, on *Rubus cissoides* (PDD 62540).

Lophodermium hauturuanum Johnston. *ibid.*, on *Gahnia* sp. (PDD 62292).

Lophodermium minus (Tehon) Johnston. *ibid.*, on *Rubus cissoides* (PDD 62541).

Herbarium material examined:

Coccomyces clavatus Johnston. New Zealand: Nelson, Abel Tasman National Park, on *Phyllocladus alpinus*, coll. P R Johnston, 28.v.1989 (PDD 55522).

Coccomyces clusiae (Léveillé) Saccardo. Guyana: Kopinang Mountain, on *Clusia* sp., coll. G J Samuels *et al.*, 22.vii.1989 (PDD 58059 ex NY).

Coccomyces crystalligerus Sherwood. New Zealand: Marlborough, Pelorous Bridge Scenic Reserve, on *Blechnum discolor*, coll. P R Johnston & E M Gibellini, 30.v.1989 (PDD 57130).

Coccomyces globosus. Australia: Tasmania, Hartz National Park, on *Eucalyptus coccifera*, coll. P R Johnston & A Mills, 19.v.1988 (PDD 48988 ex HO); Tasmania, Mt Wellington, on *Eucalyptus* sp., coll. P R Johnston, 23.v.1988 (PDD 54977 ex HO); New Zealand: Buller, Buller Gorge, on *Weinmannia racemosa*, coll. P R Johnston & G J Samuels, 16.iv.1983 (PDD 44650); Taranaki, Mt Egmont, on *Weinmannia racemosa*, coll. P R Johnston *et al.*, 25.iv.1983 (PDD 44652).

Coccomyces limitatus. New Zealand: Coromandel, Moehau, on *Knightia excelsa*, coll. P R Johnston, 28.viii.1984 (PDD 46226).

Coccomyces radiatus. New Zealand: Coromandel, Stoney Bay - Fletcher Bay Track, on *Dracophyllum traversii*, coll. P R Johnston & M Rajchenberg, 22.iv.1989 (PDD 55369); Waikato, Hakarimata Walkway, on *Rubus cissoides*, coll. P R Johnston, 18.v.1989 (PDD 55591); Taiwan: Chilan, on *Ilex* sp., coll. Y Doi, 4.viii.1984 (PDD 60449 ex TNS).

Hypoderma bihospitum Johnston. New Zealand: Mackenzie, Mt Cook National Park, on *Anisotome* sp., coll. P R Johnston, 13.ii.1989 (PDD 57142); Taupo, Tongariro National Park, on *Anisotome aromatica*, coll. P R Johnston & E H C McKenzie, 23.iii.1984 (PDD 49292); Northland, Waiotemarama Bush Walk, on *Uncinia banksii*, coll. P R Johnston, 21.x.1987 (PDD 53884); Northland, Waiotemarama Bush Walk, on *Uncinia* sp., coll. P R Johnston, 23.v.1991 (PDD 59112); Auckland, Waitakere Ranges, on *Uncinia* sp., coll. P R Johnston, 25.i.1983 (PDD 53971).

Hypoderma cordylines. New Zealand: Westland, Haast Beach, on *Cordyline australis*, coll. P R Johnston, 5.iii.1992 (PDD 59989); Taupo, Tongariro National Park, on *Cordyline indivisa*, coll. P R Johnston *et al.*, 21.iii.1984 (PDD 49293).

Hypoderma liliensis Johnston. New Zealand: Auckland, Waitakere Ranges, on *Collospermum hastatum*, P R Johnston, coll. 29.iv.1987 (PDD 45561); Northland, Waipoua Forest, on *Collospermum hastatum*, coll. P R Johnston, 13.iv.1992 (PDD 60166); Buller, St James Walkway, on *Astelia nervosa*, coll. P R Johnston, 12.v.1990 (PDD 57557).

Lophodermium agathidis. New Zealand: Auckland, Waitakere Ranges, on *Agathis australis*, coll. P R Johnston & D Jones, 8.ix.1990 (PDD 58100).

Lophodermium alpinum (Rehm) Weese. Switzerland: Graubunden, on *Sesleria coerulea*, coll. L Petrini, 20.viii.1981 (PDD 59528).

Lophodermium arundinaceum (Schrader) Chevallier. Switzerland: Schaffhausen, on *Phragmites communis*, coll. L Petrini, 5.v.1980 (PDD 59495).

Lophodermium atrum Johnston. New Zealand: Nelson, Abel Tasman National Park, on *Dracophyllum traversii*, coll. P R Johnston & E M Gibellini, 28.v.1989 (PDD 56084).

Lophodermium breve (Berkeley) de Notaris. New Zealand: Auckland, Waitakere Ranges, on *Gahnia* sp., coll. G J Samuels, 15.x.1975 (PDD 47493).

Lophodermium brunneolum Johnston. New Zealand: Otago, Mt Cargill, on *Dracophyllum longifolium*, coll. P R Johnston, 13.v.1984 (PDD 49325); Auckland, Waitakere Ranges, on *Knightia excelsa*, coll. P R Johnston, 30.xi.1990 (PDD 58144); Auckland, Waitakere Ranges, on *Knightia excelsa*, coll. P R Johnston, 23.ix.1987 (PDD 50854).

Lophodermium cladophilum (Léveillé in Mougeot & Nestler) Hazslinsky. Wales: Geirionnyld, on *Vaccinium myrtillus*, coll. P R Johnston & E M Gibellini, 29.iv.1986 (PDD 45567).

Lophodermium conigenum (Brunaud) Hilitzer. New Zealand: Auckland, Riverhead Forest, on *Pinus radiata*, coll. P R Johnston, 20.ix.1991 (PDD 59475).

Lophodermium gramineum (Fries) Chevallier. Switzerland: Canton Ticino, on *Anthoxanthum odoratum*, coll. L Petrini, 27.vii.1980 (PDD 60253).

Lophodermium hauturuanum Johnston. New Zealand: Taupo, Tongariro National Park, on *Gahnia* sp., coll. P R Johnston, 20.v.1989 (PDD 55566).

Lophodermium juniperinum (Fries) de Notaris. Sweden: Uppland, on *Juniperus communis*, coll. P R Johnston *et al.*, 1.x.1986 (PDD 45572).

Lophodermium kaikawakae Johnston. New Zealand: Taupo, Tongariro National Park, on *Libocedrus* sp., coll. P R Johnston *et al.*, 20.iii.1984 (PDD 62438).

Lophodermium mahuianum Johnston. New Zealand: Westland, Fox Glacier, on *Phyllocladus* sp., coll. P R Johnston *et al.*, 7.iv.1983 (PDD 47384); Australia: Tasmania, Mt Field National Park, on *Eucalyptus* sp., coll. P R Johnston, 24.v.1988 (PDD 56318 ex HO).

Lophodermium medium Johnston. New Zealand: Taupo, Kaimanawa Forest Park, on *Nothofagus menziesii*, coll. P R Johnston, 27.iii.1992 (PDD 60120); Westland, Haast Pass, on *Nothofagus menziesii*, coll. P R Johnston *et al.*, 12.iv.1983 (PDD 44763).

Lophodermium minus. New Zealand: Nelson, vic. Cobb Reservoir, on *Rubus australis*, coll. P R Johnston & E M Gibellini, 29.v.1989 (PDD 57127).

Lophodermium nematoideum Johnston. New Zealand: Northland, Russell Forest Park, on *Gahnia* sp., coll. P R Johnston, 11.viii.1988 (PDD 54132).

Lophodermium nigrofactum Johnston. New Zealand: Coromandel, Little Barrier Island, on *Dracophyllum pyrimidale*, coll. P R Johnston, 13.vi.1984 (PDD 45651).

Lophodermium pinastri (Schrader) Chevallier. New Zealand: Fiordland, Blackmount Forest, on *Pinus radiata*, coll. P R Johnston, 2.iii.1992 (PDD 59952); Southland, Conical Hills Forest, on *Pinus radiata*, coll. P R Johnston, 18.x.1991 (PDD 59481); Scotland: Ross & Cromarty, Loch Marree, on *Pinus* *sylvestris*, coll. P R Johnston & E M Gibellini, 10.vi.1986 (PDD 54789).

Lophodermium rectangulare Johnston. New Zealand: Westland, vic. Haast, on *Dracophyllum longifolium*, coll. P R Johnston, 15.v.1990 (PDD 57550); Chatham Islands, on *Dracophyllum arboreum*, coll. P R Johnston & E H C McKenzie, 19.xi.1992 (PDD 62440).

Lophodermium richeae Petrak. New Zealand: Northland, Waiotemarama Bush Walk, on *Dracophyllum latifolium*, coll. P R Johnston, 21.x.1987 (PDD 48023); Stewart Island, on *Dracophyllum longifolium*, coll. P R Johnston *et al.*, 4.v.1984 (49080); Australia: Tasmania, Tasman Peninsula, on *Richea dracophylli*, coll. P R Johnston & A Mills, 25.v.1988 (PDD 56080 ex HO).

Lophodermium tindalii Johnston. New Zealand: Otago, Mt Cargill, on *Dracophyllum longifolium*, coll. P R Johnston, 13.v.1984 (PDD 49320); Southland, Longwood Forest Park, on *Dracophyllum* sp., coll. P R Johnston *et al.*, 7.v.1984 (PDD 49313); Coromandel, Little Barrier Island, on *Archeria racemosa*, coll. P R Johnston, 13.vi.1984 (PDD 45654).

Lophodermium unciniae Johnston. New Zealand: Buller, Lewis Pass, on *Uncinia uncinata*, coll. P R Johnston, 8.ii.1988 (PDD 57138).

RESULTS

Illustrations (Figs. 1-30) are arranged in alphabetical order of species. All drawings are to the same scale, and ascospores are drawn with the same orientation as within the ascus.

For most species little or no difference was seen between material examined when fresh and material stored in the herbarium for up to 10 years. An exception was *Hypoderma cordylines* (Fig. 11), which has a very thick sheath when fresh, the sheath appearing much thinner in 1-year-old herbarium material. A 9-year-old collection had ascospore sheaths similar to those of the 1-year-old collection.

There is wide interspecific variation in both shape and apparent structure of the ascospore sheaths. In all cases where more than one collection of a species was examined, the appearance of the sheaths did not vary (except amongst collections of what may be heterogenous species, *Lophodermium brunneolum* and *L. bihospitum* - see below). No variation was seen in species examined from collections made in different geographic regions (e.g. *Coccomyces globosus* (Figs 4-6), *Lophodermium mahuianum* and *L. richeae* from New Zealand and Australia, *Coccomyces radiatus* from New Zealand and Taiwan, and *Lophodermium pinastri* from New Zealand and Scotland).

All but one of the species with an ascomatal structure matching *L. minus* (see Johnston 1988, as *L. multimatricum*, Johnston 1989b) and *L. cladophilum*

(≡ *Terriera cladophila*; see Eriksson 1970) lacked ascospore sheaths (i.e. *L. breve, L. cladophilum, L. minus, L. nematoideum*). The exception was *L. kaikawakae* (Fig. 23), with a sleeve-like, apparently non-gelatinous sheath covering the apical part of the spore. Amongst the other species examined only *L. tindalii* lacked a sheath.

The ascospore sheaths of *Hypoderma liliensis* (Fig. 12) are distinctive, with round, bubble-like structures embedded within the sheath, these structures appearing to be associated with invaginations into the sheath. Similar structures may also be present in the ascospore sheaths of *Hypoderma bihospitum* collections from *Uncinia* (Fig. 9), and *H. campanulatum* (Fig. 10). Although the sheaths of the last two species are clearly sculptured, and the sculpturing appears to match that seen in *H. liliensis*, the bubble-like structures are very small and difficult to see clearly. In squash mounts, sheaths of *H. bihospitum* ascospores can crack and separate more or less intact from the spores.

Many of the filiform-spored species have a gelatinous cap at one end or both ends of the spores. The shape of these caps is often characteristic with respect to species. In species with a cap at only one end of the spore, this is usually at the apex (i.e. that end of the spore uppermost within the ascus), but can be at the base (e.g. *L. agathidis*, Fig. 13). Ascospores of *Lophodermium* spp. from Pinaceae (e.g. *L. conigenum*, Fig. 19; *L. pinastri*, Fig. 27) and Poaceae (e.g. *L. alpinum*, Fig. 14; *L. gramineum*, Fig. 20) are similar in having two distinct kinds of gelatinous ornamentation - a firm, globose or cylindrical gelatinous cap at each end of the spore, and a more loosely structured sheath surrounding the entire spore.

Several of the filiform-spored species examined have ascospores characteristically bent after release (e.g. *L. brunneolum*, Figs 17 & 18; *L. nigrofactum*, Fig. 26; *L. tindalii*). Most of these have small, 'barb-like', gelatinous appendages at the point or points where the ascospores bend. The way in which the spores bend following release is characteristic of a species. For example in *Lophodermium hauturuanum* (Fig. 21) and *L. unciniae* (Fig. 30) the released spores are bent at about 120° near the base. In *C. crystalligerus* (Fig. 3) the spore is curved into a pronounced arc near the base. *L. kaikawakae* (Fig. 23) has spores curved strongly near the apex. *L. nigrofactum* (Fig. 26) has ascospores bent twice at about 120° near the centre of the spore. The released spores of *L. tindalii*, which lack any gelatinous sheaths or appendages, have a slightly more complex arrangement, being bent twice near the centre of the spore at about 135-120°, and then again near the base of the spore. The ascospores of *L. medium* are only slightly bent (Fig. 25), but here too a small, barb-like gelatinous appendage is associated with the bend.

The way in which the ascospores bend following release differs between collections of *Lophodermium brunneolum* from *Dracophyllum* and those from *Knightia*. Collections from *Dracophyllum* (Fig. 17) have ascospores arranged in a similar way to *L. nigrofactum*, with barb-like appendages at both angles. Collections from *Knightia* (Fig. 18) have ascospores with a more complex arrangement; the whole spore is gently curved, but near both ends there is a sharper, approximately 120° bend, and at the apical bend there is a small, barb-like appendage.

DISCUSSION

A number of the observations on ascospore sheaths reported here differ from previous reports on the same species, for example *Coccomyces limitatus* (cf. Sherwood 1980, Johnston 1986), *Lophodermium agathidis* (cf. Minter & Hettige 1983), and *Lophodermium brunneolum* and *L. hauturuanum* (cf. Johnston 1989a). These differences are probably due to differences in the methods used in the various studies. When the spores of these and other species are observed within the asci, especially when mounted in 3-5% KOH, they may appear to be surrounded by a slight halo, often interpreted as a poorly developed gelatinous sheath. All observations reported in this study are of released ascospores. Following spore release the gelatinous sheaths and appendages slowly dissolve in some commonly used mountants such as KOH, or may be invisible without interference contrast or phase contrast optics.

In most species there is little or no change in the appearance of the sheaths following herbarium storage, but in some species with very thick sheaths when fresh, the sheaths often appear thinner following storage. This difference is not one associated simply with living versus dead material (2-3-month-old dried collections of *Hypoderma cordylines* had sheaths of similar thickness to fresh collections), but rather is due to shrinkage following more prolonged storage.

In many older herbarium collections spores are not readily released from the asci in water, making observations on shape or size of the sheaths difficult or impossible. Dilute, 3-5% KOH assists spore release, but it may also cause any sheaths present to dissolve. Ascospores in collections around 100 years old sometimes appear to be completely lacking sheaths. Published examples noting this include the type specimens of *Hypoderma rubi* (Cannon & Minter 1983), *Lophodermium vrieseae* and *Hypoderma tillandsiae* (Johnston 1993). Although more recent collections of *L. vrieseae* and *H. tillandsiae* are not available, collections of *Hypoderma rubi* typically have well-developed ascospore sheaths.

Although members of the Rhytismataceae are usually described as having ascospores with gelatinous sheaths, variation seen in this study shows that the 'sheaths' of many species might better be described as gelatinous appendages. *Lophodermium kaikawakae* has what appears to be a non-gelatinous, sleave-like sheath which may be structurally similar to the non-mucilaginous sheaths described for *Ciboria caucus* (Baral 1992).

Ascospore sheath shape and structure can provide characters useful at various taxonomic levels in the Rhytismataceae, helping to distinguish species or to define groups of closely related species. *Lophodermium brunneolum* was originally described as restricted to two taxonomically unrelated hosts, *Dracophyllum* (Epacridaceae) and *Knightia* (Proteaceae) (Johnston 1989a). Collections from *Knightia* were confined to the northern part of New Zealand, collections from *Dracophyllum* to the southern part. The ascospores of *L. brunneolum* differ in the way they bend following release, and in the arrangement of their gelatinous appendages, these differences correlating to host preference. This evidence together with host and geographic differences suggests the two segregates may be best regarded as separate species.

Hypoderma bihospitum was also described from two taxonomically unrelated hosts, *Anisotome* (Apiaceae) and *Uncinia* (Cyperaceae) (Johnston 1990). Ascospore sheath structure provides one morphological character to distinguish collections from the two hosts. The sheaths of collections from *Uncinia* are externally finely sculptured, appearing to have numerous small, bubble-like structures embedded within the sheath. Collections from *Anisotome* have sheaths of similar thickness and size but smooth, with no apparent internal structure.

Ascospore sheath structure may also be informative at higher taxonomic levels. Examples include the group of species which share the kind of ascomatal structure described for *Lophodermium minus* by Johnston (1988), all of which have ascospores lacking a gelatinous sheath, a feature unusual for the Rhytismataceae. The lack of an ascospore sheath, together with features associated with ascomatal development and structure are likely to represent derived or apomorphic characters delimiting these species as a monophyletic group within the family. Although not noted by Johnston (1988) *Lophodermium cladophilum*, the type species of *Terriera* Eriksson, is also typical of this group with respect to both ascomatal structure and in the lack of an ascospore sheath.

The characteristic complex sheaths of the Poaceae-inhabiting and *Pinus*-inhabiting *Lophodermium* species, with a firm gelatinous cap at each end of the spore, together with another loose sheath surrounding the whole spore, provides at least one piece of evidence that these species may form a distinct group within *Lophodermium sensu lato*.

ACKNOWLEDGMENTS

The impetus for this study came largely from the observations of Liliane Petrini, who kindly provided me with a copy of her dissertation on Poaceae-inhabiting *Lophodermium* species, and who also gave me full access to a large number of her *Lophodermium* collections from Europe. Gary Samuels and Liliane Petrini acted as presubmission reviewers. This work was funded by the Foundation for Research Science and Technology under contracts CO9231 and CO9309. A grant from the New Zealand Lottery Grants Board provided the microscope used in this study.

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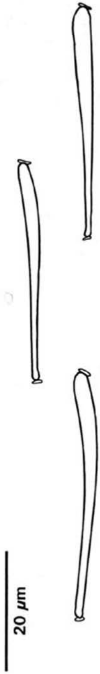

Fig. 1. *Coccomyces clavatus* (PDD 55522). Spores with small, flattened gelatinous caps at both ends.

Fig. 2. *Coccomyces clusiae* (PDD 58059). Gelatinous caps at both ends of the spores; apical cap distinctively fan-like, bottom cap very small.

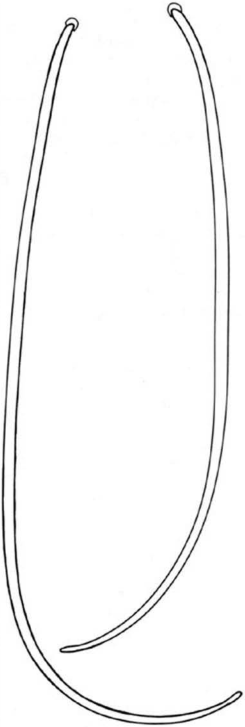

Fig. 3. *Coccomyces crystalligerus* (PDD 57130). Spores with tiny apical cap only; released spores with distinctively hooked base.

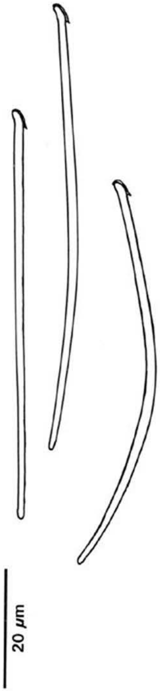

Fig. 4. *Coccomyces globosus* spores examined fresh from collection on *Nestegis* (PDD 62293). Apex slightly bent and flattened on one side, thin, with a helmet-like gelatinous cap across flattened part.

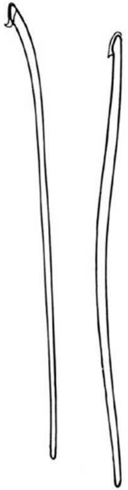

Fig. 5. *Coccomyces globosus* from collection on *Eucalyptus* from Tasmania (PDD 48988 and 54977). Shape of spore and cap identical in New Zealand material.

Fig. 6. *Coccomyces globosus* spores from collection on *Weinmannia* (PDD 44650 and 44652). Very similar to collections on other hosts, but cap not extending as far down spore, and bending into a small frill at lower end. Identical for collections from *Weinmannia* with truncate and with rounded ascus apices (see Johnston 1986).

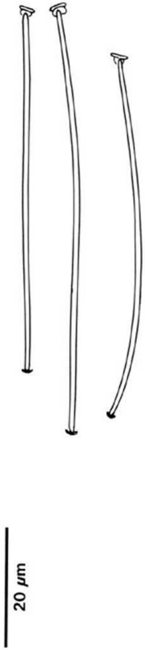

Fig. 7. *Coccomyces limitatus* (PDD 46226). Gelatinous caps at both ends of spores; upper cap complex, appearing to be of two parts, the lower globose and the upper flattened.

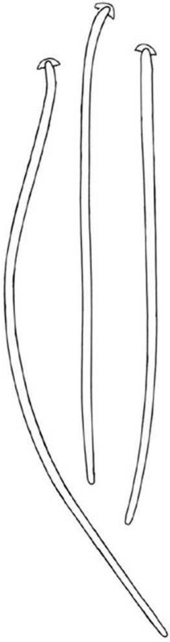

Fig. 8. *Coccomyces radiatus* (PDD 62294). With an upper gelatinous cap only, distinctively semi-circular.

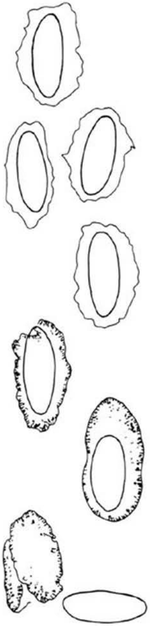

Fig. 9. *Hypoderma bihospitum*. Upper 4 spores from *Anisotome* (PDD 57142) with a thick sheath surrounding entire spore. Lower 3 spores from *Uncinia* (PDD 53884, 59112); sheath with internal structure (see text), separable more or less intact from spore.

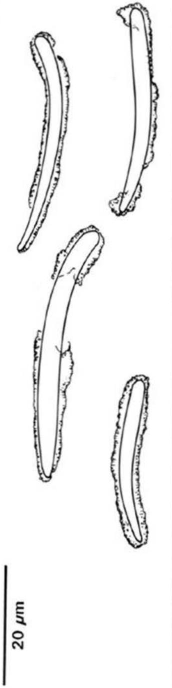

Fig. 10. *Hypoderma campanulatum* (PDD 53875, 62435). Sheath surrounding entire spore, with numerous small, vacuole-like structures embedded (see text).

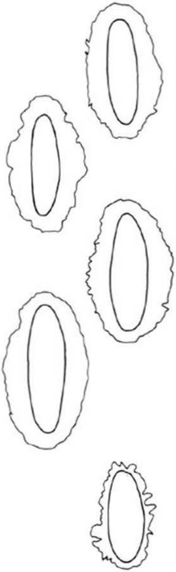

Fig. 11. *Hypoderma cordylines*. Four upper spores from fresh collection (PDD 62439), and lowermost spore from 1-year-old herbarium specimen (PDD 59989), illustrating shrinkage of sheath with storage.

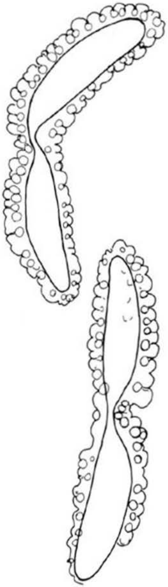

Fig. 12. *Hypoderma liliensis* (PDD 60166). Single thick sheath with vacuole-like structures embedded, these associated with invaginations into sheath (see text).

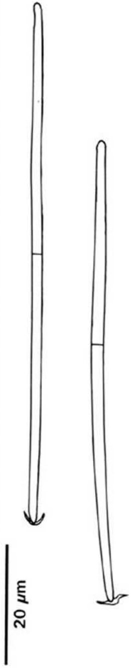

Fig. 13. *Lophodermium agathidis* (PDD 58100). A single cup-like gelatinous cap at lower end of spore.

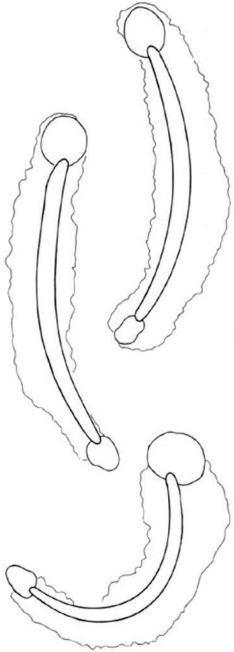

Fig. 14. *Lophodermium alpinum* (PDD 59528). Spores with a firm gelatinous cap at each end and a separate loose sheath surrounding entire spore; often curling into a semicircle on release.

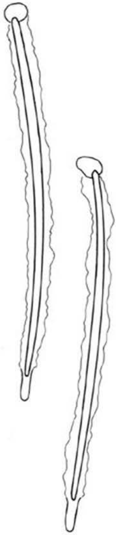

Fig. 15. *Lophodermium arundinaceum* (PDD 59495). Spores of same structure as *L. alpinum*, but differing in size and shape of gelatinous caps.

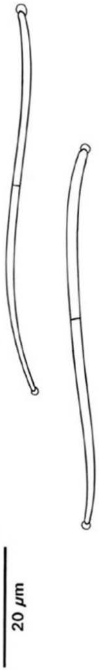

Fig. 16. *Lophodermium atrum* (PDD 56084). Spores with a tiny globose cap at each end.

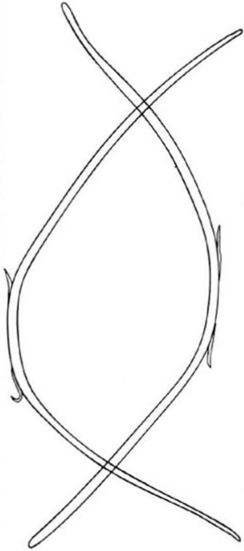

Fig. 17. *Lophodermium brunneolum* on *Dracophyllum* (PDD 49325). Released spores distinctively shaped; bent twice at about 120° near centre, with small, barb-like gelatinous appendages at both bends.

Fig. 18. *Lophodermium brunneolum* on *Knightia* (PDD 50854, 58144). Spore gently curved, with a sharper bend near each end; a small, barb-like, gelatinous appendage at upper bend.

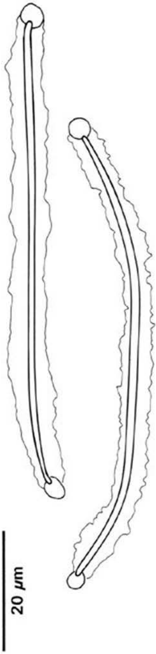

Fig. 19. *Lophodermium conigenum* (PDD 59475). Spores with a firm, globose, gelatinous cap at each end, and a loose sheath surrounding entire spore.

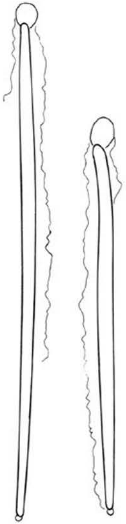

Fig. 20. *Lophodermium gramineum* (PDD 60253). Spores with apical and basal gelatinous caps, and separate sheath, typical of many Poaceae- and *Pinus*-inhabiting species. Distinguished from other Poaceae-inhabiters by very small basal appendage.

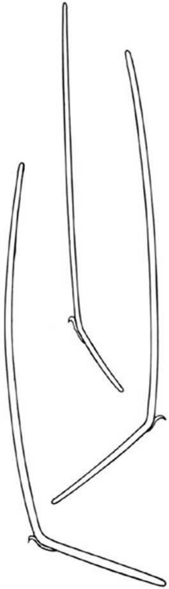

Fig. 21. *Lophodermium hauturuanum* (PDD 62292, 55566). Spores bent at about 120° in basal half, with a small, barb-like gelatinous appendage at bend.

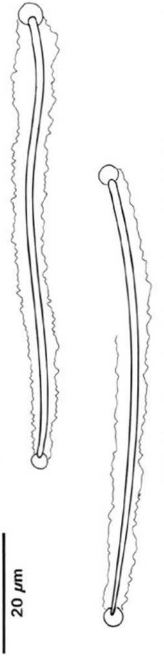

Fig. 22. *Lophodermium juniperinum* (PDD 45572). Spores with gelatinous caps, and separate loose sheath, typical also of *Pinus*-inhabiting species.

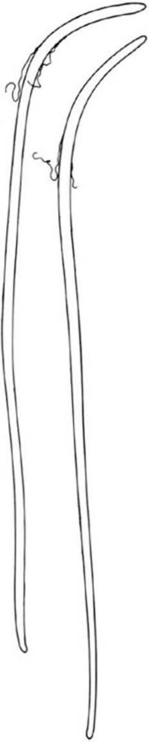

Fig. 23. *Lophodermium kaikawakae* (PDD 62438). Apical part of spore covered with a loose, apparently non-gelatinous, sheath-like structure. Released spores with a distinctive curve near apex.

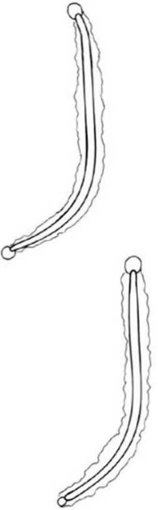

Fig. 24. *Lophodermium mahuianum* (PDD 47384). Spores with gelatinous caps, and separate loose sheath, similar to Poaceae- and *Pinus*-inhabiting species.

Fig. 25. *Lophodermium medium* (PDD 44763). Spores gently curved, bent at a slightly greater angle near apex, and at this point with a small, barb-like gelatinous appendage.

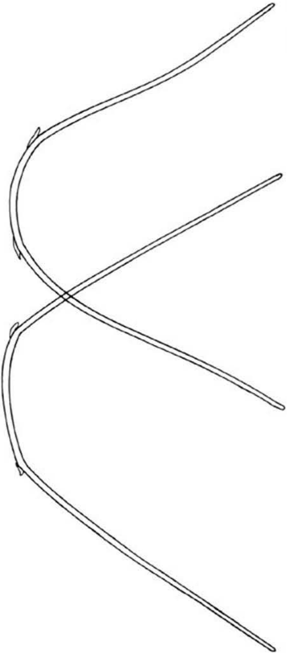

Fig. 26. *Lophodermium nigrofactum* (PDD 45651). Released spores distinctively twice bent at about 135° to 120° near centre, with small, gelatinous, barb-like appendages at bends.

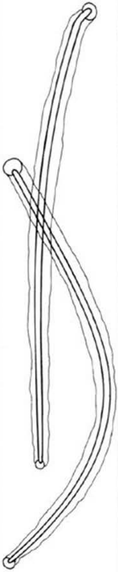

Fig. 27. *Lophodermium pinastri* (PDD 54789). Spores with globose, firm, gelatinous apical and basal caps and a separate, loose sheath covering entire spore.

Fig. 28. *Lophodermium rectangulare* (PDD 57550). A small, globose cap at each end of spores.

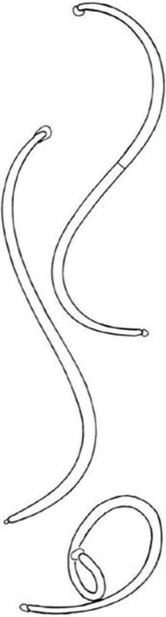

Fig. 29. *Lophodermium richeae* (PDD 48023, 56080). Spores with a tiny gelatinous cap at each end, coiling or sigmoid when released.

Fig. 30. *Lophodermium unciniae* (PDD 57138). Spores similar to *L. hauturuanum*, differing in having bend a greater distance from base.

MYCOTAXON

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ZYGOGLOEA GEMELLIPARA: AN AURICULARIOID PARASITE OF *MYXARIUM NUCLEATUM*

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Reid (1970) described a collection of the common tremellaceous fungus, *Myxarium nucleatum* Wallr., 'showing probable conidial formation' and speculated that the conidia might belong either to the *Myxarium* itself or to an unknown, basidiomycetous parasite.

Recent additional collections from Devon, England, show that the latter is true, and that the conidial state described by Reid belongs to an auricularioid parasite with several interesting and unusual features. Collectively, these features are sufficiently distinct from existing auricularioid genera to require a new genus to accommodate the species, as follows:

ZYGOGLOEA P. Roberts gen. nov.

Etym.: from the Greek 'zygo' = yoked, joined together (with reference to the zygoconidia), plus 'gloea' = glue (conventionally used for auricularioid genera).

Basidiomata nulla, in hymeniis fungorum parasitica. *Hyphae* tenuissimae, in typo generis fibulatae, haustoria tremelloidea ferentes. *Conidiophora* clavata, binatim gerentia, in hymenio hospitis fasciculata. *Zygoconidia* gemella, in typo generis duplo allantoidea, e conidiophoris conjunctis exorientia. *Basidia* cyclindracea, torsiva, transeptata. *Basidiosporae* septatae, in typo generis ellipsoideae vel allantoideae.

Typus generis: *Zygogloea gemellipara* P. Roberts

Basidiomata within the hymenium of the host. Not visible to the naked eye. *Hyphae* very thin, threadlike, clamped in the type species, connected to the host hyphae by tendril-like haustorial cells. *Conidiophores* in large clusters in the host hymenium. Each conidiophore consists of two adjacent clavate cells, each of which produces an incurving apical outgrowth which joins that of the adjacent cell to create a zygoconidium. *Zygoconidia* consisting of two small, allantoid conidia adhering in pairs. *Basidia* auricularioid, 4-celled, arising in clusters from conidia-bearing hyphae or independently. At first narrowly clavate, becoming tubular with a thin stalk and strongly spiralled. Probasidia absent. *Basidiospores* in the type species narrowly ellipsoid to allantoid with an acute apex, becoming 1-3 septate. Germination or the production of secondary spores not seen.

Zygogloea is distinguished from other parasitic auricularioid genera by its possession of zygoconidia, *Tremella*-like haustorial cells, and septate basidiospores. The genus *Occultifur*, a parasite of *Dacrymyces*, has a similar habit and similar haustorial cells, but lacks zygoconidia or septate basidiospores.

With the exception of *Auricularia* and *Mylittopsis*, all auricularioid fungi so far studied have simple-pored septa (Moore, 1990; Oberwinkler, 1990). No ultrastructure studies have yet been made of *Zygogloea*, but it seems most probable that it is also simple-pored. The new genus is thus provisionally referred to the order **Platygloeales** Moore.

Zygogloea gemellipara P. Roberts sp. nov.

Etym.: from the Latin 'gemellipara' = producing twins (with reference to the twinned zygoconidia).

Basidiomata nulla, in hymenio *Myxarii nucleati* parasitica. *Hyphae* tenuissimae, 0.5-1.0 µm latae, fibulatae, haustoria tremelloidea ferentes. *Conidiophora* clavata, *ca* 4.5-6.0 x 2.0-3.0 µm, fibulata, binatim gerentia, in hymenio hospitis

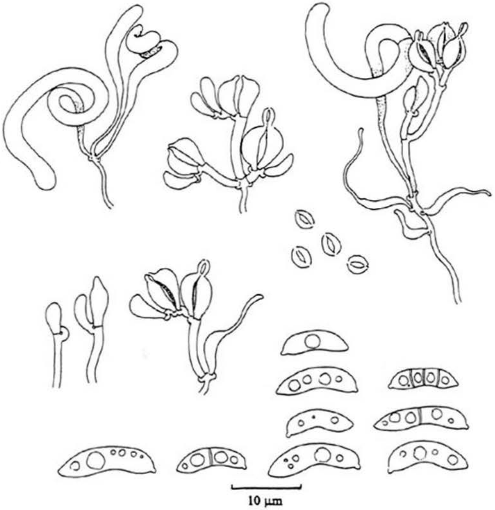

Fig. 1: ***Zygogloea gemellipara*** *showing spiralling basidia, developing and mature conidiophores, twinned conidia, and basidiospores from print (holotype specimen).*

fasciculata. *Zygoconidia* gemella, duplo allantoidea, *ca* 3.0-2.5 µm. *Basidia* cyclindracea, torsiva, usque 50 µm longa, ter transeptata. *Basidiosporae* ellipsoideae vel allantoideae, septatae, (7.0-)9.0-14.0(-17.0) x 2.5-3.5(-4.5) µm.

In hymenio *Myxarii nucleati*, Dunsford Woods, Devon, Anglia, 26 Dec. 1993, P. Roberts 812, holotypus (K).

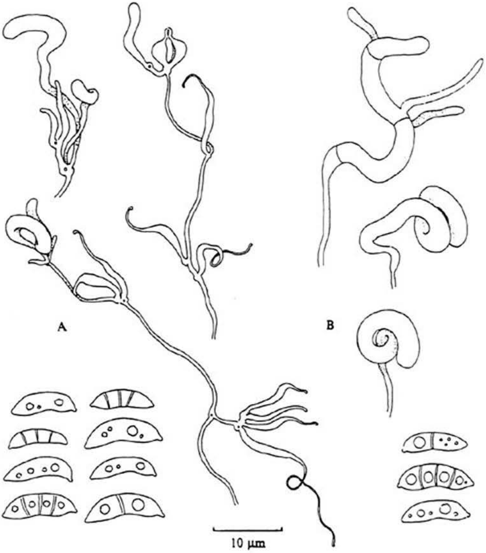

Fig. 2: ***Zygogloea gemellipara*** **(A)** *Basidia-bearing hyphae showing haustorial cells, basidiospores from print (P. Roberts 597);* **(B)** *Spiralling basidia, basidiospores from print (P. Roberts 806).*

Basidiomes as for the genus. *Hyphae* very thin, threadlike, 0.5-1.0 µm wide, slightly wider in the conidial branches. Clamp-connexions present, though inconspicuous. Parasitic haustorial cells arising from the hyphae singly or in clusters; each cell clamped at the base, tubular at first or narrowly clavate, 2.5-5.0 µm long, then producing thin, tendril-like, apical outgrowths extending up to 15 µm or more. *Conidiophores* arising as single clavate cells, 4.5-6.0 x 2.0-3.0 µm, clamped at the base, then producing a second clamped cell from the original clamp-connexion. These two cells remain separate, but curve towards each other. Each cell produces a short, apical, spiculum-like outgrowth, the two arced outgrowths joining together at each end to form a twin-celled zygoconidium. Further conidiophores are formed by proliferation from the basal clamps or on separate hyphae, ultimately creating large clusters in the host hymenium. *Zygoconidia* two allantoid cells adhering at each end, the whole measuring around 3.0 x 2.5 µm. *Basidia* auricularioid, clamped at the base, arising singly or in small clusters either from conidiophore-bearing hyphae or separately. At first weakly clavate, then elongating, becoming stalked, and spiralling up to 50.0 µm or longer. Mature basidia 4-celled, each cell producing a sterigma up to 15 µm or more long. *Basidiospores* (7.0-)9.0-14.0(-17.0) x 2.5-3.5(-4.5) µm, ellipsoid to allantoid, sometimes constricted, with an acute apex, becoming 1-3 septate at maturity.

Specimens examined: (all in hymenium of *Myxarium nucleatum*) on fallen stick, Lincombe Slopes, Torquay, Devon, 4 Feb. 1990, P. Roberts 79 (K); on *Acer pseudoplatanus* log, Watcombe Woods, Torquay, Devon, 4 June 1993, P. Roberts 597 (K); same location and substratum, 12 Dec. 1993, P. Roberts 802 (K); same substratum, Scadson Woods, Torquay, Devon, 19 Dec. 1993, P. Roberts 806 (K); on fallen *Corylus* branch, Dunsford Woods, Teign Valley, Devon, 26 Dec. 1993, P. Roberts 812 (holotype, K).

Basidia and spores are abundant in the type specimen, but sparse and localized in earlier collections. The host seems largely unaffected by the parasite and continues to sporulate, at least in some areas of the hymenium. A few scattered conidiophores have been found in additional, unretained collections and the parasite appears to be locally common if searched for. The collection studied by Reid (1970) was from Sussex, England, suggesting *Zygogloea gemellipara* may occur in Britain wherever *Myxarium nucleatum* is found.

Thanks to Dr J. Ginns for kindly reviewing this paper

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Oberwinkler, F. (1990). New genera of auricularioid heterobasidiomycetes. *Rep. Tottori Mycol. Inst.* **28**, 113-127.

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MYCOTAXON

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RAMALINA PUBERULENTA: A NEW LICHEN FROM CALIFORNIA

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ABSTRACT: *Ramalina puberulenta* Riefner and Bowler is described from California. A clarification of *Ramalina leptocarpha* is provided. *Ramalina puberulenta* and *R. leptocarpha* are closely related sister species. *Ramalina puberulenta* likely diversified in California with the emergence of the Mediterranean climate.

INTRODUCTION

This is one in a series of articles dealing with a revision of the genus *Ramalina* in western North America. Careful study of a polymorphic species often reveals morphological, chemical, and ecological discontinuities previously overlooked that may be useful in determining the integrity of a single polymorphic species. Similar chemistries and spore characteristics imply a close relationship between *R. puberulenta* Riefner and Bowler and *R. leptocarpha* Tuck., possibly as sister species. Differences in the ecologies and distribution between the two taxa are discussed. Inception of the summer-dry Mediterranean climate, and changing habitat ecologies and dichotomy of bark substrate correlated with Pleistocene and Holocene vegetation shifts between the coast and interior are discussed as probable isolating mechanisms.

THE TAXA

Ramalina puberulenta Riefner & Bowler *sp. nov.* (Figures 1-5).

TYPE: USA. California: Monterey Co.: On *Quercus lobata* in woodland-savanna along G-14 near Rte. 101, 1989, *Riefner 89-375* (Holotype: IRVC; Isotypes: ASU, DUKE, WIS); contains no acids.

DESCRIPTION: Thallus fruticosusque, parce et diffuse ramosus, caespitosus. Rami 7.5 cm long, complanati compressi solidique, minutus puberulentibus; frequentia sulcatis. Cortex coriaceous; superficies subruglosa, variabilis. Apothecia subterminalia, laminalia. Discus pallidus, 14 mm max. diam., concavus. Sporis rectis vel curvulis, uniseptatis, (11) 12-16 (18) μm x (3) 4-7 μm. Pycnidiaque ignotum; non vidi. Substratum: arbor parva. Acidum usnic ± atranorin; bourgeanic + zeorin; bourgeanic; zeorin; acidum ignotum; 0 continens.

Thallus fruticose, corticolous, up to 7.5 cm high with straplike, or irregular branches arising from the base. Lacineae flattened, minutely puberulent, often sulcate. Apices blunt with rounded rather than pointed tips in mature thalli. Apothecia sub-terminal along lobe apices and often laminal on the distal half. The apothecia disks range from cuplike to flat, up to 14 mm in diameter, are pale to pink-flesh colored, and are usually terminally situated on blades; when apothecia are laminal they occur mostly on one side of a blade. Spores are uniseptate, mostly gently curved to occasionally straight, (11) 12-16 (18) μm by (3) 4-7 μm. The cortex is coriaceous, extremely variable, ranging from smooth to irregularly corrugated or veined, lacunose, or ridged.

CHEMISTRY: Chemical races include, in addition to usnic acid, pigment SV-1, and atranorin: no acids; bourgeanic acid and zeorin; bourgeanic acid; and zeorin.

DISTRIBUTION: Endemic to Mediterranean California, principally restricted to the Foothill Woodland community in the Great Central Valley, inner Coast Ranges and the Transverse Ranges experiencing hot summers and colder winters associated with an interior climatic regime. Rare on the immediate coast.

REPRESENTATIVE SPECIMENS EXAMINED: *Medullary Chemotype 1 (no acids)*- USA. CALIFORNIA: without locality, *Bolander s.n.* (US); without locality, *Wright s.n.* (FH). ALAMEDA CO.: *Bolander 31* (FH). LOS ANGELES CO.: Santa Monica Mountains, *Hastings s.n.* (WIS); La Verne, *Wheeler 1552* (US). MONTEREY CO.: Hastings Preserve, *Ryan 27071* (ASU); Arroyo Creek, *Riefner 83-282* (COLO, IRVC); G-14 at Rte. 101, *Riefner 89-375* (DUKE, IRVC, WIS); Camp Stephani, *Wheeler 4305* (US); Priest Valley, *Hale 57903* (US). SACRAMENTO CO.: Consumnes River Preserve, *Parala s.n.* (IRVC). SAN BENITO CO.: Fremont Peak State Park, *Hale 57510* (US); Hollister, *Moore 82* (US). SAN LUIS OBISPO CO.: Shandon, *Hale 58032* (US); Santa Margarita, *Riefner 90-81* (DUKE, IRVC); Shandon, *Schallert 162531* (US); San Miguel, *Riefner 90-83* (IRVC). SANTA BARBARA CO.: Foxen Cyn., *Riefner 93-172* (IRVC, WIS); La Brea Canyon, *Bratt 4575*, (SBM); Birabent Canyon, *Bratt 87* (SBM); Colson Canyon, *Bratt 4636* (SBM); Santa Ynez Valley, *Riefner 91-59* (IRVC); Solidad, *Merrill 513* (FH). SANTA CLARA CO.: Mt. Hamilton, *Weber and Rose 3510* (FH); Los Gatos, *Herre 15* (NY) and *Herre 65* (FH); San Jose, *Underwood 37* (DH) and *Underwood 69* (NY); Stanford University Campus, *Herre s.n.* (DH) and *Baker 189* (DH). SANTA CRUZ CO.: Mt. View

Landing, *Herre 159 & 245* (NY, US). VENTURA CO.: without locality, *Hasse s.n.* (FH). *Medullary Chemotype 2 (bourgeanic acid and zeorin)*-USA. CALIFORNIA: SAN MATEO CO.: Searsville, *Herre 111* (US); SANTA CLARA CO.: San Jose, *Underwood 69* (NY); Stanford University Campus, *Keck 1374* (DH) & *Dudley s.n.* (DH). *Medullary Chemotype 3 (bourgeanic acid)*-USA. CALIFORNIA: SAN MATEO CO.: Searsville, *Herre 111*, (FH). *Medullary Chemotype 4 (zeorin)*-USA. CALIFORNIA: without locality, *Underwood 69* (NY); SANTA CLARA CO.: San Jose, *Underwood s.n.* (NY); Los Gatos, *Morse s.n.* (DH).

Ramalina puberulenta is characterized by: 1) being corticolous, the thalli typically growing individually; 2) growing primarily on *Quercus lobata* and *Q. douglasii*; 3) a puberulent, often sulcate cortex; 4) terminal/sub-terminal and usually laminal ± marginal apothecia on blunt-lobe apices; 5) chemotypes 1-4 are listed in Table II; 6) apothecia $\leq$ 14 mm in diameter, spores ellipsoid, mostly curved or occasionally straight (11) 12-16 (18) μm x (3) 4-7 μm.

Interestingly, notes written on a *Wright s.n.* collection at FH indicate Tuckerman's recognition of the significance of the puberulent cortex (dismissed by Howe 1914), stating "the delicate pubescence, unknown otherwise in the genus" might be compared to *Teloschistes*. Tuckerman was undoubtedly referring to *T. villosus* auct (sensu North American material). Bolander also noted "puberula" (*Bolander 31* FH), and Tuckerman's line drawing of the sulcate puberulent cortex of Bolander's collection is included in that packet at FH. Tuckerman (1872), however, considered the puberulent character limited to young branches, thus he did not recognize it as a distinct taxon separate from *R. leptocarpha*.

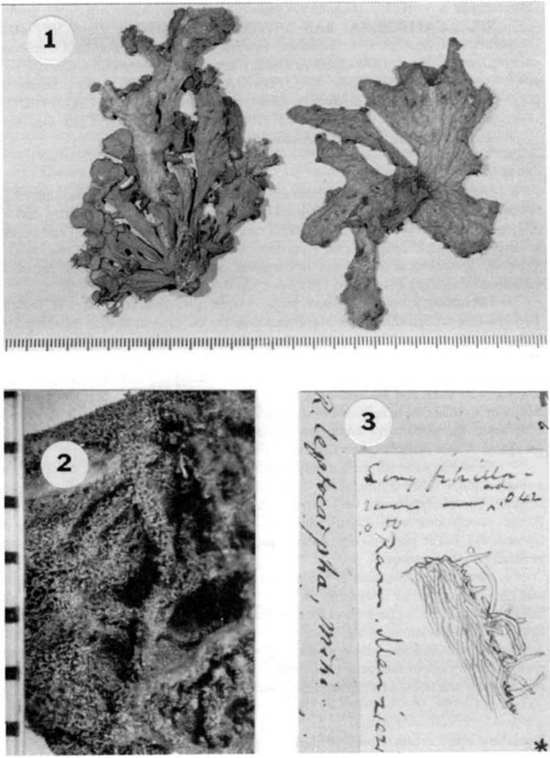
Ramalina puberulenta is a polymorphic taxon with morphotypes varying from a single shallow lobed lamina or few-branched broad-lobed forms to densely branched cespitose morphotypes with very narrow blades. Coastal and infrequent outer Coast Range populations with mostly marginal apothecia tend to intergade with *R. leptocarpha*, but *R. puberulenta* can be readily identified by its puberulent cortex and generally shorter spores.

Ramalina puberulenta is a common epiphyte of white-oak (*Quercus lobata*) and blue-oak (*Quercus douglasii*) savannas and open woodlands that dominate the Foothill Woodland, a common plant community surrounding the Central Valley and lower to mid-elevations of the inner Coast and Transverse Ranges (Griffin 1988). Apparently urbanization, smog, and changes in the fire ecology have extirpated the species from most of southern California in recent decades. *Ramalina puberulenta* may be expected in the Mediterranean climate zone of interior northern Baja Mexico.

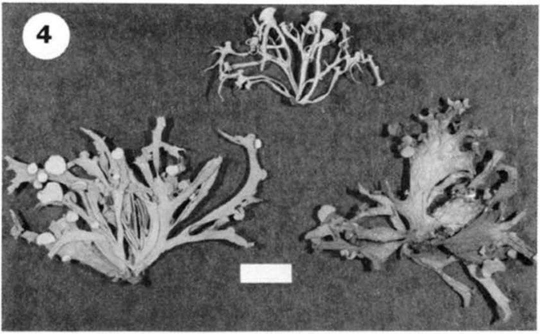
Ramalina leptocarpha Tuck. (Figures 6-7). Suppl. Enum. North Am. Lich. 423, 1858. *Ramalina menziesii* Tuck. Proc. Amer. Acad. Arts and Sci. 1:207, 1848 (non *R. menziesii* Tayl.).

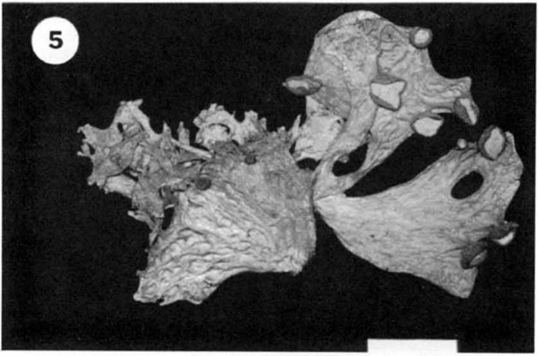
TYPE: USA. California: Monterey, *Menzies s.n.* (FH!-Holotype); glabrous, marginal apothecia, no medullary acids.

CHEMISTRY: Chemical races include, in addition to usnic acid: no acids;



Figures 1-3. Scale in mm. Fig. 1. Habit-Type collection of *Ramalina puberulenta*. Fig. 2. Closeup of puberulent cortex-Type. Fig. 3. Tuckerman's drawing of pubescence, *Bolander 31* (FH).





Figures 4-5. Bar = 1 cm. Fig. 4. Growth forms of *Ramalina puberule* subpendulous straplike form, *Herre 111* (US-left); narrow-lobe cespitose fo *Riefner 93-172* (IRVC-upper center); open form, *Riefner 83-282* (IRVC-right). F 5. Broad-lobe form, *Riefner 90-81* (IRVC).

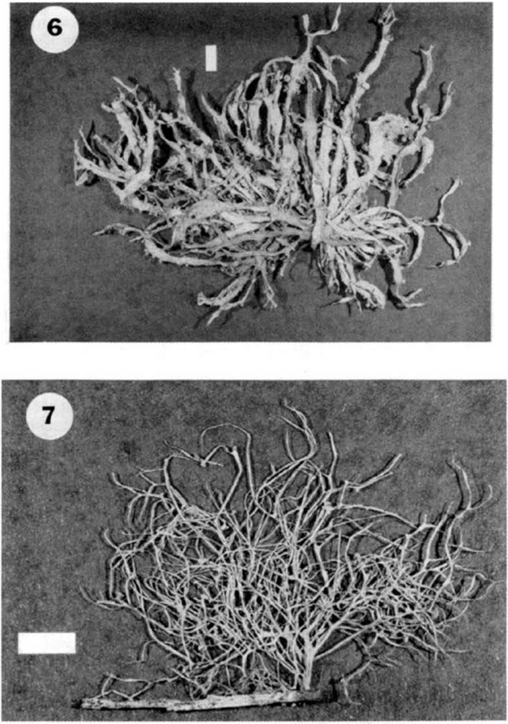
zeorin; bourgeanic acid and unidentified triterpene; and bourgeanic acid.

DISTRIBUTION: Endemic to western North America, mostly along the broad coastal strip from northern California to Baja California Sur, restricted to inland areas influenced by maritime air. This species is most abundant in central California.

> **REPRESENTATIVE SPECIMENS EXAMINED:** *Medullary Chemotype 1 (no acids)*-MEXICO. BAJA CALIFORNIA SUR: Punta Eugenia, *Nash 26246* (ASU). USA. CALIFORNIA: LOS ANGELES CO.: Santa Monica Range, *Hasse 114* (DH); San Clemente Island, *Trask 65* (NY). Marin Co.: Olema, *M. Howe 10*, (FH, MICH, NY); Stinson Beach, *Shervanick 33* (DH). MONTEREY CO.: *Underwood s.n.* (NY); without locality, *Menzies s.n.* (FH-!); New Brighton Beach, *Hale 51658* (US). ORANGE CO.: Capestrano, *Hasse s.n.* (FH). SAN DIEGO CO.: *Alderson s.n.* (NY); San Diego, *Palmer s.n.* (NY); San Diego, *Palmer 205* (US). SAN LUIS OBISPO CO.: Pico Creek, *Riefner 86-191* (DUKE, IRVC); Oso Flaco Lake, *Riefner 90-2* (DUKE, IRVC); Avila Beach, *Riefner 93-51* (IRVC). SAN MATEO CO.: San Gregorio, *Herre s.n.* (NY). SANTA BARBARA CO.: Santa Cruz Island, *Schuster 15b* (US); Sycamore Cyn., *Hasse 923* (FH); Santa Barbara, *Kingman 891* (FH). SANTA CLARA CO.: Summit Road, *Thomson and Herre 4811* (WIS); Stanford University Campus, *Abrams 49* (DH). SANTA CRUZ CO.: Boulder Creek, *Hasse & Vesta s.n.* (DH). SONOMA CO.: Santa Rosa, *Heller 5202* (DH). *Medullary Chemotype 2 (bourgeanic acid & unid. triterpene)*-Mexico. BAJA CALIFORNIA NORTE: El Rosario, *Rundel 8105* (WIS); Colonet, *Sipman 24757* (US). USA. CALIFORNIA: Berkley, *M. Howe 93* (DH). *Medullary Chemotype 3 (bourgeanic acid)*- USA. CALIFORNIA: SAN DIEGO CO.: San Diego, *Palmer 288* (US,WIS). SANTA BARBARA CO.: Constellation Rd. at Rte. 1, *Riefner 87-231* (DUKE). SANTA CRUZ CO.: Mt. View Landing, *Herrè 159* (DH, US). *Medullary Chemotype 4 (zeorin)*-USA. CALIFORNIA: SAN LUIS OBISPO CO.: Avila Beach, *Riefner 93-56* (IRVC).

Ramalina leptocarpha may be characterized by: 1) being corticolous, commonly pendulous, with thalli often growing in dense swards; 2) growing primarily on *Quercus agrifolia* and *Salix*, or shrubs in heavy fog zones; 3) a glabrous, smooth to rugose cortex; 4) marginal ± sub-terminal (more rarely laminal) apothecia on acute to attenuate lobe apices; 5) chemotypes 1-4 are listed in Table II; 6) apothecia $\leq$ 8 mm in diameter, spores ellipsoid, mostly curved (10) 11-18 (19) μm x (4) 5-7 μm.

Ramalina leptocarpha has been a source of confusion to lichenologists, including Tuckerman and Howe (Howe 1914), for decades. The numerous morphotypes, which vary from the slender-branched canaliculate form to the little-branched and more coriaceous broad-lobed forms have often been misidentified as allopatric species. *Ramalina sinensis* Jatta, an inland species which lacks medullary acids and has curved spores, has been consistently misidentified as *R. leptocarpha* in California, Arizona and Baja California. Immature or slender morphotypes of *R.*



Figures 6-7. Bar = 1 cm. Growth forms of *Ramalina leptocarpha*. Fig. 6. Broad-lobe rugose form, *Riefner 93-51* (IRVC). Fig. 7. Narrow-lobe canaliculate form, *Riefner 90-18* (WIS).

TAXA	SPORES	APOTHECIA	THALLUS	ECOLOGY- RANGE
R. puberulenta	(11) 12-16 (18) x (3) 4-7 μm, mostly slightly curved	terminal & laminal ± marginal, ≤ 14 mm dia.	puberulent ± sulcate, blunt apices, grayish	interior savannas-woodlands growing on *Quercus lobata-Q. douglasii*; CA: inner Coast & Transverse Ranges, Central Valley
R. leptocarpha	(10) 11-18 (19) x (4) 5-7 μm, mostly slightly curved	marginal ± sub-terminal or laminal, ≤ 8 mm dia.	glabrous ± rugose, attenuate apices, greenish	broadly coastal, growing on *Q. agrifolia-Salix* forests & scrub; CA to Baja California Sur

TABLE I. Comparison of the morphological and ecological characteristics of *R. puberulenta* and *R. leptocarpha*.

TAXA	CHEMOTYPE	SV-1	USNIC	ATRANORIN	BOURGEANIC	ZEORIN	UNID TERP
R. puberulenta	1	+/-	+/-	+/-	-	-	-
	2	-	+/-	-	+	+	-
	3	-	-	-	+	-	-
	4	-	+/-	+/-	-	+	-
R. leptocarpha	1	-	+/-	-	-	-	-
	2	-	+/-	-	+	-	+
	3	-	-	-	+	-	-
	4	-	+/-	-	-	+	-

TABLE II. Comparison of the chemotypes of *R. puberulenta* and *R. leptocarpha*. TLC analysis of 50 samples of each taxon using solvent systems G-A-B of White and James (1985).

sinensis may be readily distinguished from *R. leptocarpha* by predominately terminal and sub-terminal apothecia, slightly shorter spores, and a more cartilaginous thallus (often fenestrate in California material) with longitudinally oriented veins, ridges and decorticate intercalary areas towards the holdfast.

Ramalina leptocarpha is a conspicuous element of *Quercus agrifolia* and *Salix* forests and scrub communities associated with the equable, moister climatic regimens along the coastal belt. This species often dominates the epiphytic flora, forming pendulous homogeneous swards, particularly in areas commonly influenced by fogs. It is associated with coast live oak woodland at infrequent inland sites where it usually occurs with *Niebla cephalota* (Tuck.) Rundel & Bowler, a reliable indicator of inland maritime influence.

DISCUSSION

The similarities in spore characteristics and the chemical races shared between *R. leptocarpha* and *R.puberulenta* imply a close relationship, perhaps as sister species. We postulate that ancestral *R. leptocarpha* may have been an element of the summer-wet assemblages of Miocene forests discussed by Wolfe (1979) that escaped coastward adapting to increasing summer aridity of the Pliocene. *Ramalina puberulenta* likely diversified from *R. leptocarpha* sometime during the late Pleistocene to the early Quaternary in central-southern California under the influence of an emerging and increasingly xeric Mediterranean climate.

The Pliocene inception of the Mediterranean climate (Deacon 1983) produced temperature contrasts over relatively short distances between the coast and the interior in the high-relief California topography, and influenced the segregation of vegetation zones that adapted to localized subclimates within the Mediterranean regime (Axlerod 1973, 1988; Wolfe 1979). Climatic warming and spreading drier climates at the close of the Pleistocene Epoch altered the fire regime, and produced dramatic vegetation changes from the dense, closed canopy forests of the Pliocene to an increase and importance of open oak woodland and a corresponding segregation of Sierran and other species (Byrne et al. 1990). Modern Mediterranean vegetation associations include the interior oak savannas of California comprised of the endemic *Quercus lobata* Née and *Q. douglasii* H. & A., and the almost pure communities of *Q. agrifolia* Née that occur along the broad coastal belt from west-central California to northern Baja Mexico (Griffin and Critchfield 1972, Griffin 1988). *Quercus douglasii* woodland alone occupies nearly 6.5% of California, representing several million hectacres (Holland 1973).

The crucial role of Holocene thermal changes and the subsequent formation of new vegetation associations with contrasting subclimates that favored the selection of new genotypes in the California phanerogamic flora (Raven and Axelrod 1978, Axelrod 1981), also produced differences in bark substrates and habitat ecologies corresponding to vegetation shifts that became potentially important for epiphytic lichen evolution. The sensitivity of lichen growth to preferred substrates has long been appreciated by lichenologists (Brodo 1973). Differences in bark types may potentially act as a significant isolating mechanism for sympatric speciation of epiphytic lichens (Culberson 1986). The dichotomy in bark substrates and habitat ecologies between the coastal *Q. agrifolia-Salix* forests and the *Q. lobata-Q.*

douglasii savannas of the interior is striking. *Quercus agrifolia* is an evergreen tree with a dense hemispherical shade-producing crown and smooth thin bark; *Q. lobata* and *Q. douglasii* are winter-deciduous trees with spreading well-lit crowns with thick rough and often deep-fissured bark (Pavlik et al. 1992). Specific bark preference has been known for various *Ramalina* species such as *R. menziesii* Tayl. for deciduous oaks (Rundel 1974), and chemical races of *R. farinacea* (L.) Ach. (Bowler and Rundel 1978). Brodo (1973) also discusses the influence of barks with different densities, porosities, textures, and transpirational rates upon epiphytic vegetation. In regions where the *Q. agrifolia-Q. lobata* forests overlap, e.g. the Franciscan Valley and the Santa Ynez Mountains, both *Ramalina* species intermix on the dominant phorophytes but clearly prefer one or the other bark type. Under optimum conditions, *R. puberulenta* will also occasionally colonize surrounding shrublands or associated understory shrubs. The rare occurrence of *R. puberulenta* on the immediate coast may be linked to the diffusion of arid interior and semi-desert phanerogamic vegetation in the Xerothermic Period (Axelrod 1981). The distribution of *R. puberulenta* in the Coast Ranges, e.g. the Santa Monica Mountains, is nearly identical to the range of *Q. lobata* described by Griffin and Critchfield (1972).

The evolution of *R. puberulenta* conforms to the concepts outlined by Stebbins and Major (1965) that recent speciation, yielding neo-endemics, occurs in ecotonal or border areas between mesophytic forests and more xerophytic vegetation associations.

Another example of habitat selection of closely related epiphytic species involving a correlation of climatic factors and bark substrate is the preference of *Parmotrema hypotropum* (Nyl.) Hale for interior hardwoods and *P. hypoleucinum* (Steiner) Hale for coastal conifers in the southeastern United States (Culberson 1986).

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SUGGESTIONS FOR DESCRIBING AND ILLUSTRATING FUNGAL SPORES

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ABSTRACT

A system for describing and illustrating spores is proposed. It is applicable to all fungal groups and is based on spore symmetry and polarity. The aim of this paper is to define terminology, simplify nomenclature, and to give a spatial point of reference for illustrations.

Key words: spores, sporogram, symmetry, polarity.

Standardized descriptive biological terms have been proposed by the (Systematics Association for Descriptive Terminology, Anon. **1960**, **1962**). Several authors have discussed the problem of describing and/or illustrating fungal spores, of Agaricales (Corner **1947**; Heim **1957**; Josserard **1952**; Largent et al. **1977**; Maublanc & Viennot-Bourgin **1959**; Pegler & Young **1971**, **1975**, **1982**; Perreau **1961**, **1967**, **1971**, **1976**; Perreau & Heim, **1969**; Singer **1986**; Smith **1949** and Snell & Dick, **1971**) among others, and of Ascomycotina (Ingold **1954**, **1966**; Minter **1982** and Weber personal communication). Most refer to spore size and shape in side view; the aim of this paper is to expand descriptions to include symmetry and polarity.

Fungal spores occur in a wide range of shapes, from simple (Fig.1: K; R; S) to extremely complex (Fig.1:J; U; RR). Terminology for spore shapes (e.g. Hawksworth et al. **1983**; Largent et al. **1977**; Singer **1986**; Smith **1949**) includes "globose" and "ellipsoidal" for simple spore shapes or one view; for spores with complex shapes, "dictyosporae" (Fig.1: A), "helicosporae" (Fig.1: U), "staurosporae" (Fig.1: J). These terms usually do not convey a three-dimensional concept.

Because problems of describing and illustrating fungal spores persist, (i.e. Sheffy & Dilcher (**1971**) and Elsik & Jansonius (**1974**), referred to the "basal cell" which, in the terminology I present here, is the apical cell), this paper will suggest standards to allow comparison and uniformity in descriptions and illustrations of spores of all types.

It is critical to establish general rules applicable to all fungal groups.

The principal goal is to establish points of reference to determine the poles and the equator, so spores will have a standard orientation for description, and to construct a "sporogram", (from the Greek spore (σπωρ) = seed and gram (γραμ) = draw, written sign). This term has been used by several authors (e.g. Pegler & Young **1978**, **1982**) and misused by others (Huhtinen **1989**) calling "sporogram" to what should be called "sporograph". The word "sporograph" was coined by Corner in **1947**, but this refers to the straight line graph obtained by plotting the ratio between length and width of the spore. The sporogram will reflect the spore shape, symmetry, ornamentation, wall stratification and size.

Fungal spores should be illustrated in the same way as pollen grains (Erdtman **1966**, **1969**, **1972**; Walker & Doyle **1975**). The spore should be described and represented in terms of 2, 3, 4, 5 or 6 views (Fig. 2). That is to say one or several side views, an upper and a lower view, so the shape, size and the ornamentation in each view is taken in account. When intracollection variation is found that should be represented with several spores views where the variation takes place (this shape variation is generally found in the equatorial views) (Fig. 3). The written description of a spore should reflect the characteristics of all the illustrations of that spore.

POLARITY

Polarity is a quality inherent to a body that has, because of shape or other structural features, opposite parts with one main axis of symmetry, the **polar axis** (pa) (Fig. 1: C).

Spores are **apolar** or **polar**. They are **apolar** when a distinct axis is lacking. These actinomorphic spores are spherical (Fig. 1: K, R). Many spores may initially appear apolar, but upon closer examination (e.g. SEM) prove to

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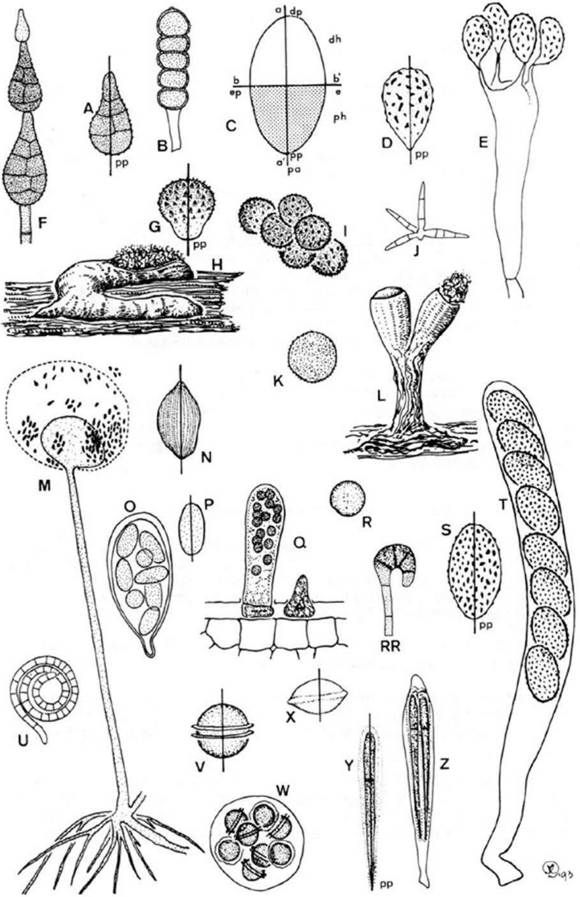
FIG. 1: A, F: *Alternaria sp.* A: Conidiophore F: Pluricellular spore (dictyosporae); B: *Phragmidium sp.*, pluricellular spore; C: Diagram of an idealized spore indicating the equator (e), the equatorial plane of symmetry b-b' (ep), polar axis a-a' (pa), proximal pole (pp), distal pole (dp), distal halve (dh) unshaded and proximal halve (ph) shaded; D-E: *Ramaria sp.*; D: Polar spore; E: Basidium; G-I: *Reticularia olivaceae* (Ehrenb.) Fries; G: Polar spore; H: Sporangium; I: Spores in bunch; J: *Tetranacrium sp.*, pluricellular spore (staurosporae); K-L: *Metatrichia vesparium.*; K: Apolar spore; L: Sporangium; M-N: *Rhizopus sp.*; M: Sporangium; N: Polar spore; O-P: *Ellisiodothis sp.*; O: Ascus; P: Polar ascospore; Q-R: *Taphrina sp.*; Q: Ascus; R: Apolar ascospore; RR: *Slimacomyces sp.*, spore; S-T: *Scutellinia sp.* S: Polar ascospore; T: Ascus; U: *Helicomyces sp.*, pluricellular spore (helicosporae); V-W: *Eurotium sp.*; V: Polar ascospore; W: Ascus; X: *Badhamia ovispora* Racib., polar spore; Y-Z: *Ceratomyces sp.*; Y: Polar ascospore; Z: Ascus. In all polar spores the polar axis has been marked.

The figures are all original drawings from spores but are not to scale. Some specimens used are stored at the University of Córdoba Herbarium (CORD) while some are at other herbaria (OSC, F).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posses a distinct feature that determines polarity. These spores may be called **cryptopolar**, (e.g. the Phallaceae, Burk et al. **1982**). Asymmetric or zygomorphic spores with a distinct axis are **polar**. Polar spores are **isopolar** when the equatorial plane divides the spore into equal or nearly equal halves (Fig. 1: P, S; 2: C, E, G). They are **heteropolar** when the polar faces are markedly unequal (Fig. 1: A, D, G, Y; 2: B, D, F). When the two halves differ slightly it may be termed **subisopolar**.

Spore polarity is related to its attachment to a cell, or to its arrangement in a definite way within the ascus, or to its particular shape. The **polar axis** (pa) is established (Fig. 1: C a-a') as an a imaginary line which runs through the center of the spore and goes through both poles. In order to determine the polar axis one must to determine if there is a point of reference. Polar spores may show any of the following characteristics: 1) attached to the supporting cell or basidium (Fig. 1: F, E); 2) with an orderly arrangement within the ascus (Fig. 1: T, Z); or 3) randomly arranged within a sporangium or ascus but with spore peculiarities (Fig. 1: H, M, O, W). If there is a point of reference (i.e. attachment to a cell or orderly arranged within the ascus), the **proximal pole** (pp) will be the nearest one, and the **distal pole** (dp) the furthest (Fig. 1: A, D, Y). When there is no point of reference but polarity is ascertained, they are termed just poles (Fig. 1: N, P) without any further delimitators.

The **equatorial plane** (ep) (Fig. 1: C b-b') perpendicularly bisects the polar axis of a spore at its midpoint. The intersection of the polar axis with the equatorial plane of the spore determines the **equator** (e). The equatorial plane delimits the **distal half** (dh) of the spore (unshaded in figure 1 C) in the upper part and the **proximal half** (ph) of the spore, the lower part (shaded in figure 1 C).

POLARITY IN DIFFERENT FUNGAL GROUPS

In the Mastigomycotina, some genera of Zygomycotina, Teliomycetes (urediniospores, teliospores and aeciospores) and Deuteromycotina, the proximal pole is in contact with the mother cell or bearing structure (Fig. 1: B, U, RR). For those species with spore chains, the proximal pole will be that nearest the conidiophore (Fig. 1: A).

In Basidiomycotina, the proximal pole is in or near the point of attachment of the spore to the basidium (Fig. 1: D, E).

In Myxomycota there are some species with spores in clusters (Martin & Alexopoulos **1969**; Mc Hugh **1986**). This is a special case and the proximal pole is situated at the extreme of the spore nearest the middle of the group (Fig. 1: G, I).

In Ascomycotina which has spores perpendicularly or obliquely arranged (Fig. 1: S, T, Y, Z), respectively, with reference to the ascus base, the proximal pole will be in the extreme of the spore nearest the ascus base, and the distal pole nearest the ascus apex. In those species with the ascospores born in asci without a particular arrangement (Fig. 1: O, P) the poles will be situated in the extremes of the longest axis of the spore. The same thing happens with spores in sporangia of Myxomycota and Zygomycotina (Fig. 1: M, N).

In Laboulbeniomycetes, according to Thaxter's (**1896-1931**) terminology, the term "basal cell" refers to the cell position once the spore is discharged and sticks to the insect cuticle; it is up-side down from the position it had within the asci. This "basal cell," thus becomes close to the asci apex while containing the distal pole of the spore (Fig. 1: Y, Z). In the terminology proposed it should be referred to as the distal cell according to the position it had in the ascus.

Some species have globose spores or flattened spores not arranged in any particular way within the sporangia or asci but having ornamentation, rings, depressions, pores, etc.; we may arbitrarily assume that these structures are located at the equator of the spore. This occurs in some species of Myxomycota (Fig. 1: X) and Ascomycotina (Fig. 1: V, W).

SYMMETRY

Symmetry is a quality inherent to a body that can be divided into similar parts by a plane passing through the center. There is correspondence of opposite parts in size, shape and position. Planes dividing the spores are known as **symmetry planes**. Symmetry planes may be either **vertical** or **horizontal.** The **vertical planes of symmetry** i.e., polar symmetry planes, go through the polar axis; there may be 1 to an infinite number of them (Fig. 1: C). The **horizontal plane**, i.e., equatorial plane (ep) (Fig. 1: C) perpendicularly bisects the polar axis at its midpoint into two halves; there may be none or only one horizontal plane of symmetry.

The imaginary lines formed by the intersection of the vertical plane of symmetry and the equatorial plane (ep) form the **equatorial axes**. They number from 1 to infinity depending on the number of vertical planes of symmetry. Spore symmetry is based on vertical symmetry planes that exist in a particular spore as seen from polar view, i.e. a globose ascospore in equatorial view (Fig. 2: C) has infinite vertical planes of symmetry (only some of them represented in the figure). On the other hand a reniform spore in polar view (Fig. 2: G) has only one vertical symmetry plane dividing the spore into mirror images.

Fungal spores are **symmetric** or **asymmetric**. **Asymmetric** spores (Fig. 2: H) have *no vertical or horizontal planes of symmetry* due to their irregular shape. **Symmetric** spores, which can be divided into similar halves, may be classified as: **radial symmetric**, **biradial symmetric** and **bilateral symmetric**; and further could be isopolar or heteropolar. **Radial symmetric** spores have one horizontal and *three or more (up to infinity) vertical symmetry planes* of the same length passing through the polar axis

(Fig. 2: B, C). Radially symmetrical heteropolar spores have no horizontal symmetry plane. **Biradial symmetric** spores have one horizontal symmetry plane and are divisible into two similar halves by *two mutually perpendicular vertical symmetry planes* passing through the polar axis (Fig. 2: D, E). These planes may or may not be of the same length. In biradial symmetric heteropolar spores there is no horizontal symmetry plane. What we call biradial symmetric here is not properly considered as bilateral symmetry by Erdtman (**1969**). He states "Bilateral isopolar spores have three planes of symmetry, one horizontal and two vertical". "In bilateral heteropolar spores there are two planes of symmetry, both vertical, of unequal lengths, and intersecting at right angles". According to Webster's (**1985**) definition, bilateral symmetry is that "in which similar anatomical parts are arranged on opposite sides of a median axis so that one and *only one plane* can divide the individual into essentially identical halves." However **bilateral isopolar** spores are divisible by *only one vertical plane of symmetry* and one horizontal (Fig.2: G). **Bilateral heteropolar** spores have no horizontal symmetry plane (Fig.2: F).

DIMENSIONS

Spores descriptions usually define the size of their **length** (i.e. the distance between the two poles) and **breadth** (i.e. the diameter of the equatorial or horizontal plane (Fig.2: A, G)).

In flattened spores it becomes necessary to make a further measurement of the **width** of the spore (i.e. in most of the Agaricales the distance from the abaxial to the adaxial surface in the median plane (Fig.2: A) and in Ascomycetes one side view or equatorial lateral (Fig.2: G)).

In Hymenomycetes spore length should be taken in a equatorial lateral view (Fig. 2: A). Spore length does not normally include the hilar appendix, which is ignored or given as a separate measurement in such taxa as it is thought to be of significance e.g. *Bovista*, *Arachnion*. When measuring ornamented spores it should always be made clear when the ornamentation is included or excluded of the overall measurement.

SPOROGRAM

To have a three dimensional idea of a spore shape it is essential to draw

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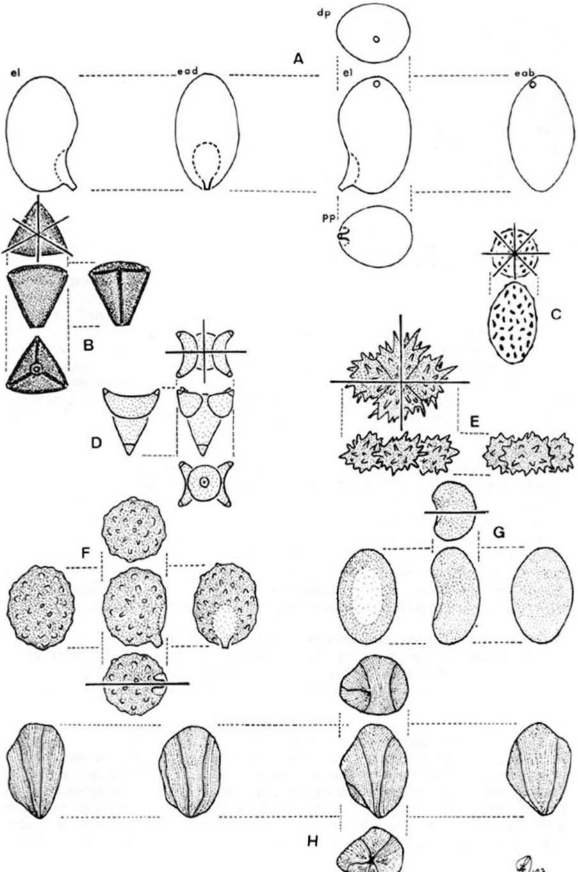
FIG. 2: A: Sporogram of an idealized basidiospore, from right to left: equatorial abaxial view (eab), equatorial adaxial view (ead), distal polar view (dp), equatorial lateral view (el), proximal polar view (pp); B-H: Sporograms; B-G: Symmetric spores; C, G, E: Isopolar spores; B, D, F: Heteropolar spores; B, C: Radial symmetric spores; D, E: Biradial symmetric spores; F, G: Bilateral symmetric spores; H: Asymmetric spore; B: *Catenularia sp.*; C: *Scutellinia sp.*; D: *Triposporina sp.*; E: *Spegazzinia sp.*; F: *Russula sp.*; G: *Selenaspora sp.*; H: *Mucor sp.*.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H

a sporogram and provide a detailed description, including size in each view when necessary (Fig. 2: A). When spore morphology varies, 3, 4, 5 or 6 more equatorial view drawings should be added.

The spore must be illustrated in its **equatorial and polar views**. In **isopolar** spores (Fig. 2: C, E, G) only one polar view needs to be illustrated (since both poles look alike). Two polar views will be necessary to illustrate in **heteropolar** spores i.e. **proximal polar view** (pp) and **distal polar view** (dp) (Fig. 2: A, B, D, F). Depending on spore symmetry it will be necessary to draw 1 (Fig. 2: C), 2 (Fig.2: B), 3 (Fig.2: F, G) or 4 (Fig.2: A, H) **equatorial views** rotating the spore 90 degrees around the geometric axis in order to draw each equatorial view.

Most spores of Basidiomycotina are oriented with reference to the longitudinal axis of the basidium when attached to the sterigma. The representation of the inner spore surface (oriented towards the axis of the basidium) is the **equatorial adaxial view** (ead) (Fig. 2: A), two **equatorial lateral views** (el), the **equatorial abaxial view** (eab) when representing the outside face of the spore, and the **proximal** (pp) and **distal** (dp) **polar views**. All these views are necessary to fully illustrate spore shape. The equatorial adaxial and abaxial views show the bilateral symmetry with the median longitudinal axis drawn from the apex bisecting the hilar appendix at the base of the spore (Fig.1:D). In lateral views the vertical axis does not pass through the hilar appendix which is eccentric in position and becomes somehow removed from the geometric axis of the spore (Fig. 1: E). The proximal pole is not coincident with the hilar appendix.

I present 3 complete spore descriptions presenting a standardized format that can be followed (**spore shape, ornamentation, color, content, spore wall, apiculum, symmetry, polarity, size and chemical reactions** (cotton blue, Melzer, etc.)). Spore measurements were taken in water. Spore numbers measured for calculating mean size ($\bar{x}$) and the length/width ratio (= E) are included in brackets; $\bar{x}$, the arithmetic means of spore length and spore width ± standards deviation; Q = the mean of E values ± standard deviation. Spore size data include ornamentation. Basidiospore size data are without hilar appendix and with the hilar appendix in profile.

Sarcosphaera crassa (Santi ex Steud.) Pouzar.(Fig. 3:A)
Spores: cilindrical in equatorial lateral view, globose in polar view, smooth, hialine, thin walled (<1μm), radial symmetric, isopolar, [17] 15-18 x 6-7.5 μm ($\bar{x}$= 16.3 ± 0.2 x 6.6 ± 0.1μm), E= 2.1 -3 (Q= 2.4 ± 0.05). Cb (-), Melzer (-).

Pyrenogaster pityophilus Maleçon & Riousset (Fig. 3:B)
Spores: globose to ellipsoid in equatorial lateral view, globose in polar view, verrucose, verrucae irregular in shape, up to 0.3 μm tall, more or less equally distributed, in some spores there is a tendency to form ridges towards the inconspicuous and short apiculum, dark brown in mass, light brown in transmitted light, spore wall two layered, inner layer up to 1μm thick, radial symmetric, heteropolar, [20] 5-9 x 5-7 μm ($\bar{x}$= 6.9 ± 0.2 x 5.9 ± 0.1 μm), E= 1-

1.5 (Q= 1.1 ± 0.1). Cb (-), Melzer (-).

Lactarius argillaceifolius var *megacarpus* Hesler & Smith (Fig. 3:C)

Spores: broadly ellipsoid in equatorial abaxial and adaxial view, globose in polar view, with a distinct plague with diffusely distributed amyloid material, ornamentation irregularly reticulated, ornamentation of low rather fine lines and ridges both short and long branched, some isolated warts present, forming a partial to broken reticulum, prominences up to 0.5 µm high, apiculum hyaline and prominent up to 2.5 µm long, truncate, hyaline in mass, contents unigutulate rarely bigutulate, wall two layered, inner layer thin < 0.5 µm, bilateral symmetric, heteropolar, [16] 7.7-10.5-x 6.3-8 µm ($\bar{x}$= 8.9 ± 0.7 x 7.1 ± 0.5 µm), E= 1.1 - 1.4 (Q= 1.2 ± 0.08), ornamentation strongly amyloid, Cb (-).

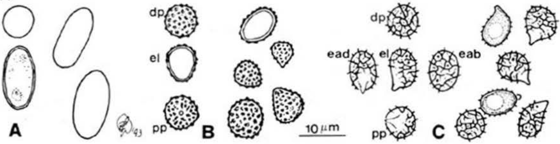

FIG.3. Sporograms of A: *Sarcosphaera crassa,* isopolar, radial symmetric spore; B: *Pyrenogaster pityophilus,* heteropolar, radial symmetric spores; C: *Lactarius argillaceifolius* var *megacarpus*, heteropolar, bilateral symmetric spores; equatorial abaxial view (eab), equatorial adaxial view (ead), distal polar view (dp), equatorial lateral view (el), proximal polar view (pp). Scale line = 10 µm.

CONCLUSIONS

The way of describing and illustrating spores here suggested leads to a full interpretation of the spore morphology as observed with either a light or electron microscope. It has the advantage of presenting a lot of information about spore morphology in a standardized format: **spore shape, ornamentation, color, content, spore wall layers, apiculum, symmetry, polarity, size, and reagent reactions** (Fig.4:A-D). A more

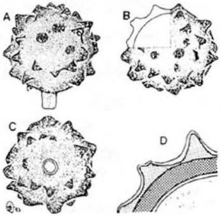

FIG. 4. A-D: *Lycoperdon perlatum* Pers. A: Equatorial lateral view (el); B: Distal polar view (dp); C: Proximal polar view (pp); D: Diagrammatic section through the basidiospore wall, enlargement from B. Based on Perreau, **1971**.

detailed diagrammatic section through the spore wall would also be helpful for comparative purposes (Fig. 4:D). An accurate interpretation of spore shape in all of its spatial views is of prime importance. In some fungal groups, spore shape determines the separation of families or genera or species (e.g. Glomales (Schenck & Pérez **1990**); *Chaetomium* (Seth **1968**); Agaricales (Smith **1986**); Uredinales (Cummins **1936**); Hyphomycetes (Ellis **1971**) etc.). The importance of precise spore analysis extends into other scientific fields, such as forensics, archeology, palinology, etc.

The proposed system has the aim to standardize the nomenclature and illustration of all fungal groups. The ideal is to supplement the drawings with photographic pictures because of the subjetiveness inherent in drawings.

ACKNOWLEDGMENTS

I extend special thanks to Drs. M.A. Castellano, A.E. Cocucci and G. Muller for their suggestions. To Drs. D. Minter and J. Trappe for reviewing the manuscript; Dr. J. Boise for linguistic improvements, CONICOR for financial support, U.S.Forest service, Pacific Northwest Research Station, for facilities and CONICET for providing the author's scholarship.

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DISCOMYCETES OF THE GUAYANAS. I. INTRODUCTION AND SOME ENCOELIA SPECIES

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ABSTRACT

Studies of the genus *Encoelia* provide two apparent new records for Venezuela, *Encoelia heteromera* (Mont.) Nannf., on logs, also apparently new for Guyana, and *Encoelia helvola* (Jungh.) Overeem, parasitic on internodes of a bamboo. Additional data and full descriptions are provided for these and for two other species previously reported from Venezuela, *Encoelia cubensis* (Berk. & Curt.) Iturriaga, Samuels & Korf, a new combination for *Patinellaria cubensis* (Berk. & Curt.) Dennis, fungicolous on Xylariaceous fungi, and *Encoelia fuscobrunnea* (Pat. & Gaillard) W. Y. Zhuang, occurring on wood.

INTRODUCTION

In a continuing investigation of the Discomycetes of Venezuela and neighboring countries, four species of *Encoelia* from Venezuela and the Guayana Region (treated here as including the Venezuelan states of Bolívar and Amazonas, Guyana, Surinam, and French Guiana) were identified and studied.

MATERIALS AND METHODS

Dried herbarium specimens collected mainly by G. Samuels, A. Rossman, and the author in the area of the Guayanas (as defined in this paper) and by K. Dumont and others in other tropical areas, were sectioned at 25 µm with a freezing microtome and sections were floated into water, then mounted in water, aqueous Poirrier's Blue, Melzer's Reagent, and KOH-Phloxine-Glycerine. Squash mounts were made and mounted in the same media. At least 30 measurements were recorded for each kind of structure for each specimen examined. Structures were measured and drawn with a calibrated ocular micrometer in a Leitz Biomed standard research microscope equipped with a Wild drawing tube. Terminology used follows Korf (1952, 1973). Abbreviations of herbarium names follow Index Herbariorum (Holmgren, et al., 1990). Abbreviated literature citations follow Botanico-Periodicum-Huntianum, B-P-H (Lawrence, et al., 1968). Throughout this paper the International Code of Botanical Nomenclature (Greuter, et al., 1988) has been followed.

Specimens examined are cited with the data exactly as they appear on the packet labels, except information that is enclosed in square brackets.

SPECIES OF ENCOELIA (FR. : FR.) P. KARST.

Encoelia cubensis (Berk. & Curtis) Iturriaga, Samuels & Korf, ***comb. nov.*** (Figs. 1, 2)

= *Patinellaria cubensis* (Berk. & Curtis) Dennis, *Kew Bull.* **1954:** 315. 1954.
= *Sphinctrina cubensis* Berk. & Curtis, *J. Linn. Soc. Bot.* **10:** 370. 1868.
= *Cenangium xylariicola* Massee, *J. Linn. Soc. Bot.* **35:** 102. 1901.
= *Dermatea mycophaga* Massee, *Kew Bull.* **1908:** 218. 1908.

Apothecia single or gregarious on pyrenomycetous fungi, frequently *Xylaria* spp., rarely on wood, frequently seated on a white mycelial tuft which may be the anamorph of the *Xylaria*, when mature mycelium surrounding and adhering to stipe in some cases, 0.25 - 1.25 mm diam, discoid with the point of attachment (stipe) present or absent. Receptacle margin undulating when mature, brown to black when dry, when rehydrated reddish-brown to black, disc brown to black with lighter margin when dry, when rehydrated greenish-beige to dark green with yellow margin. Yellow pigment exuded into 2% aqueous KOH. Stipe 0.5 × 0.25 mm, present or absent, in section <800 µm long, <440 µm wide at the disc, narrowing below to

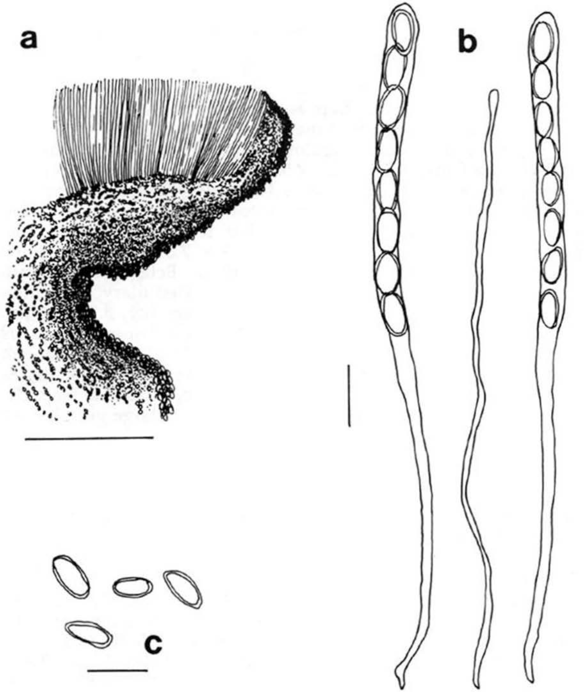

Figure 1. *Encoelia cubensis* (NY 2394). **a**. Apothecial median longitudinal section (bar 200 µm). **b**. Mature asci with ascospores and paraphyses (bar 10 µm). **c**. Ascospores (bar 10 µm).

350 µm at the base. Stipe ectal cells textura prismatica, perpendicular to the surface in the upper portion, more disorganized and textura angularis-like in the basal portion, cells all brown-walled towards the outside. Stipe medulla consisting of a mixture of wide-celled textura intricata mixed with textura epidermoidea, 5 - 9 µm broad. Ectal excipulum long-celled textura prismatica, with hyphae turning outwards towards the surface of the apothecium at the margin, with cells 8.0 - 13.2 × 2.9 - 5.9 µm, and textura angularis intermixed with prismatica towards the flanks, 13.2 - 22.0 × 5.1 - 7.3 µm; hyphae turning at a high angle towards the base and at a low angle towards the margin. Outermost cells rounder towards the surface, glued together by slight gelatinization, but loosening towards the surface of the apothecium, 5.9 - 18.3 × 7.3 - 11.0 µm. Some evidence of pustule formation evident. Ectal cells textura globulosa at the base of the apothecium. Medullary excipulum textura intricata, with broad cells glued together, 3.7 - 5.9 µm wide. Asci cylindric-clavate, with a long stipe, 8-spored, J– ascus pore with or without KOH pretreatment, 54.5 - 73.4 × 3.7 - 4.4 µm. Paraphyses filiform, same length as asci, not enlarged apically, unbranched, 1.5 - 2.2 µm wide, distantly septate. Ascospores oval, 1-seriate, biguttulate with two large guttules, 5.1 - 7.3 × 2.2 - 2.9 µm.

Substrate: On pyrenomycetous fungi, frequently *Xylaria* spp.

Specimens Examined: COLOMBIA: Dumont-CO 6006, On indet. wood [on *Xylaria* on wood], on the Quibdó-Medellín Rd. at a point ca 155 Km from the intersection with the Medellín-Anserma Rd. Dpto. Choc , Elev. ca 1800 ft., Coll.: K. P. Dumont, S. E. Carpenter, M. A. Sherwood, 10 Aug 76 (as *Patinellaria cubensis*) (NY); Dumont-CO 5966, On indet. twig [on *Xylaria*], on the Quibdó-Medellín Rd. at a point ca 155 Km from the intersection with the Medellín-Anserma Rd. Dpto. Choc , Elev. ca 1800 ft., Coll.: K. P. Dumont, S. E. Carpenter, M. A. Sherwood, 10 Aug 76 (as *Patinellaria cubensis*) (NY); Dumont-CO 5985, On Xylariaceae on indet. log, on the Quibdó-Medellín Rd. at a point ca 155 Km from the intersection with the Medellín-Anserma Rd. Dpto. Choc , Elev. ca 1800 ft., Coll.: K. P. Dumont, S. E. Carpenter, M. A. Sherwood, 10 Aug 76 (as *Patinellaria cubensis*) (NY); Dumont-CO 7375, On indet. Xylariaceae on wood, Ca 97 Km from Ansermanuevo, on the Ansermanuevo-Nívita Rd. Dpto. Choc . Elev. 400 m. Coll. K. P. Dumont, L. A. Molina, E. Forero

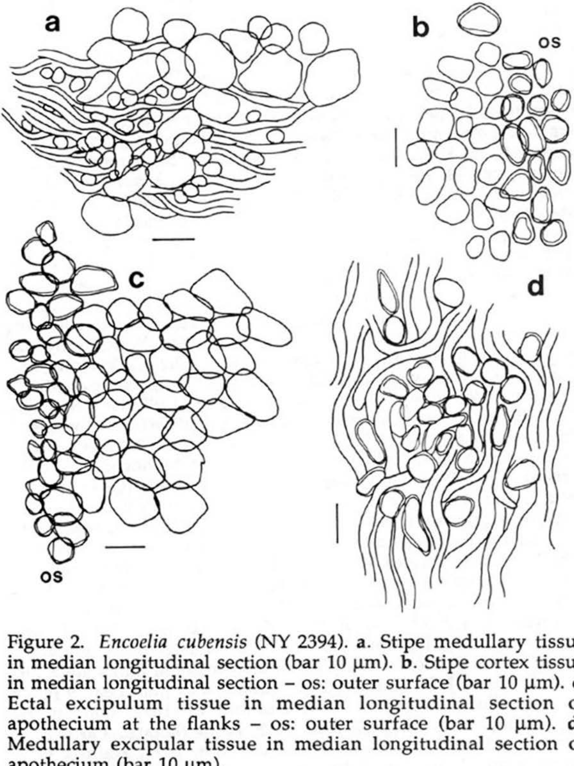

Figure 2. *Encoelia cubensis* (NY 2394). **a**. Stipe medullary tissue in median longitudinal section (bar 10 µm). **b**. Stipe cortex tissue in median longitudinal section – os: outer surface (bar 10 µm). **c**. Ectal excipulum tissue in median longitudinal section of apothecium at the flanks – os: outer surface (bar 10 µm). **d**. Medullary excipular tissue in median longitudinal section of apothecium (bar 10 µm).

et al., 26 Aug 76 [scarce collection, possibly *Encoelia cubensis*] (NY); Dumont-CO 8959, On Xylariaceae on leaf, Dpto. Magdalena, Sierra Nevada de Santa Marta, between Palo Alto (1700 m) and Refugios de la Sierra (1850 m), Coll.: K. P. Dumont, L. Ryvarden, F. Oberwinkler, P. Buritica, M. Pulido, J. Aguirre, 19 Jun 78, (as *Patinellaria cubensis*) slide and specimen (NY); Dumont-CO 1296, On unidentified wood, Finca A. Castro, ca. 5 km. W. Popayan road between Popayan and e. Tambo, Dpto. Cauca, Coll.: K. P. Dumont, J. H. Haines, J. M. Idrobo and L. F. Velasquez, 14 July 74, (as *Patinellaria cubensis*) slide and specimen (NY). FRENCH GUIANA: on *Xylaria* sp., Upper Marouini River: 5 km WSW of Monpe Soula near three inselbergs, 02 37'N, 54 03'W, Elev. 250-30 m, Aug, Sep 1987, Coll.: G. J. Samuels, J. J. deGranville, L. Allorge, W. Hahn, M. Hoff, A. Weitzman 6165 (as *Patinellaria cubensis*) (NY); on *Xylaria*, Saul ca. 10 km SW of Saul toward Mt. Galbao, 200-350 m, Jan, Feb 1986!, Coll.: G. J. Samuels & J. R. Boise 2616, (as *Patinellaria cubensis*) (NY). GUYANA: on *Xylaria* sp., Mt. Wokomung: On ridge leading NW toward summit, 1/2-1 hr walk from Base Camp; forest tall, well drained below; wet, with palms above, 05 05'N, 59 50'W, Elev. 1150-1300 m, 1 Jul 1989, Coll.: G. J. Samuels, B. M. Boom, G. Bacchus 6376 [also AD (air dried) portion inside this packet] (as *Patinellaria cubensis*) (NY). PUERTO RICO: Parasite on *Xylaria*, trail to Río Sonador on Mahogany log over stream, Nov. 1991, Coll.: Samuels, G. J. (?) (BPI) [G. J. Samuels sent me this collection with no label but the data written on the back of a presentation card from Dr. A. J. Kuthubutheen, who may be the collector, or may not have anything to do with it.] VENEZUELA: Dumont-VE 1121, On *Xylaria* sp., Path between hotel and hotel's water source, Rancho Grande, Parq. Nac. Henry Pittier, Edo. Argua, Coll.: K. P. Dumont, J. H. Haines and G. J. Samuels, 3 Jul 71, (as *Patinellaria cubensis*) (slides and specimen) (NY); Dumont-VE 1677, On *Xylaria* sp., Along road, 12 - 17 km. S. & E. of Sanare, Parq. Nac. Yacambu, Edo. Lara, Coll.: K. P. Dumont, J. H. Haines, G. J. Samuels and Juan Leal, 9 Jul 71 (as *Patinellaria cubensis*) (NY); Dumont-VE 1672, On *Xylaria* sp., Along road, 12 - 17 km. S. & E. of Sanare, Parq. Nac. Yacambu, Edo. Lara, Coll.: K. P. Dumont, J. H. Haines, G. J. Samuels and Juan Leal, 9 Jul 71 (as *Patinellaria cubensis*) (NY); Dumont-VE 1740, Along road, 12 - 17 km. S. & E. of Sanare, Parq. Nac. Yacambu, Edo. Lara, Coll.: K. P. Dumont, J. H. Haines, G. J. Samuels and Juan Leal, 9 Jul 71 (as *Patinellaria cubensis*) (NY); Dumont-VE 2587, On *Xylaria* sp. Ca. 63 km. W. of Merida, Univ.

Los Andes Forest Reserve, La Carbonera, Edo. Merida. Coll.: K. P. Dumont, J. H. Haines, G. J. Samuels, S. Silverborg and L. Borjas, 20 Jul 71 (as *Patinellaria cubensis*) (NY); Samuels 6867, on *Xylaria* sp., La Mucuy, trail from Inparques house to Laguna La Coromoto, Edo. Mérida, Coll.: G. J. Samuels, B. Hein, S. Hundhoff, T. Iturriaga, Nov. 1990; Dumont-VE 1815, On *Xylaria* sp., on unidentified wood, 2-4 km. above Jobito, near San Felipe, Parq. Yurubi, Edo Yaracuy, Coll.: K. P. Dumont, J. H. Haines, G. H. Samuels and Juan Leal, 10 Jul 71 (as *Patinellaria cubensis*) (NY); Dumont-VE 1849, On *Xylaria* sp., on unidentified wood, 2-4 km. above Jobito, near San Felipe, Parq. Yurubi, Edo Yaracuy, Coll.: K. P. Dumont, J. H. Haines, G. J. Samuels and Juan Leal, 10 Jul 71 (as *Patinellaria cubensis*) (NY); specimen 2394 AD [with no label] Dumont-VE 1740, Along road, 12 - 17 km. S. & E. of Sanare, Parq. Nac. Yacambu, Edo. Lara, Coll.: K. P. Dumont, J. H. Haines, G. J. Samuels and Juan Leal, 9 Jul 71 (as *Patinellaria cubensis*) [this has two packets inside, both marked 2394 outside: one with a large collection of this fungus on its host, and another small packet of the same thing, which is probably the AD (air dried) portion, discs seated in whitish anamorph forming a "mycelial" pad on the host which is probably *Kretschmaria*] (NY); specimen 2429 AD [with no label (as *Patinellaria cubensis*)] (NY).

Figures: Dennis 1954 p. 316; this paper, Figs. 1, 2.

Notes: Ascus measurements are smaller than the ones reported by Dennis (1954), 70 - 90 × 5 - 6 µm, I report some ectal excipular cells of larger diameter than reported by Dennis, "surface cells clavate, 6-8µ diam." Apart from the collection which Dennis cites from Venezuela, No. 255 in Herb. Berkeley (Typus of *C. xylariicola*), apparently these are the only other reports of this fungus from Venezuela. As far as I know it has also never been reported for Guyana or French Guiana.

Encoelia fuscobrunnea (Pat. & Gaillard) W. Y. Zhuang, *Mycotaxon* **31:** 275. 1988. (Figs. 3, 4)

= *Helotium fuscobrunneum* Pat. & Gaillard, *Bull. Soc. Mycol. France* **4:** 101, pl. 18, fig. 8, 1888.
= *Rutstroemia fuscobrunnea* (Pat. & Gaillard) Le Gal, *Discom. Madag.* p. 325, fig. 147. 1953.

= *Ionomidotis fuscobrunnea* (Pat. & Gaillard) Dennis, *Kew Bull.*, Addit. Ser. **3:** 345. 1970.

Apothecia deep cupulate, 1.5 - 2.0 mm tall, stipitate, stipe 1 - 1.5 mm long, disc 1 mm diam, receptacle, disc and stipe black, smooth. Apothecial structure distinctly encoelioid, with strong ionomidotic reaction. Ectal excipulum at margin and flanks textura globulosa, cells strongly pigmented, brown, with thick walls. (4.7-) 6.2 - 7.8 (-10.1) × (3.9-) 3.4 - 6.2 (-7.8) µm, with loose spherical cells. Medullary excipulum textura intricata, (2.3-) 3.1 × 3.9 (-4.7) µm wide, hyphae brown, walls with markings, with many resinous globs, very granular cytoplasm, brown pigmentation also between hyphae. Subhymenium textura intricata. Asci cylindric to clavate, small, (35.1-) 39.0 - 44.5 (-46.8) × (1.6-) 3.9 - 4.7 µm, hyaline, 8-spored, J+ ascus pore with KOH pretreatment. Ascospores ellipsoidal, uniseriate or irregularly biseriate, regularly biguttulate but from 0- to 2-guttulate at maturity, (3.9-) 4.7 - 6.2 (-7.0) × (-1.5) 2.3 µm. Paraphyses filiform, hyaline, 1.6 (–2.3) µm wide at the middle, slightly enlarged at the apex, width 2.3 - 3.1 (-3.9) µm. Stipe textura globulosa at cortex, with spherical, strongly pigmented cells 5.5 - 9.4 × 4.7 - 8.6 µm, forming distinctly tapering pustules; stipe medulla textura intricata, hyphae brown, 0.78 µm diam, brown pigmentation also between hyphae.

Substrate: unknown, since the collection "6484 AD" consisted of five loose stipitate dark-coloured apothecia with no substrate attached, and clearly not associated with the data on 6484. The holotype was collected by Gaillard on a branch: "Epars ou groupé sur écorce d'arbre, entre les petites Mousses. De Maipures à San-Fernando. Août. (No 240)" (Patouillard & Gaillard, 1888). The holotype at FH was examined by Zhuang (1988).

Specimen examined: 6484 AD (NY). Data uncertain, since this collection was supposed to be the air dried part of collection 6484 NY, and was inside the same packet. The part of the collection corresponding to 6484 matches the data on the label: "Guyana: On decaying leaf of *Clusia* sp. (Boom 9064), Mt. Wokomung: Summit. 05 05'N, 59 50'W Elev. 1650 m. 6 Jul 1989. Disc 1.2 - 1 mm diam, white, sessile. Coll.: G. J. Samuels, B. M. Boom, G. Bacchus 6484. BRG, NY." I have identified this fungus to be a species of *Mollisia*. The small packet enclosed in 6484 has 5 stipitate discs, with no substrate attached to them, and is clearly

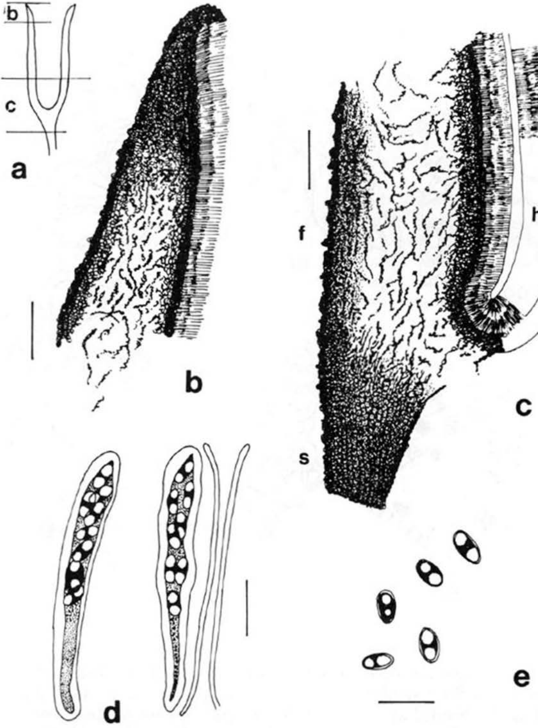

Figure 3. *Encoelia fuscobrunnea* (NY 6484 AD). **a**. Diagrammatic representation of apothecium divided into section b (extremes) and section c (basal part). **b**. Apothecial median longitudinal section of extreme part of flanks and margin (bar 100 µm). **c**. Apothecial median longitudinal section of basal part – f: flanks, s: stipe, h: hymenium (bar 100 µm). **d**. Mature asci with ascospores and paraphyses (bar 10 µm). **e**. Biguttulate ascospores (bar 10 µm).

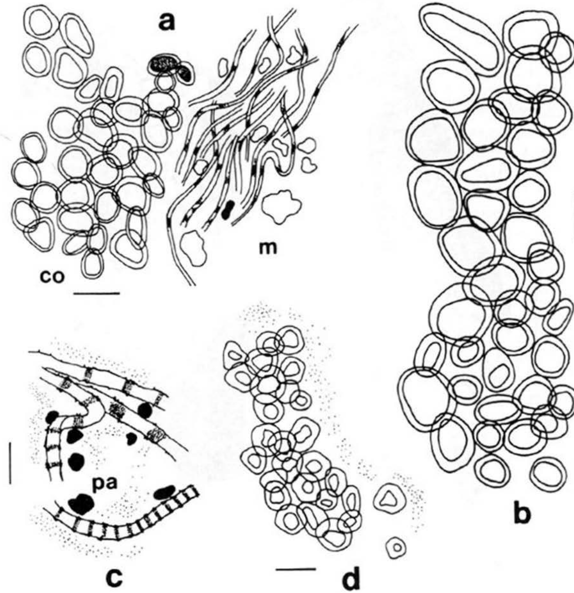

Figure 4. *Encoelia fuscobrunnea* (NY 6484 AD). **a**. Stipe central tissue in median section – m: medullary tissue, co: cortical tissue next to the medullae (bar 10 µm). **b**. Stipe outer surface cortical tissue in median longitudinal section (bar 10 µm). **c**. Medullary excipular tissue in median longitudinal section of apothecium, showing hyphae with marked walls and pigmented areas (pa) (bar 10 µm). **d**. Ectal excipulum tissue in median longitudinal section of apothecium at the flanks (bar 10 µm).

not associated with the data in 6484. I will assume that the locality, collectors and collecting date are the same for both specimens (see Notes, below).

Figures: Patouillard & Gaillard 1888, *Bull. Soc. Mycol. France* **4:** pl. 18, fig. 8 (as *Helotium fuscobrunneum*); Le Gal, 1953, *Discom. Madag.*, fig. 147 (as *Rutstroemia fuscobrunnea*); Zhuang, 1988, *Mycotaxon* **31:** 261-298, fig. 23; this paper Figs. 3, 4.

Notes: I have written to Dr. Gary J. Samuels in regard to specimen 6484 AD, and he has told me to separate it as a different collection, and this is what I have done. Ascus width is narrower than that reported by Patouillard & Gaillard (1889), 6 µm. Saccardo's (1889) description is only a translation of Patouillard and Gaillard's. Ascospore length is a little shorter than reported by Dennis (1970), 5-8 µm. The color of this species has been reported by Patouillard and Gaillard (1888) as "roux-brun brillant" (brilliant brownish-red), and by Dennis (1970) as having a vinaceous hymenium and a bright yellow-brown receptacle.

Encoelia helvola (Jungh.) Overeem, *in* Overeem & Weese, *Icones Fungorum Malayensium* **13:** 1. 1926. (Figs. 5, 6)

= *Peziza helvola* Jungh., *Praem. fl. crypt. Java* p. 30. 1838.
= *Cenangium helvolum* (Jungh.) Sacc., *Syll. Fung.* **8:** 570. 1889.
= *Helotium helvolum* (Jungh.) Pat., *Ann. Jard. Bot. Buitenzorg*, Suppl. **1:** 120. 1897.
= *Geopyxis bambusicola* Henn., *Hedwigia* **41:** 31. 1902.

Apothecia discoid when dry to cupulate when rehydrated, 0.5 - 1.0 cm tall, receptacle and stipe ochraceous yellow when dry, yellow when rehydrated, both strongly pustulate, disc brownish orange when dry, bright orange when rehydrated, 1.0 - 1.5 cm diam, margin involute when dry, straight when rehydrated, stipe pulverulent and longitudinally striate, exuding a yellow pigment in 10% KOH. Ectal excipulum textura globulosa-angularis, cells ochraceous brown in water, with thick walls, 4.7 - 9.4 × 3.1 - 7.8 (-9.4) µm, pustules present, formed by groups of thick-walled, ochraceous brown textura globulosa cells 7.0 - 12.5 × 5.5 - 10.9 (-11.7) µm, immersed in a gel. Medullary excipulum

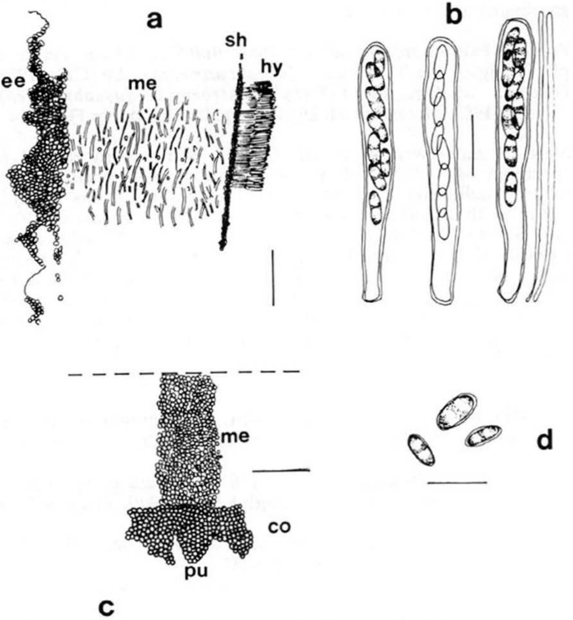

Figure 5. *Encoelia helvola* (VEN 2133). **a**. Apothecial median longitudinal section showing – ee: ectal excipulum, me: medullary excipulum, sh: subhymenium, hy: hymenium (bar 100 µm). **b**. Mature asci with ascospores and paraphyses (bar 10 µm). **c**. Stipe tissue in median section – co: cortex showing pustules (pu), me: medullae (bar 100 µm). **d**. Ascospores (bar 10 µm).

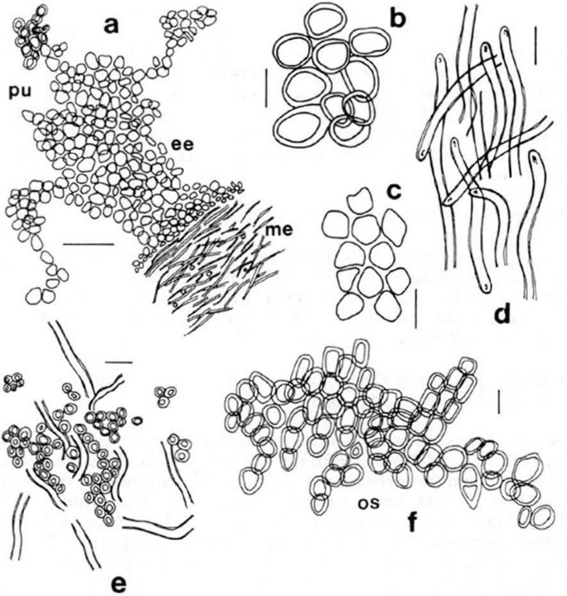

Figure 6. *Encoelia helvola* (VEN 2133). **a**. Detail of ectal excipulum tissue in median longitudinal section of apothecium at the flanks – ee: ectal excipulum, pu: pustule, me: medullary excipulum (bar 30 µm). **b**. Detail of ectal excipulum tissue at pustule in median longitudinal section of apothecium at the flanks, composed of thick-walled cells. (bar 10 µm). **c**. Detail of ectal excipulum tissue in median longitudinal section of apothecium at the flanks, composed of cells without a thick wall (bar 10 µm). **d**. Detail of medullary excipular tissue in median longitudinal section of apothecium (bar 10 µm). *Encoelia heteromera* (NY 5393). **e**. Medullary excipular tissue in median longitudinal section of apothecium (bar 10 µm). **f**. Ectal excipulum tissue in median longitudinal section of apothecium at the flanks – os: outer surface (bar 10 µm).

cells (6.2-) 7.0 -7.8 (-11.7) × 5.5 - 7.0 (-9.4) µm, pustules present, composed of groups of textura globulosa cells with thick walls immersed in a gel; medulla textura intricata-oblita, hyphae 1.6 - 2.3 (-3.1) µm wide. Asci cylindric-clavate, (40.6-) 42.1 - 43.6 × 3.1 - 3.9 µm, 8-spored, J– ascus pore with or without KOH pretreatment. Paraphyses filiform, 0.8 µm wide in the middle, not enlarged at the apex, hyaline. Ascospores subfusoid, (6.2-) 7.0 (–7.8) × 2.3 µm, unordered inside the asci, biguttulate, smooth, hyaline.

Substrate: On nodes of living culms of bamboo.

Specimen examined: Venezuela: On bamboo, living culms forming at nodes, Territorio Federal Amazonas, Neblina Base Camp on Río Baría (=Río Mawarinuma), left bank, downstream from camp, alt. 140 meters, 001 49' 50N, 66 09' 40W, 1985 Feb 17, Coll.: Amy Rossman 2133 (VEN) (BPI).

Figures: Junghuhn (1838), Tab. V, fig. 17; van Overeem (1926), Taf. XIII; this paper, Figs. 5, 6.

Notes: Ascus measurements are smaller than the ones reported by Zhuang and Korf (1989), 60 - 65 × 5 - 6 µm. This species has always been reported as a parasite at internodes on living bamboo. It has been reported from Java (Junghuhn, 1838; Patouillard, 1897; Overeem, 1926), from China (Zhuang & Korf, 1989), and from Brasil (Hennings, 1902; Viégas, 1961; both as *Geopyxis bambusicola,* a name under which it would scarcely be sought). This is apparently the first report of this species from Venezuela.

Encoelia heteromera (Mont.) Nannf., *Trans. Brit. mycol. Soc.* **23:** 239. 1939. (Fig. 7)

= *Peziza heteromera* Mont., *Ann. Sci. Nat.* Ser. 2, **13:** 206. 1840.
= *Midotis heteromera* (Mont.) Fr., *Summa Veg. Scand.*, sect post. 362. 1849.
= *Midotis verruculosa* Berk. & Curt., *J. Linn. Soc. Bot.* **10:** 370. 1868.
= *Cenangium leoninum* Cooke & Massee, *Grevillea* **21:** 72. 1893.

= *Dermatea aureo-tincta* Rehm, *Hedwigia* **39:** 84. 1900.
= *Dermatea pulchra* Starbäck, Arkiv för Bot. **2**(5): 6. 1904.

Apothecia stipitate, deep cupulate to turbinate, 0.8 - 2 cm tall, disc 1 - 2 cm diam, symmetric, spathulate or ear-shaped, when dry receptacle ochraceous brown, pulverulent, and disc dark-brown, when rehydrated receptacle, stipe and disc ochraceous, disc gelatinous, when fresh ectal dull orange to orange-yellow or rust-colored, and disc dull orange to reddish-brown. Stipe 1 cm × 1.5 mm, exuding a yellowish pigment in 10% KOH. Ectal excipulum textura globulosa to prismatica immersed in a gel, 8.8 -14.3 × 6.6 - 11.0 µm, ochraceous-yellow under water. Medullary excipulum textura intricata, hyphae 2.2 - 5.5 µm wide, immersed in a gel, light yellow in water. Subhymenium well-differentiated from the medullary excipulum, textura intricata immersed in a gel, light yellow in water. Stipe textura globulosa, immersed in a gel, ochraceous-yellow in water. Asci cylindric-clavate, 63.8 - 96.8 × 4.4 - 5.5 µm, hyaline, 8-spored, J– ascus pore with or without KOH pretreatment, arising from crosiers. Paraphyses filiform, 1.1 - 3.3 µm wide, simple, septate, hyaline, same height as asci. Ascospores ellipsoidal, 8.8 - 11 × 2.7 - 4.4 µm, hyaline, biguttulate, smooth, uniseriate.

Substrate: On logs and on recently dead tree.

Specimens examined: GUYANA: On log, Cuyuni-Mazaruni Region, VII: Mazaruni Subregion, VII-2: Foothills immediately S of Mt. Ayanganna, ca. 1 km W of Pong R., 05 28'N, 60 04'W, 550-650 m, 26 Feb 1987, Coll.: G. J. Samuels, J. Pipoli, G. Gharbarran, J. Chin R. Edwards 4833 (NY) (BPI); On log, Cuyuni-Mazaruni Region, VII; Mazaruni Subregion, VII-2: Along Koatse River, ca. 2 Km E of Pong River, ca. 5 hr. walk W of Chinoweing Village. 05 28'N, 60 04'W, 600-650 m, Feb-Mar 1987. Coll.: G. J. Samuels, J. Pipoly, G. Gharbarran, J. Chin, R. Edwards 4935 (NY); On recently dead tree, East Berbice-Corentyne Region, VI; Subregion, VI-5: Canje River, 1 km N of Ekwarun Creek, 05 20'N, 57 38'W, 0-25 m, 9 Apr 1987, Coll.: G. J. Samuels, J. Pipoli, G. Gharbarran, G. Bacchus 5393 (NY). VENEZUELA: Estación Biológica Rancho Grande, camino de Interpretación de la Naturaleza "Andy Fields," Parque Nacional Henri Pittier, sobre tronco, Junio 1991, Coll.: T. Iturriaga 2035.

Figures: Dennis (1954) Fig. 42, this paper Fig. 7.

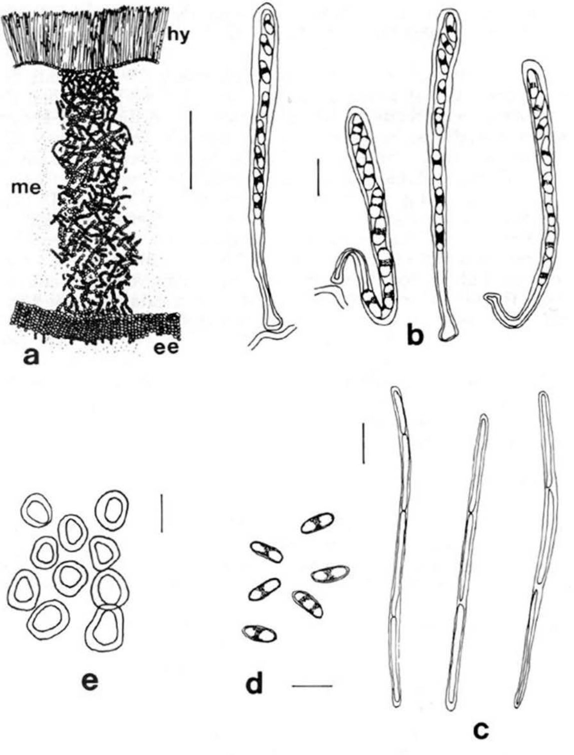

Figure 7. *Encoelia heteromera* (NY 5393). **a**. Apothecial median longitudinal section, showing – ee: ectal excipulum, me: medullary excipulum, hy: hymenium (bar 50 µm). **b**. Mature asci with ascospores (bar 10 µm). **c**. Paraphyses (bar 10 µm). **d**. Ascospores (bar 10 µm). **e**. Stipe cells (bar 10 µm).

Notes: Ascus measurements are somewhat smaller than Figure reported by Dennis (1954), 110 - 115 × 8 µm. Apparently this is the first time this species is reported for Guyana and Venezuela. Dennis (1970) states "not yet reported within our area ..." (Venezuela) "... but common in adjacent parts of South America." In Dennis (1954) collections from Cuba and Brasil are cited.

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The author wishes to thank very specially the advise and numerous valuable suggestions given by Prof. Richard P. Korf. Thanks are also given to him and to Dr. Pavel Lizoň for giving very careful and thoughtful comments when acting as presubmission reviewers. The author also wishes to thank curators of the following herbaria: NY, BPI, VEN for their loan of specimens that made this study possible, as well as to Dr. Gary J. Samuels for providing his collections and drawing my attention to *E. cubensis*. Aniuska Kazandjian's skillful annotations and pencil drawings with the help of the wild tube, as well as Eduardo Perez's help in inking them, are deeply acknowledged. Financial assistance to spend summer 1992 as a postdoctoral fellow at Cornell University to study this fungi was given by the Anna E. Jenkins bequest, and by Fundacion Gran Mariscal de Ayacucho through the Direccion de Desarrollo Profesoral, Universidad Simón Bolívar.

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MYCOTAXON

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DEVELOPMENT OF A COMPUTERIZED, SYNOPTIC KEY FOR POLYPOROID, WOOD-ROTTING FUNGI OF NORTH AMERICA

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SUMMARY

PolyKey is described as a computerized-synoptic key that provides a fast, accurate, and effective method to identify and view characters of polyporoid, wood-rotting fungi in North America. Based on information published from previous taxonomic studies, databases were developed using a spreadsheet program (Microsoft Excel 4.0) to generate tabular arrays of taxa and characters. Sort functions of the spreadsheet program provided an effective method for re-organizing taxa and screening characters potentially useful in the identification of unknown taxa. To access databases, flowcharts were developed as logical summaries of the following functions: 1) Education - Character displays of user-selected taxa; 2) Quiz - Tutorial guide to correct characters of known taxa; 3) Identification - User-selection of characters of an unidentified taxon and computer display of possible known taxa; 4) Synonymy - Computer generated lists of synonyms for user-selected taxa; 5) Definitions and Help - Computer display of terminology and explanations; and 6) Print - Character outputs for any genus or species. Programs and menu displays were designed and written in FoxPro 2.0 and Foxbase+/Mac 2.01 for use on an IBM-compatible and Apple Macintosh computer, respectively. The key provides access to 100 genera, 415 species, and 1115 synonyms contained in genus, species, and synonymy databases. On-screen menus contain lists of characters, taxa, definitions, and help functions. Selection of any function or display is done using a mouse with no keyboard entry required. Applications of computerized synoptic keys in teaching and research are discussed.

Analytical and synoptical keys represent the two, logical and structural, arrangements of characters utilized in the identification of biological specimens (Leenhouts 1966). Analytical or dichotomous keys are arranged as a sequential series of contrasting statements of one character (monothetic) or a set of characters (polythetic) (Sneath and Sokal 1972). A problem with these types keys is the inability of the user to answer a contrasting statement. This results in termination of the identification process or requires some assumption for the user to continue. Incompletely known taxa may also present difficulties in writing dichotomous keys. These taxa are often excluded or only a selected number of their characters is used (Leenhouts 1966). The latter usually results in incomplete descriptions and poor character selection during key construction. Additionally, distinctive or exclusive characters are often not used to their potential in a key using characters in a linear sequence without some redundancies. Trappe (1982) also recognized difficulties in modification of dichotomous keys and the common need for complete revision of such keys as new data, characters, or taxa are discovered.

Synoptical keys provide a simultaneous comparison of an unidentified specimen with all of the known taxa for a given character or set of characters. Furthermore, all taxa possessing a common character or all characters possessed by a single taxon can be identified concurrently. Basic types of synoptic keys include tabular and character-outlined. Tabular keys list taxa by rows and characters by column. Presence or absence of character states for taxa are indicated symbolically (+/-) or numerically (0/1). The result is a tabular data matrix. In character-outlined keys, taxa are listed after each character or character states (Korf 1972). Any character, in any order, can be selected to initiate taxon identification. By a process of elimination, an unknown taxon is identified by repeated comparisons to the taxa listed after each character. Advantages of synoptic keys include unbiased character selection in construction of the key, more complete description of taxa by utilization of numerous characters, ease of construction and modification, and the ability to use and describe incomplete specimens for identification (Leenhouts, 1966). Major disadvantages in the manual use of synoptic keys include difficulties in assembling long lists of taxa and the number of taxa that can be effectively identified. Korf (1972) indicated that a maximum number of taxa included in manual-use synoptic keys is 30, whereas Kendrick (1990) found 50 to be a limiting number of taxa.

The use of computerized keys allows for mathematical calculations to be performed rapidly on large data sets to arrive at an objective and repeatable result. As indicated by Kendrick (1990), however, computerized keys for identification of biological organisms have not been widely developed. A few programs such as SYNKEY (Mycologue Publications, Ontario, Canada) and PC-TAXON (COMPress, Div. of Wadsworth, Inc., Wentworth, NH) have been developed for Apple II+ and IBM-compatible computers and have been used effectively for developing computerized synoptic keys. Disadvantages of computerized synoptic keys previously written, however, include single-field, keyboard entry of data and single-field entry for retrieval of character information. Furthermore, for these keys to work well, character states must be entered for all characters and for all taxa. Another computer program, askSam (askSam Systems, Perry, FL), is a database program that can be used to develop a synoptic key. In this method, data can be entered in a free-form manner and records can be recalled by entering keywords or combinations of keywords using Boolean logic (e.g. and/or). Disadvantages of this system include keyboard entry of coded characters used in database development and for recalling taxa during identification. For example, spore print white could be coded SPWHITE, stipe white could be STWHITE, and so on. Thus, the more characters, the more code words required. This program functions well but was not developed specifically for a computerized synoptic key and thus, requires users to generate databases and codes for entering and recalling information.

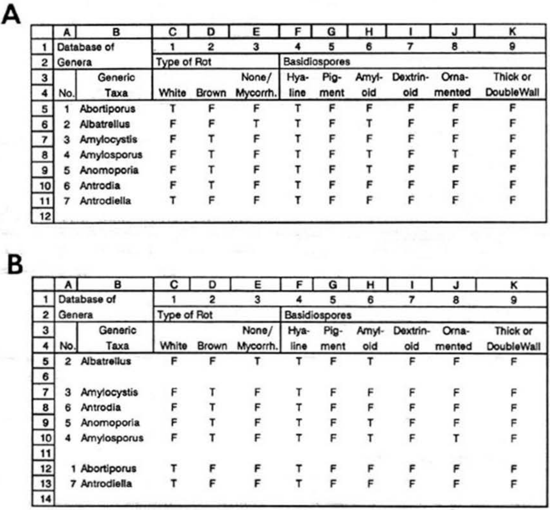
The objective of this study was to develop a computerized synoptic key to the polyporoid fungi of North America without the previous disadvantages of synoptic or computerized-synoptic keys. Critical to its development, the program would allow for an almost instantaneous identification of an unlimited number of taxa that could not be accomplished with a manually operated synoptic key. To accomplish the foregoing, methods were developed for generating a series of relational databases containing taxa and characters and logical schemes were outlined to access, retrieve, and display information about taxa for educational, tutorial, and identification purposes of the key.

MATERIALS AND METHODS

Database information. Character information for polyporoid wood-rotting fungi used in the development of databases for the key was based mostly on Gilbertson and Ryvarden (1986, 1987) and Overholts (1953). Other sources of information used for new taxa or to clarify character descriptions of taxa included Breitenbach and Kranzlin (1986), Phillips (1991), and Ryvarden (1976, 1978). The taxonomy and classification system used in this key follows Gilbertson and Ryvarden (1986, 1987).

Spreadsheet program and generation of database files. Microsoft Excel version 4.0 (Microsoft Corporation, Seattle, WA) was used for assembling arrays of taxa and characters used for databases in the key. Text, data, and mathematical or logical functions were entered into worksheets of spreadsheet programs. Information was stored in cells identified as the intersection of a row and column, e.g. A1 refers to the first row of column A. Equations were entered into cells to calculate a mathematical function for two other cells. For example, the equation A1/B1 placed in column C1 will divide the numerical value in A1 by the value in B1 and place the results in C1. Character headings were placed along the top row of cells, while names of taxa were placed in cells of the first column (Fig. 1). Data were rearranged by copying and moving cells, blocks, columns, or rows, whereas new characters or taxa were added by insertion under appropriate categories. Sorting of taxa and their characteristics was done with a sort function. This allowed for rearrangement of the data set in ascending or descending order based on alphabetical or numerical values of any one or several characters selected (Fig. 1 A, B). This procedure can be repeated for the entire data set of taxa and their characteristics or for a specific subset. This spreadsheet program is available for either a Macintosh with 2 MB random access memory (RAM) or IBM-compatible computer with a 386 microprocessor, 1 MB of RAM, DOS 3.0 or greater, and Windows Version 3.0 or greater (Microsoft Corporation).

Database programs. Foxbase+/Mac Version 2.0 for Macintosh computers or FoxPro Version 2.0 for IBM-compatible computers were used for developing programs to access databases. Flowcharts were developed and routines written using Foxbase+/Mac and FoxPro commands to execute desired functions. Multiple routines were assembled and compiled into an operational program. Programs were written to access genus, species, synonymy, definition and help databases. Programs include educational displays of taxa and their characteristics, quiz routines for testing the user's knowledge of generic characteristics, identification of generic and specific taxa using elimination and similarity methods, and synonymy displays of current and previous genera and species. Additional programs were written for help and definition databases, printer outputs, and color display of screens for computers with color monitors.



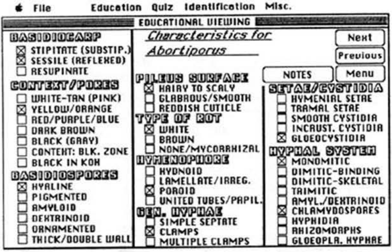
A

	A	B	C	D	E	F	G	H	I	J	K
1	Database of		1	2	3	4	5	6	7	8	9
2	Genera		Type of Rot			Basidiospores					
3		Generic			None/	Hya-	Pig-	Amyl-	Dextrin-	Orna-	Thick or
4	No.	Taxa	White	Brown	Mycorrh.	line	ment	oid	oid	mented	DoubleWall
5	1	Abortiporus	T	F	F	T	F	F	F	F	F
6	2	Albatrellus	F	F	T	T	F	T	F	F	F
7	3	Amylocystis	F	T	F	T	F	F	F	F	F
8	4	Amylosporus	F	T	F	T	F	T	F	T	F
9	5	Anomoporia	F	T	F	T	F	T	F	F	F
10	6	Antrodia	F	T	F	T	F	F	F	F	F
11	7	Antrodiella	T	F	F	T	F	F	F	F	F
12											

B

	A	B	C	D	E	F	G	H	I	J	K
1	Database of		1	2	3	4	5	6	7	8	9
2	Genera		Type of Rot			Basidiospores					
3		Generic			None/	Hya-	Pig-	Amyl-	Dextrin-	Orna-	Thick or
4	No.	Taxa	White	Brown	Mycorrh.	line	ment	oid	oid	mented	DoubleWall
5	2	Albatrellus	F	F	T	T	F	T	F	F	F
6											
7	3	Amylocystis	F	T	F	T	F	F	F	F	F
8	6	Antrodia	F	T	F	T	F	F	F	F	F
9	5	Anomoporia	F	T	F	T	F	T	F	F	F
10	4	Amylosporus	F	T	F	T	F	T	F	T	F
11											
12	1	Abortiporus	T	F	F	T	F	F	F	F	F
13	7	Antrodiella	T	F	F	T	F	F	F	F	F
14											

Figure 1. Spreadsheet design used for generating databases. A. Genera are listed in Column-B and characters are displayed in Rows 2-4. Character states are listed as true (T) or false (F) under each character for each taxon. B. Same data array as in A, but sorted by type of rot. Additional sorts can be made to further separate taxa (three groups were formed by sorting and are separated by spaces).



Characteristics for Abortiporus

BASIDIOCARP
☒ STIPITATE (SUBSTIP.)
☒ SESSILE (REFLEXED)
☐ RESUPINATE

CONTEXT/PORES
☐ WHITE-TAN (PINK)
☒ YELLOW/ORANGE
☐ RED/PURPLE/BLUE
☐ DARK BROWN
☐ BLACK (GRAY)
☐ CONTENT: BLK. ZONE
☐ BLACK IN KOH

BASIDIOSPORES
☒ HYALINE
☐ PIGMENTED
☐ AMYLOID
☐ DEXTRINOID
☐ ORNAMENTED
☐ THICK/DOUBLE WALL

PILEUS SURFACE
☒ HAIRY TO SCALY
☐ GLABROUS/SMOOTH
☐ REDDISH CUTICLE

TYPE OF ROT
☒ WHITE
☐ BROWN
☐ NONE/MYCORRHIZAL

HYMENOPHORE
☐ HYDNOID
☐ LAMELLATE/IRREG.
☒ POROID
☐ UNITED TUBES/PAPIL.

GEN. HYPHAE
☐ SIMPLE SEPTATE
☒ CLAMPS
☐ MULTIPLE CLAMPS

SETAE/CYSTIDIA
☐ HYMENIAL SETAE
☐ TRAMAL SETAE
☐ SMOOTH CYSTIDIA
☐ INCRUST. CYSTIDIA
☒ GLOEOCYSTIDIA

HYPHAL SYSTEM
☒ MONOMITIC
☐ DIMITIC-BINDING
☐ DIMITIC-SKELETAL
☐ TRIMITIC
☐ AMYL./DEXTRINOID
☒ CHLAMYDOSPORES
☐ HYPHIDIA
☐ RHIZOMORPHS
☐ GLOEOPLA. HYPHAE

Figure 2. Genus education menu showing main menu (top bar), characters listed in a "checkbox format" and option buttons (upper right).

In developing identification programs for the key, two methods were employed: elimination and similarity. In the elimination method, taxa not possessing user-selected characters are eliminated until only one or a few taxa are left with the combination of characters selected. In the similarity method, a coefficient of similarity is generated based on simple matching (Sneath and Sokal 1973) of selected and non-selected characters for all the characters displayed on the identification screen. A simple matching coefficient (SMC) is calculated based on the possible matching combinations for a given character in a specific character set and is defined as:

$$\mathbf{SMC = a+d/a+b+c+d}$$

where a = characters shared by known and unidentified taxon; b = characters present in known taxa but absent in unidentified taxon; c = characters present in unidentified taxon but absent in known taxa; and d = characters not shared by known taxa or unidentified taxon.

Calculation speed of similarity coefficients was determined on IBM compatible (486-33 MHz or 286-16 MHz) and Macintosh (Macintosh II or Macintosh Plus) computers. The largest database of taxa and characters was used to compare an unidentified taxon to known taxa.

RESULTS

Spreadsheet-generated tabular arrays. For the polyporoid, wood-rotting genera of North America, 100 taxa and 43 characters were used (Figs. 1, 2), whereas the number of characters used for species within a genus ranged from 59 in the genus *Phellinus* (48 species) to 8 in the genus *Stigmatolemma* (1 species). Data, in alphabetically-sorted tabular arrays, were saved as text files and imported into Foxbase+/Mac and FoxPro programs.

Program operations and displays. Using a Macintosh computer, operation of the program is mouse-dependent; whereas on an IBM-compatible computer, the program operates by mouse or keyboard function. Options and functions of the program are selected graphically on-screen with pointer movement controlled by the computer's mouse. Lists of taxa, definitions, help subjects, and color options are displayed on pop-up menus and are selected by operation of the mouse. Characters of taxa are also displayed on menus in a check-box format (Fig. 2). The presence of a character for a selected taxon is indicated by an 'X' in the check-box adjacent to the character. To exit any routine, the option 'Menu' is used to return the user to the main menu.

Program functions. To access databases, the following functions were developed: 1) *Education* - Character displays of user-selected taxa; 2) *Quiz* - Tutorial guide to correct characters of known taxa; 3) *Identification* - User-selection of characters of unidentified taxon and computer display of possible known taxa; 4) *Synonymy* - Computer generated lists of synonyms for user-selected taxa; 5) *Definitions, Help,* and *Print* - Computer display of terminology and explanations of program function; whereas, the print function provides character outputs for genera and species. The following outline provides explanations of the main functions of the program:

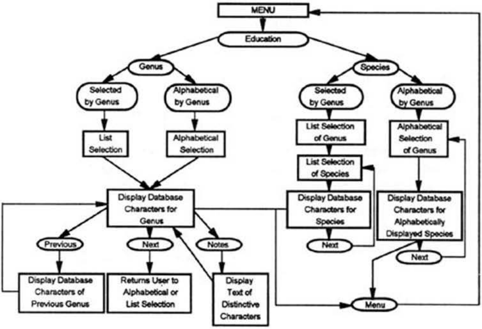


Figure 3. Flow chart of education function. Oblong symbols indicate user choices of functions; rectangular symbols indicate displays of taxa or characters in menu format.

1) *Education function.* A flowchart is shown in Fig. 3 describing the operation, commands, and displays of this routine. Characters of either a genus or species are displayed. Taxa are selected alphabetically or specifically by the user from displayed lists. The 'Notes' option provides distinctive characters and comparative information for generic taxa. Additional taxa can be displayed by selecting the option 'Next'; whereas the previous genus viewed can be recalled with the option 'Previous'.

2) *Quiz function.* This routine provides the user a tutorial guide that tests the user's knowledge of characters of polyporoid genera (Fig. 4). Taxa are selected alphabetically, randomly, or specifically by the user from a displayed list. After the genus is displayed, the user selects characters that apply to the genus. Character selections can be checked with the characters in the databases by selecting the 'Check' option. Correct characters for the selected genus will be indicated by an 'X' adjacent to the corresponding checkbox. In 'Random' or 'Alphabetical' selection, the 'Next' option provides the user with another genus, whereas in 'Specific Genus' the user selects a genus from a list.

3) *Identification function.* This routine is designed to allow the user to identify a polyporoid fungus to genus or species based on any set of characters (Fig. 5). A genus or species can be identified by elimination or similarity. In elimination, as characters are selected taxa lacking the these characters are eliminated and the remaining count of possible taxa is displayed. Deselecting a character results in the previous taxa count. In this mode, selection of characters is similar to the use of 'and', whereas not selecting a character is similar to the use of 'or' contained in keys that use Boolean logic. Calculations are almost instantaneous on most personal computers currently available. A scrollable list of taxa having the user-selected characters is displayed when the option 'Show' is used. Characteristics of any taxon displayed in the scrollable list are given by selecting a genus with the mouse. Correct characters for a selected genus are as described in the previous section; whereas correct characters of a species are displayed on a separate menu. Additionally, in the genus elimination mode, notes can be viewed for any selected genus by selecting the 'Notes' push button or species identification can be continued in the elimination mode by selecting the 'Species-ID' option. All user-selected entries can be cleared with the 'Clear' option, thus, resetting the routine for the identification process.

   In the similarity mode, identification is based on a set of selected characters and a calculated coefficient of similarity (Fig. 5). Using the 'Find' option, a similarity coefficient is calculated for the unidentified taxon compared to known taxa based on a user-selected set of characters. A list of genera and their corresponding coefficients are displayed in descending order. In generating a similarity coefficient based on simple matching, non-selected characters are as important as selected characters. Coefficient values less than 0.90 indicate unlikely matches of low confidence, while coefficients between 0.95 and 1.00 indicate matches of high confidence. As described above, characters of any taxa are displayed by selecting on a taxon in the scrollable list. Additional taxa can

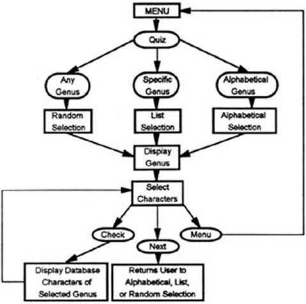


Figure 4. Flow chart of quiz function. Oblong symbols indicate user choices of functions; rectangular symbols indicate displays of taxa or characters in menu format.

be identified by selecting new characters and repeating the 'Find' option. In the genus by similarity routine, species identification by similarity can be continued with the 'Species-ID' option.

Speed of calculating similarity coefficients is dependent on a number of factors including type of computer and number of calculations. The database of polyporoid genera is the largest database accessed for an identification by similarity. It contains 100 generea and 43 characters for a total of 4300 true/false entries. Using an IBM-compatible 486-33 MHz computer, calculation similarity coefficients for all 100 generea to an unidentified taxon was clocked at 15 sec; whereas, a 286-16 MHz computer without a math coprocesser, calculations were approximately 1 min. Similar results were obtained on a Macintosh II and Macintosh Plus models, respectively.

4) *Synonymy function.* This function accesses a synonymy database either by names currently in use or by names previously used (Fig. 6). In 'Current Names', synonyms (genus and species) can be displayed for current names of a taxon. A genus is selected from the scrollable menu and species are displayed for the selected genus. After selecting a species, synonyms are displayed on screen. The 'Next' option returns the user to the menu displaying a list of genera. In the 'Previous Names' option, genera can be selected resulting in displays of previous

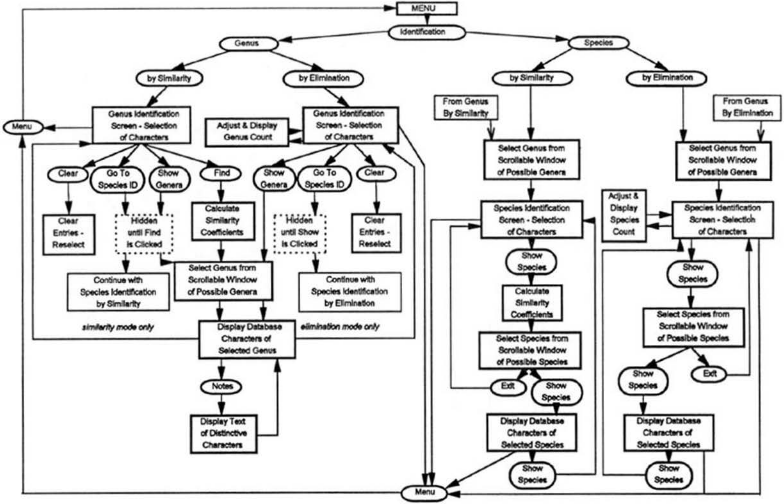


Figure 5. Flow chart of identification. Oblong symbols indicate user choices of functions; rectangular symbols indicate displays of taxa or characters in menu format.

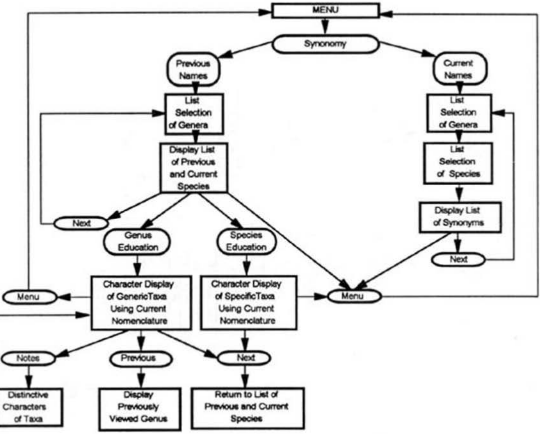


Figure 6. Flow chart of synonymy function. Oblong symbols indicate user choices of functions; rectangular symbols indicate displays of taxa or characters in menu format.

and current listings of genera and species. A genus is selected as above and an abbreviated list of species for the selected genus is displayed. For any taxon selected, the characters for a genus or species (using current nomenclature) may be displayed by using the 'Genus Education' or 'Species Education' option, respectively. The 'Next' option displays the list of previous nomenclature for the taxon selected earlier.

5) *Definitions, Help, Print, and Set Colors Functions.* Other functions of the program, provide rapid access to basic information about the fungi treated in the databases and in the operation of the program. At any time in the operation of the program, definition and help functions can be accessed. For example, by selecting 'Definitions', an alphabetical list of mycological terms used to describe the fungi in the key is displayed (Fig. 7). Selection of a word results in a displayed definition. Previous or additional words can be selected with 'Previous'and 'Next' options. The 'Topics' option displays a list of entries in the definitions database.

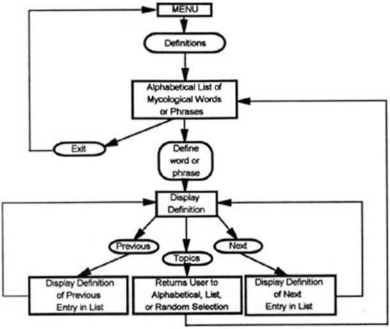


Figure 7. Flow chart of definition function. Oblong symbols indicate user choices of functions; rectangular symbols indicate displays of taxa or characters in menu format.

Characters of any genus or species can be printed for taxa displayed in the education function of the program. The format of a print output is an outline of the screen menu. Colors also can be selected or reset to personalize menu screen backgrounds, titles, answer buttons, message buttons, checkboxes, and lines used in the program. This function is for computers with color monitors.

DISCUSSION

Keys provide excellent tools in teaching and learning taxonomic groups and characteristics of fungi. In classroom exercises or personal experiences, keys are used as guides in an ongoing process of learning that continues with examination of reference specimens and a review of descriptions. The use and operation of *PolyKey*, like other keys to fungi, requires an adequate knowledge of the morphology, ecology, physiology, and biology of unknown specimens. Although an abridged mycological dictionary is included in the key, the user must have an adequate knowledge of the vocabulary used in describing polyporoid, wood-rotting fungi. In any key, inaccurate determination of the characters of a fungus may lead the user, "down the wrong path" to taxa that do not match the characters of unidentified taxa. This often requires the user to trace back to the errant choice or to begin again. In using a computerized approach, the same problems can occur as in manual keys but the speed of testing the validity of choices is greatly increased.

Functions of keys may include presentation of classification systems, identification of taxa (Parker-Rhodes 1974), a summary of characters for taxa, or any combination of these functions. Dichotomous keys may provide all of these functions but not necessarily in a readily available form. In these keys, author-selected characters are emphasized in a defined sequence that cannot always be followed when identifying incomplete specimens. Whereas, to obtain a summary of characters used to identify a given taxonomic unit, dichotomous keys can be used in reverse (Ainsworth 1973, Hanlin 1990). By employing a synoptic approach, *PolyKey* provides all of the functions previously listed in an immediate form. Any character, in any order, can be chosen for identification of taxa. This prevents identification based on a sequential method and allows for identification based on available characters. Character summaries for any taxon also can be viewed rapidly in a checkbox format. Thus, the major problems of dichotomous keys are avoided. Furthermore, the use of a computer extends the number of taxa treated in a manually-operated synoptic key from 30 (Korf 1972) or 50 (Kendrick 1990) to thousands (or an almost unlimited number) depending on available computer memory.

Features of *PolyKey* include the most rapid method for identifying, reviewing, or testing the user's knowledge of the characters of a given taxon (Adaskaveg and Dunlap 1993). As indicated by Leenhouts (1966), the structure of a key may also impair its function and inhibit access to taxa or characters. *PolyKey* is designed with screen-displayed functions and menus of characters in a checkbox format. This provides an organized and rapid viewing method to access taxa and to display their characters. Furthermore, the use of the mouse provides the most rapid selection method of commands or characters in a computerized key. Thus, manual entry of descriptions or typing of code words used in other computer programs (Kendrick 1990) is avoided or minimized. No other computer program previously written for the identification of fungi provides access to characters or taxa as described in this program (Adaskaveg and Dunlap 1993).

Databases developed for *PolyKey* were generated using a spreadsheet program. Use of this program provided an unrefined method for viewing taxa and characters, as well as providing a rapid method for adding, deleting, or sorting taxa and characters. This allowed for the compilation of extensive databases for specific groups of fungi. Characters for genera of fungi or species in a genus were placed into database files and were evaluated for use in the identification of taxa using spreadsheet sort functions. This method provided a maximum number of functional characters utilized for identification and in describing these fungi. Several databases were generated and include 100 genera, over 400 species, and over 1100 synonyms. Databases for other groups of fungi could be generated in a similar method. Recently, encoding systems for morphological characters are being developed and standardized for yeasts (Jong et al. 1988), saprolegnian fungi (Jong et al. 1991), and for species in the genera *Pythium* (Jong et al. 1992) and *Phytophthora* (Jong et al 1989). Compilations of data sets following standard codes may eventually lead to the development of computer programs for identification and for studying taxonomic relationships among these groups of fungi.

Information used in the databases of *PolyKey* was mainly obtained from Gilbertson and Ryvarden (1986, 1987) and Overholts (1953). Thus, the program supplements and compliments the taxonomy and detailed descriptions found in these works. As indicated above, the key functions as a guide and relies on the drawings and detailed descriptions found in "North American Polypores" (Gilbertson and Ryvarden 1986, 1987) and other references. Future versions of *PolyKey* could provide drawings, pictures, and routines that generate databases for user identified taxa or provide entry and retrieval of descriptions utilized in databases of herbaria.

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MYCOTAXON

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PSEUDOVALSA SMITHII IS AN EARLIER NAME FOR *MYCOPEPON GUIANENSIS*

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Since describing *Mycopepon* gen. et sp. nov. (Boise, 1987), it has come to my attention (M. E. Barr, *pers. comm.*) that the description of *Pseudovalsa smithii* Ellis & Everh. (Smith, 1893) matches that of *Mycopepon guianensis* Boise. I have now examined the specimen that Charles Smith distributed in his exsiccata *Central American Fungi* (Smith, 1896) and find that the two names are synonymous. Thus, a new combination is proposed:

Mycopepon smithii (Ellis & Everh.) Boise
≡ *Pseudovalsa smithii* Ellis & Everh. in Smith, *Bull. Lab. Nat. Hist. Iowa State Univ.* 2(4): 404. 1893. Isotype: C. L. Smith, *Central American Fungi*, fasc. 1, no. 16, "On bark, Feb.-Mar., 1893. Castillo Viejo, Nicaragua." (FH!).
= *Mycopepon guianensis* Boise, *Systema Ascomycetum* 6(1): 168. 1987.

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MYCOTAXON

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TYPE STUDIES IN AMANITA SECTION VAGINATAE I: SOME TAXA DESCRIBED IN THIS CENTURY (STUDIES 1-23) WITH NOTES ON DESCRIPTION OF SPORES AND REFRACTIVE HYPHAE IN AMANITA

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Summary

Type studies on *Amanita antillana*, *A. arctica*, *A. argentea*, *A. beckeri*, *A. constricta*, *A. dunicola*, *A. groenlandica*, *A. huijsmanii*, *A. lactea*, *A. lividopallescens* var. *malleata*, *A. lividopallescens* var. *tigrina*, *A. magnivolvata*, *A. malleata*, *A. mortenii*, *A. oblongospora*, *A. pachycolea*, *A. pachyvolvata*, *A. submembranacea* var. *submembranacea*, *A. submembranacea* var. *bispora*, *A. supravolvata*, *A. tuza*, *Amanitopsis vaginata* var. *crassivolvata*, and *Amanita yucatanensis* are reported. One paratype of *A. arctica* proved not to be conspecific with the holotype; apparently it represents an undescribed species. Three paratypes of *A. constricta* are not conspecific with the holotype; one is assignable to *A. protecta*; the other two represent undescribed species. The type of *A. malleata* is a mixed collection; material best fitting the protologue is segregated, described, and designated the lectotype. Some paratypes of *A. mortenii* are not conspecific with the holotype; those conspecific with the holotype are indicated; the species description is emended. An holotype of *A. oblongospora* is designated and the name is validated. A new name, *Amanita violettae*, is proposed to replace *Amanitopsis vaginata* var. *crassivolvata*. It is proposed that *Amanita malleata*, *A. lividopallescens* var. *malleata*, and *A. lividopallescens* var. *tigrina* are taxonomic synonyms; but no judgment is made concerning the appropriate rank of this taxon.

Résumé

On a étudié les types de *Amanita antillana*, de *A. arctica*, de *A. argentea*, de *A. beckeri*, de *A. constricta*, de *A. dunicola*, de *A. groenlandica*, de *A. huijsmanii*, de *A. lactea*, de *A. lividopallescens* var. *malleata*, de *A. lividopallescens* var. *tigrina*, de *A. magnivolvata*, de *A. malleata*, de *A. mortenii*, de *A. oblongospora*, de *A. pachycolea*, de *A. pachyvolvata*, de *A. submembranacea* var. *submembranacea*, de *A. submembranacea* var. *bispora*, de *A. supravolvata*, de *A. tuza*, de *Amanitopsis vaginata* var. *crassivolvata*, et de *Amanita yucatanensis*. Un paratype de

A. arctica n'est pas conspécifique à l'holotype. Ce paratype répresente probablement une espèce nouvelle. Trois paratypes de *A. constricta* ne sont pas conspécifiques à l'holotype. L'un répresente *A. protecta*, et les autres répresentent deux espèces nouvelles. Le type de *A. malleata* est hétérogène; l'échantillon qui répond le mieux à la description du protologue est décrit, et ce spécimen est designé le lectotype. Quelques paratypes de *A. mortenii* ne sont pas conspécifiques à l'holotype. Les paratypes qui sont conspécifiques à l'holotype sont indiqués, et la description de *A. mortenii* est émendée. Un holotype de *A. oblongospora* est designé, et le nom est validé. On a proposé un nom nouveau (*Amanita violettae*) pour remplacer *Amanitopsis vaginata* var. *crassivolvata*. On a proposé que *Amanita malleata*, *A. lividopallescens* var. *malleata*, et *A. lividopallescens* var. *tigrina* sont synonymes taxonomiques; mais on n'arrive à aucune conclusion concernant le niveau le plus approprié à ce taxon.

Introduction

Especially in countries outside of Europe, the great number of taxa that remain undescribed in *Amanita* section *Vaginatae* (Fr.) Quél. are difficult to deal with taxonomically. In part, this is because of the lack of uniform and thorough descriptions of existing taxa in the section. While many papers have been written proposing subsectional and lower level placement and relationships, none have been based on thorough examination of types or, where such are lacking, on good "representative collections." This paper presents the first results of a research program intended to improve the anatomical understanding of the complex set of taxa already described in the section.

The work on the present project is expected to take a number of years. Meanwhile, a number of authors are actively publishing taxa in section *Vaginatae*; and some of these descriptions continue to be of a nature that minimally satisfies the requirements for valid publication (thus frustrating all mycologists—possibly including the authors of such taxa). Considering this state of affairs, I thought it useful to publish results of my work in installments—in hopes that, if the approach used is deemed as useful as I find it to be, the method and its results would be used by others. If this publication were to prompt the writing of more detailed protologues, this would be a blessing to workers in the field. If other authors correct and/or improve upon these methods, so much the better. The mycological literature and the community of agaricologists would be benefited.

The methods are not remarkable for novelty. A debt of great magnitude is owed to the publications of Dr. Cornelis Bas, Rijksherbarium, Leiden, the Netherlands, and to my correspondence and conversations with him. Dr. David T. Jenkins, University of Alabama, Birmingham, U.S.A., has independently arrived at the same conclusions reached by me (Tulloss, 1993) concerning the great importance of the anatomy of the lamellae; and I have benefited from my talks with him. Errors arising in my application of the methods are solely my own.

Materials & Methods

This article is the first of a projected series reporting type studies in *Amanita* (not only restricted to section *Vaginatae*). For the convenience of the reader, macroscopic descriptions and habitat information from the protologues (translated into English where necessary) are presented for each species. Where examination of an exsiccatum provided an expansion of the macroscopic description from the protologue, I have inserted the additional data. With the exception of my observations concerning colors observed in exsiccata, color information is drawn from the protologues. Habitat information is drawn from the protologues, herbarium labels, and (on one occasion) from examination of plentiful conifer litter included in an herbarium box with a specimen. Stipes of all species described are totally elongating—no bulb is present.

Notations, abbreviations, and technical terminology follow Bas *et al.* (1988), Tulloss *et al.* (1992), and Tulloss (1993). Treatment of the lamella trama follows the method described in detail in Tulloss (1993).

All anatomical studies were done on dried material. Microscopic examination of tissues was made in 10% NH_4OH or 2% - 3% KOH. All tissues were hyaline and colorless to very pale yellowish unless otherwise noted. Cell wall stains used were Congo Red and eosin. Spores were examined in Melzer's Reagent and in 10% NH_4OH or 2% - 3% KOH.

In descriptions of marginal striations of the pileus, the abbreviation *n*R is used where *n* is the ratio of striation length to the radius (R) of the pileus.

Dimensions for spores are given using notation of the form *(a-) b - c (-d)*. The range *b - c* contains a minimum of 90% of the measured values. If less than 100% of the measured values fall within the range *b - c*, then *a* (if such exists < *b*) represents the smallest value measured and *d* (if such exists > *c*) represents the largest value measured.

Color codes of the form "11D2" are from (Kornerup & Wanscher, 1978). Color codes of the form "7.5YR 8/6" are from (Munsell Color, 1975). Color names in italics with first letters capitalized are from Ridgway (1912). Translations of Ridgway color names into Munsell codes follows Hamly (1949). Colors denominated in lower case italic type between single quotation marks are based on Séguy (1936).

Specimens examined in preparing this paper or unseen portions of such collections are deposited in the following herbaria:

C - Botanical Museum and Herbarium, Copenhagen, Denmark.
CAG - Erbario, Istituto di Botanica e Orto Botanico, Università di Cagliari, Italy [includes the personal herbarium of Dr. M. Contu].
E - Herbarium, Royal Botanic Gardens, Edinburgh, Scotland, U.K.
ENCB - Herbario, Escuela Nacional de Ciencias Biológicas, México, D.F., Mexico.

H - Herbarium, Botanical Museum, University of Helsinki, Finland.
K - Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, England, U.K.
L - Rijksherbarium, Leiden, The Netherlands.
MASSART - personal herbarium of F. Massart, Gradignan, France.
MBON - personal herbarium of Dr. M. Bon, Station d'Études en Baie de Somme, Saint Valery sur Somme, France.
NY - Herbarium, The New York Botanical Garden, Bronx, U.S.A.
NYS - Herbarium of the New York State Museum, Albany, U.S.A.
RET - personal herbarium of the author.
ROMAG - personal herbarium of Prof. H. Romagnesi, Paris, France.
SFSU - Harry D. Thiers Herbarium, San Francisco State University, California, U.S.A.
SLBORD - Herbier, Société Linnéenne de Bordeaux, France.
TBOR - personal herbarium of T. Borgen, Paamiut, Greenland.
XAL - Herbario, Instituto de Ecología, Xalapa, Veracruz, Mexico.

Herbarium codes used follow Holmgren *et al.* (1990) except in cases in which an herbarium is either a personal one or in which an institutional herbarium is not listed by Holmgren *et al.*

NOTES ON DESCRIPTION OF SPORES

Spores were measured at 1000× in lateral view (apiculus in profile) when the spores fell into one of the following categories defined by Bas (1969): globose, subglobose, broadly ellipsoid, ellipsoid. Elongate, cylindric, and bacilliform spores may be measured with the apiculus not in view because they tend to have a width that varies little when the spore is viewed from different positions perpendicular to the longitudinal diameter (major axis). Length of a spore was taken to be the longest measurement that could be made parallel to the flattened adaxial region if such was present or to the length of the major diameter of a spore that appeared more nearly symmetrical in a lateral view. Perfect symmetry in lateral view is not common in my experience with *Amanita* spores. *I wish to emphasize the importance of following a procedure such as the one just given.* Many published drawings of apparently globose to subglobose *Amanita* spores either do not show an apiculus or show a spore that is symmetrical with respect to a line drawn from the center of the apiculus through the center of the spore. In both cases, the spore is not positioned for measurement according to the method I have described. I do not include measurements from spores so positioned in my findings. It is my impression that many authors present *Amanita* spores as more perfectly round than they are when measured by the method just advocated.

In addition, Dr. C. Bas (pers. comm.) has called my attention to the widespread use of "hyaline" to mean "hyaline and colourless" (*e.g.*, within descriptions of *Amanita* spores). In the following, "hyaline" is restricted to meaning "transparent" without prejudice as to color.

NOTES ON DESCRIPTION OF REFRACTIVE HYPHAE

The research reported in this article was carried out over a period of nearly four years. About one and one-half years ago, while pursuing another topic, I observed in the universal veil of *Amanita nauseosa* (Wakef.) Reid that there were two types of distinctly yellowish elements easily visible at low power. The most common are smooth, often narrow, septate, branching, filamentous hyphae with yellowish, refractive walls. These may have inflated terminal cells of the same coloring. The second, less common sort of elements are yellow to orangish to orangish-brown in 3% KOH and more strongly refractive than the first sort; are rarely septate; often have an irregular (knobby) outline; often coil or tangle with themselves; branch infrequently; and, when cut or perforated in sectioning or mounting, exude an easily seen and apparently poorly soluble substance. Further studies have shown that these two forms of (often) similarly colored hyphae are to be found, in one species or another, in all *Amanita* tissues. They are to be distinguished from the partially gelatinized, usually minimally curving refractive hyphae that may frequently be found in the pileipellis of several *Amanita* species. The walls of the latter are often seen to be longitudinally splitting when viewed at 1000×.

It is my impression that most previous authors (myself included) have lumped the two forms of hyphae together under the term "gleoplerous" or "oleiferous" or (most recently) "vascular" hyphae. Since these terms are commonly defined by reference to "refractive contents," I believe they are best applied to the second sort of hyphae just described. The first type has no technical name at present.

Unfortunately, the discovery of this distinction late in my research created a problem with regard to a number of descriptions already written. As far as was practicable, I checked earlier observations. Where this was not done, I have referred to "refractive hyphae," under which term the reader must consider that a mixture of hyphae of unknown proportions of the two sorts is being described.

Distribution of vascular hyphae can be variable in some tissues of some taxa in *Amanita*; it is not known what taxonomic weight should be given to presence or absence, rarity or commonness of such hyphae. Nevertheless, when there is a striking difference in the quantity of vascular hyphae in some tissue in two taxa, I have called attention to the fact.

Taxonomic Part

1. *AMANITA ANTILLANA* Dennis. 1952. *Kew Bull.* 4: 459.

Illus.: Dennis. 1970. *Fungus Fl. Venezuela*: p. 8.
Illus.: Pegler. 1978. *Agaric Fl. Lesser Antilles*: p. 289, fig. 51 E-H; pl. 7 C-D.

Figs. 1-2.

PILEUS: up to 90 mm wide, olive brown, convex, subumbonate, subviscid, smooth; *context* not described; *margin* sulcate-striate (approx. 0.5R); *universal veil* absent.

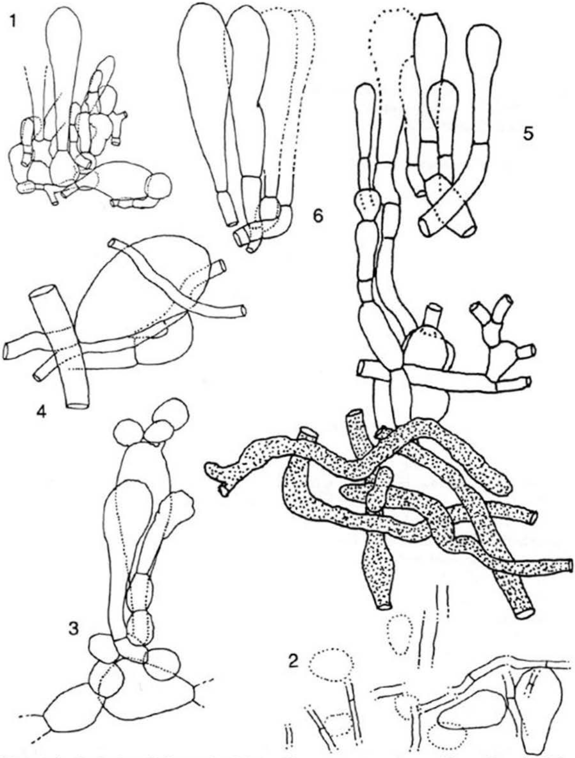
LAMELLAE: free, white, very broad.

STIPE: 90 × 13 mm, narrowing upward, decorated with fibrils; *context* hollow; *exannulate*; *universal veil* disappearing.

Odor and *taste* not recorded.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 65 - 130 μm thick, with upper highly gelatinized region hyaline and colorless and with lower region more yellow than pileus context in KOH; filamentous, undifferentiated hyphae 2.0 - 7.0 μm wide, subradially arranged, becoming disordered near pileus context, somewhat loosely interwoven and separated by gelatinized material, occasionally with yellow subrefractive walls; vascular hyphae 1.5 - 10.5 μm wide, without dominant orientation, common, some at surface, but not gelatinized. PILEUS CONTEXT: filamentous, undifferentiated hyphae 2.1 - 14.7 μm wide, branching, interwoven in loose disorderly manner, occasionally with yellow subrefractive walls; acrophysalides, dominating, ovoid to ellipsoid, thin-walled, up to 60 × 37 μm; vascular hyphae 0.8 - 11.2 μm wide, branching, common. LAMELLA TRAMA: bilateral, with central stratum very poorly rehydrating, angle of divergence very shallow at first then curving outward smoothly to an angle near 60°, often with curve continued in basal third or half of basidia, with slightly inflated cells intercalary in subhymenial base (*e.g.*, 24 × 13.3 μm); filamentous, undifferentiated hyphae 1.9 - 5.5 μm wide, branching, occasionally constricted at septa; divergent, terminal inflated cells not observed; vascular hyphae 1.9 - 5.6 μm wide, branching, having irregular outline. SUBHYMENIUM: w_{st}-near = 15 - 40 μm; w_{st}-far = 30 - 55 μm; inflated cells moderately plentiful [in two to three (or four) layers] to sparse, clavate to ovoid to ellipsoid to branched, up to 17.0 × 11.0 μm, occasionally giving rise to basidia, with basidia arising (for the most part) from plentiful uninflated hyphal segments (with these latter arising from inflated cells or from hyphae originating in the central stratum), with shortest basidioles arising from uninflated hyphal segment or short obclavate cell or irregular (branched cell) and with base of such basidioles one-half to one and one-half cells from base of longest nearby basidium/-ole. BASIDIA: (22-) 31 - 63 × 9.1 - 13.3 μm, thin-walled, 4- and occasionally 2-sterigmate; sterigmata up to 4.9 × 3.5 μm (on 2-spored basidium); clamps not observed. UNIVERSAL VEIL: *At stipe base*: absent (see discussion, below). *On pileus*: a very small patch of extensively gelatinized hyphae and inflated cells; filamentous, undifferentiated hyphae 1.4 - 4.2 μm wide, in fragments, colorless; inflated cells elongate pyriform to ellipsoid to ovoid to clavate, up to 30 × 20 μm, orange brown when gelatinized, yellow-brown otherwise, in clusters, thin-walled, apparently dominant; vascular hyphae not observed. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.3 - 6.7 μm wide, branching, dominant; acrophysalides thin-walled, up to 105 × 35 μm or larger; vascular hyphae 6.3 - 11.2 μm wide, not common, ser-



Figs. 1-6. Scale for all figures is 600:1. Figs. 1-2. *Amanita antillana* (Dennis 286, holotype). 1. Elements of hymenium and subhymenium. 2. Elements of universal veil (interior, near inner surface) from pileus. Figs. 3-4. *Amanita arctica* (Borgen TB.85.204, holotype). 3. Elements of hymenium and subhymenium. 4. Elements of universal veil (interior) from stipe base. Fig. 5. *Amanita sp.* (Bas 6105) elements of hymenium and subhymenium and vascular hyphae of lamella trama. Stippling in this and following figures indicates refractive elements. Fig. 6. *Amanita nivalis* (Watling 17489, neotype) elements of hymenium and subhymenium.

pentine; clamps rare or absent.

BASIDIOSPORES: [40/1/1] (8.4-) 9.8 - 13.3 (-14.3) × (7.1-) 7.7 - 10.5 (-11.9) µm, (**L** = 11.2 µm; **W** = 9.1 µm; Q = (1.08-) 1.09 - 1.40 (-1.42); **Q** = 1.24), hyaline, colorless, thin-walled, smooth, inamyloid, subglobose to broadly ellipsoid, occasionally ellipsoid, usually adaxially flattened; apiculus sublateral, prominent, cylindric to truncate-conic; contents guttulate; color in deposit not recorded.

Habitat: At sea level, in sandy soil in forest.

Collection examined: **TRINIDAD:** Quinam, 4.xi.1949 R. W. G. Dennis 286 (holotype, K).

DISCUSSION

The illustration in Dennis (1970) shows rather long marginal striation and a stipe that is not much longer than the pileus diameter. The stipe is depicted completely devoid of universal veil material.

The holotype was poorly dried and is not now in good condition. For this reason, I have relied to some degree on information from prior examinations of the specimen by Pegler (1978) and Bas (notes deposited with specimen in K). Nevertheless, I also examined all tissues myself in as much detail as possible.

Neither Dr. Bas nor Dr. Pegler found universal veil material on the specimen. Dr. Bas' notes include mention of a few hyphae found on the lower stipe surface that might have come from the inner surface of the universal veil. Serendipitously, I found a minute patch of extensively gelatinized material mixed with soil particles on the pileipellis near the disc. I believe this to represent the structure of the inner surface of the universal veil. The interior of the universal veil may have larger inflated cells than I noted. This structure is consistent with that of the universal veil in recently collected material from Martinique and Guadeloupe assigned to *A. antillana* by Pegler (1978). Pegler described the universal veil (based on the new material) as "membranous but very fragile, thin, ochraceous brown, soon lost." As to its anatomy, Pegler reported "narrow, branched, hyaline hyphae, 3-7 µm wide, producing large, terminal sphaerocysts, 18 - 55 µm wide, with brown vacuolar pigment."

I examined one of the collections cited by Pegler [MARTINIQUE—Caravelle, Tartane, 22.ix.1977 D. N. Pegler 2823b (K)] and believe it to represent *A. antillana*. I made the following observations that supplement the above description: The lamellae dried an orange-tan (a little browner than 5A4). The structure of the subhymenial tree was confirmed; w_{st}-near = 15 - 40 µm; and w_{st}-far = 40 - 55 µm. The subhymenium is not pseudoparenchymatous as Pegler (1978) said, but comprised of a mixture of uninflated, partially inflated, and inflated elements as in the holotype. The central stratum rehydrated to a greater degree than in the holotype; w_{cs} = 30 - 40 µm; and filamentous, undifferentiated hyphae in the lamella trama are 2.4 - 6.0 µm wide.

BASIDIOSPORES from Pegler 2823b: [20/1/1] (9.6-) 9.8 - 11.3 (-12.6) × (8.5-) 8.6 - 10.4 (-10.5) μm, (**L** = 10.7 μm; **W** = 9.4 μm; **Q** = (1.05-) 1.08 - 1.22 (-1.23); **Q** = 1.14).

Pegler's illustration of the present species (Pegler, 1978: 289, fig. 51E) displays rather short marginal striation in contrast to Dennis' illustration cited above. I examined this character in the exsiccata of the holotype and Pegler 2823b and found that the striation were relatively short in both cases.

After an extensive search for clamps in all tissues of the holotype, I found no more than three or four possible clamps; but, because of the condition of the material, I am not certain about the observations. Neither Pegler's nor Bas' previous examination of the type resulted in the finding of clamps.

Of the taxa treated in this paper, *A. antillana* seems closest to *A. beckeri*, but differs significantly from the latter in pileus color, shape of spores, frequency of inflated elements in the subhymenium, and the presence of vascular hyphae in many tissues.

2. *AMANITA ARCTICA* Bas, Knudsen & Borgen *in* Knudsen & Borgen *in* Laursen *et al.* 1987. *Arct. Alp. Mycol.* 2: 239.

Figs. 3-4.

PILEUS: 20 - 80 mm wide, at first white to ivory or pale cream, becoming distinctly ochraceous buff at center (4A3-4), hemispheric to conical, expanding to convex or applanate with umbo, slightly viscid, shining when dry; *context* not recorded; *margin* sulcate (0.2 - 0.3R); *universal veil* absent or occasionally as a single patch.

LAMELLAE: free, white, drying grayish buff (10YR 7/4), having flocculose white margin, distally slightly ventricose.

STIPE: 45 - 130 × 6 - 20 mm, with white floccose girdles above, sometimes with prominent fibrillose-scaly covering on a pale cream or whitish background, cylindric or slightly narrowing upward; *context* white; *exannulate*; *universal veil* membranous to submembranous, sometimes leaving patch on stipe separated from remains of volva, with *limbus internus* placed rather high on inside of volval limb, white inside, outer surface white developing ochraceous spots in age.

Odor and *taste* not distinctive.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 70 - 80 μm thick, barely to not at all gelatinizing; filamentous, undifferentiated hyphae 2.8 - 13.5 μm wide, branching, radially arranged; vascular hyphae not observed. PILEUS CONTEXT: dominated by filamentous, undifferentiated hyphae 2.2 - 15.2 μm wide, interwoven, frequently branching and anastomosing, some of the largest with walls to 0.8 μm thick, mostly thin-walled, occasionally with intercalary inflated segment, not infrequently with yellowish subrefractive walls; acrophysalides broadly ellipsoid to elongate to clavate, to 86 × 40 μm; vascular hyphae 6.0 - 8.0 μm wide, not common, frequently branching locally. LAMELLA TRAMA: bilateral, but somewhat obscurely so in some regions, with w_{cs} = 85 - 90 μm (about half this width in immature material); filamentous, undifferentiated hyphae 1.5 - 10.0 μm wide, branching, with inflated intercalary segments fusiform to ellipsoid to ovoid to broadly clavate to clavate (up to 41 × 33 μm, mostly 75% of this size or smaller); divergent, terminal, inflated cells apparently absent; vascular hyphae relatively uncommon, 2.0 - 5.8 μm; clamps infrequent. SUBHYMENIUM: cellular (pseudoparenchymatous) in mature material, locally cellular to subcellular or inflated ramose in less mature regions of hymenium, with w_{st}-near = 15 - 20 μm and w_{st}-far = 35 - 45 μm; basidia arising from subglobose to ellipsoid cells usually no longer than 12 μm, in chains; some basidia arising from points several cells deep in this region. BASIDIA: 42 - 78 × 11.0 - 17.5 μm, thin-walled, dominantly 4-sterigmate, but slightly under one-third 2-sterigmate; sterigmata up to 10 μm long; clamps and proliferated clamps uncommon. UNIVERSAL VEIL: *On pileus*: absent. *At stipe base, exterior surface*: filamentous, undifferentiated hyphae 4.8 - 10.0 μm wide, gelatinizing, longitudinally oriented, interwoven; inflated cells and vascular hyphae not observed. *At stipe base, interior*: filamentous, undifferentiated hyphae 1.5 - 12.5 μm wide, branching, interwoven, dominating, not infrequently with yellowish subrefractive walls; inflated cells, terminal, singly or in short chains, ellipsoid to clavate, to 103 × 52 μm, mostly thin-walled, a few with walls 0.5 - 0.8 μm thick; vascular hyphae not common, 2.5 - 6.0 μm wide. *At stipe base, inner surface*: like the interior, but more extensively gelatinizing. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 3.0 - 10.5 μm wide, branching, occasionally with yellowish subrefractive walls; acrophysalides with walls 0.5 - 0.8 μm thick, often rather broad and rounded at base, to 155 × 46 μm; vascular hyphae up to 10.5 μm wide, branching.

BASIDIOSPORES: [140/6/1] (9.0-) 10.0 - 13.2 (-18.5) × (8.2-) 8.8 - 12.5 (-16.8) μm, (**L** = 11.0 - 11.9 μm; **L'** = 11.4 μm; **W** = 9.9 - 10.8 μm; **W'** = 10.5 μm; Q = (1.0-) 1.03 - 1.18 (-1.34); **Q** = 1.06 - 1.12; **Q'** = 1.09), hyaline, colorless, inamyloid, smooth, thin-walled, globose to subglobose to broadly ellipsoid (only one "giant spore" found in this category); apiculus sublateral, cylindric to narrowly truncate-conic, up to 1.5 μm wide; contents monoguttulate with or without some additional small granules; color in deposit not recorded.

Habitat: Solitary or in small groups with *Betula pubescens* Ehrh., *B. glandulosa* Michx., *Salix glauca* L., *S. herbacea* L., or *Polygonum viviparum* L. in dry or moist shrubs or snowbeds.

Collection examined: **GREENLAND:** Grønnedal, 15.viii.1985 Torbjørn Borgen TB.85.204 (holotype, C).

DISCUSSION

Dr. Henning Knudsen (pers. comm.) notes that the stipe base of *A. arctica* arises from rather deep in the substrate often resulting in collection of incomplete or uncharacteristic specimens with the universal veil left in the ground in whole or in part. Continuing, he says that the species is locally common in southern and southwestern Greenland. He warns that it may be hard to distinguish pale *A. groenlandica* from "beige" *A. arctica* when comparing old, weathered material of the two species in the field. In my experience, the taxa can be separated easily by the structure of their subhymenia and by the presence of clamps at bases of some basidia in *A. arctica*.

I have had the opportunity to study Bas 6105 (L), a specimen from Lapland that is cited as a paratype in the protologue of *A. arctica*. A photograph of this collection serves as the illustration of *A. arctica* in the protologue and is cited as the underlying example for some of the macroscopic characters—certainly the form of the universal veil and the position of the *limbus internus* and possibly the tendency to leave a patch of the universal veil on the stipe. Unfortunately, Bas 6105 is not conspecific with the holotype. Bas 6105 consists of three basidiocarps that were collected a considerable distance apart and probably are from distinct mycelia (Bas, pers. comm.). The three specimens are conspecific. Among the characters separating Bas 6105 from *A. arctica* are

- nearly total absence of clamps in the lamella trama,
- extensive refractive hyphae that somewhat obscure the bilateral nature of the trama,
- spores with **Q** = 1.15 - 1.26,
- a subhymenium of occasionally branching hyphae (Fig. 5).

It would appear from the extensive field and laboratory notes with Bas 6105 in L that the protologue made very little, if any, use of that collection as far as anatomy is concerned. Nevertheless, it would be very valuable to collect more material of *A. arctica* in order to get a better view of the macroscopic details. After the examination of such material, emendation of the macroscopic description may be required. For purposes of completeness, the spore data obtained from Bas 6105 follow:

BASIDIOSPORES of Bas 6105: [40/3/1] (9.0-) 9.3 - 15.3 (-17.7) × (6.9-) 7.8 - 13.7 (-13.8) μm, (**L** = 11.8 - 13.8 μm; **L'** = 12.4 μm; **W** = 9.4 - 11.8 μm; **W'** = 10.4 μm; Q = (1.03-) 1.05 - 1.42 (-1.50); **Q** = 1.15 - 1.26; **Q'** = 1.20), hyaline, colorless, inamyloid, thin-walled, smooth, globose to subglobose to broadly ellipsoid, occasionally ellipsoid, usually somewhat adaxially flattened; apiculus sublateral, cylindric, rather large (up to 2.0 μm wide); contents granular to guttulate; color in deposit not recorded.

The considerable range in **L** and **W** should be noted. All three specimens were in early stages of sporulation when dried. This undoubtedly contributes a few "giant spores" that extend the upper ranges of dimensions and, possibly, of Q.

An anatomical comparison of *A. arctica* to *A. nivalis* Grev. has not been made previously. I have examined the neotype material (Watling, 1985) of *A. nivalis* [Watling 17489 (E)]. The subhymenium of *A. nivalis* (Fig. 6) is composed of branching hyphae with relatively short segments some of which are slightly inflated. The lamella trama is dominated by filamentous, undifferentiated hyphae, sometimes with segments inflated up to 15.5 μm wide [18.5 μm wide (Watling, 1985)]. This structure is very different from that seen in *A. arctica*. For completeness, there follows information on basidiospores measured:

BASIDIOSPORES of *A. nivalis* neotype: [40/1/1] (10.0-) 10.2 - 11.5 (-13.0) × (9.0-) 9.2 - 10.8 (-11.8) μm, (**L** = 10.8 μm; **W** = 10.0 μm; Q = (1.0-) 1.03 - 1.13 (-1.16); **Q** = 1.08), hyaline, colorless, inamyloid, thin-walled, smooth, globose to subglobose, occasionally broadly ellipsoid, usually somewhat adaxially flattened; apiculus sublateral, cylindric to truncate-conic, rather small; contents granular to guttulate; white in deposit.

Based on the spore size and shape alone, it would appear that the entity reported from northern Québec by Hutchison *et al.* (1988) as *A. arctica* is not that species. I have not had a chance to examine the Canadian material.

In the protologue of this species Borgen 85.204 is designated as the holotype in the Latin diagnosis; the packet containing this collection (C) is also marked as holotype. The reference (Knudsen & Borgen, 1987: 240) to Borgen 85.220a as "type" and the omission of Borgen 85.204 from the list of materials examined are apparently typographic errors.

3. *AMANITA ARGENTEA* Huijsman. 1959. *Bull. Trimestriel Soc. Mycol. France* 75: 14, figs. 1-2.

≡*Amanitopsis argentea* (Huijsman) Wasser. 1988. *Ukrayins'k. Bot. Zhurn.* 45(6): 77.
≡*Amanita mairei* var. *argentea* (Huijsman) Bon & Contu. 1985. *Doc. Mycol.* 15(59): 53.

Figs. 7-8.

PILEUS: 60 - 100 mm wide, hemispheric, becoming convex to broadly convex, lacking any trace of umbo, slightly viscid, smooth, silvery gray or ash gray, barely shiny; *context* not very thin, white, grayish under the pileipellis especially in disc; *margin* pectinate-striate (up to 0.3R), approx. five striae per 10 mm; *universal veil* sometimes covering disc with large thick white patch.

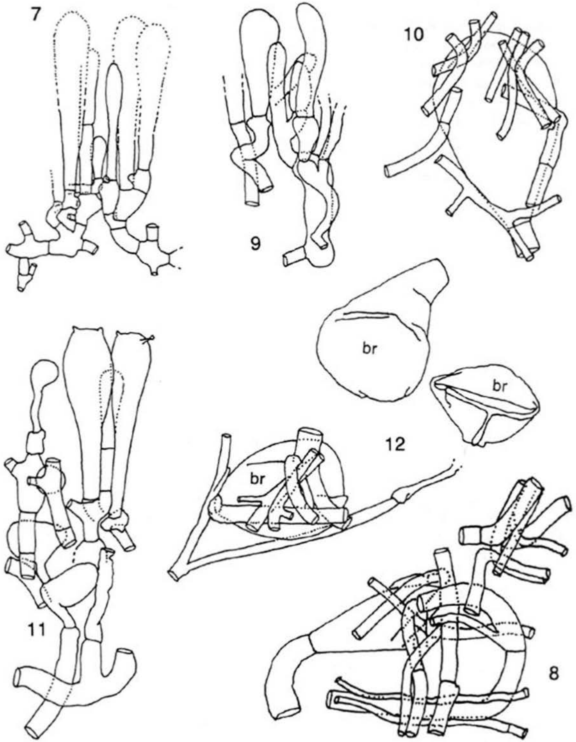
LAMELLAE: free, slightly convex, at first white, becoming silvery gray eventually, drying 7.5YR 6/6, 12± mm broad; edge fimbriate, white and remaining so; *lamellulae* infrequent, truncate.

STIPE: often attaining 140 × 17 mm, white above, grayish toward base, subcylindric and rather squat, widening slightly toward both ends, subsquamulose toward base with fibrils in zones somewhat suggesting garlands draped around stipe, becoming flocculose-tomentose toward apex and there often with striae remaining from original contact of lamellae with stipe; *context* pale gray below and white above, with central cylinder stuffed with material soon developing horizontal cracks and eventually breaking up; *exannulate*; *universal veil* ample, thick, membranous, often dividing into two or three lobes, up to 45 mm or longer from point of juncture with stipe to highest point on a lobe, whitish or spotted with pale tan on exterior, having *limbus internus* placed at point of juncture of stipe and limbs.

Odor weakly of a soiled dust cloth. *Taste* not noteworthy.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: about 70 μm thick; filamentous, undifferentiated hyphae 2.5 - 5.9 μm wide, with colorless walls; additional filamentous, undifferentiated hyphae with yellowish subrefractive walls 1.7 - 8.7 μm wide, criss-crossing, plentiful in surface view, difficult to see in cross-section; vascular hyphae not observed. PILEUS CONTEXT: filamentous, undifferentiated hyphae 3.4 - 11.2 μm wide, loosely interwoven; acrophysalides clavate to ventricose to ellipsoid, thin-walled, up to 135 × 48 μm; refractive hyphae 4.2 - 12.3 μm wide, locally common. LAMELLA TRAMA: bilateral; w_{cs} = 45 - 55 μm (rehydrating unevenly); filamentous, undifferentiated hyphae 2.3 - 11.3 μm wide; inflated cells slenderly clavate to clavate, thin-walled, sometimes in short chains, up to 76 × 25 μm, with terminal ones rather sparsely distributed (w_{ct} = 85± μm, but not very useful in this case), diverging from central stratum at angles from very shallow to 45° or more; refractive hyphae infrequent, 1.6 - 5.5 μm wide. SUBHYMENIUM: w_{st}-near = 25± μm; w_{st}-far = 70 - 75 μm; w_{ex}-near = 5 - 10 μm; w_{ex}-far = 55 - 60 μm; with branching filamentous, undifferentiated hyphae approaching hymenium at an angle of up to 90° to central stratum, interwoven, with branch elements (sometimes comprising several hyphal segments) running parallel to central stratum both toward and away from edge of lamella, with narrowly clavate to ovoid cells occasionally present, with basidia arising from uninflated short hyphal segments. BASIDIA: 26 - 59 × 9.3 - 13.6 μm, dominantly 4-, occasionally 2-sterigmate, thin-walled; clamps present. UNIVERSAL VEIL: *On pileus*: absent. *At stipe base, exterior surface*: filamentous, undifferentiated hyphae 1.7 - 7.3 μm wide, branching, criss-crossed, tangled, gelatinizing, sometimes in fascicles; refractive hyphae 5.0± μm wide. *At stipe base, interior*: filamentous, undifferentiated hyphae 1.4 - 20.0 μm wide, branching, often in fascicles, loosely interwoven, dominating; inflated cells very narrowly clavate to clavate, terminal, singly, up to 88 × 22 μm; refractive hyphae 1.7 - 7.0 μm wide. *At stipe base, inner surface*: filamentous, undifferentiated hyphae 2.0 - 9.8 μm wide, branching, gelatinizing, dominant, many at very surface having sublongitudinal orientation, with infrequent slightly gelatinizing terminal segments slightly inflated (*e.g.*, 79 × 24 μm); refractive hyphae 0.8 - 5.6 μm wide, not uncommon. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 2.8 - 9.5 μm wide, branching; acrophysalides up to 235 × 42 μm; refractive hyphae 2.8 - 6.7 μm wide.



Figs. 7-12. Figs. 7-8. *Amanita argentea* (Huijsman 4320, holotype). 7. Elements of hymenium and subhymenium, showing branches of subhymenial tree running parallel to central stratum. 8. Elements of universal veil. Figs. 9-10. *Amanita beckeri* (Huijsman 4275, holotype) 9. Elements of hymenium and subhymenium. 10. Elements of universal veil (interior) from wart at stipe base. Figs. 11-12. *Amanita constricta* (Breckon 302, isotype). 11. Elements of hymenium and subhymenium. 12. Elements of universal veil (interior, near exterior surface) from pileus (crush mount). The letters "br" are used to label brown elements; and "gr," gray elements.

BASIDIOSPORES: [40/1/1] (9.1-) 9.3 - 12.0 (-12.7) × (6.4-) 7.3 - 9.1 (-9.3) μm, (**L** = 10.8 μm; **W** = 8.1 μm; Q = (1.09-) 1.17 - 1.50 (-1.56); **Q** = 1.34), hyaline, colorless, inamyloid, smooth, thin-walled, subglobose to broadly ellipsoid to ellipsoid, occasionally expanded at one end; apiculus sublateral, cylindric; contents granular to guttulate; color in deposit not recorded.

Habitat: On hill slope in deciduous forest.

Collection examined: **FRANCE:** DÉP. DOUBS - Lougres, 7.viii.1956 H. S. C. Huijsman 4320 (holotype, L 956-110-613).

DISCUSSION

For comparison with *A. dunicola*, *A. huijsmanii*, *A. supravolvata*, and *A. yucatanensis*, see discussions following descriptions of these taxa. It was hoped that a study of authentic material (if not syntypes) of *A. mairei* Foley (1949; 1951) could be made so a direct comparison of that species with the present one would be possible, for the names are often treated as synonyms. However, multiple letters to four herbaria did not succeed in producing even the courtesy of a negative reply.

4. *AMANITA BECKERI* Huijsman *ex* Huijsman. 1962. *Bull. Trimestriel Soc. Mycol. France* 78: 217.

≡*Amanita beckeri* Huijsman *nom. inval.* 1962 [''1961'']. *Bull. Trimestriel Soc. Mycol. France* 77: 349. [Holotype not cited. ICBN §37.1.]
≡*Amanitopsis beckeri* (Huijsman) Bon. 1975. *Bull. Mens. Soc. Linn. Lyon* 44(6): 180.
≡*Amanitopsis beckeri* (Huijsman) Wasser. 1988. *Ukrayins'k. Bot. Zhurn.* 45(6): 77. [Superfluous combination.]
=*Amanita strangulata* (Fr.) Quél. *sensu* Huijsman. 1959. *Bull. Trimestriel Soc. Mycol. France* 75: 24.

Figs. 9-10.

PILEUS: up to 120 mm wide, hemispheric, Séguy 134 ['*gris noisette*' (slightly browner than 2.5YR 6/6), not '*brun havane*' (browner than 2.5YR 4/6) as in protologue] or golden walnut over disc, a little paler and often more ochraceous towards margin especially when young, becoming convex, more rarely campanulate, not umbonate, slightly viscid, smooth; *context* rather thin and fragile, white, browning slightly, rapidly losing its turgidity and then liquefying; *margin* striate-sulcate (up to 0.35R), sometimes becoming fissurate at margin with splits descending into trama of lamellae; *universal veil* covering pileus with flocculose-tomentose polygonal white warts, rarely exceeding 5 mm in width, browning in age, never becoming gray or black.

LAMELLAE: free, white to cream, brownish spots appearing in age, rather narrow, concave especially in young specimens, with finely fimbriate edge browning in age; *lamellulae* few in number, truncate.

STIPE: 100 - 200 × 12 - 20 mm, straight and thin, cylindric to narrowing slightly upward, decorated above belt of universal veil material with zones of fibrils in garland-like form becoming finer and finer approaching apex, with decoration near apex consisting of fine longitudinal striations at first white and then turning brownish; *context* white, browning slightly on exposure, at first stuffed then hollow; *exannulate*; *universal veil* white, becoming brownish, not very coherent, leaving belt of tissue around lower stipe not far from its base, forming a small cup at stipe base.

Odor at first weakly radish-like, soon fetid. *Taste* not distinctive.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 145 - 150 μm thick in young basidiocarp (just prior to sporulation), with partial to extensive gelatinization at surface, pale yellowish near surface, grading into deep orange-brown at interface to pileus context; filamentous, undifferentiated hyphae 2.0 - 5.8 μm wide, subradially arranged, densely interwoven; vascular hyphae not observed. PILEUS CONTEXT: filamentous, undifferentiated hyphae 2.8 - 15.0 μm wide, branching, plentiful; acrophysalides thin-walled, dominating, apparently terminal, fusiform to clavate to broadly clavate to ellipsoid to pyriform to subreniform, up to 115 × 52 μm; vascular hyphae not observed. LAMELLA TRAMA: w_{cs} = 35 - 50 μm; angle of divergence acute to nearly perpendicular to central stratum to obscure; filamentous, undifferentiated hyphae 2.0 - 8.5 μm wide; divergent, terminal, inflated cells apparently absent; vascular hyphae not observed. SUBHYMENIUM: with w_{st}-near = 20 - 45 μm and w_{st}-far = 50 - 75 μm, a tangle of frequently branching hyphae, with occasional segments (including branched segments) slightly inflated, with basidia arising from segments roughly perpendicular to central stratum. BASIDIA: 40 - 64 × 14.2 - 17.5 μm, dominantly 4-sterigmate, infrequently 3-sterigmate, thin-walled; clamps not observed. UNIVERSAL VEIL: *At stipe base, exterior surface*: orange-brown, extensively gelatinized; filamentous, undifferentiated hyphae 2.5 - 6.2 μm wide, often in fascicles; inflated cells as in interior but smaller, collapsed, gelatinized; vascular hyphae not observed. *At stipe base, interior*: filamentous, undifferentiated hyphae 2.2 - 11.8 μm wide, plentiful, frequently branching, at times in fascicles; inflated cells plentiful, ellipsoid to broadly clavate to clavate, up to 95 × 50 μm, terminal, thin-walled, largest away from surfaces; vascular hyphae not observed. *On pileus, exterior surface*: as on stipe base. *On pileus, interior*: with proportionately fewer hyphae than on stipe base; filamentous, undifferentiated hyphae 2.0 - 10.8 μm wide, frequently branching, plentiful; inflated cells ovoid to ellipsoid to subglobose, thin-walled, in short chains (up to 3) or terminal, up to 63 × 45 μm, plentiful; vascular hyphae not observed. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.5 - 10.0 μm wide, branching, plentiful, dominating near exterior surface; acrophysalides thin-walled, up to 139 × 39 μm, plentiful in interior; vascular hyphae uncommon 7.0 - 19.0 μm wide, locally in loose tangles.

BASIDIOSPORES: [29/2/1] (8.8-) 9.8 - 11.8 (-13.0) × (7.2-) 9.0 - 11.0 (-12.2) μm, (**L** = 10.5 - 11.0 μm; **L'** = 10.8 μm; **W** = 10.0 - 10.2 μm; **W'** = 10.1 μm; Q = (1.0-) 1.03 - 1.13 (-1.22); **Q** = 1.05 - 1.08; **Q'** = 1.07), hyaline, colorless, thin-walled, smooth, inamyloid, globose to subglobose, occasionally broadly ellipsoid, often adaxially flattened, often expanded at one end, infrequently pip-shaped; apiculus sublateral, cylindric; contents granular to monoguttulate with small additional granules; color in deposit unrecorded.

Habitat: Solitary to subsolitary to gregarious, only in very wet periods, in deciduous woods, on calcareous soils.

Collection examined: **FRANCE:** DÉP. DOUBS - Lougres, Bois du Cré, 29.vii.1956 G. Becker & H. S. C. Huijsman [Huijsman 4275] (holotype, L 955.239-091).

DISCUSSION

For comparison with *A. antillana* and *A. malleata* see discussions following the descriptions of those species.

In the protologue, Huijsman describes the pileus as "*brun havane* (Séguy 134)." However, Séguy 134 is called '*gris noisette*,' and the Séguy number corresponding to '*brun havane*' is 131. The pileus of *A. beckeri* is usually depicted as rather more pale than '*brun havane*' and closer to '*gris noisette*.' Therefore, in the macroscopic description above, I've retained Séguy 134 rather than '*brun havane*.'

5. *AMANITA CONSTRICTA* Thiers & Ammirati. 1982. *Mycotaxon* 15: 65.

Illus.: Arora. 1979. *Mushr. Demystified*: 252.
Illus.: Arora. 1986. *Mushr. Demystified* (2nd ed.): 289.
Illus.: Jenkins. 1986. *Amanita N. Amer.*: pl. 35.
Illus.: Arora. 1991. *All Rain Promises*: 73.

Figs. 11-12.

PILEUS: 50 - 130 mm wide, gray to brownish gray, *Pale Mouse Gray* (7.5YR 6.5/1.0) to *Light Drab* (10YR 5.8/2.0) to *Drab* (10YR 5.5/3.0) to *Hair Brown* (10YR 4.4/1.0), disc at time as dark as *Chaetura Black* (10YR 2.4/1.0), often with inconspicuous dark radial streaks, convex when young, becoming plano-convex to plane, eventually subumbonate to umbonate in age; *context* white except next to pileipellis and there gray to drab, sometimes becoming faintly pinkish on exposure especially in young basidiocarps, 5 -17 mm thick at disc, thinning toward margin; *margin* decurved at first, soon plane to undulate, slightly uplifted in age, entirely becoming rimose, strongly sulcate to tuberculate striate (0.2 - 0.25R); *universal veil* absent or as a membranous somewhat fibrillose patch over disc, typically < 1 mm thick, sometimes breaking up at edges in age, white to buff to *Smoke Gray* (5Y 6.8/2.0) or sometimes with pale vinaceous shades, bruising salmon color when moistened, slowly returning to white.

LAMELLAE: close to crowded, adnate to decurrent by a short hook when young, becoming free, white at first, becoming gray, *Smoke Gray* (5Y 6.8/2.0) to *Pallid Mouse Gray* (5YR 8.0/0.5) to *Pale Drab-Gray* (10YR 8.5/0.5), drying tan to sordid tan to brownish gray (grayer than 7.5YR 6/6 to 10YR 5/4 to 10YR 7-8/4), moderately broad, with edge usually gray and fimbriate; *lamellulae* in several ranks.

STIPE: 100 - 160 (-200) mm long, 7 - 17 mm wide at apex, white, cylindric or narrowing upward, with apex longitudinally striate or pruinose, becoming appressed-fibrillose below, with stipitipellis often rupturing and forming rings of appressed-fibrillose scales (gray and darkening when bruised); *context* white, stuffed, becoming hollow; *exannulate*; *universal veil* membranous, white to pale buff or pale yellow, bruising reddish when wet then fading, adnate to stipe for one-third to one-half of stipe length, then flaring in a manner suggesting an annulus, collapsing with age.

Odor and *taste* not distinctive.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 200± μm thick; thin layer at surface gelatinized; upper 40± μm incompletely gelatinized; upper 80 - 95 μm colorless to pale yellowish; lower portion light brownish orange (mounted in 10% NH_4OH); filamentous, undifferentiated hyphae 2.2 - 8.5 μm wide, criss-crossed, largely uncurving, many subradially arranged, a few containing red-brown granules (mounted in 3% KOH); vascular hyphae not observed. PILEUS CONTEXT: filamentous, undifferentiated hyphae 1.5 - 14.0 μm wide, branching, very loosely interwoven; acrophysalides dominating, subglobose to pyriform to ellipsoid to broadly clavate to clavate, up to 129 × 74 μm; vascular hyphae 6.0 - 17.5 μm wide, loosely coiling, locally tangled. LAMELLA TRAMA: bilateral, with divergence obscured by plentiful hyphae parallel to hymenial surface and tangled nature of subhymenial tree except near edge of lamella; central stratum having boundaries somewhat difficult to define because of density of subhymenium and divergence beginning within central stratum and many hyphae of subhymenial base diverging at very shallow angles maintained for relatively long distances, sometimes imperfectly rehydrating and then dense and brown to orange-brown, with w_{cs} = 110 - 145 μm in cases of most complete rehydration (65 - 85 μm in most common degree of moderate rehydration, 30 - 55 μm in poorly rehydrating trama); with hyphae of subhymenial base diverging at angles from very shallow to over 60°; filamentous, undifferentiated hyphae 1.8 - 9.8 μm wide, sometimes coiling, interwoven, frequently branching, with central stratum and subhymenial base including intercalary inflated cells [thin-walled, subventricose to ventricose to subclavate to clavate to broadly clavate to irregular, up to 53 × 35 μm (most often about half this width)]; divergent, terminal, inflated cells not observed; vascular hyphae 2.5 - 12.5 μm wide, occasionally branching, infrequent to somewhat common to common. SUBHYMENIUM: w_{st}-near = 80 - 140 µm in cases of most complete rehydration [(25-) 30 - 80 µm in most common degree of moderate rehydration, 0 - 30 µm in poorly rehydrating trama]; w_{st}-far = 110 - 175 µm in cases of most complete rehydration (60 - 105 µm in most common degree of moderate rehydration, 35 - 60 µm in poorly rehydrating trama); a complexly interwoven structure comprising frequently septate, frequently branching hyphae, with segments uninflated or partially inflated (or occasionally inflated and then clavate to subpyriform to somewhat irregular, *e.g.*, 19 × 14 µm), with hyphae of the subhymenium occasionally running parallel to the hymenial surface (sometimes in rather dense clusters) within 10 µm of bases of longest basidia, with basidia often arising from uninflated segments (80% or more of cases examined), but also from any type of cell cited, with ½ to 2½ (rarely 3) cells between base of short basidiole and longest nearby basidium/-ole, with cell immediately below a short basidiole uninflated (9.0 - 21 × (2.5-) 3.2 - 6.8 µm) to narrowly clavate or with short branch giving rise to second basidiole (12.6 - 20 × 5.8 - 8.8 µm) to ellipsoid or pyriform (7.5 - 10.0 × 7.8 - 11.8 µm). BASIDIA: 54 - 78 × 8.5 - 19.5 µm, thin-walled, dominantly 4-, but occasionally 1- or 2-sterigmate; sterigmata up to 16.0 × 3.5 µm; clamps rather infrequent to rather common (even within the type collection). UNIVERSAL VEIL: *On pileus, upper portion*: filamentous, undifferentiated hyphae 1.5 - 8.2 µm wide, occasionally in fascicles, often collapsed; inflated cells dominating, thin-walled, clavate to broadly clavate to subpyriform to ellipsoid, often pale brownish or pale orange-brown, terminal, singly, up to 46 × 33 µm, collapsed; vascular hyphae not observed. *On pileus, lower portion (adjacent to pileipellis)*: hyphae more frequent; all elements extensively compressed. *On stipe about 10 mm above base*: structures similar to those on pileus; inflated cells (collapsed and partially gelatinized) and fragments of same easily dissociated from surface leaving mostly tangled hyphae; inflated cells up to 95 × 45 µm, with uncollapsed whole cells colorless; scant fragments of vascular hyphae 3.0 - 6.0 µm. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.5 - 11.5 µm wide, branching, plentiful; acrophysalides thin-walled, plentiful, up to 271 × 45 µm, with those of broader diameter often rather broad quite close to basal septum; vascular hyphae 2.8 - 14.0 µm wide, loosely coiling.

BASIDIOSPORES: [454/23/9] (7.2-) 9.5 - 12.8 (-19.0) × (6.2-) 8.2 - 11.5 (-17.8) µm, (**L** = (10.3-) 10.4 - 11.8 µm; **L'** = 11.0 µm; **W** = (8.8-) 9.0 - 10.5 (-10.9) µm; **W'** = 9.9 µm; Q = (1.0-) 1.04 - 1.25 (-1.56); **Q** = (1.06-) 1.07 - 1.17 (-1.18); **Q'** = 1.12), smooth, thin-walled, hyaline, colorless, inamyloid, globose to subglobose to broadly ellipsoid, occasionally ellipsoid, in some specimens frequently lacrymoid, adaxially flattened (often strongly), often swollen at one end; apiculus sublateral, cylindric to truncate-conic, at times quite prominent; contents mono- to multiguttulate to granular; white in deposit.

Habitat and distribution: Single to scattered to gregarious, December to March, along Pacific Coast of U. S. A., apparently limited to coastal forest, under hardwoods such as coastal spp. of *Quercus* (*e.g.*, *Q. agrifolia* Née) and *Arbutus menziesii* Pursh., occasionally under *Pseudotsuga menziesii* (Mirb.) Franco or in mixed woods of *P. menziesii* and *Q. agrifolia* or under *Umbellularia californica* (Hook. & Arn.) Nutt. in area of mixed *Quercus* and *Umbellularia*. Holotype found under *Quercus* and *A. menziesii*.

Collections examined: **UNITED STATES OF AMERICA:** CALIFORNIA—Marin Co. - Alpine Lake, 20.xii.1963 Harry D. Thiers 11146 (paratype, SFSU); Muir Woods Nat. Mon., 1.i.1967 D. E. Madden 904 (paratype, SFSU), 25.i.1967 Gary J. Breckon 881 (paratype, SFSU), 31.i.1967 G. J. Breckon 906 (paratype, SFSU). San Mateo Co. - San Francisco Watershed, 22.xii.1963 H. D. Thiers 11184 (paratype, SFSU), 11.i.1965 H. D. Thiers 12064 (paratype, SFSU), 22.i.1965 G. J. Breckon 302 (holotype, SFSU; isotype, NY), 22.ii.1965 H. D. Thiers 12211 (paratype, SFSU), 6.i.1967 G. J. Breckon & H. D. Thiers [Breckon 674] (paratype, SFSU). Solano Co. - Green Valley, 1.iii.1968 Walter J. Sundberg 1167 (paratype, SFSU).

DISCUSSION

Large lacrymoid spores (not uncommon in some specimens of the present species) are extremely difficult to measure accurately because the large end tends to sink producing a foreshortening of the spore as viewed, preventing a lateral view, and making the process of spore measurement for this taxon extremely tedious. Lacrymoid spores were not measured unless they could be viewed fully in focus in optical cross-section. This methodological decision tends to produce a lower **Q** than might be expected for specimens in which lacrymoid spores occurred with any frequency. In the specimens with lacrymoid spores, subglobose to globose spores were always present and in equal or greater number than the lacrymoid ones. As a consequence, the distribution of Q for spores measured from these specimens is often distinctly bimodal.

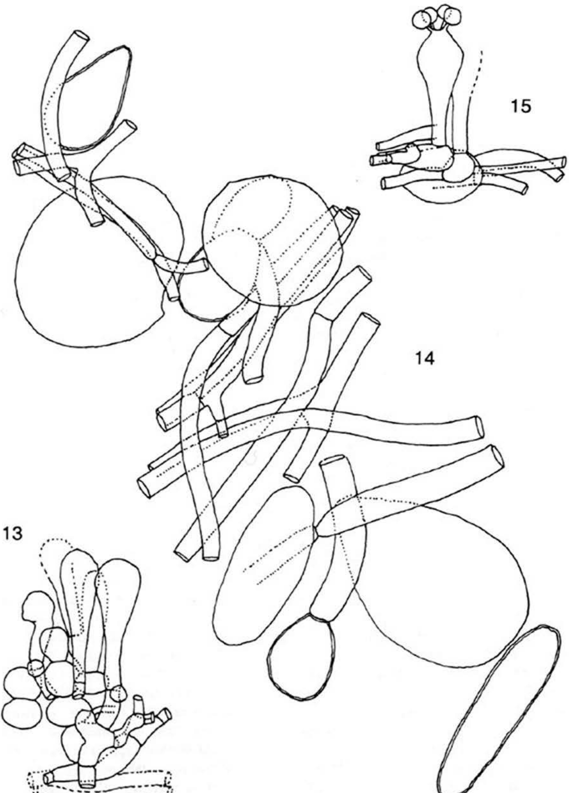
The combination of

- a salmon or reddish color appearing in the universal veil when moistened
- spore shape
- usually strongly strangulate, usually graying, submembranous volva
- relatively high values for w_{st}-near, w_{st}-far, and w_{cs}.

separates this species from all somewhat similar taxa treated in this paper.

The single specimen of Thiers 11184 exhibited the lowest value of **Q** measured for any specimen of the present species—1.06. The lamella trama of lamellae examined was not equally inflated on both sides of the central stratum; also, all parts of the trama rehydrated poorly (the poorest rehydration achieved in any examined specimen of the present species). I judged that the specimen was conspecific with the holotype of *A. constricta*, but was poorly developed.

The single specimen of Thiers 12211 is a robust, immature basidiocarp with sterigmata just beginning to form on the basidia. Insufficient spores were present to allow a sample to be measured. In this specimen, however, excellent rehydration of



Figs. 13-15. Fig. 13. *Amanita species NW5* (Breckon 684) elements of hymenium, subhymenial tree, and central stratum. Fig. 14. *Amanita species C12* (Breckon 669) elements of universal veil. Fig. 15. *Amanita dunicola* (Guzmán 21235, isotype) elements of hymenium and subhymenium.

the lamella trama was achieved producing the highest values measured for length of a basidium, w_{cs}, w_{st}-near, and w_{st}-far.

The relatively large collection Breckon 881 illustrates that the graying of the universal veil (both on the pileus and in the volval limb on the stipe) may begin before sporulation starts, in fact while the universal veil is just beginning to be split in "buttons."

Breckon 684 [Santa Barbara Co. - SE of Santa Ynez, Lk. Cachuma, 29.i.1967 (SFSU)], Breckon 669 [San Mateo Co. - San Francisco Watershed, 23.xii.1966 (SFSU)], and Breckon 865 [Marin Co. - Muir Woods Nat. Mon., 15.i.1967 (SFSU)] are paratypes of the present species that are not conspecific with the holotype. Breckon 684 is an undescribed species with which I am familiar through a collection sent to me from the northwestern U.S.A. [WASHINGTON—Skagit Co. - Mt. Baker Nat. For., near Rainbow Falls, above Baker Lk., 22.ix.1991 Buck McAdoo 193#17 (RET)] and has been listed in regional lists as "*Amanita sp.* NW5." Breckon 865 represents a robust collection of *A. protecta* Tulloss & G. Wright (1989). Both taxa can be distinguished from *A. constricta* by the presence of plentiful inflated cells in the subhymenial base (*e.g.*, see Fig. 13). The universal veils in *A. sp.* NW5 and *A. protecta* are off-white with ochraceous stains and not graying—even on the interior surface. Moreover, there is never a strangulate appearance to the volva in *A. protecta* [in fact, much of the volva is left as warts and patches on the pileus so that the base of the stipe in this species suggests the bulb of *A. pantherina* (DC.:Fr.) Krombh.]. In the few specimens of *A. sp.* NW5 I have examined, much of the universal veil was found on the pileus as a large calyptra.

Breckon 669 represents an undescribed species previously known to me and included in regional lists as "*Amanita sp.* C12." It differs from *A. constricta* in having a narrower central stratum and a shallower subhymenial tree and by having a subhymenium in which basidia arise from the sides of hyphae and at the end of chains of five or more small, partially inflated to inflated cells (as opposed to chains of fewer, longer, uninflated hyphal segments in *A. constricta*). Moreover, the universal veil of *A. sp.* C12 contains plentiful, terminal, easily dissociated, elongate inflated cells with thickened walls (up to 83 μm long) mixed with ellipsoid and subglobose cells with thinner walls (Fig. 14). It is my impression from the exsiccata of Breckon 669 and a collection of *A. sp.* C12 that I examined in a fresh state [Marin Co. - Mt. Tamalpais St. Pk., Bootjack Trail, Marsha Heidt *s.n.* {Tulloss 11-24-89-B} (RET)], that this entity has no strangulate region in the volva; and if the universal veil has a tendency to become grayish, the change must be slight. (On the other hand, about half of the paratypes that I took to be conspecific with the holotype of *A. constricta* contained at least one specimen with a universal veil that was rather pale gray or more brown than gray as dried. Moreover, the isotype of *A. constricta* in NY contains one specimen that lacks a strangulate region of the volva; but this is the only such specimen reviewed.) *Amanita sp.* C12 has a slightly fruit-like odor when fresh.

The presence of discordant specimens among the paratypes suggests that a re-examination of original collectors' notes on the holotype and on all paratypes would be useful in order to determine if the protologue contains diagnostic data extracted from any of the discordant paratypes. Regretably, Mr. Breckon (whose notes would be key to resolving the matter) is no longer working in mycology; and his present address is unknown (D. E. Desjardin, pers. comm.; H. D. Thiers, pers. comm.).

6. *AMANITA DUNICOLA* Guzmán. 1982. *Mycotaxon* 16: 256.

Illus.: Guzmán. 1983. *Biótica* 8: 91, fig. 9.

Fig. 15.

PILEUS: 15 - 40 mm wide, convex to subcampanulate or somewhat plane, subviscid, pale brownish to leather brown; *context* white; *margin* smooth to short sulcate-striate; *universal veil* as white, irregular, medium to small patches or warts (often densely distributed) over disc and without much sand on the upper surface.

LAMELLAE: free to narrowly adnate, sometimes with decurrent line on upper stipe, whitish rose to rose brown, drying yellow-brown to orange-brown (more yellow than 5B5 or close to 10YR 7/8 to 7.5YR 5/8 to 7.5YR 7/8 over disc and slightly redder than 7.5YR 5/8 near edge), with white fimbriate edge; *lamellulae* present, subtruncate to truncate.

STIPE: 30 - 80 × 3 - 7 mm, cylindric to somewhat narrowing downward, smooth appearing, minutely flocculose (lens); *context* white; *exannulate*; *universal veil* as a membranous saccate volva, white, delicate, often encrusted with sand, more or less retained at maturity.

Odor not distinctive (but, in exsiccata, very pleasant—like fresh bread). *Taste* pleasant.

MACROCHEMICAL TESTS: not recorded.

PILEIPELLIS: 50 - 70 µm thick, colorless; filamentous, undifferentiated hyphae 1.5 - 10.0 µm wide, subradially oriented, densely interwoven, partially gelatinizing and then only at surface; refractive hyphae 2.0 - 6.8 µm wide, branching. PILEUS CONTEXT: orange-brown pigment notable below pileipellis; filamentous, undifferentiated hyphae 4.0 - 8.8 µm wide, branching; acrophysalides thin-walled, clavate to broadly clavate to pyriform, up to 82 × 43 µm; refractive hyphae $1.8^{\pm}$ µm wide, not common. LAMELLA TRAMA: obscurely (if at all) bilateral, imperfectly rehydrating, with $w_{ct} = 80^{\pm} - 90$ µm; filamentous, undifferentiated hyphae 2.0 - 7.8 µm wide, interwoven, for the most part subparallel to hymenial surface; with possibly terminal, inflated cells subventricose (concentrated toward center of trama) to ellipsoid (adjacent to and partially within subhymenium), with major axis subparallel to hymenial surface, thin-walled, up to 82 × 28 µm; vascular hyphae not observed. SUBHYMENIUM: with w_{ex}-near = $0^{\pm}$ µm and w_{ex}-far = $25^{\pm}$ µm, with hyphae subparallel to the hymenial surface to be found immediately below the basidia; basidia arise from small inflated cells and uninflated short hyphal segments that arise from the hyphae of the trama, with quantity of inflated cells variable from region to region. BASIDIA: 36 - 53 × 11.0 - 17.0 μm, dominantly 4-, occasionally 2-sterigmate, thin-walled; clamps not uncommon. UNIVERSAL VEIL: *On pileus*: filamentous, undifferentiated hyphae 5.5 - 9.5 μm wide, dominating, partially gelatinizing near surfaces, frequently branching, somewhat loosely interwoven; inflated cells thin-walled, broadly clavate to subovoid to broadly ellipsoid, to 40 × 33 μm, collapsing. *At stipe base*: heavily encrusted with sand and difficult to examine; almost entirely composed of filamentous, undifferentiated hyphae rather loosely interwoven, frequently branching; inflated cells amidst ungelatinized (interior) hyphae are scarce or absent; vascular hyphae not observed; exterior and interior surfaces gelatinizing(?); mounts sparsely populated by extensively gelatinized, subglobose, inflated cells apparently associated with an extensively gelatinized layer that is dominated by inflated cells and that separates from the limb in the mounting liquid—possibly remnants of a *limbus internus*. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.2 - 9.0 μm wide, branching; acrophysalides thin-walled, slender, up to 188 × 33 μm, one seen arising from a subglobose intercalary cell; refractive hyphae 1.5 - 12.5 μm wide, common, locally branching and in tangles, serpentine; clamps present.

BASIDIOSPORES: [60/3/1] (8.5-) 10.0 - 13.9 (-15.0) × (6.0-) 7.2 - 9.5 (-11.2) μm, (**L** = 11.0 - 12.8 μm; **L'** = 11.8 μm; **W** = 8.0 - 9.1 μm; **W'** = 8.6 μm; Q = (1.17-) 1.25 - 1.56 (-1.67); **Q** = 1.35 - 1.41; **Q'** = 1.38), hyaline, colorless, thin-walled, smooth, inamyloid, broadly ellipsoid to ellipsoid, occasionally elongate, often adaxially flattened, sometimes adaxially depressed, infrequently pyriform, often expanded at one end, infrequently expanded in the middle; contents monoguttulate; apiculus sublateral to subapical, cylindric; color in deposit not recorded.

Habitat: Gregarious to solitary, in sand below *Coccoloba uvifera* L., in dunes close to sea. Probably ectomycorrhizal (*fide* Guzmán).

Collection examined: **MEXICO:** YUCATAN—Municipio de Ixil - Progreso to Telchac road, 18.xi.1981 G. Guzmán 21235 (holotype, ENCB (*n.v.*); isotype, XAL).

DISCUSSION

Structure of the volva is very difficult to ascertain because of sand encrusting it in two of the specimens examined. It is interesting to note there is no encrusting sand on patches and warts on the pilei of the exsiccata. It appears that the outer part of the universal veil with its covering of sand particles is sufficiently tough so that it often takes the form of a saccate volva while leaving an inner portion with a slightly greater(?) proportion of inflated cells as sand-free patches and warts on the pileus.

Everything observed in the limb of the universal veil on the stipe base in *A. dunicola* is consistent with the material on the pileus—except a thin, bent, or curved membrane dominated by extensively gelatinized hyphae and including relatively common, inflated cells. This membrane was observed in a crush mount; the same mount was littered with extensively gelatinized, subglobose, inflated cells that were much like those in the gelatinized membrane. This structure is consistent with that of a *limbus internus* that is more friable than the outer limb of the universal veil. It would be valuable to confirm this morphology in fresh material.

Species of *Amanita* treated in this paper having spore size and shape and universal veil similar to those of *A. dunicola* are *A. argentea*, *A. huijsmanii*, *A. supravolvata*, and *A. yucatanensis*.

Amanita argentea, *A. huijsmanii*, and *A. supravolvata* have subhymenia including ramifying elements that are *not* subparallel to the hymenial surface and, indeed, may be perpendicular to it. In addition, in these European species

- the pileus is gray or grayish
- clamps are less frequent at the bases of basidia
- there is a well differentiated central stratum of the lamella trama
- the subhymenial tree is not so reduced as in *A. dunicola*
- somewhat refractive hyphae are more plentiful in the pileipellis and universal veil
- there are divergent, terminal, inflated cells in the lamella trama in the first two named
- the spores of the first two named are somewhat smaller than those of *A. dunicola*.

Amanita yucatanensis was described from tropical forest, apparently (rehydration was imperfect in both holotype and isotype) has a lamella trama of about half the width of the lamella trama of the present taxon, and, additionally, differs from *A. dunicola* in the following:

- color of its pileus (white to pale yellowish)
- size of the basidiocarp
- size of basidia (ranges of length disjoint)
- presence of some elements in the subhymenium that are perpendicular to the hymenial surface
- plaques on the surface of hyphae and inflated cells of the universal veil
- slightly thickened cell walls of some elements in universal veil
- size (up to 79 μm long) and shape of the inflated cells (clavate to narrowly clavate to ventricose) in the universal veil
- distribution of refractive hyphae in the tissues (plentiful in the pileus and less common in the stipe in *A. yucatanensis*, vice versa in *A. dunicola*).

7. *AMANITA GROENLANDICA* Bas *ex* Knudsen & Borgen *in* Laursen *et al.* 1987. *Arct. Alp. Fungi* 2: 241, fig. 2.

≡*A. groenlandica* Bas *nom. prov. in* Clémençon. 1977. *Spec. Concept Hymenomyc.*: 87.

Figs. 16-18.

PILEUS: (30-) 50 - 90 (-120) mm wide, ranging from pale straw to straw (3A2-3) especially near the margin or when young to grayish yellow (4B5) or most commonly with deeper brown and gray colors like fulvous (5D4-7), clay buff (5C3-4), drab (5D3), hazel (5E4) or snuff brown (6E4), often darkest over disc, but also uniformly colored or with mixed gray, brown and yellowish colors, hemispheric, expanding to convex and broadly umbonate, finally applanate with or without a low umbo, slightly viscid when young, becoming shiny when dry; *context* white, pale brown under the pileipellis, rather soft; *margin* weakly sulcate (0.1 - 0.2R); *universal veil* present as one or a few broad patches or as numerous small flat scale-like patches, whitish to pale grayish brown (5B2) to gray.

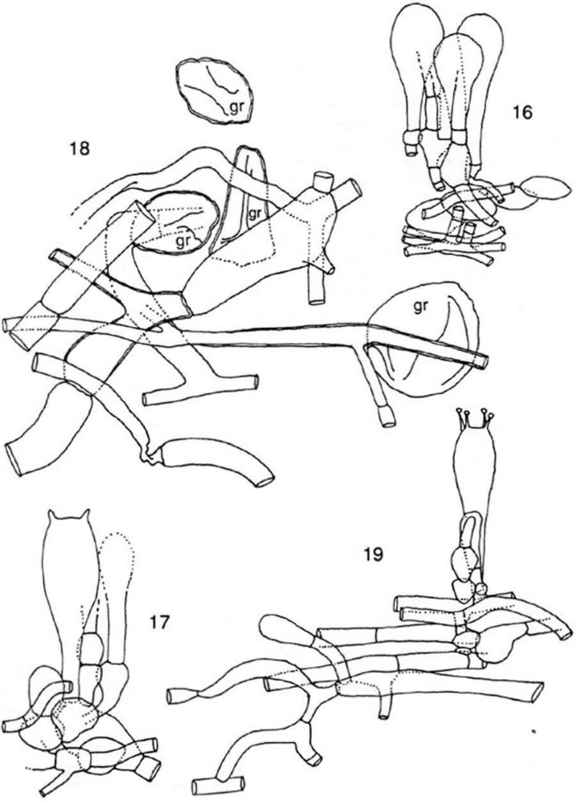
LAMELLAE: free, white then very pale cream, drying 5A3 to a little browner than 5A4 to 5C4 to 10YR 6/8 (somewhat sordid tan) to 10YR 8/6 (slightly sordid pale yellow) to a little more gray than 10YR 8/6, with pale gray-brown edge, distally slightly ventricose; *lamellulae* present.

STIPE: 40 - 150 × 8 - 20 mm (up to 33 mm wide at base), narrowing upward rather markedly, ground color whitish with pale dirty gray brown (5B2), pale grayish buff, pale grayish, or pale brown (4A3) floccose girdles becoming darker when bruised, finely sulcate at apex; *context* not recorded; *exannulate*; *universal veil* fragile and easily disrupted, generally whitish at base and grayish above, interior surface grayish but paler than exterior, drying darker gray than when fresh, sometimes with thin outer orange brown layer; *limbus internus* often present, white, floccose, 2 - 3 mm broad, low on stipe or inside volval sac.

Odor and *taste* not distinctive.

MACROCHEMICAL TESTS: Phenol in stipe flesh - pale salmon color after 5 min., later close to purple (but browner), days later remaining chocolate brown.

PILEIPELLIS: 30 - 65 μm thick, containing orange-brown pigment; filamentous, undifferentiated hyphae 1.8 - 4.8 μm wide, tightly interwoven, subradially arranged, slightly to extensively gelatinized at surface, with some apparently having yellowish walls; vascular hyphae 3.0 - 7.8 μm wide, branching, uncommon. PILEUS CONTEXT: in region close to pileipellis, similarly colored to the latter; filamentous, undifferentiated hyphae 1.2 - 10.5 μm wide, loosely interwoven, branching, occasionally with yellowish walls; acrophysalides ventricose to ovoid, thin-walled, *e.g.*, 82 × 40 μm, sometimes in short chains; vascular hyphae 2.0 - 8.2 μm wide, with slight brownish tint in 3% KOH, sinuous, branching, uncommon, relatively frequent in some regions. LAMELLA TRAMA: bilateral; angle of divergence quite variable (rather shallow to nearly 90), with divergent segments inflated to partially inflated to uninflated; filamentous, undifferentiated hyphae 1.5 - 13.2 μm wide, branching, sometimes with those of largest diameter having slightly thickened walls, with some segments slightly inflated; inflated elements ellipsoid to ovoid to clavate to pyriform, often intercalary, occasionally seeming to be truly terminal, inflated cells,



Figs. 16-19. Figs. 16-18. *Amanita groenlandica*. 16. Elements of hymenium and subhymenium (not completely mature) (Borgen TB.82.46, paratype). 17. Elements of hymenium and subhymenium (mature) (Knudsen 574, holotype). 18. Elements of universal veil (interior) from stipe base (Borgen TB.82.46, paratype). Fig. 19. *Amanita huijsmanii* (Massart 89 A1, holotype) elements of hymenium and subhymenium.

thin-walled or with walls slightly thickened, with some embedded in central stratum, up to 64 × 36 μm (mostly with minor diameter about two-thirds this size or less); vascular hyphae 1.2 - 12.0 μm wide, locally relatively common, branching. *When immature*: without marked divergence from central stratum, with w_{cs} = 130 - 160 μm, containing both hyphae and occasional inflated elements, many (all?) of which are intercalary. *When mature*: clearly divided into a central stratum (with w_{cs} = 70± μm) and a pair of adjacent regions of diverging elements (in some sections, some apparently terminal). SUBHYMENIUM: *When immature*: frequently septate, filamentous, undifferentiated hyphae, moderately branching, with some inflated to partially inflated intercalary elements, occasionally locally forming one to four layers of small ventricose cells that lie in outermost part of central stratum, with w_{st}-near = (0-) 5 (-20?) and w_{st}-far = 45± μm, with longest basidia having bases adjacent to elements running parallel to central stratum and (consequently) with some subhymenial elements arising from hyphae appearing to be at some distance into central stratum; basidia arising from very short, uninflated or slightly inflated, often simple, occasionally branched, hyphal segments. *When mature*: a branching structure of inflated to partially inflated to (occasionally) uninflated elements, with w_{st}-near = 30 - 60 μm and w_{st}-far = 55 - 95 μm, in some regions nearly pseudoparenchymatous (but with branching structure still evident), with intercalary inflated cells up to 28 × 21 μm, with inflated cells nearest central stratum often having major diameter roughly parallel to central stratum. BASIDIA: 40 - 78 × 12.0 - 19.0 μm, 4-sterigmate, thin-walled; clamps not observed. UNIVERSAL VEIL: *At stipe base, exterior surface*: a loose weave of hyphae a few hyphal diameters thick, having gaping openings irregularly spaced, orange-brown to yellow-brown, significantly darker than interior; filamentous, undifferentiated hyphae 1.8 - 9.5 μm wide, branching, occasionally in fascicles (but most often not), slightly gelatinized, thin-walled or with walls slightly thickened (rarely to 0.5 μm thick) or with plaques as in stipe context (but thinner); inflated cells ellipsoid to broadly ellipsoid to subglobose, often with pale gray walls, up to 64 × 45 μm, thin-walled, occasionally gelatinized; refractive hyphae (at least some of narrower diameters appearing vascular) 2.5 - 9.0 μm wide, infrequent, occasionally branching, with slightly thickened walls, occasionally in fascicles with colorless filamentous, undifferentiated hyphae. *At stipe base, interior*: filamentous, undifferentiated hyphae 2.8 - 13.0 μm wide, some segments with mid-portion swelling up to 16.0 μm wide, branching (often from broadest point of segment), in a very loose tangle, dominating, with walls thin or up to 1.0 μm thick, occasionally with yellowish subrefractive walls; inflated cells terminal, clavate to elongate to narrowly ellipsoid to ellipsoid to pyriform to subglobose, pale brown to pale gray, thin-walled or with walls up to 0.5 μm thick, collapsing, plentiful, up to 64 × 35 μm; vascular hyphae 3.0 - 8.5 μm wide, unevenly distributed, not common. *At stipe base, inner surface*: a very loose weave of hyphae, broken further by gelatinization, spotted with small orange brown clumps of gelatinized hyphae. *On pileus, upper surface*: scattered fragments of collapsed fascicles of filamentous, undifferentiated hyphae. *On pileus, interior*: filamentous, undifferentiated hyphae 1.8 - 16.2 μm wide, as in interior on stipe base except more densely interwoven in some regions, often having somewhat sordid yellowish walls and refractive deposits on inside of walls, with inflated and branched segments up to 16.5 μm wide; inflated cells predominantly terminal, sometimes chains of two, thin-walled or with walls slightly thickened, with pale brownish tint, clustered in regions of loosely interwoven hyphae, subfusiform to narrowly clavate to clavate to elongate to ellipsoid to ovoid to subglobose, up to 81 × 59 μm; vascular hyphae rare or absent. *On pileus, lower surface*: similar to the interior in mature material, but extensively to totally gelatinized. STIPE CONTEXT: longitudinally acrophysalidic, with those elements lacking refractive contents occasionally having surface plaques < 0.5 μm thick; filamentous, undifferentiated hyphae 1.5 - 6.0 μm wide, branching; acrophysalides narrow, dominating, thin-walled or with walls very slightly thickened (< 0.5 μm), up to 191 × 29 μm; vascular hyphae 2.0 - 10.5 μm wide, with brown tint in 3% KOH, scattered or uncommon.

BASIDIOSPORES: [240/10/8] (7.8-) 9.2 - 12.5 (-23.0) × (7.8-) 8.2 - 11.5 (-16.0) μm, (**L** = 9.7 - 11.4 (-12.2) μm; **L'** = 10.9 μm; **W** = (8.9-) 9.3 - 10.6 μm; **W'** = 9.9 μm; Q = (1.0-) 1.02 - 1.20 (-1.44); **Q** = 1.08 - 1.12 (-1.15); **Q'** = 1.11), inamyloid, hyaline, colorless, smooth, thin-walled, mostly at least somewhat adaxially flattened, globose to subglobose to broadly ellipsoid, rarely ellipsoid; apiculus sublateral, small, cylindric to truncate-conic; contents granular to mono- and multiguttulate; white in deposit.

Habitat: Solitary or in small groups with combination of *Salix glauca*, *S. herbacea*, *S. arctophila* Cockerell., *Betula glandulosa*, *B. nana* L., and *B. pubescens*; in moist shrubs or in dry and exposed heath or in snow-beds with *S. herbacea*.

Collections examined: **GREENLAND:** Eqaluit, 7.viii.1982 T. Borgen TB.82.29 (paratype, C), 12.viii.1981 T. Borgen TB.81.134 (paratype, C). Grønnedal, 7.viii.1984 T. Borgen 84.72 (paratype, C). Holsteinsborg—Præstefjord, 28.viii.1972 P. Milan Petersen Blå 45 (paratype, C). Hospitalsdalen—near Narssarssuaq, 10.viii.1984 H. Knudsen & T. Laessøe [Knudsen 574] (holotype, C). N of Igaliko, 28.vii.1981 H. Dissing Gr.81.86 (paratype, C). Isungua—Ø. Disko, 5.viii.1981 Jon Feilberg 3001a & 3001b (paratypes, C). Paamiut, 10.viii.1982 T. Borgen TB.82.46 (paratypes, C & TBOR).

DISCUSSION

Among the paratypes examined, Feilberg 3001a and 3001b contain one specimen each; both were dried before the start of sporulation. Feilberg 3001b has an unusual distribution of universal veil material—as a series of submembranous rings down the length of the stipe. Borgen 84.72 comprises two specimens (one in the "button" stage); both lack spores.

The protologues of *A. groenlandica* and *A. mortenii* provide a number of macroscopic characters that separate the two taxa among which are the following: The former is rather squat in appearance, has relatively short striations on the pileus margin, almost always has a considerable amount of universal veil left on the pileus in multiple warts or patches, and has lamellae with gray brown margins. *Amanita mortenii* has a habit much more like that of *A. fulva* (Schaeff.) Fr. and has a single patch or no universal veil on the pileus. The spores of *A. groenlandica* are less frequently globose than those of *A. mortenii* (**Q'** = 1.11 vs. 1.07); the lamella trama of *A.*

groenlandica is nearly twice as wide as that of *A. mortenii*; and many elements of *A. mortenii* have thickened walls, which is not the case in the present species.

The short marginal striations of the pileus, the squat habit, the distribution of universal veil on the pileus, and the breadth of the subhymenium and the relatively plentiful inflated cells that comprise it at maturity, serve to distinguish the present taxon from *A. submembranacea* var. *submembranacea* and *A. submembranacea* var. *bispora*.

8. *AMANITA HUIJSMANII* Massart & Rouzeau. 1990 [''1989'']. *Bull. Soc. Linn. Bordeaux* 17(3): 159, pl. 1.

Illus.: Massart. 1990. *Connaître Champ. Sud-Ouest*: 7.

Fig. 19.

PILEUS: 45 - 60 mm wide, beautifully metallic gray, subcampanulate at first, then convex, with a distinct broad umbo in some specimens, occasionally slightly darker in disc and this color persisting in exsiccata, dry, under a strong lens appearing to have a short fibrillose covering on disc and in region of striation; *context* not recorded; *margin* strongly striate (0.25±R), with 6 - 7 striae per cm at margin; *pileipellis* separable only with difficulty; *universal veil* absent in illustrations of protologue.

LAMELLAE: free, not too close, white with a flesh-cream tone in mass in mature specimens, drying more yellow than 10YR 7/4 and more brown than 2.5Y 7/4-6, rounded at pileus margin, 7 - 8 per cm at pileus margin; *lamellulae* truncate at a right angle or at a slight slant.

STIPE: not much longer than pileus is wide, 55 - 70 × 7 - 9 mm, white, narrowing slightly and evenly upward, ornamented with fine white fibrils in a zig-zag pattern; *context* white, hollow; *exannulate*; *universal veil* membranous, white, of a thickness common in section *Vaginatae*, often completely lacking a *limbus internus*.

Odor and *taste* not distinctive.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: up to 70 μm thick, extensively gelatinized at surface; filamentous, undifferentiated hyphae with thin colorless walls 1.5 - 6.0 μm wide, entirely colorless (near gelatinized region) or with orangish brown to brownish intracellular pigment, dominant, gelatinizing, interwoven, subradially arranged; filamentous, undifferentiated hyphae 1.2 - 12.5 μm wide, with slightly thickened (< 0.5 μm thick) yellowish subrefractive walls, branching, common to plentiful just below surface (in scalp viewed from above, harder to see in cross-sectional view), straight or sinuous, locally in loose tangles; vascular hyphae not observed. PILEUS CONTEXT: filamentous, undifferentiated hyphae 2.5 - 13.5 μm wide, loosely interwoven, branching; acrophysalides thin-walled, narrowly clavate to subclavate, to 121 × 41 μm; vascular hyphae 2.0 - 10.0 μm wide. LAMELLA TRAMA: obscurely bilateral, having divergent elements (largely uninflated) scattered and somewhat hidden diverging at angles from very shallow to 45° (occasionally up to 60°), with w_{cs} = 40 - 55± μm (moderately rehydrated); filamentous, undifferentiated hyphae 3.5 - 11.2 μm wide, frequently branching, with scattered intercalary inflated segments ventricose to clavate (up to 69 × 21 μm, but more often two-thirds this size or less); divergent, terminal, inflated cells not observed; vascular hyphae not observed. SUBHYMENIUM: w_{st}-near = 15 - 30 μm (moderately rehydrated); w_{st}-far = 25 - 55 μm (moderately rehydrated); basidia arise from small clavate cells and from short uninflated or partially inflated hyphal segments; hyphal segments running parallel to central stratum are common in subhymenium. BASIDIA: 35 - 59 × 10.0 - 14.8 μm, 4-sterigmate, thin-walled, clavate; clamps uncommon (occasionally in subhymenium one short hyphal segment away from basidium). UNIVERSAL VEIL: *On pileus*: absent. *At stipe base, exterior surface*: a very thin layer of filamentous, undifferentiated hyphae 1.5 - 5.8 μm wide, often in fascicles, gelatinizing, longitudinally oriented, branching. *At stipe base, interior*: filamentous, undifferentiated hyphae 2.8 - 10.0 μm wide, interwoven, dominating, branching, locally predominantly longitudinally oriented, at times in fascicles; inflated cells terminal, clavate to broadly clavate to ovate, scattered, to 73 × 28 μm; refractive hyphae common, 2.8 - 5.8 μm. *At stipe base, inner surface*: filamentous, undifferentiated hyphae 2.2 - 4.0 μm wide, extensively gelatinized, longitudinally oriented; refractive hyphae 4.0± μm wide. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 2.0 - 10.2 μm wide, branching; acrophysalides thin-walled, slender, to 158 × 28 μm; refractive hyphae 1.5 - 5.2 μm wide, branching, locally in tangles.

BASIDIOSPORES: [40/1/1] (8.5-) 10.8 - 12.8 (-15.0) × (6.8-) 7.8 - 9.8 (-10.5) μm, (L = 11.5 μm; **W** = 8.7 μm; Q = (1.10-) 1.17 - 1.56 (-1.65); **Q** = 1.30), hyaline, colorless, thin-walled, smooth, inamyloid, broadly ellipsoid to ellipsoid, occasionally subglobose, infrequently elongate, occasionally adaxially flattened, occasionally expanded at one end; apiculus sublateral, cylindric; contents guttulate; white in deposit.

Habitat: On right bank of Garonne in Entre-deux-mers, August and September, in deciduous or mixed woods, on clayey-calcareous soil.

Collection examined: **FRANCE:** DÉP. GIRONDE - St. Vivien-de-Monségur, 25.viii.1989 Francis Massart 89 A1 & A2 (*n.v.*) (holotype, MASSART).

DISCUSSION

If the anatomical data from the holotype of *A. huijsmanii* is compared with those from the holotype of *A. argentea*, it will be noted that the two sets of observations are rather similar except for some cell dimensions.

- Both have criss-crossing, refractive hyphae at the pileipellis surface.

- Both have rather narrow, inflated, intercalary cells in the pileus context.
- Both have a lamella trama that is dominated by hyphae running parallel to the central stratum and that includes rather narrow inflated cells.
- Both have a dominantly hyphal subhymenium—with many basidia arising from uninflated segments and with hyphae parallel to the central stratum appearing in the subhymenial region.
- The basidia in the two specimens are of comparable size.
- Clamps were found in the subhymenium (including at the base of basidia) in both specimens.
- While the universal veil at the stipe base in the holotype of *A. huijsmanii* was gelatinized to a greater extent than that in the holotype of *A. argentea*, the dominance of hyphae in the interior of the limbs and the form of the inflated cells are comparable in the two specimens.
- The spores of the two holotypes are very close in size and shape.

Possibly terminal, inflated cells were rather sparse in the lamella trama of *A. argentea*, but were not observed (possibly due to poorer rehydration) in the same tissue in *A. huijsmanii*. The acrophysalides of the stipe in *A. argentea* were larger than those found in *A. huijsmanii*; however, this is not a sufficient difference to use in separation of taxa at the level of either species or variety—if for no other reason than that the degree of variation of acrophysalides of stipe context is not well-understood in the genus.

In the protologue of *A. huijsmanii*, the authors noted unusual, hydra-like structures on the pileus. I was unable to find such structures. Dr. C. Bas (priv. comm.) examined a specimen of *A. huijsmanii* forwarded to him by M. Massart; on the pileus surface of this specimen, Bas found what appeared to him to be scattered remnants of the inner surface of the universal veil. The specimen that I examined was the same that served as the basis for reporting the hydra-like structures. M. Massart was kind enough to share with me microphotographs of the structures. In these excellent photographs one can see that the pileipellis has above it, a gelatinized loosely woven layer of hyphae; occasionally a hyphal segment is seen arising perpendicular to the pileipellis. From the upper end of such segments may arise 2 to 4 long, sinuous lines that seem most likely to be the results of optical sections of remnants of broken cells. This interpretation would be consistent with the occurrence (not uncommon in *Amanita* section *Vaginatae*) of a bit of the inner surface of the universal veil remaining "glued" to the pileipellis after expansion of the basidiocarp.

Another character of *A. huijsmanii* emphasized in the protologue is the apparent lack of a *limbus internus* on a rather thin, collapsed volval limb. A number of taxa that have a distinguishable *limbus internus* in early stages of expansion will lose this character due to collapse of the tissue of the universal veil during aging. It seems to me that this may be the case with the holotype of *A. huijsmanii* and is consistent with the rather advanced state of gelatinization in the universal veil of the specimen examined.

Based on my studies, if *A. huijsmanii* is to be differentiated from *A. argentea* anatomically, it must be on the basis of the degree of gelatinization of the universal veil or the values of w_{st}-near and w_{st}-far (but see above). It should be noted that M. Massart, who has more than three decades of field experience with *A. argentea*, assures me (pers. comm.) that the two taxa can be easily distinguished using macroscopic characters; for example, *A. argentea* was described as lacking any trace of an umbo on the pileus while an umbo is sometimes present in *A. huijsmanii*.

For comparisons to *A. dunicola*, *A. supravolvata*, and *A. yucatanensis*, see the discussions following the descriptions of those taxa.

9. *AMANITA LACTEA* Malenç., Romagn. & Reid. 1968 [''1967'']. *Rev. Mycol. (Paris)* 32: 408, fig. 1-2.

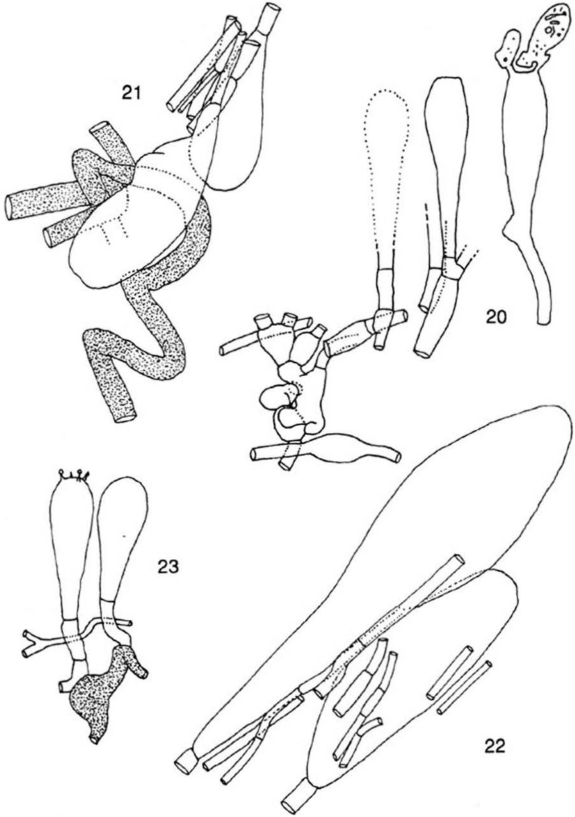
Illus.: Merlo & Traverso. 1983. *Nostri Funghi Amanite*: 45.

Figs. 20-22.

PILEUS: 40 - 130 mm wide, pure white, becoming somewhat sordid ochraceous in age, and then also slightly brownish or grayish especially over disc, at first convex-hemispherical, then convex to plano-convex, and even planar, sometimes flattened or slightly depressed; *context* white, not taking on pink tint, sometimes straw colored or brownish locally, rather thick, firm; *margin* nonappendiculate, incurved at first, then decurved, more or less sulcate from the outset (0.15±R); *pileipellis* separable, shiny; *universal veil* absent or in a few membranous patches.

LAMELLAE: free, rather close to distant, white, with pink tone in mass when collected, later becoming pale ochraceous butter colored in age, with farinose irregular edge whiter than lamella surface, 8 - 10 mm wide, segmentiform, rather thick, sometimes forking; *lamellulae* infrequent, truncate at right angle.

STIPE: 50 -115 × 10 - 30 mm, white, becoming slightly sordid in age, cylindric, with apex slightly expanded in age, base pointed or even somewhat radicating, satiny-silky below remnants of partial veil; *context* stuffed, becoming hollow; *partial veil* a mat cottony soft narrow adnate ring in Moroccan specimens, striate above, about median in young specimens, but eventually about four-fifths of the way down the stipe and then incomplete and loosely attached, in Greek and French collections less membranous, more often a granular-farinose mass [in one exsiccatum, appearing as a subfelted covering from apex to mid-point of the portion of stipe exposed above the volval sac and having a marked, thickened edge] or even only pruinose remains near apex with farinose crumbs on lower half of stipe or absent, some such remains faintly striate; *universal veil* as a thick membranous white saccate volva reminiscent of that of *A. ovoidea* (Bull.:Fr.) Link, becoming stained by soil, ovoid in button stage; *limbus internus* small, incomplete, at juncture of stipe and volval limb and leaving one or two small rings on lower part of stipe perhaps not persisting as long as portion first mentioned.



Figs. 20-23. Figs. 20-22. *Amanita lactea* (Romagnesi 66.620, holotype). 20. Elements of hymenium and subhymenium. 21. Elements of partial veil. 22. Elements of universal veil (interior) from stipe base. Fig. 23. *Amanita lividopallescens* var. *malleata* (Romagnesi 57.46, holotype) elements of hymenium and subhymenium.

Odor not distinctive. *Taste* not recorded.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 85 - 125 μm thick, somewhat browner than adjacent pileus context, surface gelatinized to a depth of 15 μm; filamentous, undifferentiated hyphae 2.5 - 8.0 μm wide, subradially arranged, interwoven, sometimes in fascicles, with some having yellowish subrefractive walls; refractive hyphae (possibly gelatinizing filamentous, undifferentiated hyphae) 7.0± μm wide. PILEUS CONTEXT: filamentous, undifferentiated hyphae 2.0 - 10.5 μm wide, frequently branching, loosely interwoven, occasionally in fascicles, with some having yellowish subrefractive walls; acrophysalides common, thin-walled, narrowly clavate to clavate to ventricose-rostrate to narrowly ellipsoid to ovoid, up to 78 × 34 μm; vascular hyphae up to 16.8 μm wide, sinuous, sometimes branching. LAMELLA TRAMA: bilateral, with diverging elements making a rather shallow angle with central stratum, with w_{ct} = 65± μm; central stratum narrow; filamentous, undifferentiated hyphae 2.5 - 7.5 μm wide, frequently branching, relatively commonly having yellowish subrefractive walls; inflated cells thin-walled, ovoid to clavate, up to 38 × 22 μm, many with major axis parallel to central stratum; vascular hyphae not observed. SUBHYMENIUM: w_{ex}-near = 30± μm; w_{ex}-far = 50± μm; w_{st}-near = 40 - 55 μm; w_{st}-far = 70 - 80 μm; comprising frequently branching structures originating roughly perpendicular to central stratum, with branched elements spreading broadly and interweaving, with hyphae running parallel to central stratum throughout region; at first, with basidia arising from short, uninflated, sometimes branched hyphal segments perpendicular to central stratum, with some slightly inflated segments giving rise to basidia later in development. BASIDIA: 53 - 97 × 10.0 - 16.0 μm, mostly 2- and 4-sterigmate, some 1- or 3-sterigmate, thin-walled; clamps not observed. UNIVERSAL VEIL: *At stipe base, exterior surface*: filamentous, undifferentiated hyphae 2.5 - 6.0 μm wide, in gelatinized fascicles (mostly longitudinally to sublongitudinally arranged), otherwise loosely interwoven; vascular hyphae 2.5 - 6.0 μm wide, not common, mostly below surface hyphae. *At stipe base, interior*: filamentous, undifferentiated hyphae 2.5 - 13.5 μm wide, loosely interwoven, often in fascicles, branching, plentiful to locally dominant; inflated cells thin-walled, narrowly clavate to clavate to subpyriform, up to 163 × 40 μm, plentiful; vascular hyphae 1.8 - 7.5 μm wide, branching, infrequent to common to locally plentiful, sometimes tangled or knotted. *At stipe base inner surface*: filamentous, undifferentiated hyphae partially gelatinized, longitudinally arranged, closely packed, 1.2 - 5.5 μm wide; vascular hyphae uncommon or absent. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 2.5 - 10.0 μm wide, branching; acrophysalides clavate, thin-walled, up to 125 × 39 μm; vascular hyphae 2.5 - 6.5 μm wide. PARTIAL VEIL: filamentous, undifferentiated hyphae 1.5 - 13.0 μm wide, plentiful, often in fascicles, dominantly radially oriented; inflated cells plentiful, thin-walled, broadly clavate to clavate to subfusiform (up to 85 × 41 μm) or broadly ellipsoid (*e.g.*, 51 × 42 μm); vascular hyphae 5.0 - 9.0 μm wide, common, branching, sometimes coiled and tangled.

BASIDIOSPORES: [80/4/1] (11.0-) 12.2 - 17.2 (-21.0) × (7.8-) 8.0 - 11.2

(-15.2) µm, (**L** = 13.5 - 13.9 µm; **L'** = 13.8 µm; **W** = 9.0 - 9.4 µm; **W'** = 9.2 µm; Q = (1.18-) 1.36 - 1.62 (-1.73); **Q** = 1.48 - 1.52; **Q'** = 1.50), thin-walled or (rarely) with walls up to 0.8 µm thick, smooth, hyaline, colorless, inamyloid, mostly ellipsoid, occasionally broadly ellipsoid or occasionally elongate; irregularly shaped spores not uncommon, with all seen still attached to sterigmata, some malformed [quite consistently in every basidiocarp, ''Y''-shaped or shaped like a triangular headed flatworm (*Planaria*) with truly lateral apiculus]; apiculus almost always sublateral, rather broad, truncate-conic to cylindric; contents guttulate; white in deposit.

Habitat and distribution: May and November, in sandy soil among *Quercus suber* L. (*chênes-lièges*) in Morocco. On ferruginous soil under *Q. ilex* L. (*chênes verts*) in France. Also reported from Greece in protologue.

Collection examined: **FRANCE:** DÉP. BOUCHES-DU-RHôNE—la Crau, Région de Maillane, 4.xi.1961 L. Riousset *s.n.* [H. Romagnesi 66.620] (holotype, PC (*n.v.*); isotype, ROMAG; isotype, L).

DISCUSSION

This species can be distinguished from the similarly pallid *A. tuza* by the following characters:

- The partial veil in *A. tuza* is well-formed, persistent, and membranous in contrast to the cottony or granular-farinose and at times ephemeral partial veil of *A. lactea*.
- Basidial clamps are common in *A. tuza*, but were not observed in *A. lactea*.

The presence of deformed and ''giant'' spores in the specimens of the holotype that I reviewed as well as the rather large number of two-spored basidia with variably shaped sterigmata suggest that the material was in a very early stage of sporulation when it was dried. Therefore, the average dimensions of spores in mature material may be smaller than the averages I report; and I hesitate, on the basis of current evidence, to cite spore size as a character separating *A. lactea* and *A. tuza*.

10. *AMANITA LIVIDOPALLESCENS* var. *MALLEATA* Piane *ex* Romagn. 1982. *Bull. Trimestriel Soc. Mycol. France* 98: 169, fig. 1.

=*Amanita lividopallescens* var. *tigrina* Romagn. *nom. inval.* 1961. *Nouv. Atlas Champ.* 3: pl. 180. [No type specified. ICBN §37.1. Note: Plate too yellow *fide* Romagnesi (1982: 169).]

Figs. 23-24.

PILEUS: 75 - 90 mm wide, pearl gray with tints of brownish ocher to pale ocher, at first obtusely conic, then expanded, at times with slight umbo, smooth, rather shiny when collected, becoming mat on drying and then pileipellis developing an inate, frosted appearance; *context* white, brownish under pileipellis; *margin* sulcate; *universal veil* absent.

LAMELLAE: free, distant, whitish to white-cream, 7 - 8 mm broad, thin, with a barely uneven edge, subventricose, obtuse at pileus margin, with edge tinted bister (lens) near pileus margin; *lamellulae* in several ranks.

STIPE: 130 - 140 × 9 - 12 mm, with white ground color, decorated with coarse irregular bands of gray-brown fibrils in the lower part, decoration finer above this region, pruinose or farinose and white in upper portion, entirely without yellow tints, narrowing upward, flaring just at apex, deeply inserted in substrate; *context* white, somewhat brownish in central cylinder, hollow, filled with tangled silky fibrils, with central cylinder rather broad; *exannulate*; *universal veil* as a saccate volva, with top of limb 40 - 50 mm from stipe base, thick, membranous, but easily breaking up into patches, with white exterior and gray interior.

Odor very weak. *Taste* not recorded.

MACROCHEMICAL TESTS: KOH - negative on context and pileipellis. Tl-4 (Kühner and Romagnesi, 1984: 493) - negative on context and pileipellis. Phenol - rather rapidly brown-purple. Guaiac - positive in 3 minutes. Phenolaniline - weak reaction.

PILEIPELLIS: 45 - 100 μm thick, orange-brown viewed from above; filamentous, undifferentiated hyphae 1.8 - 5.5 μm wide, densely interwoven, subradially arranged, extensively gelatinizing near surface; vascular hyphae 3.2 - 4.0 μm wide, infrequent. PILEUS CONTEXT: filamentous, undifferentiated hyphae 2.0 - 11.8 μm wide, branching, plentiful, often with fine guttules on inner surface of cell wall, often in fascicles; acrophysalides thin-walled, plentiful, subpyriform to broadly clavate to clavate to elongate-ellipsoid to subfusiform, up to 103 × 48 μm or more; vascular hyphae 5.2 - 9.8 μm wide, branching. LAMELLA TRAMA: bilateral, with subhymenial elements diverging shallowly or at angles up to 90°, forming a smooth curve when diverging shallowly; $w_{cs} = 50^{\pm}$ μm; filamentous, undifferentiated hyphae 1.5 - 5.0 μm wide, branching; apparently lacking inflated cells; vascular hyphae absent in some regions, but dominating in others and then in dense tangles, 2.8 - 13.5 μm wide. SUBHYMENIUM: w_{st}-near = $15^{\pm}$ μm; w_{st}-far = $35^{\pm}$ μm; comprising occasionally branching structure of short hyphal segments, uninflated or barely inflated, roughly perpendicularly oriented to central stratum, with hyphae parallel to central stratum sometimes passing within 5 - 10 μm of base of a basidia. BASIDIA: 40 - 65 × 13.0 - 18.2 μm, dominantly 4-, also 2- and 1-sterigmate, with sterigmata up to 6.8 × 1.8 μm; clamps not observed. UNIVERSAL VEIL: *On pileus*: as a few microscopic fragments of extensively gelatinized and collapsed tissue; filamentous, undifferentiated hyphae 1.8 - 7.5 μm wide, branching, in fascicles; inflated cells dominating, apparently thin-walled, ellipsoid to ovoid to subglobose [up to 52 × 36 μm, in clusters (possibly short chains?)], broadly clavate to clavate (up to 75^{+} × 41 μm, clearly terminal); vascular hyphae not observed. *At stipe base*: no material available.

STIPE CONTEXT: no material available.

BASIDIOSPORES: [40/1/1] (10.5-) 11.0 - 13.8 (-16.0) × (8.5-) 8.8 - 11.0 (-11.5) μm, (**L** = 12.3 μm; **W** = 9.7 μm; **Q** = (1.12-) 1.16 - 1.37 (-1.42); **Q** = 1.27), hyaline, colorless, thin-walled, smooth, inamyloid, broadly ellipsoid to ellipsoid, infrequently subglobose, usually adaxially flattened, occasionally expanded at one end; apiculus sublateral, cylindric to truncate-conic; contents monoguttulate with some additional small granules; white in deposit.

Habitat and distribution: In calcareous or calcareous-clay soils, under broadleafed trees, at times with some admixture of *Pinus*, in départments of Doubs, Marne, and Oise.

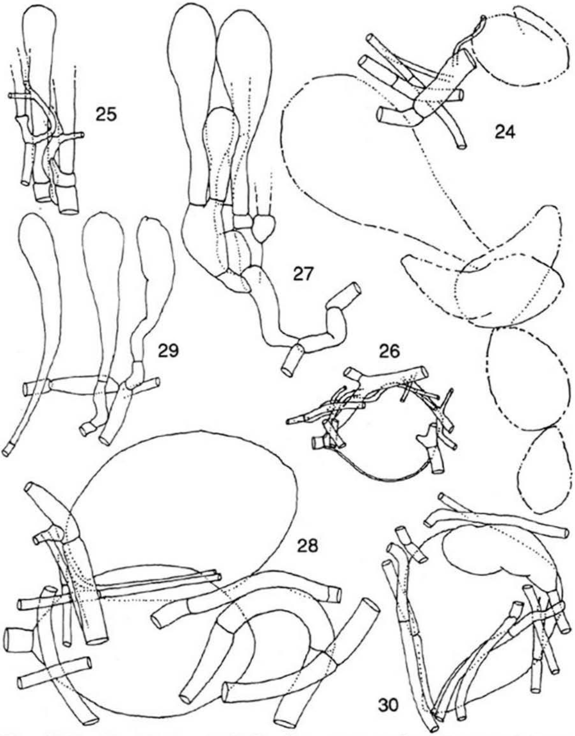
Collection examined: **FRANCE:** DÉP. OISE—Maysel, 6.viii.1957 H. Romagnesi 57.46 (holotype, ROMAG).

DISCUSSION

Based on the portions of the anatomy examined, this entity seems to be very close to, if not identical with, *A. malleata*. The local dominance of vascular hyphae in the lamella trama of *A. lividopallescens* var. *malleata* is not a character that is well understood in *Amanita*, and it seems unwise to base a taxonomic distinction upon it when the material available is limited. For comparison to other taxa, see the discussion following *A. malleata*.

Romagnesi (1982) states that *A. lividopallescens* var. *tigrina* was never published validly by him. This is confirmed by Bon (1986: 51). Therefore, the claim that the name *A. lividopallescens* var. *malleata* is invalid per ICBN §33.2 (*Index of Fungi*, 1985: 329) cannot be correct; for the later name was not intended to replace a previously validly published name, but to replace a previously invalidly published one. Bon's validation of *A. lividopallescens* var. *tigrina* (because *A. lividopallescens* var. *malleata* was supposedly invalid because *A. lividopallescens* var. *tigrina* Romagn. was supposedly valid) is logically inconsistent. Since Bon designated one of his own collections as holotype of var. *tigrina*, synonymy of var. *malleata* and var. *tigrina* has to be judged on taxonomic, rather than nomenclatural, grounds. Unfortunately, the confusion with regard to validity of these names has been maintained by Romagnesi's (1992) acceptance in error of var. *tigrina* as the correct name for the taxon.

When the holotypes of *A. malleata*, *A. lividopallescens* var. *malleata*, and *A. lividopallescens* var. *tigrina* are considered together, characters seem to vary among the basidiocarps involved only as much as one might expect to find within a single taxon at the rank of variety. Considering that all three names were intended by the authors involved to refer to a single entity, it is not surprising that they appear to be contaxic. If this taxon is to be interpreted as a variety of *A. lividopallescens* (Gill.) Seyot, the nomenclaturally correct name would be *Amanita lividopallescens* var. *malleata* Piane *ex* Romagn.; and the holotype would be Romagnesi 57.46.



Figs. 24-30. Fig. 24. *Amanita lividopallescens* var. *malleata* (Romagnesi 57.46, holotype) elements of universal veil (interior, near inner surface) from pileus. Figs. 25-26. *Amanita lividopallescens* var. *tigrina* (Bon 50715, holotype). 25. Elements of hymenium and subhymenium. 26. Elements of universal veil (interior) from stipe base. Figs. 27-28. *Amanita magnivolvata* (Aalto 1600, holotype). Slightly thickened cell walls not represented. 27. Elements of hymenium and subhymenium. 28. Elements of universal veil (interior) from above pileus of button-stage exsiccatum. Figs. 29-30. *Amanita malleata* (Bon 80092206, isotype) 29. Elements of hymenium and subhymenium. 30. Elements of universal veil (interior) from pileus.

11. *AMANITA LIVIDOPALLESCENS* var. *TIGRINA* Romagn. *ex* Bon. 1986. *Doc. Mycol.* 17(65): 51.

≡*Amanita lividopallescens* var. *tigrina* Romagn. *nom. inval.* 1961. *Nouv. Atlas Champ.* 3: pl. 180. [No type specified. ICBN §37.1. Note: Plate too yellow *fide* Romagnesi (1982: 169).]
≡*Amanitopsis lividopallescens* f. *tigrina* (Romagn.) Court. *nom. inval.* 1986. *Clé Dét. Macroscop. Champ. Sup. Reg. Nord France*: 189. [Published as "*comb. ined.*" Basionym not cited. ICBN §33.2.]
≡*Amanita oblongospora* var. *tigrina* (Romagn. *ex* Bon) Contu *nom. inval.* 1989. *Bol. Soc. Micol. Madrid* 13: 91. [Species name not validly published prior to this combination. ICBN §43.1.]
≡*Amanita tigrina* (Romagn. *ex* Bon) Contu *nom. inval.* 1990. *Funghi Ambiente* 53: 9. [Basionym not cited. ICBN §33.2.]

Figs. 25-26.

Bon's publication contains no description of either macroscopic or microscopic detail, but simply cites Romagnesi's publication of 1961. The following macroscopic description is a translation of Romagnesi's.

PILEUS: 75 - 140 mm, pale pearl gray, with a tint of ochraceous brown or pale brown, at first obtusely conic, then completely expanded, smooth, shiny at first, becoming mat when dry; *context* white or with a touch of color under pileipellis, rather thin although somewhat thicker in disc, fragile; *margin* striate, with striations rather short, but as distinct and irregularly wrinkled grooves; *universal veil* rarely present.

LAMELLAE: free, very close, whitish then cream white, with brown or gray-brown tint on edge at least near pileus margin, thin, at least 7 - 8 mm broad, somewhat ventricose; *lamellulae* of diverse lengths.

STIPE: 130 - 250 × 10 - 17 mm, ground white, narrowing upward although somewhat restricted within volval sac, not flaring at apex, decorated with rather narrow bands of gray-brown longitudinally oriented fibrils, becoming finer toward apex and finally passing into a white pruina; *context* white, stuffed with a pith at first, then hollow; *exannulate*; *universal veil* as a saccate volva, white on exterior surface, gray-brown on inner surface, felted, obconic, quite large, at least 40 mm from base of stipe to highest point of limb.

Odor and *taste* indistinct. EDIBLE.

MACROCHEMICAL TESTS: None recorded.

PILEIPELLIS: extensively gelatinized at surface, less than 25 to about 70 μm thick, brownish orange in cross-section, with this coloration shared by immediately adjacent tissues of pileus context; filamentous, undifferentiated hyphae 1.5 - 5.2 μm wide, densely interwoven, subradially oriented, gelatinized and collapsed; vascular hyphae 4.2 - 6.5 μm wide, sinuous, infrequent. PILEUS CONTEXT: densest and dominated by hyphae in region just adjacent to pileipellis, otherwise dominated by acrophysalides; filamentous, undifferentiated hyphae 1.8 - 8.8 μm wide, branching, interwoven, usually in fascicles, sometimes with slightly thickened walls, occasionally slightly refractive; acrophysalides clavate (up to 91 × 52 μm), ellipsoid to subpyriform (up to 60 × 48 μm), thin-walled; vascular hyphae 3.2 - 13.5 μm wide, branching, infrequent to locally common. LAMELLA TRAMA: bilateral, angle of divergence from very shallow to 90°; w_{cs} = 40± μm; filamentous, undifferentiated hyphae 1.0 - 6.2 μm wide, densely entangled in some regions, some coparallel in other regions, branching; inflated cells apparently absent; vascular hyphae 2.5 - 8.8 μm wide. SUBHYMENIUM: w_{st}-near = 20± μm; w_{st}-far = 30± μm; consisting entirely of filamentous, undifferentiated hyphae, very densely entangled, with some running parallel to central stratum, with basidia arising from short uninflated hyphal segments perpendicular to central stratum. BASIDIA: (38-) 48 - 63 × 9.2 - 15.5 (-18.5) μm, thin-walled, dominantly 4-, but also relatively commonly 2- and 1-sterigmate, with sterigmata up to 8.0 × 3.0 μm (largest on 1-sterigmate basidia and then slightly irregular); clamps rare. UNIVERSAL VEIL: *On pileus*: no material available. *At stipe base, exterior surface*: a slightly yellowish, partially to extensively gelatinized layer 4.9 - 10.5 μm thick; composed entirely of filamentous, undifferentiated hyphae 1.8 - 5.5 μm wide, branching, in fascicles, with fascicles tightly packed and having strong sublongitudinal orientation. *At stipe base, inner surface*: distinctly more yellowish or brownish yellow than interior, thicker and less gelatinized than exterior surface layer, 8.4 - 27 μm thick, composed entirely of somewhat collapsed and partially gelatinized, filamentous, undifferentiated hyphae. *At stipe base, interior*: filamentous, undifferentiated hyphae 1.8 - 6.0 μm wide, dominating, branching, in large fascicles somewhat loosely interwoven and progressively less longitudinally oriented at greater and greater distances from surfaces; inflated cells terminal, clustered, with walls about 0.5 μm thick, elongate to clavate (up to 82 × 33 μm), subpyriform to ovoid (up to 59 × 46 μm), with tendency toward narrower forms near exterior surface; vascular hyphae 1.8 - 5.2 μm wide, infrequent. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.8 - 15.5 μm wide, branching, thin-walled or with slightly thickened walls, dominating; acrophysalides up to 182 × 48 μm, thin-walled or with walls up to 0.5 μm thick; vascular hyphae 2.5 - 6.5 μm wide, infrequent.

BASIDIOSPORES: [60/3/1] (10.0-) 10.5 - 14.0 (-20.0) × (7.0-) 7.8 - 11.5 μm, (**L** = 11.5 - 12.2 μm; **L'** = 11.8 μm; **W** = 8.8 - 9.5 μm; **W'** = 9.2 μm; Q = (1.09-) 1.13 - 1.51 (-2.0); **Q** = 1.22 - 1.41; **Q'** = 1.28), hyaline or with slightly obscured contents, colorless, smooth, thin-walled, inamyloid, often adaxially flattened, occasionally expanded at one end, with those from immature material often distorted (*e.g.*, langeniform, pyriform, or with triangular cross-section); apiculus sublateral or rarely lateral, truncate-conic, relatively broad; contents guttulate; white in deposit.

Habitat: Under broad-leafed trees. Uncommon, end of spring into summer, in woods on calcareous clay. Originating deep in hard, clayey soil and difficult to collect without damage.

Collection examined: **FRANCE:** DÉP. SOMME—Ribeaucourt-Franqueville, vii.1965 Dupuis & M. Bon 50715 (holotype, MBON).

DISCUSSION

One of the specimens of the holotype was dried just at the start of sporulation and has gigantic and distorted spores. It was this specimen for which the **Q** value of 1.41 was computed. If this specimen's spores are not included, the spore data would be [40/2/1] (10.0-) 10.2 - 13.2 (-16.2) × (7.5-) 8.5 - 11.5 µm, (**L** = 11.5 - 11.6 µm; **L'** = 11.6 µm; **W** = 9.4 - 9.5 µm; **W'** = 9.5 µm; Q = (1.09-) 1.12 - 1.35 (-1.39); **Q** = 1.22; **Q'** = 1.22).

See discussions under descriptions of *A. lividopallescens* var. *malleata*, above, and *A. malleata*, below. Also note that this taxon differs substantially from *A. oblongospora* (see below) and cannot be a variety of it.

12. *AMANITA MAGNIVOLVATA* Aalto. 1974. *Karstenia*: 93, fig. 1.

≡*Amanitopsis magnivolvata* (Aalto) Bon. 1978. *Doc. Mycol.* 8(29): 36.

Figs. 27-28.

PILEUS: 80 - 115 mm wide, gray with slight olive tinge, faint deeper gray ring on the inner edge of sulcations, becoming leather brown on drying, hemispheric when young, dry, glossy; *context* not recorded; *margin* sulcate (0.25R); *universal veil* absent on mature specimens, with surface layer peeling for short distance radially after being started by razor scalping in "button" stage exsiccatum.

LAMELLAE: free, cream colored or whitish, drying pale tan (10YR 8/4), with edges white and conspicuously flocculose, 3 - 4 mm or more broad (nearly 4 mm broad in most mature of exsiccata), thick; *lamellulae* unevenly distributed, of varying lengths, truncate(?).

STIPE: 95 - 125 × 15 - 20 mm, whitish, with tomentum of slightly sticky hyphae, finely striate at apex; *context* not recorded, firmly stuffed, stuffing collapsing upon drying and developing transverse fissures; *exannulate*; *universal veil* as a saccate volva, membranous, ample, with felty and smooth surface, pure white when collected, after handling developing small rusty yellow spots on exterior, which persist after drying, about 60 mm from stipe base to tip of highest limb, 5 - 10 mm thick (remaining up to 5 mm thick in most mature exsiccatum), ovoid in button stage and not showing any constriction below margin of developing pileus, with *limbus internus* very small at point of attachment to stipe or absent, in button-stage exsiccatum adnate to stipe from point of previous pileus contact with stipe, with surface (in exsiccata) peeling for short distance longitudinally after peel being started by razor scalping. *Odor* and *taste* not recorded.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: In mature specimen: 60 - 70 µm thick, extensively gelatinized just at surface, colorless or nearly so; filamentous, undifferentiated hyphae 1.8 - 8.0 µm wide, branching, tightly interwoven, subradially arranged; vascular hyphae 1.8 - 8.2 µm wide, sinuous, coiling, relatively common, occasionally descending into pileus context. In button: 50± µm thick, orange-brown, ungelatinized. PILEUS CONTEXT: orange-brown immediately below pileipellis, otherwise colorless; filamentous, undifferentiated hyphae 3.0 - 14.0 µm wide, notably dominating, loosely interwoven, frequently branching, with some septa quite close together, with relatively frequent intercalary segments slightly inflated, with those of smaller diameter occasionally in fascicles, with slightly thickened walls (up to 0.5 µm thick in hyphae of largest diameters), occasionally containing one or two refractive guttules; acrophysalides broadly clavate to clavate to elongate, up to 38 × 20 µm, relatively common, with rather uniform slightly thickened walls about 0.5 µm thick; vascular hyphae 3.5 - 10.0 µm wide, branching. LAMELLA TRAMA: bilateral; central stratum densely woven, with w_{cs} = 140± µm, with divergence occurring at almost any angle including away from lamella edge; filamentous, undifferentiated hyphae 3.2 - 7.5 µm wide, branching, with swollen intercalary segments (including branched elements) up to 65 × 21 µm, with many of larger diameters having slightly thickened walls; terminal inflated cells not observed; vascular hyphae 6.5 - 7.2 µm wide. SUBHYMENIUM: w_{st}-near = 105± µm; w_{st}-far = 130± µm; a tightly interwoven tangle of frequently branching, often quite short, uninflated to partly inflated to inflated (ovoid to broadly clavate to clavate to irregular) elements, with elements of larger diameters having slightly thickened walls, with basidia arising from elements of all types including branched and subinflated ones. BASIDIA: 52 - 82 × 12.5 - 19.0 µm, with slightly thickened walls (up to 0.5 µm thick), about 50% 2-sterigmate, 25% 4-sterigmate, 25% 1-sterigmate, rarely 3-sterigmate, with sterigmata up to 10.0 × 5.0 µm; clamps relatively common to common. UNIVERSAL VEIL: *On pileus of button-stage exsiccatum, exterior surface*: 90 µm thick; just at surface comprising widely and unevenly spaced partially gelatinized fascicles of filamentous, undifferentiated hyphae without dominant orientation; below these fascicles comprising a denser (but still rather loosely interwoven) mass of hyphae without dominant orientation; filamentous, undifferentiated hyphae 2.5 - 12.8 µm wide, branching, slightly and smoothly curved or relatively straight, not coiling or twisted, often with a refractive deposit on interior of wall and/or with slightly thickened (up to 0.5 µm thick) walls; vascular hyphae not observed. *On pileus of button-stage exsiccatum, interior*: filamentous, undifferentiated hyphae 2.8 - 12.2 µm wide, branching, dominant near exterior surface layer, becoming less dominant and finally plentiful toward pileipellis, with a distinct tendency to twist and coil, with those of larger diameters often having constrictions at septa, with those of smaller diameters often in fascicles, with some of larger diameters having slightly swollen intercalary segments, with walls thickened as in hyphae of exterior surface layer; inflated cells terminal, clavate to broadly fusiform to ovoid, up to 96 × 55 µm, scarce near exterior surface layer, becoming more plentiful and finally dominating toward pileipellis, thin-walled or (frequently) with walls 0.5 - 0.8 μm thick; vascular hyphae not observed. *On pileus of button-stage exsiccatum, inner surface*: a narrow and rather compressed region, otherwise like interior. *At stipe base of mature specimen, exterior surface*: as on pileus of button, but surface fascicles are not so distant. *At stipe base of mature specimen, interior*: as on pileus of button, with inflated cells up to 141 × 63 μm. *At stipe base of mature specimen, inner surface*: extensively gelatinized, orange-brown. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 3.2 - 12.5 μm wide, branching, with those of larger diameters having slightly thickened walls; acrophysalides narrowly clavate, often with rather abrupt expansion at basal septum, up to 164 × 47 μm, with wall thickened at cell apex (from 0.5 - 1.0 μm thick), dominating; vascular hyphae 2.5 - 10.5 μm wide, branching.

BASIDIOSPORES: [40/1/1] (9.0-) 10.0 - 16.5 (-17.5) × 8.5 - 12.8 (-14.5) μm, (**L** = 12.5 μm; **W** = 10.5 μm; Q = (1.03-) 1.07 - 1.36 (-1.50); **Q** = 1.19), hyaline, colorless, thin-walled, smooth, inamyloid, subglobose to broadly ellipsoid, occasionally ellipsoid or globose, often at least somewhat adaxially flattened, with giant spores sometimes adaxially indented; apiculus sublateral to lateral, rather broad, cylindric; contents monoguttulate with additional small granules; white in deposit.

Habitat: In small group in grass-herb forest in deep shade, developing in substrate of leaf and twig litter over clay in manner making "button" stage almost entirely above surface of soil, in forest dominated by *Corylus avellana* L. with *Populus tremula* L., *Betula pubescens*, *B. verrucosa* Ehrh., and *Picea abies* L. Shrub layer abundant and including *Rhamnus frangula* L., *Salix spp.*, *Alnus incana* (L.) Moench., and *Prunus padus* L. Herb layer including *Hepatica nobilis* Schreber (=*Anemone hepatica* L.).

Collection examined: **FINLAND:** Varsinais-Suomi, Karjalohja parish, Puujärvi village, Herniemi, 1.x.1972 M. Aalto 1600 (holotype, H).

DISCUSSION

More than half of each lamella (portion adjacent to the stipe) is extensively gelatinized. The spores from the most well-preserved portions of the lamellae of the only mature basidiocarp in the holotype are sometimes "giant" and sometimes slightly deformed, and the basidia are dominantly bisterigmate. Both these facts suggest that the specimen was just beginning to sporulate when it was dried. Thus the above data on anatomy of lamellae are likely to represent a stage of development that is less than fully mature; the spores of a mature specimen might well differ—possibly being somewhat smaller on average and (because the highest values of Q were associated with the largest spores) with a somewhat lower value of **Q** as well. It is also possible that the acrophysalides of the pileus context may be larger and more plentiful in more mature material.

The pigmented inner surface of the universal veil at the stipe base of the most mature specimen suggests that this surface is at least sometimes pallidly concolorous with the pileus.

The present species can be distinguished from *A. pachycolea* and *A. pachyvolvata* on the bases of difference in pileus color, the relatively more elongate stipes of these two entities, and their lack of the slightly thickened cell walls prevalent in *A. magnivolvata*. Spore size and shape may prove to be different as well. However, see the cautionary remarks, above. *Amanita pachycolea* lacks vascular hyphae in its pileipellis in contrast to the present species.

For comparison with *A. violettae*, see the discussion following the description of that species.

Peeling of the surface of the universal veil is recorded for this species for future reference and not as a contrast to other taxa the holotypes of which may not have been in a condition allowing a similar observation to be made.

13. *AMANITA MALLEATA* (Bon) Contu. 1986. *Boll. Assoc. Micol. Ecol. Romana* 6-7: 43.

≡*Amanitopsis malleata* Bon. 1983. *Doc. Mycol.* 12(48): 33. [Since the epithet *malleata* was previously validated by Romagnesi (1982), "Piane *ex*" is here omitted from the authorial citation.]

≡*Amanita malleata* Piane *nom. inval.* 1972. *Bull. Soc. Naturalistes Oyonnax* 19-21: 51-58. [No type specified. ICBN §37.3.]

=?*Amanita pianei* Migliozzi & Lavorato *nom. prov.* 1987. *Micol. Veg. Medit.* 2: 43 with unnumbered fig. and pl. on p. 38. [Material depicted and described appears to belong to a taxon other than the elliptical-spored element in the holotype of *A. malleata*.]

=*Amanita vaginata* var. *malleata* Piane *ex* Becker *nom. inval.* 1975. *Bull. Trimestriel Féd. Mycol. Dauphiné-Savoie* 15(56): 23. [Basionym not cited. ICBN §33.2.]

Figs. 29-30.

PILEUS: (30-) 50 - 120 (-150) mm wide, grayish beige to leaden, becoming pallid, dirty white in age, hemisperical at first, then more or less conic or campanulate, with silhouette appearing somewhat polygonal due to flattening of some areas as if hammered flat or squeezed by hand, appearing like dimples at point of full expansion of pileus; *context* white, unchanging when cut or bruised, rather thin above lamellae; *margin* strongly striate for up to 10 - 15 (-20) mm (approx. 0.25 - 0.4R), nonappendiculate, liable to become rimose; *universal veil* in large warts or patches, friable, becoming subglobose warts, pale at first, then yellowish or pale ochraceous, pale (to dirty white) in age.

LAMELLAE: free, creamy white to ochraceous cream and even slightly pinkish when drying, ochraceous (10YR 7/8) in exsiccatum examined, somewhat ventricose, with fimbriate or lightly puncticulate edge sometimes having pinkish hue; lamellulae infrequent in portion of exsiccatum examined.

STIPE: (60-) 100 - 120 (-150) × 10 - 20 mm, smooth and white to off-white above, becoming progressively more snakeskin-patterned and grayer towards the base, most strongly patterned just above region bearing universal veil remnants, narrowing upward, lacking a strangulated zone as is often illustrated for *A. ceciliae* (B. & Br.) Bas; *context* white, stuffed at first, rapidly becoming hollow, with central cylinder diameter up to two thirds of overall stipe diameter; *exannulate*; *universal veil* as a fragile, saccate volva breaking up into more or less floccose shreds and fragments, 2 - 3 mm thick, whitish or with ochraceous stains or spots on exterior, with grayer hues on inner surface, exterior pale ochraceous with gray tone as dried, interior tissue paler and with gray tint as dried, with *limbus internus* apparently lacking.

Odor and *taste* not distinctive.

MACROCHEMICAL SPOT TEST: Phenol - a rather drab vinaceous purple.

PILEIPELLIS: strongly gelatinized in some regions, 20 - 40 μm thick, very pale brownish yellow (barely darker than context); filamentous, undifferentiated hyphae 1.2 - 10.8 μm wide, branching, rather tightly interwoven, without dominant orientation; refractive hyphae 2.8 - 8.5 μm wide, branching, smoothly curving. PILEUS CONTEXT: filamentous, undifferentiated hyphae 1.2 - 10.2 μm wide, branching, thin-walled, loosely interwoven, often in fascicles; acrophysalides clavate to narrowly clavate to narrowly subventricose, thin-walled, plentiful, up to 121 × 35 μm; refractive hyphae 4.5 - 10.8 μm wide, locally plentiful, not coiling tightly. LAMELLA TRAMA: bilateral, with $w_{cs} = 45^{\pm}$ - 60 μm (but not rehydrating well), with angle of divergence 30° - 45° and elements (dominantly hyphae) continuing to diverge in a relatively smooth curve until perpendicular (or nearly so) to central stratum; filamentous, undifferentiated hyphae 1.8 - 7.0 μm wide, in a dense tangle, branching, dominating, occasionally with very slightly inflated intercalary elements; inflated cells absent or obscured by tangled hyphae; refractive hyphae 3.0 - 4.0 μm wide, uncommon. SUBHYMENIUM: a tangle of filamentous, undifferentiated hyphae, with w_{st}-near = $5^{\pm}$ μm and w_{st}-far = $30^{\pm}$ μm (but tissue difficult to rehydrate), containing some hyphal segments running parallel to central stratum and some very slightly inflated segments, with basidia arising from hyphal segments perpendicular to central stratum or nearly so. BASIDIA: 39 - 75 × 9.0 - 15.5 (-18.0) μm, dominantly 4-, but also 1- and 2-sterigmate, with 2-sterigmate ones locally common, thin-walled; sterigmata up to 3.0 μm wide at base; clamps not observed. UNIVERSAL VEIL: *On pileus, upper surface*: pigmentation (pale yellowish tan) restricted to broken and partially to strongly gelatinized cells at surface; with occasional remains of one to two hyphal diameter thick layer, composed of filamentous, undifferentiated hyphae 2.0 - 7.0 μm wide, loosely interwoven, fractured, gelatinized; inflated cells at surface like those of interior, but gelatinized and broken; vascular hyphae not observed. *On pileus, interior*: filamentous, undifferentiated hyphae 1.8 - 11.0 μm wide, frequently branching, loosely woven, often in fascicles, plentiful; inflated cells, dominating at least locally, globose to subglobose to broadly ellipsoid to ellipsoid to broadly clavate to ovoid to pyriform, up to 68 × 51 μm, walls thin to very slightly thickened; refractive hyphae 3.2 - 4.8 μm wide, not tightly coiled. *On pileus, lower surface*: like interior, but with a greater proportion of filamentous, undifferentiated hyphae. *From base of stipe*: lacking in specimen examined. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.5 - 8.5 μm wide, branching, thin-walled or with walls slightly thickened, dominating; acrophysalides narrow, thin-walled or with walls up to 0.5 μm thick, up to 150 × 32 μm; refractive hyphae 1.0 - 8.0 μm wide, branching.

BASIDIOSPORES: [40/1/1] (9.8-) 10.0 - 12.8 (-14.0) × (6.5-) 8.0 - 10.5 (-11.8) μm, (**L** = 11.6 μm; **W** = 9.5 μm; Q = (1.10-) 1.14 - 1.39 (-1.54); **Q** = 1.23), inamyloid, smooth, hyaline, colorless, thin-walled, subglobose to broadly ellipsoid, occasionally ellipsoid, infrequently pip-shaped, often at least somewhat adaxially flattened, occasionally expanded at one end; contents monoguttulate to multiguttulate to granular; apiculus sublateral, cylindric, occasionally thick and prominent; color in deposit not recorded.

Habitat: Gregarious, in grassy area with calcareous soil near areas of brush or forests of broad-leafed trees, Jura Mtns.

Collection examined: **FRANCE:** DÉP. AIN—Arfontaine, near Oyonnax, 22.ix.1980 L. Bas *s.n.* [M. Bon 80092206] (holotype, MBON, includes lectotype as designated by me below).

DISCUSSION

Unfortunately, the type collection is a mixed collection. It includes a segment of pileus with a grayish tint to its lamellae [slightly sordid tan (2.5Y 7/6) in exsiccatum], with a very narrow lamella trama, with very shallow subhymenial tree, and having spores with the following characteristics:

BASIDIOSPORES (from smaller pileus fragment in material examined): [40/1/1] (8.5-) 9.0 - 11.2 (-12.0) × (7.5-) 8.0 - 10.8 (-11.8) μm, (**L** = 10.1 μm; **W** = 9.3 μm; Q = 1.02 - 1.18 (-1.25); **Q** = 1.09), hyaline, colorless, smooth, inamyloid, thin-walled, globose to subglobose, infrequently broadly ellipsoid, often adaxially flattened, occasionally swollen at one end, occasionally pip-shaped; contents monoguttulate for the most part; apiculus sublateral, cylindric to subcylindric.

The subhymenium of the smaller fragment is difficult to reinflate, but appears to consist largely of hyphae that run parallel to the hymenial surface; occasionally a basidium arises from a hyphal segment perpendicular to the central stratum. The basidia are rather short and stubby. There appear to be no fully or partially inflated cells present.

The second, larger pileus fragment in the material examined had a rather long piece of stipe connected to it. This fragment was chosen by me as lectotype of *A. malleata* for the following reasons:

- While Bon, in the protologue, at first says that the spores are "rondes pour la plupart," he goes on to say, "on peut trouver en mélange quelques spores piriformes ou obovoïdes par exemple (10)11-13(14) × (8,5)9-10(12) μm..."; this range is very close to that which I found for spores from the larger pileus. Even in the case of the round spores reported by Bon, the dimensions given by him ("diamètre 11-13 μm") are a poor match for the spore sizes measured from the smaller pileus segment. Moreover, it was Bon's intention to validate the name "*Amanita malleata* Piane"; and Piane (1972) describes the spores as 11 - 13 × 8.5 - 10.5 μm—a very good match to my findings for spores of the larger fragment.
- The larger pileus fragment had a thick fragment of universal veil on it, and a thick universal veil is emphasized as an important diagnostic character in the protologue. The smaller pileus fragment was devoid of universal veil material.
- The protologue states that the basidia are elongately clavate and that the subhymenium is subcellular whereas the the basidia of the smaller fragment are short and stubby and its subhymenium contains no elements that are even partially inflated. Further, there is no region of the lamella trama of the smaller fragment that could be interpreted as an hymenopodium containing tangled hyphae as described in the protologue.
- The protologue emphasizes the ochraceous to pinkish tones of the lamellae (even when drying) and does not mention gray tones in the lamellae.

The specimen of the holotype conforming to the full anatomical description given above ("larger specimen") was segregated by me in a plastic envelope containing a small label marked "A." I designate it as the lectotype of *A. malleata* (ICBN §9.2). The smaller specimen is segregated in a plastic envelope with a small label marked "B." At present, I am unable to determine it.

In the protologue, Bon cited a few macroscopic characters of *A. malleata* useful for distinguishing *A. malleata* from *A. beckeri*. To that list, can be added broadly ellipsoid to ellipsoid, larger spores of the former.

Although the name has been ignored in recent literature for the most part, *A. biovigera* Sing. ≡ *A. strangulata sensu* Bresadola is a validly published name of a species of *Amanita* section *Vaginatae* with subglobose to broadly ellipsoid to ellipsoid spores and a friable or weakly structured universal veil. The original publication is in a list of taxa assigned to *Amanita* section *Ovigerae* Sing. in (Singer, 1951 ["1949"]) and consists entirely of the following: "*A. biovigera* Sing. [*A. strangulata* (Fr.) Quél. sensu Bres. non al.]." Dr. C. Bas pointed out to me that, because Bresadola's description was in Latin, the brief passage just cited results in a valid publication of *A. biovigera*. Dr. Bas was very generous in sending me notes that he had prepared on the subject several years ago. He had examined potential syntypes of *A. biovigera* among Bresadola's collections at S. The composite of Dr. Bas' spore measurements follows: [25/3/3] (10.8-) 11.2 - 13.9 (-14.4) × (8.2-) 8.3 - 11.5 (-11.7) μm, (L =

11.7 - 12.9; **L'** = 12.4 μm; **W** = 8.6 - 10.4 μm; **W'** = 9.8 μm; Q = (1.07-) 1.08 - 1.45 (-1.51); **Q** = 1.18 - 1.35; **Q'** = 1.27). (Note that Dr. Bas records that the specimen with spores having **Q** = 1.18 was marked "juvenilis" by Bresadola.) Bresadola's (1927: 18 & tab. XVIII) description includes an umbrinous pileus 80 - 100 mm wide and a stipe 120 - 160 × 11 - 15 mm. The color of the pileus in the accompanying plate is between *Light Brownish Olive* (2.5Y 4.6/3.5) and *Buffy Olive* (5Y 5.0/4.0) or a little lighter (difficult to determine precisely due to uneven application of pigment in the copy of the illustration reviewed (NY)).

In comparison to *A. malleata*, *A. biovigera* has a differently colored (darker) pileus and larger, somewhat more elongate spores. Future selection of a lectotype of the latter name will facilitate a more thorough comparison.

For comparison to *A. lividopallescens* var. *malleata* and *A. lividopallescens* var. *tigrina* see the discussion following the description of the first named of these taxa.

A comparison to *A. oblongospora* is required due to the broadly ellipsoid to ellipsoid spores of the material that I have selected as the lectotype of *A. malleata*. See discussion following the description of *A. oblongospora*.

14. *AMANITA MORTENII* Knudsen & Borgen *emend. nov.* Tulloss & Borgen.

≡*Amanita mortenii* Knudsen & Borgen *in* Laursen *et al.* 1987. *Arct. Alp. Fungi* 2: 244, fig. 3.

Figs. 31-32.

In examination of the paratypes of this species, I noted that they included two distinct taxa, properties of which appeared in combination in the protologue. The macroscopic description presented immediately below is based on field notes and photographs of the material contaxic with the holotype and on examination of exsiccata.

PILEUS: 50 - 55 mm wide, olive gray to olive brown, first conic, later convex, sometimes with umbo; *margin* sulcate (0.4 - 0.5R); *universal veil* absent or in a few gray patches.

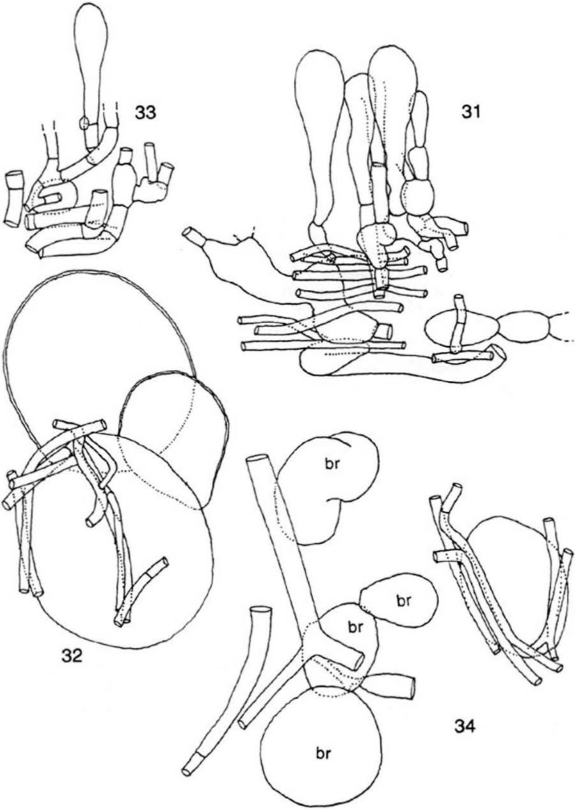
LAMELLAE: close, white at first, then pallid, drying pale yellowish (slightly paler than 4A3) with slightly sordid margin; *lamellulae* truncate to subtruncate to subattenuate, of diverse lengths, unevenly distributed, occasionally adjoining stipe rather than pileus margin.

STIPE: 110 × 7 - 11 mm, pale brownish without strangulate belts of universal veil tissue; *exannulate*; *universal veil* as a saccate volva, fleshy, gray, with uppermost point of limb 40 - 45 mm from base of stipe, lower half appressed to stipe, with white floccose *limbus internus* placed at point of attachment.

Odor absent. *Taste* not recorded.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 70 - 110 μm thick, yellowish brown for most part, colorless in strongly gelatinized region, composed of filamentous, undifferentiated hyphae 1.0 - 3.5 μm wide, densely interwoven, subradially arranged, partially gelatinizing to extensively gelatinizing at surface, rather easily separating from pileus context in holotype; vascular hyphae 3.5 - 5.2 μm wide, infrequent, not radially arranged. PILEUS CONTEXT: filamentous, undifferentiated hyphae 2.5 - 12.0 μm wide, branching, interwoven, some with walls up to 0.8 μm thick, sometimes with granular contents; acrophysalides terminal, subfusiform to clavate to broadly clavate to ellipsoid to pyriform (up to 148 × 63 μm), with walls up to 1.0 μm thick; vascular hyphae uncommon, 9.0 - 18.0 μm wide. LAMELLA TRAMA: bilateral, with $w_{ct} = 95^{\pm}$ μm, with much of region taken up by a proportionally broad central stratum ($w_{cs} = 65^{-}$ - 70 μm), with very variable angle of divergence; filamentous, undifferentiated hyphae 2.0 - 6.5 μm wide, branching, tightly packed, with some having long uninflated segments and others having shorter, fusiform to subfusiform to clavate segments (up to 11.0 μm wide); inflated cells ellipsoid to clavate, up to 64 × 27 μm (mostly two-thirds this size or less), relatively common (but not densely arrayed) to infrequent or obscured by hyphae, divergent or not; vascular hyphae not observed. SUBHYMENIUM: densely interwoven and branching, with w_{ex}-near = $0^{\pm}$ μm and w_{ex}-far = $30^{\pm}$ μm, with some inflated cells of trama exceeding bases of longer basidia, with narrow diameter hyphae running parallel to central stratum rather plentiful near bases of longer basidia, with basidia arising from branched or simple, partially inflated or uninflated hyphal segments (oriented at many angles to central stratum, but dominantly perpendicular to it), with basidia arising singly or in pairs from side or end of segment. BASIDIA: 43 - 70 × 12.8 - 19.0 μm, predominantly 4-sterigmate, occasionally 2- or 1-sterigmate, thin-walled, with sterigmata up to 12.5 × 4.0 μm; clamps not observed. UNIVERSAL VEIL: *At stipe base, exterior surface*: a very thin layer comprising narrow groups of fascicles of hyphae, moderately gelatinized, well-separated, co-parallel, with plentiful inflated cells of interior easily visible between groups; filamentous, undifferentiated hyphae 3.2 - 5.0 μm wide, branching; vascular hyphae $3.2^{\pm}$ μm wide, branching, not common. *At stipe base, interior*: filamentous, undifferentiated hyphae 2.5 - 6.8 μm wide, plentiful, branching, in loosely interweaving fascicles, many segments (particularly near-terminal segments) with somewhat thickened walls (up to 0.5 μm thick); inflated cells dominating, often yellowish brown to very pale brown, globose to subglobose to subpyriform to broadly ellipsoid (up to 78 × 69 μm), clavate to broadly clavate to ellipsoid (up to 79 × 41 μm), terminal, singly or in short chains, with walls thin or up to 1.0 μm thick; vascular hyphae 2.0 - 5.0 μm wide, infrequent. *At stipe base, inner surface*: no data taken. *On pileus*: absent in material reviewed. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.8 - 10.5 μm wide, branching, dominating, with those of larger diameter having walls up to 0.5 μm thick; acrophysalides common, clavate to narrowly clavate, with walls up to 0.8 μm thick, up to 135 × 43 μm; vascular hyphae 1.2 - 8.0 μm wide, branching, unevenly distributed (locally uncommon to locally plentiful).



Figs 31-34. Figs. 31-32. *Amanita mortenii* (Petersen 150, holotype). 31. Elements of hymenium and subhymenium. 32. Elements of universal veil (interior) from stipe base. Figs. 33-34. *Amanita oblongospora* (Contu 86 10 25/05, holotype). 33. Elements of hymenium and subhymenium. 34. Elements of universal veil (interior)—original orientation on basidiocarp unknown.

BASIDIOSPORES: [131/7/3] (8.7-) 9.8 - 12.0 (-14.3) × (8.1-) 9.0 - 11.2 (-13.0) µm, (**L** = 10.3 - 11.2 µm; **L'** = 10.7 µm; **W** = 9.6 - 10.6 µm; **W'** = 10.1 µm; Q = (1.0-) 1.02 - 1.11 (-1.22); **Q** = 1.06 - 1.08; **Q'** = 1.07), inamyloid, thin-walled, hyaline, colorless, globose to subglobose, rarely broadly ellipsoid, frequently adaxially flattened, sometimes swollen slightly at one end; contents mono- or multiguttulate; apiculus sublateral, truncate-conic to cylindric, can be rather large relative to spore size; color in deposit not recorded.

Habitat: Scattered on dry heath among *Betula glandulosa* and *Empetrum sp*.

Collections examined: **GREENLAND:** Kangilinnguit (Grønnedal) - "Elleslie havn" (25 km from Paamiut), 13-14.viii.1985 T. Borgen TB.85.133 *p.p.* (paratype, C; portions in RET & TBOR are not contaxic with holotype). Near Narssarssuaq - at Rosenvinges Plantation, 29.vii.1983 H. Knudsen, T. Borgen, J. H. Petersen [J. H. Petersen 150] (holotype, C). Qunqua Valley - Taserssuaq Lk., 27.vii-23.viii.1983 H. Knudsen, T. Borgen & J. H. Petersen [J. H. Petersen 462] (paratype, C & L).

DISCUSSION

The above description corrects errors made in describing the anatomy of *A. mortenii* in Tulloss (1988) due to basing the description on some of the nonconformant paratypes.

Knudsen & Borgen (1987) used thick-walled cells for the first time as a character to support establishment of a species concept in *Amanita*. I discussed this briefly before (Tulloss, 1988; Tulloss & Wright, 1989). Since that time, I have watched for such cells and have found them in many species of the genus. To date, my experience indicates that the character is a rather stable one for a given taxon.

For comparison with *A. groenlandica* see the discussion following the description of that taxon.

Amanita submembranacea var. *submembranacea* differs from *A. mortenii* by having slightly larger spores; by lacking thickened walls in all elements; by having a narrower lamella trama with smaller inflated cells; and by lacking the relatively plentiful chains of short, partially inflated segments seen in the lamella trama of the present taxon. While there are strong similarities in the structure of the subhymenium in these two taxa, that of *A. submembranacea* contains relatively few inflated or partially inflated elements in contrast to that of the present species.

Amanita submembranacea var. *bispora* differs from *A. mortenii*, by having a rather dark brown pileus, by having no notable inflated elements in the lamella trama and subhymenium, and by lacking thick-walled elements. I am not inclined to give taxonomic importance to the proportion of 2-sterigmate basidia in the holotype of *A. submembranacea* var. *bispora* because (as noted below) it appears to have been dried in the early stages of sporulation.

Several of the paratypes of the present taxon were found to have a consistently different spore shape than the others have. While the collections described above have Q in the very restricted range 1.06 - 1.08, the remaining paratypes of *A. mortenii* have Q in the range 1.10 - 1.18. For the aberrant collections, a macroscopic description distilled from their field notes proved to differ from the description that could be gained from the field notes on the collections cited above. The narrower spored entity is distinguishable by a less strongly umbonate pileus with a less decurved/incurved margin even at an early stage; pileus colors that are more ochraceous than olivaceous; filamentous, undifferentiated hyphae of the universal veil that are of considerably larger diameter; lack or scarcity of filamentous, undifferentiated hyphae running parallel to the central stratum in the subhymenial region; and the spore shape difference noted. The disparate paratypes will be described in a separate publication as a new taxon. The protologue of *A. mortenii* includes details from the field notes on collections of both entities, and the macroscopic description of *A. mortenii* has been emended as noted above.

For the time being, I provide a macroscopic description of the *nonconformant collections* and a description of their spores:

PILEUS: campanulate at first with a suggestion of an umbo, in this form 24 - 52 mm wide and 23 - 40 mm high, ocher (near 10YR 6/6) to warm ocher (10YR 5-6/8) to cardboard brown, paler to off-white toward margin, tacky to dry, glistening when moist, slightly shiny when dry; *context* rather soft; *margin* striate-sulcate (0.4R), striations rather faint at first although long even then; *universal veil* absent or as small, pale saffron "flakes" or as pallid small patches with gray margins.

LAMELLA: free?, close, very pale buff (a little paler than 10YR 8/2) to off-white, with white, flocculose edge.

STIPE: 70 - 110 × 8 - 16 mm, pulverulent especially near apex, off-white to very pale gray brown, pale gray-brown near bruises and wounds, palest toward apex; *exannulate*; *universal veil* as a saccate volva, submembranous, with upper tip of limb about 30 mm from base of stipe, fleshy, flexible at first, then rather fragile, 0.5 - 2 mm thick, with exterior pale gray to gray (near 10YR 5/1), at times with saffron tint in free limb, paler toward the stipe base (*e.g.*, 10YR 8/1), inner surface off-white to pale gray, with *limbus internus* placed at the point of attachment between stipe and volval limb.

Odor lacking. *Taste* not recorded.

BASIDIOSPORES: [120/6/4] (8.5-) 9.2 - 13.5 (-16.5) × (7.2-) 8.2 - 11.5 (-15.0) μm, (**L** = 10.1 - 11.9 μm; **L'** = 10.9 μm; **W** = 8.9 - 10.1 μm; **W'** = 9.6 μm; Q = (1.0-) 1.05 - 1.28 (-1.47); **Q** = 1.10 - 1.18; **Q'** = 1.13), hyaline, colorless, smooth, thin-walled, inamyloid, subglobose to broadly ellipsoid, infrequently globose or ellipsoid, usually at least somewhat adaxially flattened; contents most frequently multiguttulate, occasionally monoguttulate; apiculus sublateral, truncate-conic to cylindric; color in deposit not recorded.

Habitat of nonconformant collections: On heath near *Betula glandulosa* and *Empetrum sp.*

Nonconformant collections examined: **GREENLAND:** Kangilinnguit (Grønnedal)—Eqaluit fjord - Paamiut (Frederikshåb) area, 19.viii.1973 P. M. Petersen 73.319 (C), 24.viii.1984 T. Borgen TB.84.172 (C); "Elleslie havn" (25 km from Paamiut), 13.viii.1985 T. Borgen TB.85.133 *p.p.* (RET & TBOR); no specific locale other than "Equaluit [sic]," 11.viii.1981 T. Borgen TB.119-81 (C). Near Narssarssuaq - Rosenvinges Plantation 27.vii-23.viii.1983 H. Knudsen, T. Borgen, & J. H. Petersen 151 (C).

Knudsen *et al.* 151 comprises a single, immature specimen lacking spores that is tied to a card with nylon thread. There is a color photo in C depicting two basidiocarps with graying, submembranous universal veil and having a strong orangish tint to the pileus. The back of this photograph is marked "HK, TB, JP 151." On the grounds of this photo, the specimen is placed with the narrow-spored specimens.

15. ***AMANITA OBLONGOSPORA*** Contu *ex* Tulloss & Contu. *sp. nov.* Holotypus: Italy, Sardinia, Prov. Cagliari, "Is Cannoneris" St. For., Punta Sebera, 25.x.1986 M. Contu 86 10 25/05 (CAG).

≡*Amanita oblongospora* Contu *nom. inval.* 1988. *Bol. Soc. Micol. Madrid* 12: 90. [All requirements for valid publication were met except that a type was not specified, although the herbarium in which it is deposited was mentioned. ICBN §37.1, §37.3.]

Figs. 33-34.

In validating this name, I am pleased to be joined by its original author. We wish to make it clear that we exclude from the protologue any descriptive material in Dr. Contu's publication of 1988 that is not in agreement with the following description. The macroscopic description presented below is based strictly on the field notes and drawing deposited with the holotype in CAG and Dr. Contu's notes on the Laconi collections that we include as paratypes. The description of anatomical detail is mine. Dr. Contu's notes (in CAG) on the size of the spores of this species are in agreement with my findings reported below.

Pileus 65 - 80 mm *latus, carnosus, campanulatus dein expansus, umbonatus, humidus dein siccus, albo-griseus, disco ochraceo-brunneo. Lamellae confertae, crassiusculae, liberae, albae sed in acie interdum griseo-brunneae. Stipes* 80 - 150 × 6 - 15 mm, *exannulatus, albus vel griseo-variegatus, farctus dein cavus. Volva alba, fragilis, friabilis vel submembranacea, saepe cupulata. Sporae* (8.2-) 10.5 - 13.8 (-16.2) × (7.2-) 7.8 - 10.8 (-13.5) μm, *ellipsoideae vel elongatae, inamyloideae. Basidia* 36 - 87 × 8.5 - 17.0 μm, *tetrasporigera. Fibulae praesentes.*

PILEUS: 65 - 80 mm wide, light pearl gray, with disc brown-ocher, darkening with age, campanulate at first, later planoconvex to planar, often with a prominent and broad umbo, glabrous, moist and lubricious at first to slightly viscid, then dry; *context* rather fleshy; *margin* striate-sulcate up to 7 mm (0.1 - 0.2R); *universal veil* absent or as a large patch or patches, submembranous to membranous, rather thick, white to off-white, in exsiccata white with brownish stains to pale brownish gray.

LAMELLAE: free, subdistant, white, orangish tan (5B4) to grayish brown to sordid tan (10YR 7/6) in exsiccata (after several months), rather broad and thick, with edge concolorous with pileus or lightly tinted bister and entire; *lamellulae* present.

STIPE: 80 - 150 × 6 - 15 mm, cylindric to narrowing upward, subsmooth, white to whitish above, sometimes with rather pale brown-bister fibrils in bands below; *context* white to slightly bister towards base, stuffed to hollow, quite firm, but fragile and quick to decay; *exannulate*; *universal veil* as small, cup-like volva or a fragile saccate volva or in fragments, white to ochraceous, friable to submembranous, extending up to 30 mm up stipe, not easily removed from substrate.

Odor and *taste* not distinctive.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 55 - 90 μm thick, slightly more brownish yellow than context to brownish orange; filamentous, undifferentiated hyphae 1.2 - 6.2 μm wide, extensively gelatinized near surface, subradially arranged, tightly interwoven; vascular hyphae 3.8 - 4.0 μm wide, uncommon, branching. PILEUS CONTEXT: filamentous, undifferentiated hyphae 3.5 - 12.5 μm wide, branching, apparently rarely in fascicles; acrophysalides dominating, thin-walled, clavate to pyriform to ovoid, up to 123 × 72 μm; vascular hyphae 2.8 - 7.5 μm wide, branching. LAMELLA TRAMA: bilateral, with $w_{cs} = 60 - 80^{\pm}$ μm, with hyphae diverging at an angle ranging from very shallow (quite commonly) to nearly perpendicular to central stratum; filamentous, undifferentiated hyphae 3.0 - 10.5 μm wide, sometimes with intercalary segments inflated up to 18.5 μm wide; inflated cells difficult to distinguish in tangle of hyphae (*e.g.*, 43 × 16.0 μm, 66 × 30 μm, etc.), at shallow angle to central stratum; refractive hyphae $3.0^{\pm}$ μm wide, scarce. SUBHYMENIUM: w_{ex}-near = 10 - 20 μm; w_{ex}-far = 25 - 35 μm; tangled, interwoven mass of filamentous, undifferentiated hyphae, branching, mostly uninflated, with a few partially inflated to inflated intercalary cells, with some hyphae running parallel to central stratum; with basidia mostly arising from short, uninflated hyphal segments that are roughly perpendicular to central stratum, but also arising from partially inflated (*e.g.*, clavate) or (more rarely) inflated cells. BASIDIA: 36 - 87 × 8.5 - 17.0 μm, dominantly 4-sterigmate, thin-walled; clamps common. UNIVERSAL VEIL: *At stipe base, exterior surface*: filamentous, undifferentiated hyphae 1.2 - 5.0 μm wide, branching, loosely interwoven, single and in fascicles (some longitudinally oriented), gelatinizing to extensively gelatinizing, only a few hyphal diameters thick, covering interior tissues completely occasionally, usually with a very open weave exposing interior tissues; vascular hyphae not distinguishable due to gelatinization. *At stipe base, interior*: filamentous, undifferentiated hyphae 2.2

- 8.2 μm wide, branching, plentiful, occasionally to often in fascicles, many with sublongitudinal orientation, dominant very close to surfaces; inflated cells subglobose to pyriform to ovoid to ellipsoid to broadly clavate to clavate to subfusiform, up to 78 × 50 μm, colorless to sordid to pale brown, thin-walled, terminal, plentiful to dominant; vascular hyphae not observed; clamps present. *At stipe base, inner surface*: partially gelatinizing; hyphae dominant, rather densely packed, sublongitudinally oriented; inflated cells fewer, smaller, and relatively narrower than in interior. STIPE CONTEXT: longitudinally acrophysalydic; filamentous, undifferentiated hyphae 2.2 - 10.0 μm wide, branching, plentiful, sometimes with guttulate material lining inside of cell wall; acrophysalides clavate to narrowly subfusiform, thin-walled, plentiful to dominant, up to 214 × 38 μm; vascular hyphae 5.0 - 11.8 μm wide, branching, uncommon; clamps present.

BASIDIOSPORES: [160/7/4] (8.2-) 10.5 - 13.8 (-16.2) × (7.2-) 7.8 - 10.8 (-13.5) μm, (**L** = (11.5-) 12.0 - 12.6 μm; **L'** = 12.1 μm; **W** = 8.5 - 9.9 (-10.1) μm; **W'** = 9.2 μm; Q= (1.07-) 1.14 - 1.59 (-2.16); **Q** = (1.19-) 1.23 - 1.45; **Q'** = 1.33), hyaline, colorless, thin-walled, smooth, inamyloid, broadly ellipsoid to ellipsoid, occasionally elongate, infrequently cylindric, occasionally subventricose to ovoid, often adaxially flattened; apiculus sublateral, cylindric, broad at times; contents granular to mono- or multiguttulate; white in deposit.

Habitat: Infrequent, holotype found under mixed, broad-leafed trees (including *Quercus spp.*) in humicolous, acid soil.

Collections examined: **ITALY:** SARDINIA—Prov. Cagliari - "Is Cannoneris" St. For., Punta Sebera, 25.x.1986 M. Contu 86 10 25/05 (holotype, CAG). Prov. Nuoro - Laconi, 20.vi.1992 M. Contu 92/37 (paratype, CAG), 92/38 (paratype, CAG; fragments, RET), 92/43 (paratype, CAG).

DISCUSSION

Contu (1988) warns that this species may be confounded with *A. lividopallescens* and *A. malleata*. The former can be distinguished (at least) by its dominantly subglobose spores, membranous universal veil, and (in immature basidiocarps) by its fragile and ephemeral partial veil. There may be further distinctions, but presently I am not sufficiently familiar with *A. lividopallescens* to know of them.

Contu (1988) distinguished *A. oblongospora* from *A. malleata* primarily on the basis of the globose spores that he found in his type study of *A. malleata* (he has kindly confirmed this in personal correspondence). As noted in the discussion of that species, the holotype of *A. malleata* is heterogeneous; I have proposed to designate as lectotype the component of the holotype collection of which the spores are subglobose to broadly ellipsoid to ellipsoid. Nevertheless, *Amanita oblongospora* is distinguishable from *A. malleata* as defined by the lectotype designated, above. The pileus of the latter is hemispherical at first rather than campanulate, and the ratio of its marginal striations' length to the radius of the pileus is nearly twice that seen in *A. oblongospora*. The pileus of *A. malleata* becomes pale with age while that of *A.*

oblongospora becomes darker. The anatomy of the lamella trama and subhymenium are quite similar in the two taxa; however, the frequent presence of clamps at the base of the basidia in *A. oblongospora* and the frequently higher value of **Q** of its spores in the material examined are reasons for maintaining the taxa as distinct. I made a very extensive search for clamps at the base of basidia in the lectotype of *A. malleata*; the subhymenium is extremely dense, which made the task rather difficult; however, I was not able to identify a clamp on any septum that I was able to view clearly. As noted above, I believe *A. malleata*, *A. lividopallescens* var. *malleata*, and *A. lividopallescens* var. *tigrina* to be contaxic. No clamps were found in the holotype of *A. lividopallescens* var. *malleata*, and they are very rare in the holotype of var. *tigrina*.

One reviewer of this paper raised the issue of choosing a name other than *A. oblongospora* for the present taxon because of the degree to which the description of the species has been revised by us. Of course, we are at liberty to validate the epithet or take up a new one. There has been enough confusion generated by past treatments of *A. malleata* and similar taxa. Therefore, it seems best to fix application of an existing name and reduce potential for further confusion.

The lowest value of **Q** measured for any specimen examined was from Contu 92/43. The three specimens in the collection had values of **Q** (1.19, 1.25, 1.29) lower than all but one (1.23) measured for any other specimen. The values of **L** for the specimens of Contu 92/43 were 11.5, 12.0, and 12.6 μm, while **L** values of the other specimens were 12.0, 12.2, 12.2, and 12.3 μm. The values of **W** for Contu 92/43 were 9.4, 9.7, and 10.1 μm, while the other **W** values were 8.5, 8.7, 8.7, and 9.9 μm. In both cases, the ranges overlap extensively. Partially inflated cells and small inflated cells were somewhat more common in the subhymenia of specimens of Contu 92/43 than in the subhymenia of specimens in the other collections of *A. oblongospora*; and the lamella trama in the specimens of Contu 92/43 had numerous inflated, intercalary segments that were broader (18.5 μm *vs.* 10.5 μm) than any seen in other specimens. Otherwise, no anatomical differences were found between specimens in Contu 92/43 and the material of the other collections. We have chosen to treat Contu 92/43 as a paratype of *A. oblongospora* judging that its spore dimension ranges are very close to those seen in the other material cited and that the more inflated lamella trama and somewhat rounder spores (on average) may be attributable to environmental conditions.

16. *AMANITA PACHYCOLEA* Stuntz *in* Thiers & Ammirati. 1982. *Mycotaxon* 15: 158.

Illus.: Arora. 1979. *Mushr. Demystified*: 251.
Illus.: Smith *et al.* 1979. *Know Gilled Mushr.*: 156, fig. 217.
Illus.: Lincoff. 1981. *Audubon Soc. Field Guide N. Amer. Mushr.* fig. 112.
Illus.: Thiers. 1982. *Agaricales Calif. I. Amanitaceae*: two unnumbered figs.

Illus.: Arora. 1986. *Mushr. Demystified* (2nd ed.): 290 & pl. 65-66.
Illus.: Jenkins. 1986. *Amanita N. Amer.*: figs. 31, 42.
Illus.: Arora. 1991. *All Rain Promises*: 72.

Figs. 35-36.

PILEUS: 70 - 120 mm wide, dark brown, *Carob Brown* (2.5YR 2.0/4.0) to *Chestnut-Brown* (2.5YR 3.4/3.0) to *Mummy Brown* (10YR 3.4/3.0) on disc, fading toward margin to brown or grayish brown, *Hazel* (2.5YR 4.4/5.5) to *Sayal Brown* (8.5YR 5.2/5.0) to *Tawny-Olive* (1Y 5.2/4.5), sometimes with a ring of dark pigment at inner end of striation, convex to near campanulate when young, becoming convex to plano-convex to umbonate to sometimes irregular in outline with undulating margin in age, viscid to subviscid; *context* white, floccose, 5 - 10 mm thick in disc, thinning toward margin, unchanging when bruised or exposed; *margin* decurved, unchanging or becoming plane to uplifted in age, entire, typically becoming rimose and eroded, conspicuously striate or tuberculate striate (0.3 - 0.4R); *universal veil* usually absent or leaving only a few fibrils, rarely as a solitary white to whitish patch.

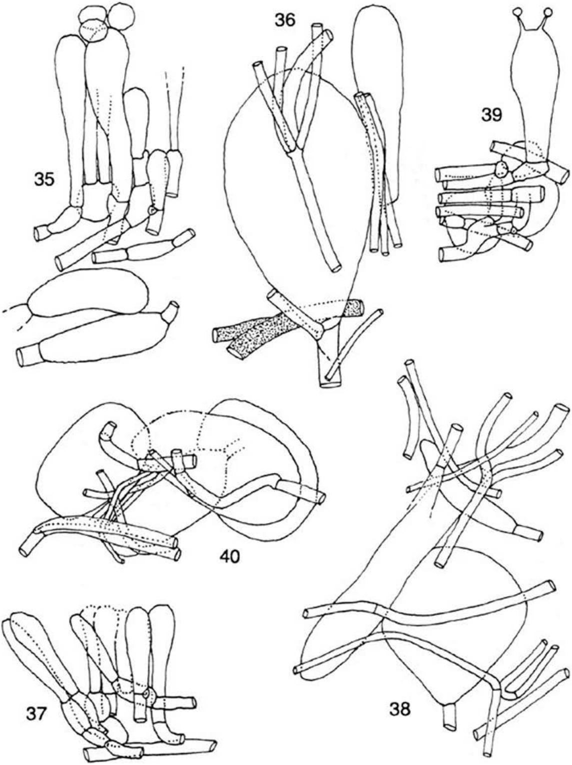
LAMELLAE: adnate to decurrent by a short inconspicuous hook, usually free in age, close to subdistant or occasionally crowded, white when young, unchanging or becoming tawny to orange-brown or orange-yellow with age, sometimes with spots of these colors, usually drying yellow to buff to orangish tan (*e.g.*, 7.5YR 6/8, 7.5YR 7-8/6, or a little paler than 10YR 7/8), ventricose, broad, with edges fimbriate and usually grayish to slightly drab or dark brown; *lamellulae* truncate to subtruncate, of diverse lengths, plentiful, unevenly distributed.

STIPE: 110 - 240 mm long, 9 - 17 mm wide at apex, white to olive buff to sometimes as dark as orange brown or darker, cylindric or narrowing upward, dry, typically with appressed fibrils or fibrillose scaly, sometimes only slightly farinaceous at apex; *context* white, stuffed, becoming hollow in age; *exannulate*; *universal veil* as a very large felted to membranous volva, up to 5 mm thick, white on inner surface, on outer surface white to off-white and usually developing rust colored to brown to yellow-brown spots with age, sometimes becoming entirely ferruginous or dingy yellowish white, up 80 mm from stipe base to top of highest limb, persistent, but collapsing in age.

Odor and *taste* not distinctive.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 175± μm thick; upper 20 - 50 μm extensively gelatinized; lower portion brownish orange, with pigmentation slowly lost (one to two hours) in 10% NH_4OH; dominated by filamentous, undifferentiated hyphae 1.5 - 8.5 μm wide, subradially arranged, densely interwoven, some slightly refractive due to gelatinization; vascular hyphae not observed. PILEUS CONTEXT: filamentous, undifferentiated hyphae 1.5 - 7.5 μm wide, loosely interwoven, often in fascicles; acrophysalides plentiful, narrowly clavate to clavate to elongate to ellipsoid to ovoid, up to 101 × 42



Figs. 35-40. Figs. 35-36. *Amanita pachycolea*. 35. Elements of hymenium and subhymenium (Thiers 21502, isotype). 36. Elements of universal veil (interior) from stipe base (Thiers 21502, holotype). Figs. 37-38. *Amanita pachyvolvata* (Bon 770906, holotype). Fig. 37. Elements of hymenium and subhymenium. Fig. 38. Elements of universal veil (interior) from stipe base. Figs. 39-40. *Amanita submembranacea* var. *submembranacea* (Bon 740917, holotype). 39. Elements of hymenium and subhymenium. 40. Elements of universal veil (interior) stipe base.

µm, thin-walled; vascular hyphae 1.2 - 12.8 µm wide, locally frequent, generally uncommon, often strongly sinuous, and locally in knot-like tangles. LAMELLA TRAMA: bilateral, with angle of divergence less than 30°, but divergence often obscured in tangle of hyphae of subhymenial base, with w_{cs} = 130 - 170 µm (very well rehydrated) to 35 - 55 µm (poorly rehydrated) or 75 - 110 µm (moderately rehydrated); filamentous, undifferentiated hyphae 1.5 - 11.0 µm wide, branching, thin-walled, those of largest diameter dominating and having constrictions at septa and having subventricose segments (up to 58 × 20 µm); terminal, inflated cells not observed; vascular hyphae 3.5 - 5.2 µm wide, scarce to locally common, sinuate; clamps present. SUBHYMENIUM: w_{st}-near = 5 - 45 (-50) µm; w_{st}-far = 30 - 60 (-70) µm; comprising a tightly packed mass of short uninflated or partially inflated hyphal segments and small inflated cells (subglobose to ovoid to clavate, with major diameter up to about 12 µm), showing marked contrast to dominant inflated intercalary cells of central stratum when latter is well rehydrated; subhymenial elements arising from short uninflated elements bordering and subparallel to central stratum or elements of any of cited types with shallow angle of divergence, within two or three cells curving to be nearly perpendicular to central stratum and then giving rise to basidia; basidia arising from all mentioned cell types; at times two basidia arising from single inflated cell. BASIDIA: 42 - 75 × 12.0 - 19.8 µm, thin-walled, dominantly 4-sterigmate, but also 2- and, occasionally, 1-sterigmate; sterigmata rather robust with bases up to 3.5 µm wide; clamps present. UNIVERSAL VEIL: *On pileus*: absent. *At stipe base, exterior surface*: impregnated with soil, comprising an open lattice 10 - 20 µm thick of fascicles of filamentous, undifferentiated hyphae 1.2 - 6.8 µm wide and sublongitudinally oriented; vascular hyphae 3.5 - 7.5 µm wide, scattered, brownish-yellow or sordid yellow. *At stipe base, interior*: filamentous, undifferentiated hyphae 0.8 - 7.0 µm wide, loosely interwoven, branching, dominating except in clusters of inflated cells, mostly in fascicles, often coiling loosely when not in fascicles, sometimes with yellowish subrefractive walls, sometimes with slightly inflated intercalary segments (up to 12.6 µm or more wide); inflated cells ovoid to ellipsoid to broadly clavate to clavate to subventricose, locally plentiful to dominant, up to 158 × 85 µm; vascular hyphae 2.2 - 28 µm wide, scattered to locally common, branching. *At stipe base, inner surface*: a separable, gelatinized layer 30± µm thick, composed mostly of elements seen in interior, with notable addition of thin, straight refractive hyphae like those on surface of pileipellis. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.8 - 12.5 µm wide, dominant; acrophysalides thin-walled, rather narrow, up to 152 × 35 µm; vascular hyphae not observed.

BASIDIOSPORES: [420/20/14] (7.8-) 10.0 - 13.5 (-16.5) × (7.5-) 8.8 - 11.8 (-14.0) µm, (**L** = (10.7-) 10.8 - 12.1 (-12.2) µm; **L'** = 11.5 µm; **W** = 9.6 - 11.1 (-11.2) µm; **W'** = 10.4 µm; **Q** = (1.0-) 1.04 - 1.28 (-1.65); **Q** = 1.06 - 1.20 (-1.21); **Q'** = 1.11), inamyloid, hyaline, colorless, smooth, thin-walled, globose to subglobose to broadly ellipsoid, in some specimens quite commonly lachrimiform or lageniform (then occasionally constricted or contorted and, often, immature), adaxially flattened, sometimes swollen at one end; contents predominantly monoguttulate, sometimes with numerous small granules; apiculus sublateral, cylindric, short, but occasionally rather broad; white in deposit.

Habitat and distribution: Often common in north coastal forests of western North America especially north of Monterey Co., California, under conifers and in mixed woods often including *Quercus*. Holotype found in humus in mixed woods. Thiers 23806 found under conifers (litter with specimen identifiable as including *Tsuga*).

Collections examined: **UNITED STATES OF AMERICA:** CALIFORNIA—Del Norte Co. - Jedediah Smith St. Pk., 12.xi.1966 G. J. Breckon 568 (paratype, SFSU). Humboldt Co. - Prairie Creek St. Pk., 12.xi.1966 G. J. Breckon 564 (paratype, SFSU). Marin Co. - Alpine Lake, 18.xi.1979 P. Smith 121 (paratype, SFSU). Mendocino Co. - Jackson St. For., near Mendocino, 25.xi.1960 H. D. Thiers 8449 (paratype, SFSU), 9.xi.1961 J. Jensen 22 (paratype, SFSU), 20.xii.1962 H. D. Thiers 9740 (paratype, SFSU), 14.xi.1967 H. D. Thiers 21502 (holotype, SFSU; isotype, NY), 9.ix.1968 H. D. Thiers 23086 (paratype, SFSU); Mushroom Corners, 11.xi.1963 G. J. Breckon 211 (paratype, SFSU); no locality cited, 17.ix.1961 Largent, Thiers, Motta & Peters [Largent 577] (paratype, SFSU). San Mateo Co. - Huddart Pk., W. J. Sundberg 33 (paratype, SFSU); San Francisco Watershed, near Water Temple, 12.xii.1975 R. E. Halling 1197 (paratype, SFSU), 13.xii.1975 H. D. Thiers 35612 (paratype, SFSU). Santa Cruz Co. - Big Basin, Hwy. 236, 15.xi.1975 R. E. Halling 1104 (paratype, SFSU).

DISCUSSION

The younger of the two specimens represented in the isotype at NY as well as the three specimens of Sundberg 33 produced very variably shaped spores (the isotype also had spores very few of which were monoguttulate) that affected the ranges of **W** and **Q** (tending to reduce **W'** and drive up **Q'**). Given the incompletely expanded pileus in the isotype specimen, it may have been dried in an early stage of sporulation, which would account for the irregularities in spore shape that were seen only very infrequently in spores of the more mature specimen of the isotype. The three specimens of Sundberg 33 were clearly mature; and despite this, the distribution of Q for the 60 spores measured from those specimens is markedly bimodal.

Based on these observations, the spore shape (**Q'**) in *A. pachycolea* and *A. pachyvolvata* cannot be said with certainty to differ much. As to differences between the present species and *A. pachyvolvata*:

- The spores of *A. pachycolea* are smaller than those of *A. pachyvolvata*.
- The pigmentation of the North American fungus is much darker: the pileipellis in the button stage may be fuliginous or nearly black, the lamellae are marginate, the decoration on the stipe surface is dark (brown) from the first.
- The occasionally zonate pileus of *A. pachycolea* (especially the frequent appearance of a dark ring placed just at the inner end of the pileus striations) appears not to be a character seen in *A. pachyvolvata*.
- Serpentine refractive hyphae were not observed in the pileipellis of *A. pachycolea*; they are present in the pileipellis of *A. pachyvolvata*.

For comparison with *A. magnivolvata* and *A. violettae*, see discussions following the descriptions of those species.

Apparently, the name *A. pachycolea* was originally proposed by Nakamura (1965) in an unpublished Master's thesis.

17. *AMANITA PACHYVOLVATA* (Bon) Krieglsteiner. 1984. *Beih. Z. Mykol.* 5: 191, fig. opposite p. 190.

≡*Amanitopsis pachyvolvata* Bon. 1978. *Doc. Mycol.* 8(29): 36.
≡*Amanita pachyvolvata* (Bon) Garcin *nom. inval.* 1984. *Amanites Européennes*: 165. [Autographic publication, etc. ICBN §29.3, §29.4, §32.1a.]
≡*Amanita pachyvolvata* (Bon) Contu. 1985. *Funghi Ambiente* 3(=no. 40): 24. [Superfluous combination.]
≡*Amanita pachyvolvata* (Bon) Reid. 1987. *Notes Roy. Bot. Gard. Edinburgh* 44: 511. [Superfluous combination.]
≡*Amanita pachyvolvata* (Bon) Romagn. 1992. *Bull. Trimestriel Soc. Mycol. France* 108: 73. [Superfluous combination.]
Illus.: Bon. 1979. *Fungorum Rar. Icon. Color.* 11: 37, fig. 6g-i [microscopy] and pl. 88.
Illus.: ?Merlo & Traverso. 1983. *Nostri Funghi Amanite*: 37 [as *A. magnivolvata*].
Illus.: ?Ballero & Contu. 1988. *Mycologist* 2: fig. on p. 67.

Figs. 37-38.

Some data are derived from the review of *Amanitopsis pachyvolvata* provided by Bon (1979). The two descriptions were apparently based on the same (holotype) collection. When the descriptions from the two articles differ, I cite the source of each of the alternate phrasings.

PILEUS: 50 - 80 (-110) mm wide, sordid ochraceous (Bon, 1978) or fauve-gray to bister over disc and a paler brown-yellow (with olive tints in early stages of expansion) toward margin (Bon, 1979), hemispheric or ovate, then plano-convex, shiny or subviscid, rather pruinose toward margin, more mat toward disc, with disc flecked or rivulose due to concentrically arranged, beige or somewhat brownish, fine squamules; *context* white; *margin* striate-sulcate (0.35±R), straight, becoming rimose; *universal veil* absent.

LAMELLAE: creamy white (Bon, 1978) or white (Bon, 1979), rather broad, segmentiform (Bon, 1979), with edge fimbriate or slightly fimbriate and serrate (Bon, 1979) and yellowish white; *lamellulae* not described.

STIPE: (120-) 150 - 200 × 20 - 30 mm (Bon, 1978) or (120-) 150 - 180 (-200) × (10-) 15 - 30 mm (Bon, 1979), white, then more or less grayish (Bon, 1978) or yellowish gray (Bon, 1979), variegated, narrowing upward; *context* stuffed at first, then quickly hollow, with central cylinder often having diameter greater than half of that of stipe; *exannulate*; *universal veil* as a very large volval sac, white, membranous, persistent, 4 - 7 mm (Bon, 1978) or 4 - 6 mm (Bon, 1979) thick, ovoid at first and retaining a subcylindric to elongately ellipsoid form for some time, with overall dimensions 60 - 80 (-100) × 30 - 50 (-60) mm, obtuse below, smooth to slightly furfuraceous on exterior, not bruising or staining except sometimes more or less ochraceous toward base in older material, with low, rounded *limbus internus* at point of juncture between stipe and volval limb.

Odor and *taste* not recorded.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 100 - 140 µm thick, yellow-brown to orange-brown intracellular pigment mostly concentrated in hyphae of lower half; filamentous, undifferentiated hyphae 1.0 - 6.7 µm wide, subradially arranged, partially to nearly completely gelatinizing at surface, densely packed vertically; refractive hyphae 2.8 - 6.0 µm wide, serpentine. PILEUS CONTEXT: filamentous, undifferentiated hyphae 1.8 - 9.5 µm wide, frequently branching, in fascicles that are loosely interwoven; acrophysalides terminal, singly or in short chain, thin-walled, subcylindric to clavate to ovoid to subpyriform, to 70 × 42 µm; refractive hyphae 2.8 - 11.6 µm wide, branching, common, locally loosely knotted, at times penetrating pileipellis. LAMELLA TRAMA: obscurely bilateral (divergent structures close to base of basidia); $w_{cs} = 85 - 110^{\pm}$ µm in immature specimen; filamentous, undifferentiated hyphae 1.8 - 11.2 µm wide, dominating and obscuring other structures, branching, with those of higher diameter having constrictions at septa and intergrading with chains of subventricose to ellipsoid(?) segments (up to 61 × 33 µm); terminal, inflated cells not observed; refractive hyphae 3.2 - 5.8 µm wide. SUBHYMENIUM: with w_{st}-near = (0-) $5^{\pm}$ µm and w_{st}-far = $25^{\pm}$ (-40) µm in immature specimen; basidia arising from a thin layer (1 - 3 cells thick) of small cells (subglobose to ovoid to clavate) and from partially inflated and uninflated hyphal segments (the latter often perpendicular to hymenial surface, but arising from hyphae running parallel to that surface with only one or two intervening, short, intercalary segments; filamentous, undifferentiated hyphae running parallel to hymenial surface are commonly seen in subhymenial region. (In immature material, inflated cells are somewhat fewer, but otherwise above description holds. In mature material, subhymenium and basidia have largely been destroyed due to infection by fungus with thick-walled, conidia bearing hyphae.) BASIDIA: 55 - 66 × 14.5 - 21 µm, 4- and, occasionally, 1-sterigmate, thin-walled; clamps present [less frequent(?) in more mature material]. UNIVERSAL VEIL: *On pileus*: absent. *On stipe base, exterior surface*: outermost layer (only 2 - 3 hyphal diameters thick) consists of very loosely interwoven fascicles of slightly gelatinizing to gelatinizing filamentous, undifferentiated hyphae, with majority having very narrow diameter, with hyphae below this layer forming tighter weave; filamentous, undifferentiated hyphae 1.8 - 7.4 (-15.4) µm wide, branching, tip cells occasionally with small particles on very tip; refractive hyphae 1.8 - 7.0 µm wide, branching, locally common. *On stipe base, interior*: filamentous, undifferentiated hyphae 3.5 - 14.4 µm wide, loosely interwoven, loosely coiling, branching, dominant; inflated cells terminal, thin-walled, plentiful, subcylindric to narrowly clavate to clavate to ellipsoid to subpyriform, up to 105 × 70 μm; refractive hyphae 3.5 - 6.7 μm wide. *On stipe base inner surface*: like interior, but slightly gelatinized. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.8 - 6.0 μm wide; acrophysalides thin-walled, plentiful, up to 219 × 40 μm, most smaller than 155 μm long; refractive hyphae 4.5 - 5.2 μm wide, branching.

BASIDIOSPORES: [40/1/1] (10.2-) 11.0 - 14.2 (-15.0) × (9.5-) 10.8 - 13.2 (-15.0) μm, (**L** = 12.4 μm; **W** = 11.5 μm; Q = (1.0-) 1.02 - 1.14 (-1.20); **Q** = 1.08), inamyloid, smooth, thin-walled, hyaline, colorless, globose to subglobose to (infrequently) broadly ellipsoid, often adaxially flattened; contents mono- or biguttulate; apiculus sublateral, prominent, cylindric; color in deposit not recorded.

Habitat: Under *Picea* and *Abies*, by edge of road.

Collection examined: **FRANCE:** DÉP. HAUTE-LOIRE - Le Puy, Lac du Bouchet, 6.ix.1977 M. Bon 770906 (MBON).

DISCUSSION

The packet of holotype material loaned to me contained an immature basidiocarp in which the pileus was just free of the tubular, saccate volva. Sporulation seems not to have begun in this specimen, which unfortunately makes up most of the material I have reviewed. The packet contained a few narrow, radial slices of pileus with mature lamellae attached; plentiful spores were found on these fragments; however, the mature structure of the lamellae was not clearly discernible due to destruction caused by a mold. The dimensions given above for the lamella trama and subhymenium may be less than would be found in a mature specimen. Acrophysalides of the stipe context may not be fully inflated in the immature material examined.

When I borrowed this collection a second time, it arrived badly broken in the mails. Fortunately, I had drawn the stipe base of the immature specimen including the surrounding volval sac. I have deposited that drawing with the collection.

For comparison with *A. magnivolata*, *A. pachycolea*, and *A. violettae*, see the discussions following the descriptions of those species.

18. *AMANITA SUBMEMBRANACEA* (Bon) Gröger var. *SUBMEMBRANACEA*. 1979. *Boletus* 3: 27, fig. on p. 29.

≡*Amanitopsis submembranacea* Bon. 1975. *Bull. Mens. Soc. Linn. Lyon* 44(6): 176, fig 5.
Illus.: Knudsen & Sørensen. 1980. *Svampe* 1: 43, fig. 2.
Illus.: Merlo & Traverso. 1983. *Nostri Funghi Amanite*: 48.
Illus.: Krieglsteiner. 1984. *Beih. Z. Mykol.* 5: fig. opposite p. 190.

Illus.: Outen. 1988. *Mycologist* 2: 34.

Figs. 39-40.

PILEUS: 60 - 80 (-100) mm wide, hemispherical to evenly convex with slight umbo especially visible after full expansion, smooth, viscid to subviscid to sticky, lustrous, of a color difficult to define (rather olivish-brown) with coppery tint or slightly bronzy [Séguy 337 (redder than 5YR 6/6) mixed with Séguy 301 (deep olive with brownish tint)], with paler margin slightly more yellowish [Séguy 338 (pale brown)], the whole suggesting lightly pigmented specimens of "*A. umbrinolutea* Secr.," but not zonate as in that entity; *context* unrecorded; *margin* even, decurved at first, finally flaring upward, long striate (0.25 - 0.5±R); *universal veil* in irregular, subpulverulent, grayish patches, mostly concentrated over disc.

LAMELLAE: free, subdistant, not very crowded, sordid whitish to slightly brownish or browning with age, drying pale brownish yellow, slightly flocculose on edge; *lamellulae* truncate to subtruncate, unevenly distributed, plentiful.

STIPE: 120 - 130 (-150) × 6 - 12 (-15) mm, subcylindric to narrowing upward, slightly bulbous at base, smooth and white at apex, somewhat pulverulent below this, and progressively decorated toward base with grayish yellow rings or a zigzag (snake-skin) pattern; *context* white, unchanging, hollow, with central cylinder of diameter often greater than 50% of stipe diameter and extending down into slightly swollen base; *exannulate*; *universal veil* at times suggesting a false annulus near stipe base by being in one or a few submembranous zones, at times incomplete, derived from a more or less pulverulent or friable and often limbate volva, rarely complete and saccate (then rather ample), relatively appressed to stipe base for bottom 10 - 20 mm, at times slightly strangulate above this point.

Odor lacking. *Taste* indistinct.

MACROCHEMICAL TESTS: Phenol - sordid reddish brown to pinkish wine colored, not bright cassis, but between reaction in *A. fulva* and in *A. crocea* (Quél.) Sing.

PILEIPELLIS: 50 - 75 μm thick, gelatinizing just at surface or to depth of 30 μm, colorless in upper half, orange-brown in lower half, with pigmentation extending slightly into immediately adjacent context; filamentous, undifferentiated hyphae 1.5 - 6.2 μm wide, densely packed, interwoven, subradially arranged; vascular hyphae 3.5 - 4.5 μm wide, uncommon. PILEUS CONTEXT: filamentous, undifferentiated hyphae 2.5 - 15.0 μm wide, branching, plentiful, with those of smaller diameter mostly in loosely interweaving fascicles, with those of largest diameter not in fascicles, with some branched elements of largest diameters; acrophysalides dominating, terminal, thin-walled, subfusiform to clavate to broadly clavate to elongate to ovoid to ellipsoid, up to 106 × 50 μm; vascular hyphae 4.2 - 16.0 μm wide, branching, infrequent, locally in tangles. LAMELLA TRAMA: bilateral, although somewhat obscurely so in some regions, with angle of divergence negligible to 90°, mostly at extremes of this range; consisting of central stratum (w_{cs} = 35 - 50 μm) flanked on each side by a region up to 20 μm wide (w_{ct} up to 90 μm) containing occasional terminal inflated cells (sometimes several together) in a single (rarely double, more frequently sparsely populated to locally absent) layer; filamentous, undifferentiated hyphae 1.8 - 9.5 μm wide, branching, closely packed, largely co-parallel; inflated cells broadly ellipsoid to subglobose, up to 30 × 19.0 μm, with majority less than half this size, thin-walled, not or minimally diverging; vascular hyphae 3.0 - 7.5 μm wide, scarce. SUBHYMENIUM: very dense tissue with many hyphae running parallel to central stratum, indeed seeming to be a continuation of latter; very shallow, sometimes entirely eclipsed by shallow region of inflated cells (*i.e.*, w_{ex}-near may be 0), comprising branching hyphae having very short segments at and after divergence, occasionally with hyphae running parallel to central stratum giving rise to a basidium without any divergence whatever, with basidia arising from very short uninflated hyphal segments. BASIDIA: 32 - 55 × 8.8 - 16.9 μm, thin-walled, predominantly 4-sterigmate, occasionally 2-sterigmate, with sterigmata up to 6.0 × 3.2 μm; clamps rare. UNIVERSAL VEIL: *On pileus*: absent. *At stipe base, exterior surface*: an occasionally disrupted layer of partially gelatinized to gelatinized fascicles of hyphae one or two fascicles thick, commonly closely packed, but also somewhat loosely interwoven in some regions, dominantly sublongitudinally oriented, with somewhat gelatinized tissue of interior exposed in some areas; filamentous, undifferentiated hyphae 1.0 - 8.5 μm wide, branching, almost entirely in aforementioned fascicles; vascular hyphae 2.5 - 4.8 μm wide, branching, not included in fascicles. *At stipe base, interior*: all elements with slightly brownish tint in region near exterior surface; filamentous, undifferentiated hyphae 3.0 - 5.8 μm wide, plentiful, branching, loosely interwoven, in fascicles or not; inflated cells dominating, often very densely packed, terminal, thin-walled, broadly fusiform to elongate to narrowly clavate to broadly clavate to subpyriform to subglobose, up to 116 × 61 μm, with tendency to take on more elongate forms near surfaces; vascular hyphae 1.8 - 4.0 μm wide, scarce. *At stipe base, inner surface*: like interior, but with proportionately more hyphae and with inflated cells on average smaller and more elongate, somewhat gelatinized. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 0.7 - 9.8 μm wide, dominating; acrophysalides common, thin-walled, up to 298 × 63 μm; vascular hyphae 3.5 - 18.2 μm wide, common to plentiful, branching, occasionally in loose tangles.

BASIDIOSPORES: [40/1/1] (9.2-) 10.2 - 13.0 (-13.8) × (8.2-) 9.0 - 12.0 (-12.5) μm, (**L** = 11.5 μm; **W** = 10.6 μm; Q = (1.04-) 1.05 - 1.14 (-1.22); **Q** = 1.09), inamyloid, thin-walled, smooth, hyaline, colorless, globose to subglobose to broadly ellipsoid, usually at least slightly adaxially flattened; contents mono- or multiguttulate; apiculus rather large, abrupt, subcylindric to cylindric; off-white in deposit.

Distribution and habitat: Holotype found in *Abies* forest with admixture of *Betula*, in low vegetation and mosses under *Vaccinium*, 1100 m elevation.

Collection examined: **FRANCE:** DÉP. HAUTE LOIRE - Fontanet, *ca.* Le Puy, 17.ix.1974 M. Bon 740917 (holotype, MBON (*n.v.*) & L (fragment)).

DISCUSSION

This anatomical description differs from that of Tulloss (1988) in several points. My earlier description relied heavily upon material other than the holotype, which was not examined in detail at the time and of which, apparently, very little remains. After the study of the holotype reported above, I regard the earlier description as in error in reporting the small, subglobose to broadly ellipsoid, terminal, inflated cells in the subhymenial region as part of the subhymenium rather than part of the subhymenial base. In the previous description the pileipellis is described as much thicker than was found in the holotype and larger, clavate, inflated cells are described in the lamella trama. In addition to these differences, new data has been added.

For a comparison of the present species with *A. groenlandica*, *A. mortenii*, and *A. submembranacea* var. *bispora*, see the discussions following the descriptions of those taxa.

19. *AMANITA SUBMEMBRANACEA* var. *BISPORA* Reid. 1987. *Notes Roy. Bot. Gard. Edinburgh* 44: 514.

Illus.: ?Phillips. 1981. *Mushr. Fungi Gr. Brit. Eur.*: 22. [As "*A. vaginata*," two specimens in lower left of photo.]

PILEUS: 70 mm wide, Vandyke brown, paler toward margin, shallowly convex with central umbo; *context* not described; *margin* plicate, nonappendiculate; *universal veil* absent.

LAMELLAE: pinkish; *lamellulae* not described [apparently few in var. *submembranacea sensu* Reid (1987: 513)].

STIPE: 150 × 15 mm, pallid ground, decorated with gray zig-zag scales; *context* not described; *exannulate*; *universal veil* saccate, submembranous, cracking and breaking into patches, gray inside and out except white on exterior at very base of stipe.

Odor and *taste* not recorded.

MACROCHEMICAL TESTS: None reported.

PILEIPELLIS: 25 - 80 μm thick, orange-brown; filamentous, undifferentiated hyphae 1.0 - 7.7 μm wide, with hyphae of smaller diameters concentrated near surface, branching, subradially arranged, tightly interwoven, partially gelatinized, often containing yellow-brown to orange-brown intracellular pigment (in flocculent clumps in 3% KOH); vascular hyphae 1.0 - 7.8 μm wide, branching, common, locally densely tangled. PILEUS CONTEXT: filamentous, undifferentiated hyphae 1.3 - 5.6 μm wide, in fascicles, plentiful; acrophysalides elongate to broadly clavate to ellipsoid, narrowest near pileipellis, thin-walled, plentiful to dominant, up to 94 × 44 μm; vascular hyphae 7.8 - 8.4 μm wide, infrequent. LAMELLA TRAMA: bilateral, but obscurely so (see curved bases of basidia); w_{cs} = 40 - 55 μm (moderately good reinflation); filamentous, undifferentiated hyphae 2.0 - 5.0 μm wide, densely interwoven, obscuring inflated cells if any are present, coiled and twisting, branching, occasionally with yellowish walls; inflated cells not observed; vascular hyphae 1.7 - 3.0 μm wide, sinuous or corkscrew-like. SUBHYMENIUM: twisted and tangled, filamentous, undifferentiated hyphae; w_{st}-near ≤ 0 μm (*i.e.*, with some basidia/-oles arising within central stratum); w_{st}-far = 15 - 20 μm. [Reid (1987: 535, fig. 9d) provides an excellent illustration in the protologue.] BASIDIA: 26 - 44 × 7.8 - 14.7 μm, sometimes curved to one side at base, thin-walled, with 50% 4-sterigmate, 40% 2-sterigmate, remainder 1- and 3-sterigmate; no clamps observed. UNIVERSAL VEIL: *On pileus*: absent except for a scattering of gelatinized fragments of inflated cells and hyphae. *At stipe base, exterior surface*: filamentous, undifferentiated hyphae 2.1 - 7.7 μm wide, branching, in fascicles that are very well separated and lack any dominant orientation, partially gelatinized, some with exterior incrustation, often with yellow deposits on interior of cell walls, occasionally with yellowish walls; vascular hyphae 2.1 - 9.8 μm wide, common, locally plentiful in tangles and knots, occasionally branching. *At stipe base, interior*: filamentous, undifferentiated hyphae 0.8 - 9.1 μm wide, often in fascicles, loosely interwoven, branching, thin-walled or (especially those of larger diameter) with walls slightly thickened (up to 0.5 μm thick), often with longitudinal orientation, occasionally with yellowish walls; inflated cells globose to subglobose (up to 55 × 49 μm) or ellipsoid to broadly clavate to clavate (up to 55 × 40 μm), sometimes elongate (*e.g.*, 56 × 13.3 μm) and then occasionally being slightly curved, terminal, thin-walled, sometimes with yellow-brown intracellular pigment, often colorless; vascular hyphae 1.6 - 7.7 μm wide, branching, locally in small knots or tangles. [Reid (1987: 535, fig. 9a) provides an excellent illustration in the protologue.] *At stipe base, inner surface*: similar to interior. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.5 - 9.8 μm wide, in fascicles, often with yellow deposit on interior cell walls or with yellowish walls; acrophysalides up to 170 × 32 μm, occasionally with yellowish walls; vascular hyphae 4.9 - 9.1 μm wide, with irregular outline, yellowish with brown tint, uncommon.

BASIDIOSPORES: [40/1/1] (9.8-) 10.9 - 13.2 (-15.4) × (9.0-) 9.1 - 11.2 μm, (**L** = 11.5 μm; **W** = 10.5 μm; Q = 1.01 - 1.23 (-1.34); **Q** = 1.10), hyaline, colorless, smooth, thin-walled, inamyloid, globose to subglobose to broadly ellipsoid, infrequently ellipsoid, usually at least somewhat adaxially flattened, occasionally expanded at one end; apiculus sublateral, cylindric, prominent; contents granular or monoguttulate with or without small granules; white in deposit.

Habitat: In calcareous region.

Collection examined: **UNITED KINGDOM:** SURREY - Ranmore, Montain Wood, 28.ix.1980 D. A. Reid *s.n.* (holotype, K).

DISCUSSION

This entity differs from *A. submembranacea* var. *submembranacea* in ways suggesting that it is not a variety of it. For example, the absence of small inflated cells in the lamella trama and the difference in pileus coloration. I am not inclined to give much importance to the approximately even distribution of 2-sterigmate and 4-sterigmate basidia in the holotype of var. *bispora* because this character may be seen not infrequently in material that has been dried early in sporulation—which seems to be the case here. I have collected *A. submembranacea sensu* Reid (1987) personally and plan to treat it in a future article.

For comparison to *A. mortenii*, see the discussion following the description of that species.

20. *AMANITA SUPRAVOLVATA* Lanne. 1979 [''1978'']. *Doc. Mycol.* 9(34): 24.

≡*Amanita supravolvata* Lanne *nom. inval.* 1978. *Vie Bordeaux.* 20 mai 1978: 7. [ICBN §29.4.]

≡*Amanita supravolvata* Lanne *nom. inval.* 1978. *Bull. Trimestriel Sect. Mycol. Soc. Linn. Bordeaux* 1: 10-16. [ICBN §35.1, §36.1, and §37.1. [Lanne published a provisional description and explicitly assigned no rank.]

≡*Amanita argentea* var. *supravolvata* (Lanne) Contu. 1985 [''1984'']. *Doc. Mycol.* 14(56): 26.

≡*Amanita mairei* f. *supravolvata* (Lanne) Romagn. *nom. inval.* 1992. *Bull. Trimestriel Soc. Mycol. France* 108(2): 76. [ICBN §33.2.]

≡*Amanita mairei* f. *supravolvata* (Lanne) Romagn. *ex* Lanne. 1993a. *Doc. Mycol.* 23(91): 21.

Illus.: Lanne. 1979. *Bull. Trimestriel Sect. Mycol. Soc. Linn. Bordeaux* 4(no. spéc.): pl. I-V, unnumbered figs. on pp. 16, 22.

Illus.: Massart. 1984. *Approche Genre Amanita*: 122, pl. 36.

Illus.: Massart. 1984a. *Bull. Soc. Linn. Bordeaux* 12(3): 132, pl. 9.

Illus.: Lanne. 1993. *Doc. Mycol.* 23(89): 53.

Figs. 41-42.

Due to the damaged state of the holotype, additional anatomical information from an authentic topotype is provided in the discussion following this description.

PILEUS: 25 - 85 (-90) mm wide, pale gray, Séguy 233 (approximately between 7.5YR 8/2 and 7.5YR 7/2, a moderate brownish gray with a slightly yellowish tint) with a slight tinge of Séguy 200 (rather pallid peach, close to 5YR 8/4), paler at first, hemispherical, then pulvinate to plano-convex, rarely bluntly umbonate; *context* white, pearly, contrasting to color of lamellae, thinning evenly and rapidly toward margin; *margin* decurved, short striate or short sulcate (0.1±R); *universal veil* absent or more often as a small to large white cottony membranous patch over disc;

pileipellis completely separable.

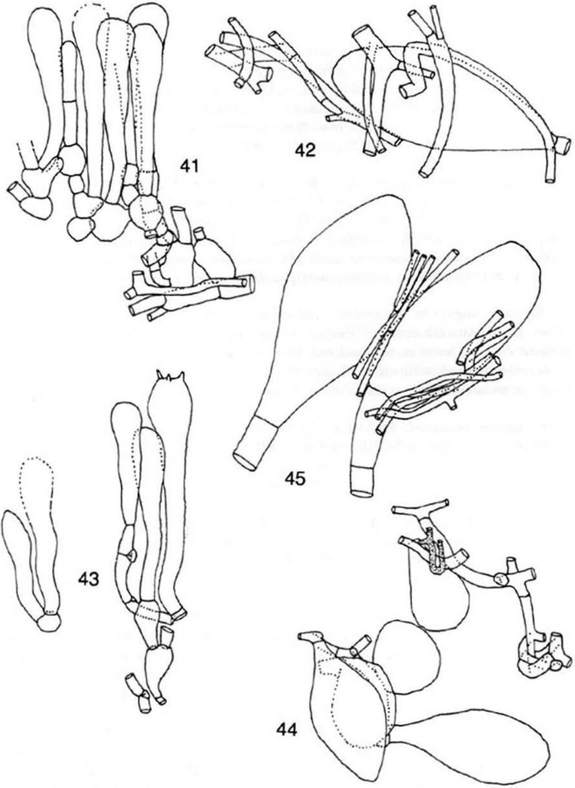
LAMELLAE: free, rather close, whitish cream, with some flesh tones at first, up to 8 mm wide, rather thick, rarely forking; *lamellulae* scattered, truncate at right angle.

STIPE: 90 - 185 × 6 - 17 mm, very white, very slender, narrowing upward and expanding at apex, with surface rarely pilose, lacking any obvious pseudorhiza at base but often roughly obconic; *context* white, pearly, easily separable from that of pileus, stuffed, then hollow; *exannulate*; *universal veil* as a cylindric saccate volva, with highest point 35 - 67 mm from stipe base, standing out evenly from stipe for upper 15 - 35 mm, abruptly becoming adnate to stipe below this portion, often with small *limbus internus* at point of flaring of volva from stipe.

Odor absent. *Taste* absolutely absent, certainly not radish-like.

MACROCHEMICAL TESTS: NH_4OH, NaOH, H_2SO_4, $FeCl_2$, and aniline - all negative. Guaiac - positive (blue black) only in and on base of stipe, in central cylinder of stipe, and on interior and exterior of volval sac. Phenol - slowly vinaceous rose on pileipellis, volval sac, and in context of pileus and stipe. $Fe_2(SO_4)_3$ - faintly, slowly, sordid green.

PILEIPELLIS: 75± μm thick, gelatinizing at surface, with surface damaged by mold in some regions; filamentous, undifferentiated hyphae 0.7 - 8.0 μm wide, tightly interwoven, subradially arranged; vascular hyphae not observed. PILEUS CONTEXT: filamentous, undifferentiated hyphae 1.5 - 17.0 μm wide, branching, loosely interwoven, in fascicles or not, plentiful; acrophysalides dominant except close to pileipellis, thin-walled, subglobose to broadly ellipsoid to ellipsoid to subovoid to broadly clavate to clavate, up to 79 × 48 μm, narrowest close to pileipellis; vascular hyphae 1.4 - 8.4 μm wide, branching, infrequent to locally common and loosely tangled. LAMELLA TRAMA: obscurely bilateral; w_{cs} = 55± - 65± μm wide; with angle of divergence varying from shallow to 90°, nearly encompassing all tissues between nearest opposing bases of basidia, poorly rehydrating in holotype; filamentous, undifferentiated hyphae 2.2 - 7.0 μm wide, branching, apparently with occasional intercalary inflated segments (*e.g.*, 31^+ × 15.0 μm); divergent, terminal, inflated cells not observed; vascular hyphae 2.5 - 8.2 μm wide, infrequent to common, branching, sometimes in tangles. SUBHYMENIUM: w_{st}-near = 0± μm; w_{st}-far = 25± μm; sparsely branching structure composed mostly of short uninflated hyphal segments, with occasional small ellipsoid or clavate cell, with plentiful hyphae running parallel to hymenial surface directly below bases of basidia, with basidia arising from uninflated elements; clamps occasional and often one hyphal segment away from base of basidium. BASIDIA: 45 - 57 × 10.2 - 14.5 μm, 4-sterigmate, almost all in holotype damaged by mold and collapsed; clamps occasional. UNIVERSAL VEIL: *At stipe base, exterior surface*: a loosely woven network of fascicles of partially gelatinized, branching, filamentous, undifferentiated hyphae, occasionally coparallel and more densely arranged, covered with particles of sand. *At stipe base, interior*: filamentous, undifferentiated hyphae 1.4 - 11.9 μm wide, rather densely



Figs. 41-45. Figs. 41-42. *Amanita supravolvata*. 41. Elements of hymenium and subhymenium (?.x.1977 Lanne *s.n.*, topotype). 42. Elements of universal veil (Lanne 1, holotype). Figs. 43-45. *Amanita tuza*. 43. Elements of hymenium and subhymenium (Guzmán 825-A, isotype (L)). 44. Elements of partial veil (Guzmán 825-A, isotype (MICH)). 45. Elements of universal veil (interior) from stipe base (Guzmán 825-A, isotype (L)).

interwoven, in fascicles or not, branching, dominant to plentiful; terminal inflated cells thin-walled, narrowly clavate to clavate to narrowly ellipsoid, common to locally plentiful, up to 112 × 39 μm; vascular hyphae 4.5 - 7.7 μm wide, scarce to locally common. *At stipe base, inner surface*: covered with particles of sand. *On pileus*: badly damaged by mold; possibly with inflated cells more plentiful than in volval limb. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 2.0 - 15.2 μm wide, branching; acrophysalides thin-walled, up to 173 × 37 μm; vascular hyphae 6.0 - 8.5 μm wide, scarce.

BASIDIOSPORES: [130/6/1] (8.8-) 10.0 - 13.5 (-15.2) × (6.5-) 7.2 - 10.0 (-14.0) μm, (**L** = 10.5 - 12.3 μm; **L'** = 11.5 μm; **W** = 8.0 - 9.3 μm; **W'** = 8.7 μm; Q = (1.07-) 1.17 - 1.55 (-1.82); **Q** = 1.24 - 1.43; **Q'** = 1.33), hyaline, colorless, smooth, thin-walled, inamyloid, broadly ellipsoid to ellipsoid, infrequently subglobose or elongate, sometimes adaxially flattened; apiculus sublateral, cylindric, rather small to prominent; contents monoguttulate; cream in deposit.

Habitat: August to November, solitary to scattered, in sand on forest side of dunes along Atlantic coast of France, always near edge of maritime pine (*Pinus pinaster* Soland) forest or near isolated thickets of stunted pines. Most of basidiocarp commonly covered with sand. Lanne (1979) did an extensive survey of vascular plants in areas surrounding his collecting sites.

Collection examined: **FRANCE:** DÉP. GIRONDE - Lacanau-Océan, 18.x.1978 C. Lanne 1 (holotype, SLBORD; isotype, RET).

DISCUSSION

Mold on the hymenial surfaces of the holotype has partially destroyed the basidia, and the tissues of the lamella trama and subhymenium are difficult to rehydrate. Mold also is to be found on the stipe surface, the surfaces of the universal veil, and on the surfaces of fractures through the pileus context that must have occurred after drying.

Fortunately, I was able to locate an authentic topotype in L (dated "?.x.1977"). This collection is in good condition with a lamella trama that rehydrates well; and I believe it to be conspecific with the holotype material. The basidia are predominantly immature; but, even in this state, the subhymenium clearly contains many small, inflated cells. Information from my examination of this topotype follows:

LAMELLA TRAMA: w_{cs} = 40 - 60 μm, with angle of divergence rather shallow, with elements of subhymenial tree curving away from central stratum and becoming perpendicular to it; filamentous, undifferentiated hyphae 1.2 - 6.8 μm wide; terminal, inflated cells absent or obscured by intercalary inflated elements of central stratum; vascular hyphae 1.8 - 3.5 μm wide, very scarce; clamps rather common and prominent in central stratum. SUBHYMENIUM: w_{st}-near = 15 - 35 μm; w_{st}-far= 45 - 65 μm; a branching structure of small inflated cells and uninflated and partially inflated hyphal segments, with basidia arising from cells of all types, with no hyphae parallel to central stratum immediately below bases of basidia.

BASIDIOSPORES: [20/1/1] (8.4-) 9.3 - 11.2 (-14.6) × (6.4-) 7.2 - 9.0 (-9.1) μm, (**L** = 10.3 μm; **W** = 7.8 μm; Q = (1.11-) 1.15 - 1.47 (-1.60); **Q** = 1.32).

Amanita supravolvata differs from *A. argentea* and *A. huijsmanii* by having a peach tint to the gray of the pileus, a lower ratio of the length of marginal striation to radius of the pileus, a volval sac with a distinctive flaring in the uppermost part of the limb, placement of the *limbus internus* well above the juncture of the stipe and the volval limb, and slightly larger spores. Inflated cells are much more common in the universal veil of *A. supravolvata* than they are in the same tissue in the other two species. The subhymenial tree of *A. supravolvata* contains more inflated cells than are found in the same structure in the other two species. Unlike the lamella trama in *A. argentea* and *A. huijsmanii*, that of the present species lacks even sparsely distributed, divergent, terminal, inflated cells. The evidence cited supports distinguishing *A. supravolvata* at the rank of species.

The acrophysalides in the pileus context of *A. supravolvata* were found to be markedly shorter than those in the other two taxa. With regard to the inflated cells in the interior of the universal veil, the largest such cells of *A. supravolvata* are more than 50% longer than the largest seen in the holotypes of *A. huijsmanii* and *A. argentea*.

Amanita supravolvata is compared to *A. dunicola* and *A. yucatanensis* in the discussions following the descriptions of these taxa.

When I examined the above-mentioned topotype in Dr. Bas' laboratory (L), he also showed me additional collections from Germany (near Potsdam, Fresdorf, 26.viii.1970 D. Benkert *s.n.*) and Poland (Cracow, near Tyniec, 20.viii.1967 Hanns Kreisel & M. Lisiewska *s.n.*) that he considered possibly assignable to *A. supravolvata*. I examined the Polish collection and reviewed Dr. Bas' notes on the German collection. I concur with his determination. The Polish specimen is well-preserved and more mature than the topotype discussed above; it is worth noting that the cells of its subhymenial tree are even more predominantly inflated than those illustrated for the topotype (Fig. 41). These two collections considerably extend the known range for the present species. Both collections are said to have been made in sandy soil in association with *Pinus*.

M. Lanne's most recent views on the present species are set forth in his 1993 publications and in personal communications to me. He is inclined to treat the present species as a form of *A. mairei*. Contu (1989a) has rejected his previous idea that the present species is a form or variety of *A. argentea* and now considers *A. supravolvata* to be a form of *A. mairei*—perhaps not justifying a taxonomic distinction. My inability to examine authentic material of *A. mairei* is all the more unfortunate on account of these opinions.

21. *AMANITA TUZA* Guzmán. 1975. *Beih. Nova Hedwigia* 51: 112.

Illus.: Guzmán. 1980. *Ident. Hongos*: lám. 133-135.
Illus.: Montiel-Arcos *et al.*. 1984. *Biótica* 9: 240, figs. 52-54.
Illus.: Pérez-Silva & Herrera Suárez. 1991. *Iconogr. Macromic. Mexico. I. Amanita*: 39, lám. V.

Figs. 43-45.

PILEUS: 70 - 120 mm wide, white to yellowish gray, viscid, smooth; *context* white, fleshy, up to 5 mm thick at stipe; *margin* slightly sulcate, nonappendiculate; *universal veil* thick, white, calyptrate, sometimes divided into two or more pieces.

LAMELLAE: subadnate to free, white, brownish yellow in dry specimens, with floccose edges; *lamellulae* truncate to subtruncate, rather sparsely(?) and unevenly distributed.

STIPE: 50 - 150 (-200) × 10 - 25 mm; *context* white and fleshy; *annulus* white, pendant and apical, membranous, persistent, more or less thick, striate on upper surface, smooth on underside; *universal veil* as a thick, membranous, saccate volva giving impression of a subbulbous or fusiform stipe base, well-developed, free, as in *A. caesarea*, with upper parts of limbs thinner than lower parts, with lower parts of limbs separating from stipe in exsiccata.

Odor indistinct or pleasant. *Taste* indistinct or pleasant.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 95 - 110 μm thick, gelatinizing strongly at surface, partially gelatinizing within 30 μm of surface, colorless except for gelatinized surface being brownish yellow here and there; filamentous, undifferentiated hyphae 1.2 - 5.2 μm wide, subradially oriented, densely interwoven; vascular hyphae not observed. PILEUS CONTEXT: filamentous, undifferentiated hyphae 1.8 - 6.0 μm wide, branching, plentiful, in loosely interweaving fascicles; acrophysalides dominant, thin-walled, fusiform to subfusiform to clavate to ellipsoid to subpyriform, up to 91 × 40 μm; vascular hyphae not observed. LAMELLA TRAMA: somewhat obscurely bilateral, with w_{cs} = approx. 25 μm; angle of divergence of hyphae and inflated elements shallow up to about 45°; filamentous, undifferentiated hyphae 2.0 - 9.0 μm wide; inflated cells infrequent, thin-walled, clavate, (*e.g.*, 28 × 13.0 μm); vascular hyphae not observed; clamps common. SUBHYMENIUM: w_{st}-near = $10^{\pm}$ μm; w_{st}-far = $50^{\pm}$ μm; tangled, including largely uninflated hyphal segments in a branching structure with terminal one or two elements (at least) being perpendicular to central stratum, with occasional segments inflated (sometimes in chains of two to four clavate to ovoid to narrowly ellipsoid to irregular elements) up to 17.5 × 11.0 μm; basidia arising most frequently from uninflated hyphal segments, but also arising from small inflated or partially inflated cells; clamps common. BASIDIA: 44 - 77 × 10.0 - 13.5 μm, thin-walled, dominantly 4-sterigmate, occasionally 2-sterigmate;

clamps relatively common. UNIVERSAL VEIL: *On pileus, exterior surface*: filamentous, undifferentiated hyphae 1.0 - 3.5 μm wide, partially gelatinized, orange-brown, in disordered and widely spaced fascicles; vascular hyphae not distinguishable due to gelatinization; clamps present. *On pileus, interior*: filamentous, undifferentiated hyphae 1.0 - 5.8 μm wide, branching, in sometimes rather thick fascicles, with fascicles interwoven among inflated cells, plentiful to dominant; inflated cells terminal, singly, plentiful, thin-walled, broadly ellipsoid to ovoid to subglobose (up to 76 × 53 μm), clavate (up to 125 × 39 μm); vascular hyphae 2.0 - 4.8 μm wide, occasional, coiling here and there; clamps present. *On pileus, inner surface*: a thin layer of nearly completely gelatinized hyphae (apparently subradially oriented) overlaying a similarly thin layer of densely interwoven hyphae. *At stipe base, exterior surface*: highly gelatinized, impregnated extensively with soil particles, orange-brown, largely comprising filamentous, undifferentiated hyphae. *At stipe base, interior*: filamentous, undifferentiated hyphae 2.2 - 10.8 μm wide, plentiful, branching, sometimes partially gelatinized, in fascicles that are loosely interwoven; inflated cells dominating, subglobose to broadly clavate to clavate to narrowly clavate or subfusiform, up to 109 × 65 μm, terminal, single, thin-walled; vascular hyphae not observed. *At stipe base, inner surface*: a layer 13 - 26 μm thick, partially gelatinized; filamentous, undifferentiated hyphae 1.5 - 5.0 μm wide, branching, densely interwoven, sublongitudinally arranged; vascular hyphae not observed. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.0 - 8.2 (-10.8) μm wide, plentiful; acrophysalides often somewhat broad for their length (compared to usually rather narrowly clavate acrophysalides in stipes of many species of *Amanita*), up to 151 × 50 μm, thin-walled or with very slightly thickened walls, plentiful to dominating; vascular hyphae not observed. PARTIAL VEIL: filamentous, undifferentiated hyphae 2.2 - 8.5 μm wide, frequently branching, collapsed, thin-walled, plentiful to dominant, moderately loosely interwoven, mostly in fascicles, with some fascicles subradially oriented (*e.g.*, on upper surface); inflated cells terminal, thin-walled, plentiful to locally dominant (away from surfaces), elongate to clavate to subfusiform to broadly fusiform (up to 73 × 34 μm), infrequently subglobose (*e.g.*, 41 × 35 μm); vascular hyphae 1.2 - 5.5 μm wide, branching, relatively common; clamps rather large, common.

BASIDIOSPORES: [71/3/1] (10.0-) 10.8 - 13.7 (-15.4) × (7.1-) 7.8 - 10.1 (-11.5) μm, (**L** = 11.6 - 12.4 μm; **L'** = 12.0 μm; **W** = 8.3 - 9.4 μm; **W'** = 8.7 μm; Q= (1.14-) 1.20 - 1.60 (-1.74); **Q** = 1.32 - 1.44; **Q'** = 1.39), hyaline, colorless, thin-walled, smooth, inamyloid, often adaxially flattened; apiculus sublateral, prominent, cylindric to truncate-conic; contents granular to guttulate; color in deposit not recorded.

Habitat and distribution: Known from central Mexico, in *Pinus* and *Abies* forests, solitary.

Collection examined: **MEXICO:** MÉXICO—Nevada de Toluca region - near San Pedro Tlanixco, 28.viii.1957 G. Guzmán 825-A (holotype ENCB (*n.v.*); isotype, L; isotype, MICH).

DISCUSSION

Guzmán explains the origin of the specific epithet as follows: "The sporophore almost completes its development under the surface of the soil, but when it is mature it suddenly emerges raising the soil with it, like the pocket gopher of the Geomydae family." He notes that *tuza* is the popular Mexican name for pocket gophers (*Cratogemys spp.*).

For comparison with *A. lactea*, see the discussion following the description of that species.

22. *AMANITA VIOLETTAE* Tulloss *nom. nov.*

Basionym: *Amanitopsis vaginata* var. *crassivolvata* Peck *in* V. S. White. 1902. *Bull. Torrey Bot. Club* 29: 562. Holotypus: Maine, Hancock County, Bar Harbor, 20.vii.1901 V. S. White 39 (NY). [Part of collection in box, remainder (filed separately) in packet glued to watercolor of mature specimen.]

≡*Amanita vaginata* var. *crassivolvata* (Peck) E. J. Gilb. 1941. *Notules Amanites (Suppl.)*: 10.

Figs. 46-47.

Etymology: Named in honor of the holotype's collector, Miss Violetta Susan Elizabeth White (1875 - 1949).

PILEUS: 70 - 100 mm wide, "creamy yellow" (?) [depicted as rather strongly olivaceous yellow in watercolor of mature specimen of holotype (NY)], broadly convex to nearly plane, umbonate, viscid when moist; *context* not described; *margin* deeply striate (up to 25 mm long striations; 0.35R as dried); *universal veil* absent.

LAMELLAE: free, close, not crowded, white, sometimes tinged with yellow, broad; *lamellulae* truncate.

STIPE: 150 - 200 × 20± mm, equal, "darker than pileus" (with gray decoration in painting of holotype); *context* stuffed with slimy, cottony fibers; *exannulate*; *universal veil* as a saccate volva, membranous, rather thick, copious, at first shaped like a wine glass or goblet, white, with "wooly" or "felty" surface texture.

Odor not reported. *Taste* very sweet, but unpleasant.

MACROCHEMICAL TESTS: none reported.

PILEIPELLIS: 20 - 45 μm thick, partially to totally gelatinizing, orangish in 3% KOH; filamentous, undifferentiated hyphae 1.5 - 7.8 μm wide, dominantly subradially arranged, interwoven, colorless or with uniformly distributed orangish intracellular pigment; vascular hyphae not observed. PILEUS CONTEXT: somewhat difficult to rehydrate; filamentous, undifferentiated hyphae 2.0 - 10.5 μm wide, branching, loosely interwoven, often in fascicles; acrophysalides plentiful, thin-walled, pyriform to ovoid to ellipsoid, up to 62 × 53 μm or larger; vascular hyphae $6.0^{\pm}$ μm wide, some reddish brown in 3% KOH, branching. LAMELLA TRAMA: bilateral, poorly or very poorly rehydrating; central stratum obscure (with $w_{cs} = 50^{\pm}?$ μm); angle of divergence of inflated cells difficult to ascertain (about 20°?); filamentous, undifferentiated hyphae 1.2 - 7.2 μm wide, branching; diverging, terminal, inflated cells broadly clavate to clavate (*e.g.*, 61 × 29 μm), thin-walled; vascular hyphae absent or not distinguishable from locally plentiful hyphae of invasive mold. SUBHYMENIUM: with w_{st}-far minus w_{st}-near = 15 - 20 μm; with basidia arising from short uninflated or slightly inflated hyphal segments or from ovoid to pyriform to clavate inflated cells (*e.g.*, 13.5 × 10.0 μm) in a branching structure, with some uninflated branches nearly parallel to central stratum; with many elements at angles of 30° - 60° (to nearly perpendicular) to central stratum just below bases of basidia/-oles; clamps present. BASIDIA: 40 - 56 × 9.5 - 17.5 μm, thin-walled, dominantly 4-, also occasionally 2-sterigmate, with sterigmata up to 8.0 μm long; rather large clamps present. UNIVERSAL VEIL: *On pileus*: absent. *At stipe base, exterior surface*: filamentous, undifferentiated hyphae 2.2 - 11.0 μm wide, branching, partly gelatinizing, loosely interwoven. *At stipe base, interior*: filamentous, undifferentiated hyphae 2.2 - 12.5 μm wide, often in fascicles, loosely interwoven, plentiful, branching, sometimes with yellowish subrefractive walls or with yellowish refractive material deposited on inner wall surface; inflated cells plentiful, terminal or in short chains, thin-walled, clavate to ventricose (up to 210 × 51 μm), ovoid to subpyriform to subglobose (up to 90 × 88 μm); vascular hyphae not observed. *At stipe base, inner surface*: filamentous, undifferentiated hyphae 2.5 - 8.0 μm wide, dominating, longitudinally oriented, densely packed in thin layer; vascular hyphae not observed. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.5 - 8.5 μm wide, relatively frequently with yellowish subrefractive walls; acrophysalides up to 166 × 38 μm, thin-walled; vascular hyphae 5.0 - 15.0 μm wide, scattered, locally plentiful in loose knots, rarely branching.

BASIDIOSPORES: [40/1/1] (8.5-) 10.0 - 11.8 (-12.2) × (7.8-) 9.0 - 11.0 (-11.2) μm, (**L** = 10.9 μm; **W** = 10.0 μm; Q = (1.0-) 1.03 - 1.17 (-1.23); **Q** = 1.09), inamyloid, thin-walled, hyaline, colorless, smooth, globose to subglobose to broadly ellipsoid, usually at least somewhat adaxially flattened; apiculus sublateral, cylindric, prominent; contents guttulate; color in deposit not reported.

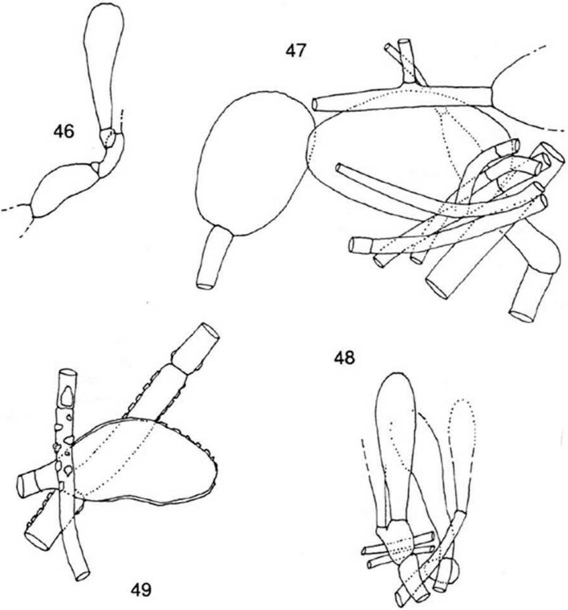
Habitat: In damp soil by brook.

Collection examined: **UNITED STATES OF AMERICA:** MAINE—Hancock Co. - Bar Harbor, 20.vii.1901 V. S. White 39 (holotype, NY).

DISCUSSION

This entity belongs with the group of large species with copious, membranous volval sacs, and clamps at the base of basidia. It can be distinguished from *A. magnivolvata* by pileus color, thickness of pileipellis, spore size and shape, and its lacking the slightly thickened cell walls prevalent in *A. magnivolvata*.

Amanita violettae can be distinguished from *A. pachycolea* and *A. pachyvolvata* by pileus color, thickness of the pileipellis, spore size, and the presence of terminal, inflated cells in the lamella trama.



Figs. 46-49. Figs. 46-47. *Amanita violettae* (V. S. White 39, holotype). 46. Elements of hymenium and subhymenium. 47. Elements of universal veil (interior) from stipe base. Figs. 48-49. *Amanita yucatanensis* (Guzmán 21044, isotype (XAL)). 48. Elements of hymenium and subhymenium. 49. Elements of universal veil (interior) in optical cross section except for the nearly vertically oriented hypha, which is drawn to show surface decoration—original orientation on basidiocarp unknown.

The epithet *crassivolvata* is not available at the rank of species because of the existence of *Amanita crassivolvata* Krieger (1927). Therefore, I selected an epithet honoring the collector of the holotype of the present taxon. V. S. White had a short, but distinguished mycological career. Her handwritten manuscript on earth stars illustrated with detailed pen and ink drawings is on file at NY. Her letters to C. H. Peck are preserved in NYS. Her watercolor paintings of fungi are preserved at Montgomery House, Red Hook, New York (John H. Haines, pers. comm.).

23. *AMANITA YUCATANENSIS* Guzmán. 1982. *Mycotaxon* 16: 255.

Illus.: Guzmán. 1983. *Biótica* 8: 91, fig. 9.

Figs. 48-49.

PILEUS: $25^{\pm}$ mm wide, convex to near planar, smooth, dry, white to pale yellowish; *margin* striate; *context* white; *pileipellis* easily peeling in exsiccatum; *universal veil* absent or as scattered irregularly shaped, whitish, thin, flat patches.

LAMELLAE: narrowly adnate, white to whitish rose, drying pale orange-brown (more yellow than 7.5YR 7/6 and close to 5B5), with fimbriate edges (remaining pale in exsiccatum); *lamellulae* truncate, unevenly distributed.

STIPE: $12^{\pm}$(?) × $5^{\pm}$ mm, narrowing markedly upward, floccose-scaly below, pruinose above; *context* not recorded; *exannulate*; *universal veil* as a membranous sac, white, and delicate.

Odorless. *Taste* not recorded.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 20 - 40 μm thick, extensively gelatinizing at the surface; filamentous, undifferentiated hyphae 1.5 - 4.5 μm wide, subradially oriented, interwoven, densely packed, more yellow brown than adjacent context; refractive hyphae 2.5 - 7.0 μm wide, branching, locally common, sometimes descending into pileus context. PILEUS CONTEXT: filamentous, undifferentiated hyphae 2.2 - 12.5 μm wide, loosely interwoven, branching, often constricted at septa, with some terminal segments narrowly clavate; acrophysalides thin-walled, broadly clavate to ovoid to ellipsoid to oblong to subcylindric, up to 98 × 36 μm; refractive hyphae 2.8 - 7.8 μm wide, branching, common. LAMELLA TRAMA: bilateral, in some sections obscurely so; $W_{cs} = 50^{\pm}$ μm; in some sections dominated by a densely tangled central stratum, imperfectly rehydrating; filamentous, undifferentiated hyphae 2.0 - 7.5 μm wide, subparallel to hymenial surface, sometimes obscuring both inflated intercalary cells and divergent elements, with inflated intercalary segments ellipsoid to subcylindric, up to 42 × 23 μm; apparently terminal, inflated cells resulting from sectioning, with major axis parallel to hymenial surfaces or diverging (as result of sectioning and mounting) at angles up to 45°; vascular hyphae not observed. SUBHY-

MENIUM: w_{st}-near = 5± μm; w_{st}-far = 35± μm; a branching structure dominated by filamentous, undifferentiated hyphae, although with small inflated cells rather plentiful in some regions; basidia arising from small ovoid to subglobose cells and from uninflated or slightly inflated hyphal segments; filamentous, undifferentiated hyphae present running subparallel to hymenial surface near bases of longer basidia. BASIDIA: 54 - 70 × 9.0 - 17.0 μm, thin-walled, 4-, or occasionally 2-sterigmate; clamps present, occasionally rather small and somewhat difficult to locate in some sections. UNIVERSAL VEIL: *At stipe base, exterior surface*: surface layer with thickness of only one or two hyphal diameters; filamentous, undifferentiated hyphae 1.0 - 6.0 μm wide, dominating, loosely woven, often in fascicles, many sublongitudinally oriented, partially gelatinized; inflated cells uncommon, nearly fully gelatinized, having same form as those of interior; refractive hyphae 2.8 - 6.5 μm wide, lacking a common orientation, sometimes included in fascicles. *At stipe base, interior*: filamentous, undifferentiated hyphae 1.5 - 10.2 μm wide, dominating, sometimes with very narrowly fusiform intercalary segments, branching, loosely interwoven, constricted at septa, commonly with irregular, flat plaques less than 0.5 μm thick on surface; inflated cells clavate to narrowly clavate to ventricose, terminal, thin-walled or with walls slightly thickened, at times with exterior wall having small surface plaques as in hyphae (only seen on thin-walled cells or on thin-walled parts of cell surfaces), up to 79 × 39 μm; vascular hyphae not observed. *At stipe base, inner surface*: filamentous, undifferentiated hyphae in fascicles, partially gelatinized, fragmented, occasional; inflated cells slightly narrower on average than in interior; otherwise, like interior. *On pileus*: absent. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.4 - 10.5 μm wide, plentiful, branching; acrophysalides up to 186 × 39 μm, thin-walled; refractive hyphae 0.7 - 8.8 μm wide, especially frequent near stipe surface; clamps observed.

BASIDIOSPORES: [40/1/1] (7.8-) 9.5 - 13.0 (-14.2) × (7.0-) 7.5 - 9.5 (-11.8) μm, (**L** = 11.6 μm; **W** = 8.7 μm; Q = (1.11-) 1.17 - 1.44 (-1.53); **Q** = 1.33), hyaline, colorless, smooth, thin-walled, inamyloid, broadly ellipsoid to ellipsoid, occasionally subglobose, dominantly adaxially flattened, sometimes expanded in middle, often expanded at one end; apiculus sublateral, infrequently lateral, cylindric; context dominantly monoguttulate with a few small granules; color in deposit not recorded.

Habitat: Solitary on soil in secondary, perennial, tropical rain forest.

Collection examined: **MEXICO:** QUINTANA ROO—Road to Vallarta, *ca.* crossing from Puerto Morelos to Tulum Road, 10.xi.1981 G. Guzmán 21044 (holotype, ENCB (*n.v.*); isotype, XAL).

DISCUSSION

The length of the stipe given in the protologue must be in error. The isotype specimen I examined has a very thin stipe exceeding the length reported for the fresh material.

The exterior decoration of cell walls in the universal veil is limited to cases in which the walls otherwise are not thickened. This suggests that the cells have one or more outer layers that rupture in a roughly areolate manner thus giving rise to the patches observed—superimposed on a thin, innermost, tegumentary layer.

As in the case of *A. dunicola*, a comparison to *A. argentea*, *A. huijsmanii*, and *A. supravolvata* is warranted. The pilei of these taxa are gray. Their universal veil, when it is left on the pileus, takes the form of a rather thick, white patch over the disc. The margins of their pilei are markedly striate. The pileipellis in *A. argentea* and *A. huijsmanii* is thicker than in *A. yucatanensis* and exhibits a criss-cross pattern of somewhat refractive elements. Surface plaques are lacking on all elements of the anatomy of the European taxa. *Amanita supravolvata* lacks divergent, terminal, inflated cells in the lamella trama and lacks hyphae of the trama running parallel to the central stratum close to the bases of longer basidia.

Comparison to *A. dunicola* is provided in the discussion following the description of that species.

Summary Key

I have been very conservative about proposing taxonomic synonymy in this paper. In general the amount of material examined for each taxon is small, and very few of the taxa are known to me from direct experience with living basidiocarps.

While the number of taxa treated in this paper is only a small fraction of the number of taxa that can be assigned to section *Vaginatae*, a provisional key is provided for this somewhat arbitrary grouping in order to provide a simple means of distinguishing them without needing to refer to the sometimes lengthy discussions in this paper. The key serves as a summary of my current thinking on one portion of a useful taxonomic structuring of section *Vaginatae*.

KEY TO TAXA TREATED IN THIS PAPER

Primary Key.

1. Universal veil pulverulent, as warts or plaques on pileus; on stipe base, often as ring of material above strangulate pallid region or absent, *not* as weakly structured, saccate volva and *not* as collapsed, graying limb; partial veil absent........ *Key A.*

1. Universal veil otherwise; partial veil present or not.

   2. Universal veil weakly structured and, therefore, breaking up into warts or patches on the pileus, but also commonly found collapsed against stipe, often discoloring rather strongly during and after expansion of basidiocarp............ *Key B.*

   2. Universal veil membranous, thin to very thick, exterior white, occasionally with superficial staining (often brown, rusty, or ochraceous), occasionally

leaving one or a few membranous patches on pileus—a constant and diagnostic feature in some species, a rare occurrence in others.

3. Stipe appearing to have slight, ellipsoid bulb at its base within volval sac. [If this proves true, these taxa may have to be moved to *Amanita* section *Amanita*.] (No taxa treated in this group.)

3. Stipe totally elongating—without bulb.

4. Stipe annulate—at least at first.. *Key C.*

4. Stipe always exannulate from beginning of basidiocarp expansion.......... *Key D.*

Key A—Pulverulent universal veil.

1. Universal veil neither pallid nor white in the button stage, *e.g.*, fulvous or orange-yellow. (No taxa treated in this group.)

1. Universal veil pallid or whitish at first (or original color not known at present).

2. Universal veil becoming gray or brownish gray, but not brown or black. If gray-brown, see also second choice of this pair. (No taxa treated in this group.)

2. Universal veil becoming gray-brown or brown or black.

3. Universal veil eventually black. (No taxa treated in this group.)

3. Universal veil eventually brown or gray-brown.

4. Pileus brown; universal veil ochraceous brown; subhymenium with w_{st}-far = 30 - 55 μm, containing moderately plentiful (two to three layers) to sparse, clavate to ovoid to ellipsoid inflated cells up to 17.0 × 11.0 μm; spores (8.4-) 9.8 - 13.3 (-14.3) × (7.1-) 7.7 - 10.5 (-11.9) μm, with Q = 1.24; described from Trinidad.. 1. *Amanita antillana* Dennis.

4. Pileus '*brun havane*' or golden walnut in disc, a little paler and often more ochraceous towards the margin especially when young; universal veil brown; subhymenium with w_{st}-far = 50^{+} - $75^{\pm}$ μm, predominantly composed of hyphae; spores (8.8-) 9.8 - 11.8 (-13.0) × (7.2-) 9.0 - 11.0 (-12.2) μm, with Q = 1.05 - 1.08; described from France..................... 4. *Amanita beckeri* Huijsman.

Key B—Weakly structured volva, often discoloring.

1. Stipe annulate—at least at first. (No taxa treated in this group.)

1. Stipe always exannulate from beginning of basidiocarp expansion.

2. Universal veil not discoloring gray, brown, or black on exposure (but possibly discoloring to some other color in age or taking on ochraceous or brownish stains); inflated cells in universal veil of mature (but not senescent) specimen all colorless or with a few very faintly sordid.

3. Universal veil having an interior, pulverulent layer and a thick, submembranous outer layer and usually leaving both inner layer and warts or small patches of outer layer on pileus; all parts of basidiocarp taking on ochraceous spots and stains; spores (8.7-) 9.4 - 12.8 (-20.5) × (7.3-) 8.7 - 11.2 (-16.2)

μm, with **Q** = (1.07-) 1.10 - 1.17 (-1.19); described from southern California, U.S.A. .... *Amanita protecta* Tulloss & G. Wright.

3. Universal veil lacking a pulverulent layer, membranous, flexible, sometimes strangulate, sometimes breaking up into plaques sometimes lost in substrate, often staining rusty orange, but other parts of basidiocarp not sharing this character.

4. Subhymenium with plentiful large cells throughout, with 2½ to 5 cells between base of long basidium/-ole and shortest nearby basidiole; universal veil with combination of large thin-walled inflated cells and smaller thick-walled inflated cells, and with many of latter easily dissociated; spores (7.8-) 9.5 - 12.2 (-16.2) × (7.5-) 8.5 - 11.0 (-13.8) μm, with **Q** = 1.09 - 1.13, material from California, U.S.A. .... nonconformant paratype of *A. constricta* (*A. species* C12).

4. Subhymenium with large inflated cells concentrated in base, with ½ to 3½ cells between base of long basidium/-ole and shortest nearby basidiole; universal veil with inflated cells dominantly thin-walled, not easily dissociating, and occasionally in chains of up to four or more cells; spores (8.8-) 9.8 - 12.8 (-18.5) × (7.8-) 8.0 - 11.0 (-13.0) μm, with **Q** = 1.15, material from California, U.S.A. .... nonconformant paratype of *A. constricta* (*A. species* NW5).

2. Universal veil discoloring (usually gray or brownish gray, but also brown or black) on exposure at least on inner surface of limbs of universal veil, seen in mature basidiocarps well before senescence, with discoloration often occurring in "button" stage; some or all inflated cells of universal veil in mature specimen not colorless (usually, brownish or grayish); universal veil, when fresh, rarely becoming temporarily salmon color or reddish when moistened.

5. Subhymenium dominantly ramose or rather tangled, with few fully inflated cells; most basidia arising from uninflated or (occasionally) partially inflated hyphal segments.

6. Subhymenial tree very shallow, nowhere more than 15 μm thick and somewhat difficult to distinguish from central stratum, with the latter < 40 μm wide; spores (8.5-) 9.0 - 11.2 (-12.0) × (7.5-) 8.0 - 10.8 (-11.8) μm, with **Q** = 1.09, material from France... specimen "B" in holotype of *A. malleata*.

6. Subhymenial tree more than 15 μm thick below shortest basidioles.

7. Clamps common; spores (8.2-) 10.5 - 13.8 (-16.2) × (7.2-) 7.8 - 10.8 (-13.5) μm, with **Q** = (1.19-) 1.23 - 1.45; described from Sardinia, Italy.. 6. *Amanita oblongospora* Contu *ex* Tulloss & Contu.

7. Clamps rare or absent; spores with **Q** = 1.06 - 1.35 in mature material, infrequently up to 1.41 in immature material.

8. Pileus umbrinous; inflated cells present in lamella trama; spores (10.8-) 11.2 - 13.9 (-14.4) × (8.2-) 8.3 - 11.5 (-11.7) μm, with **Q** = (1.18-) 1.33 - 1.35; described from Italy..................................... *Amanita biovigera* Sing.

8. Pileus not umbrinous; lamella trama often lacking terminal inflated

cells; subhymenium lacking or having few fully inflated cells; spores with $Q < 1.30$ in mature basidiocarps.

9. Spores with $Q \geq 1.20$; lamella trama apparently lacking terminal inflated cells; subhymenium lacking fully inflated cells. [Subhymenium with w_{st}-near ≥ 15 μm and w_{st}-far ≤ 35 μm, with occasional hyphae running parallel to the central stratum; lamella trama without divergent, terminal, inflated cells exceeding the broad central stratum; $Q = 1.20 - 1.30$ in mature basidiocarps. The following taxa are essentially anatomically identical according to my type studies; note that the names are *not* nomenclatural synonyms.]

10. Pileus grayish beige to leaden, becoming dirty white in age; spores (9.8-) 10.0 - 12.8 (-14.0) × (6.5-) 8.0 - 10.5 (-11.8) μm, with $Q = 1.23$; described from France................................

13. *Amanita malleata* (Bon) Contu.

10. Pileus pearl gray with tints of brownish ocher to pale ocher; spores (10.5-) 11.0 - 13.8 (-16.0) × (8.5-) 8.8 - 11.0 (-11.5) μm, with $Q = 1.27$; described from France................................

10. *Amanita lividopallescens* var. *malleata* Piane *ex* Romagn.

10. Pileus of similar color; spores (10.0-) 10.5 - 14.0 (-22.0) × (7.0-) 7.8 - 11.5 (-12.8) μm, with $Q = 1.22 - 1.41$; described from France...

11. *Amanita lividopallescens* var. *tigrina* Romagn. *ex* Bon

9. Lamella trama with or without terminal, inflated cells; subhymenium sometimes with scattered inflated cells, but these never subglobose or globose; spores with $Q < 1.20$.

11. Pileus with gray tones; universal veil on stipe often strongly strangulate; universal veil on pileus becoming salmon or reddish when moistened; terminal, inflated cells present in lamella trama; scattered inflated cells in subhymenium; spores (7.2-) 9.5 - 12.8 (-19.0) × (6.2-) 8.2 - 11.5 (-17.8) μm, with $Q = (1.06\text{-})\ 1.07 - 1.17\ (\text{-}1.18)$; described from California, U.S.A........................

5. *Amanita constricta* Thiers & Ammirati.

11. Pileus lacking gray tones; universal veil on stipe not strongly strangulate; universal veil on pileus not becoming salmon color or reddish when moistened; terminal, inflated cells present in lamella trama or not; fully inflated cells lacking in subhymenium.

12. Pileus with olivaceous or bronzy tones, not deep brown or ochraceous; spores with Q usually < 1.10.

13. Pileus olive-gray to olive-brown; spores (8.7-) 9.8 - 12.0 (-14.3) × (8.1-) 9.0 - 11.2 (-13.0) μm, with $Q = 1.06 - 1.08$; acrophysalides and larger diameter hyphae of pileus and stipe context and interior of universal veil having walls up to 1.0 μm thick; described from Greenland.......................................

14. *Amanita mortenii* Knudsen & Borgen
emend. Tulloss & Borgen.

13. Pileus rather olivaceous brown with a coppery tint or slightly bronzy, with paler and slightly more yellowish margin; acrophy-

salides and hyphae of pileus and stipe context and in interior of universal veil thin-walled; universal veil in exsiccata having thin flakes (like peeling paint) on surface; spores (9.2-) 10.2 - 13.0 (-13.8) × (8.2-) 9.0 - 12.0 (-12.5) µm, with **Q** = 1.09; described from France..
18. *Amanita submembranacea* (Bon) Gröger var. *submembranacea*.

12. Pileus Vandyke brown or with orangish or ochraceous tones; spores with **Q** usually ≥ 1.10.

14. Pileus Vandyke brown; acrophysalides thin-walled; inflated cells of universal veil with walls up to 0.5 µm thick; lamella trama without inflated cells; spores (9.8-) 10.9 - 13.2 (-15.4) × (9.0-) 9.1 - 11.2 µm, with **Q** = 1.10; described from the U.K..
19. *Amanita submembranacea* var. *bispora* Reid.

14. Pileus not a deep brown, with orangish tones; acrophysalides and inflated cells of universal veil with walls up to 1.0 µm thick; lamella trama with plentiful inflated cells; spores (8.5-) 9.2 - 13.5 (-16.5) × (7.2-) 8.2 - 11.5 (-15.0) µm, with **Q** = 1.10 - 1.18; material from Greenland..
nonconformant paratypes of *A. mortenii*.

5. Subhymenium dominated by inflated to partially inflated cells at maturity (branching structure may still be apparent); pileus having olivaceous tones; spores (7.8-) 9.2 - 12.5 (-23.0) × (7.8-) 8.2 - 11.5 (-16.0) µm, with **Q** = 1.08 - 1.12 (-1.15); described from Greenland....................................
7. *Amanita groenlandica* Bas *ex* Knudsen & Borgen.

Key C—Universal veil membranous and firm; stipe annulate—at least at first.

1. Universal veil thick to exceedingly thick and robust when pileus emerging from substrate.

2. Partial veil weakly structured and/or ephemeral; pileus white; clamps rare or absent; spores (11.0-) 12.2 - 17.2 (-21.0) × (7.8-) 8.0 - 11.2 (-15.2) µm, with **Q** = 1.48 - 1.52; described from Mediterranean region............................
9. *Amanita lactea* Malenç., Romagn. & Reid.

2. Partial veil persistent. Pileus white at first; clamps plentiful; spores (10.0-) 10.8 - 13.7 (-15.4) × (7.1-) 7.8 - 10.1 (-11.5) µm, with **Q** = 1.32 - 1.44; described from Mexico..
21. *Amanita tuza* Guzmán.

1. Universal veil thin, sometimes rather small and thimble-like. (No taxa treated in this group.)

Key D—Universal veil membranous and firm; stipe always exannulate from beginning of basidiocarp expansion.

1. Universal veil at stipe base as a saccate volva, large, thick, robust.

2. Pileus gray with slight olive tinge, with faintly deeper gray ring at inner edge of sulcations; spores (9.0-) 10.0 - 16.5 (-17.5) × 8.5 - 12.8 (-14.5) µm

[spores to be expected in low end of range in mature material; holotype barely mature], with **Q** = 1.19; described from Finland..................................
12. *Amanita magnivolvata* Aalto.

2. Differing in character or characters.

3. Pileus fuliginous at first, becoming brown, campanulate in early stages of expansion, developing distinctly pigmented ring over inner ends of marginal striae; spores (7.8-) 9.8 - 13.0 (-15.0) × (7.5-) 8.2 - 11.8 (-14.0) μm, with **Q** = 1.06 - 1.15; described from northwestern U.S.A...........................
16. *Amanita pachycolea* Stuntz *in* Thiers & Ammirati.

3. Differing in a character or characters; not developing distinctly pigmented ring over inner ends of marginal striae.

4. Pileus sordid ochraceous; spores (10.2-) 11.0 - 14.2 (-15.0) × (9.5-) 10.8 - 13.2 (-15.0) μm, with **Q** = 1.08; described from France....................
17. *Amanita pachyvolvata* (Bon) Krieglsteiner.

4. Pileus creamy yellow to yellowish olive; spores (8.5-) 10.0 - 11.8 (-12.2) × (7.8-) 9.0 - 11.0 (-11.2) μm, with **Q** = 1.09; described from Maine, U.S.A...
22. *Amanita violettae* Tulloss.

1. Volval sac neither large nor thick nor robust.

5. Subhymenium ramose, with plentiful uninflated hyphal segments in subhymenial tree.

6. Pileus whitish to pale grayish buff; spores (10.0-) 10.2 - 12.2 (-14.0) × (8.5-) 9.2 - 11.2 (-12.8) μm, with **Q** = 1.08 - 1.11; described from arctic-alpine habitat in Scotland...
Amanita nivalis Grev.

6. Spores with **Q** ≥ 1.15.

7. Pileus a shade of gray.

8. Spores having **Q** in the range 1.25 - 1.45.

9. Pileus pale gray with slight tinge of rather pallid peach; *limbus internus* of universal veil on inner surface of limb well above point of attachment to stipe; inflated cells rather common in universal veil interior; subhymenium having rather common inflated cells; spores (8.8-) 10.0 - 13.5 (-15.2) × (6.5-) 7.2 - 10.0 (-14.0) μm, with **Q** = 1.24 - 1.43; described from France..
20. *Amanita supravolvata* Lanne.

9. Pileus lacking pale peach tint; *limbus internus* positioned at point of juncture of universal veil and stipe; inflated cells infrequent in universal veil interior; inflated cells not common in subhymenium.

10. Pileus silvery gray to ash gray; universal veil without gelatinized elements or gelatinized only on surfaces; spores (9.1-) 9.3 - 12.0 (-12.7) × (6.4-) 7.3 - 9.1 (-9.3) μm, with **Q** = 1.34; described from France...
3. *Amanita argentea* Huijsman.

10. Pileus metallic gray; universal veil partially gelatinized throughout; spores (8.5-) 10.8 - 12.8 (-15.0) × (6.8-) 7.8 - 9.8 (-10.5) μm, with **Q** = 1.30; described from France..
8. *Amanita huijsmanii* Massart & Rouzeau.

8. Pileus pale gray to dark smoke gray, at times with yellowish or bister tint when young, having paler version of these same colors or often with pale violaceous tint at maturity, *Drab-Gray*, *Light Drab*, *Light Grayish Olive*, *Smoke Gray*, *Pallid Vinaceous-Drab*; spores "11.5 - 13.5 × 7.6 - 8.3 (-9.3) μm," with estimated Q = 1.55; described from Algeria.........
Amanita mairei Foley.

7. Pileus not a shade of gray.

11. Pileus white to pale yellowish to pale brownish to leather brown; universal veil absent from pileus or present as scattered patches; subhymenium not pseudoparenchymatous, but with small inflated cells rather plentiful in some regions; Q ≥ 1.3.

12. Pileus white to pale yellowish; elements of universal veil interior with surface plaques or slightly thickened walls; spores (7.8-) 9.5 - 13.0 (-14.2) × (7.0-) 7.5 - 9.5 (-11.8) μm, with Q = 1.33; described from neotropical forest, Mexico..
23. *Amanita yucatanensis* Guzmán.

12. Pileus pale brownish to leather brown; elements of universal veil interior thin-walled and without surface plaques; spores (8.5-) 10.0 - 13.9 (-15.0) × (6.0-) 7.2 - 9.5 (-11.2) μm, with Q = 1.35 - 1.41; described from neotropical seacoast, Mexico................................
6. *Amanita dunicola* Guzmán.

11. Pileus white; universal veil as large calyptra on pileus; subhymenium with only scattered, small inflated cells; spores (9.0-) 9.3 - 15.3 (-17.7) × (6.9-) 7.8 - 13.7 (-13.8) μm, with Q = 1.15 - 1.26; material from Lapland..
nonconformant paratype of *A. arctica*.

5. Subhymenium pseudoparenchymatous and with mature basidia all or predominantly arising from inflated cells in fully mature material; pileus white at first; spores (9.0-) 10.0 - 13.2 (-18.5) × (8.2-) 8.8 - 12.5 (-16.8) μm, with Q = 1.06 - 1.12; described from Greenland..
2. *Amanita arctica* Bas, Knudsen & Borgen.

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