MYCOTAXON

AN INTERNATIONAL JOURNAL DESIGNED TO EXPEDITE PUBLICATION OF RESEARCH ON TAXONOMY & NOMENCLATURE OF FUNGI & LICHENS

Volume X October-December 1979 No. 1

CONTENTS

[MYCOTAXON for July-September 1979 (9: 365-528) was issued July 13, 1979]

ISSN 0093-4666 *MYXNAE 10(1) 1-264 (1979)*

Library of Congress Catalogue Card Number 74-7903

Published quarterly by MYCOTAXON, Ltd., P.O. Box 264, Ithaca NY 14850
For subscription details and availability in microform, see back cover

MYCOTAXON

Vol. X, No. 1, pp. 1-20 October-December 1979

ANNOTATED, ILLUSTRATED, HOST INDEX OF SONORAN DESERT RUST FUNGI[1]

GEORGE B. CUMMINS

Department of Plant Pathology
University of Arizona, Tucson, AZ 85721

SUMMARY

Spore dimensions and illustrations are presented for 90 species of Uredinales under an alphabetized arrangement of the genera of host plants. There are 12 species on Gramineae, 21 on Compositae and 21 on Leguminosae; other families have four or fewer. An addendum lists 13 species occasionally reported on cultivars. A status change is *Puccinia grindeliae* Peck ssp. *riddelliae* (Griff.) stat. nov. (*Gymnoconia ridelliae* Griff.) on *Baileya multiradiata* and *Psilostrophe cooperi*.

INTRODUCTION

The Sonoran Desert has an abundant and varied vegetation of herbs, shrubs, and trees. For this reason, much of the area does not correspond to the popular conception of a desert. Shreve and Wiggins (1964) required 1740 pages to describe the vegetation and flora; 193 pages are devoted to a general description of the area and 1548 pages to a taxonomic exposition of the plants. The desert (Shreve and Wiggins, 1964) occupies the southeastern corner of California, southwestern Arizona, most of Baja California except the northwestern section, and most of the western half of Sonora. The elevation is mostly below 3000 ft. The outline of the desert often is irregular, due to extensions into canyons and the intrusion of mountains.

Most of the records of fungi that I have used are in the Arizona Mycological Herbarium. Early collections included a few by Edward Palmer in Sonora and by J. W. Toumey, J. J. Thornber, and David Griffiths in Arizona. Later collectors who accounted for many records were R. B. Streets, L. N. Goodding, and P. D. Keener. From about 1960 onward, G. B. Cummins added both Sonoran and Arizona records and, after 1967, R. L. Gilbertson has been an active collector in Arizona. Many areas, especially Baja California, are largely unknown mycologically, so this index can be only provisional. The numbers of species probably will be subject to limited additions, but distributions and host records will be extended. *Puccinia turgidipes*, for example, in Arizona occurs within five miles of the border but is not recorded in Mexico. Some species, e.g. *Puccinia leptochloae*, occur in Mexico at sea level but Arizona records are above the desert, which is the reverse of the expected distribution.

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[1] University of Arizona Agricultural Experiment Station Journal Article No. 2974.

Because the principal rains come in the latter half of summer, most aecial stages occur in late summer. Exceptions are the rusts of bulbous plants, such as *Allium* and *Dichelostemma*, which develop early in the spring. Dormancy, for most species, involves a long dry period rather than a cold period. Heteroecious species are less common than at higher elevations and more humid areas. When they do occur, both host plants always are intimately associated and lateral spread is minimal. Cyperaceae are not common and this alone reduces the potential for heteroecious rust fungi. Shreve and Wiggins (1964) list only two species of *Carex*. *Puccinia canaliculata* is the only sedge rust in my list. Grasses are more numerous than sedges and composites and legumes are abundant. Disregarding rusts of cultivars, there are 12 species of rust fungi on grasses, 21 species on composites, and 21 on legumes.

Descriptions are limited to little more than spore dimensions in µm; shape, surface, and germ pores are shown in the illustrations. Greater detail is available in Arthur (1907-27, 1934) or, for the rusts of grasses or of composites and legumes, in Cummins (1971, 1978).

HOST INDEX

ABUTILON (Malvaceae)

Puccinia heterospora Berk. & Curt. Fig. 18.
Life cycle microcyclic; spores mostly 1-celled (13-)17-25(-28) long; 2-celled (20-)27-34(-38); brown. Distribution: Arizona and Sonora on *A. californicum* Benth., *A. incanum* (Link) Sweet, *A. sonorae* Gray, *Herissantia crispa* (L.) Briz.

ACACIA (Leguminosae)

Ravenelia cumminsii J. W. Baxt. Fig. 1.
Life cycle unknown. Urediniospores (20-)24-30(-33) x (8-)10-14 (-15), yellowish; teliospore heads (70-)80-105(-120) diam, 6-10(-12) cells across, brown; cysts appressed. Distribution: Sonora on *A. willardiana* Gray.

Ravenelia expansa Diet. & Holw. Fig. 2.
Life cycle unknown. Urediniospores (13-)15-18(-20) x (11-)13-16 (18-), golden; teliospore heads (55-)60-90(-100) diam, (4)5 or 6(7) cells across, brown; cysts pendent. Distribution: Baja California Sur and Sonora on *A. goldmanii* Rose, *A.* sp.

Ravenelia pringlei Cumm. Fig. 3.
Life cycle macrocyclic, autoecious. Aecia uredinoid on witches' brooms, spores (20-)26-33(-35) x (10-)11-15(-17), golden; urediniospores as the aeciospores; teliospore heads (55-)70-95(-105) diam, (5)6-8 cells across, brown; cysts appressed or semipendent. Distribution: Arizona, California, and Sonora on *A. greggii* Gray, *A. wrightii* Benth.

Ravenelia scopulata Cumm. & J. W. Baxt. Fig. 4.
Life cycle demicyclic, autoecious, all spore forms on witches' brooms. Aecia uredinoid, spores (17-)19-24(-27) x (11-)12-14(-15), brown; teliospore heads (55-)65-100(-110) diam, 5-8 cells across, brown; cysts semipendent. Distribution: Sonora on *A. greggii* Gray, *A. occidentalis* Rose.

Ravenelia thomberiana Long. Fig. 5.
Life cycle macrocyclic, autoecious. Aecia uredinoid on witches' brooms, spores (18-)22-27(-30) x (12-)14-17(-19), brown; urediniospores as the aeciospores; teliospore heads (65-)75-98(-105) diam, (4)5-7 cells across, brown; cysts pendent. Distribution: Arizona

and Sonora on *A. constricta* Benth.

ACALYPHA (Euphorbiaceae)

Puccinia dietelii aecial stage; see *Chloris*.

ALLIUM (Liliaceae)

Puccinia blasdalei Diet. & Holw. Fig. 38.
Life cycle macrocyclic, autoecious. Aecia aecidioid, spores (18-)20-27(-30) x (15-)18-22(-24), colorless; urediniospores (21-)23-28(-30) x (17-)19-22(-24), yellowish; teliospores in locules, (30-)35-50(-60)x (17-)20-25(-27), brown. Distribution: Arizona on *Allium macropetalum* Rydb.

ALTHAEA (Malvaceae)

Puccinia malvacearum Bert. ex Mont.; see addendum.

AMBROSIA (Compositae)

Puccinia franseriae Syd. Fig. 21.
Life cycle macrocyclic, autoecious. Aecia uredinoid, spores as the urediniospores; urediniospores (23-)25-32(-38) x (18-)20-28(-30), brown; teliospores (32-)37-52(-59)x(23-)25-30(-33), brown. Distribution: Arizona, California, and Sonora on *A. deltoidea* (Torr.) Payne, *A. dumosa* (Gray) Payne.

Puccinia sonorae J. Parm. Fig. 19.
Life cycle macrocyclic, autoecious. Aecia aecidioid, spores 24-29 x 17-22, colorless; urediniospores (17-)18-22(-24) x (15-)17-20(-22), brown; teliospores (26-)30-38(-42) x (18-)20-24(-26), brown. Distribution: Baja California and Sonora on *A. carduacea* (Greene) Payne, *A. cordifolia* (Gray) Payne.

ANEMONE (Ranunculaceae)

Tranzschelia cohaesa Long. Fig. 27.
Life cycle macrocyclic, autoecious. Aecia aecidioid, systemic, spores (18-)20-24(-28) x (16-)17-20(-22), yellowish; urediniospores (22-)25-35(-40) x (16-)18-20(-23), brownish; teliospores (24-)30-40(-44) x (15-)18-22(-24), dark brown. Distribution: Arizona and Sonora on *A. tuberosa* Rydb.

ANISACANTHUS (Acanthaceae)

Puccinia anisacanthi Diet. & Holw. Fig. 23.
Life cycle macrocyclic, autoecious. Aecia aecidioid, spores 25-36 x 17-24, yellowish; urediniospores (23-)25-29(-32) x (15-)17-23(-25), brown; teliospores (35-)39-50(-53) x (24-)26-30(-34), brown. Distribution: Arizona and Sonora on *A. thurberi* (Torr.) Gray, *Carlowrightia arizonica* Gray, *C. cordifolia* Gray, *C. glabrata* Fern.

ANTIRRHINUM (Scrophulariaceae)

Puccinia antirrhini Diet. & Holw.; see addendum.

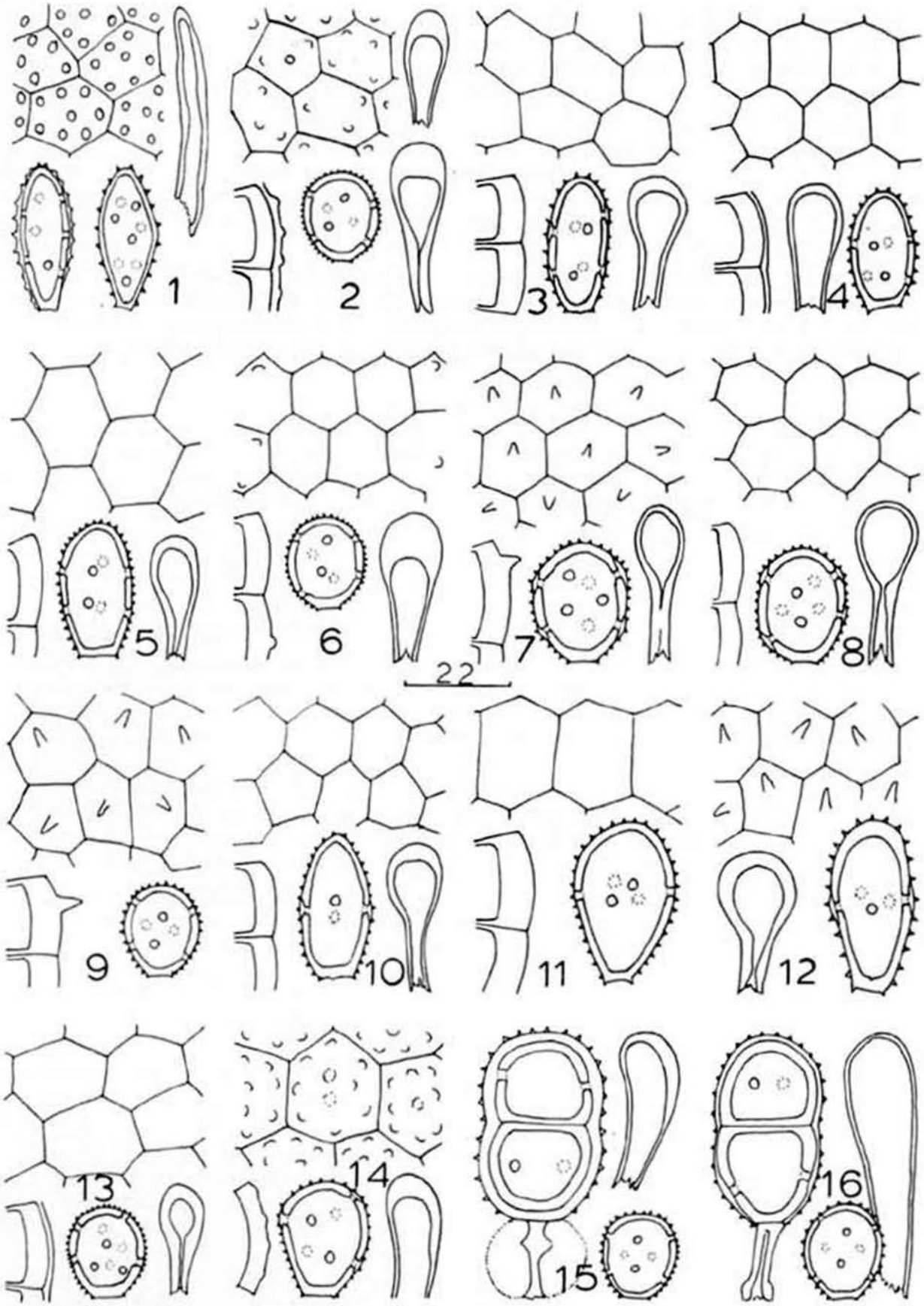
ARISTIDA (Gramineae)

Puccinia aristidae Tracy var. *chaetariae* Cumm. & Husain. Fig. 22.
Life cycle macrocyclic, heteroecious. Aecia aecidioid on *Boerhaavia* but above the desert; urediniospores 23-30(-32) x (19-)21-26(-29), brown; teliospores (29-)32-44(-50) x (19-)22-28(-32), brown. Distribution: Arizona and Sonora on *A. adscencionis* L.

Puccinia sonorica Cumm. & Husain, var. *sonorica*. Fig. 20.
Life cycle unknown. Urediniospores (23-)25-30(-33) x (18-)20-24(-25), brown; teliospores (29-)32-37(-40) x (21-)23-26(-28), brown. Distribution: Arizona and Sonora on *A. hamulosa* Henr., *A. ternipes* Cav.

ARTEMISIA (Compositae)

Puccinia cnici-oleracei Pers. ex Desm. Fig. 28.
Life cycle microcyclic. Teliospores (32-)37-54(-60) x (13-)15-20(-23), brown. Distribution: Arizona on *A. ludoviciana* Nutt.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ASPARAGUS (Liliaceae)

Puccinia asparagi DC.; see addendum.

ASTER (Compositae)

Uromyces compactus Peck. Fig. 78.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (26-)28-35(-40) x (20-)22-27(-30), colorless; urediniospores (30-)32-40(-46) x (20-)23-28(-31), brown; teliospores (28-)33-42(-48) x (19-)22-28(-30), brown. Distribution: Sonora on *A. spinosus* Benth.

ASTRAGALUS (Leguminosae)

Uromyces punctatus Schroet. Fig. 80.
Life cycle macrocyclic, heteroecious. Aecia systemic, aecidioid, on *Euphorbia*, but not known in area. Urediniospores (19-)22-28(-30) x (17-)19-23(-25), brown; teliospores (17-)19-25 x (14-)17-24, brown. Distribution: Arizona and California on *A. allochrous* Gray, *A. crotalariae* (Benth.) Gray, *A. lentiginosus* Dougl.

ATRIPLEX (Chenopodiaceae)

Uromyces shearianus Arth. Fig. 75.
Life cycle demicyclic, autoecious. Aecia systemic, aecidioid, aeciospores (18-)22-27(-33) x (13-)17-20(-22), colorless; teliospores (23)25-31(-33) x (18-)20-23(-26), brownish. Distribution: Arizona on *A. polycarpa* Wats.

BACCHARIS (Compositae)

Puccinia baccharidis Diet. & Holw. Fig. 24.
Life cycle macrocyclic, autoecious. Aecia caeomoid, aeciospores (27-)30-48(-60) x (20-)22-26(-30), colorless; urediniospores (28-)32-43(-46) x (17-)20-24(-27), yellowish; teliospores (45-)50-68(-72) x (22-)24-28(-31), brownish. Distribution: Arizona on *B. glutinosa* Pers.

Puccinia evadens Hark. Fig. 25.
Life cycle macrocyclic, autoecious. Aecia caeomoid, aeciospores (32-)36-55(-60) x (17-)23-25(-28), colorless; urediniospores (25-)30-38(-42) x (19-)22-27(30), yellowish; teliospores (48-)54-74(-80) x (22-)26-30(-33), brownish. Distribution: Arizona on *B. emoryii* Gray, *B. sarothroides* Gray.

BAILEYA see *Psilostrophe*.

BELOPERONE (Acanthaceae)

Uromyces beloperones G. F. Laun. Fig. 79.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores (23-)26-30(-33) x (19-)21-25(-27), brown; urediniospores as the aeciospores; teliospores (26-)30-40(-44) x (22-)24-30(-33), dark brown. Distribution: Arizona, Baja California, California, and Sonora on *B. californica* Benth.

BETA (Chenopodiaceae)

Uromyces betae (Pers.) Tul.; see addendum.

BOGENHARDIA = *Herissantia*, which see.

BOUTELOUA (Gramineae)

Puccinia cacabata Arth. & Holw. Fig. 26.
Life cycle macrocyclic, heteroecious. Aecia aecidioid on *Gossypium*,

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Figure 1-16. Species of *Ravenelia* and *Uropyxis*; teliospores and urediniospores. 1. *R. cumminsii*. 2. *R. expansa*. 3. *R. pringlei*. 4. *R. scopulata*. 5. *R. thomberiana*. 6. *R. humphreyana*. 7. *R. spinulosa* v. *papillifera*. 8. *R. mesillana*. 9. *R. bajacalensis*. 10. *R. lysilomae*. 11. *R. epiphylla*. 12. *R. arizonica*. 13. *R. fragrans* v. *evernia*. 14. *R. pisciae*. 15. *U. daleae* v. *eysenhardtiae*. 16. *U. nissoliae*.

aeciospores 16-21 x 15-16, colorless; urediniospores (22-)24-30(-32) x (17-)19-23(-25), brown; teliospores (27-)34-40(-44) x (17-)20-24 (-26), brown. Distribution: Arizona and Sonora on *B. aristidoides* (H.B.K.) Griseb., *B. barbata* Lag., cultivated cotton.

Puccinia vexans Farl. Fig. 31.
Life cycle macrocyclic, heteroecious. Aecia aecidioid on *Fouquieria*, aeciospores 27-32(-34) x 23-27(-30), colorless; ordinary urediniospores 26-30 x 23-29, pale brown; amphispores 34-42 x 26-35, dark brown, *Uromyces*-like; teliospores 32-40 x (19-)23-29, brown. Distribution: Arizona and Sonora on *B. curtipendula* (Michx.) Torr., *F. splendens* Engelm.

BOUVARDIA (Rubiaceae)

Puccinia diplachnis aecial stage; see *Leptochloa*.

BRAYULINEA (Amaranthaceae)

Puccinia guillemineae Diet. & Holw. Fig. 29.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (15-)17-22(-24) x (12-)15-18, colorless; urediniospores (18-)20-24 (-26) x (16-)18-20(-22), brownish; teliospores (28-)30-38(-41) x (16-)19-23(-25), brown. Distribution: Arizona on *B. densa* (Willd.) Small.

CAESALPINIA (Leguminosae)

Ravenelia humphreyana P. Henn. Fig. 6.
Life cycle unknown. Urediniospores (15-)17-19(-20) x (13-)14-17 (-18); teliospore heads (60-)70-100(-120) diam, 5-8 cells across; cysts appressed to semipendent. Distribution: Sonora on *C. caladenia* Standl., *C. palmeri* Wats., *C. pulcherrima* (L.) Swartz.

CAMISSONIA (Onagraceae)

Puccinia oenotherae Vize. Fig. 32.
Life cycle macrocyclic, autoecious. Aecia systemic, aecidioid, spores 18-23 x 13-18, colorless; urediniospores (20-)22-26(-28) x (16-)18-22(-24), brown; teliospores (28-)32-45(-50) x (17-)19-24 (-26), brown. Distribution: Arizona, Baja California Sur, and Sonora on *C. brevipes* (Gray) Raven, *C. californica* (Nutt.) Raven, *C. claviformis* (Torr. & Frém.) Raven.

CARDIOSPERMUM (Sapindaceae)

Puccinia arechavaletae Speg. Fig. 30.
Life cycle microcyclic. Teliospores mostly 20-30 x 13-20 but giant spores common, 1-celled spores usually commoner than 2-celled. Distribution: *C. corindum* L. in Sonora.

CARLOWRIGHTIA see *Anisacanthus*

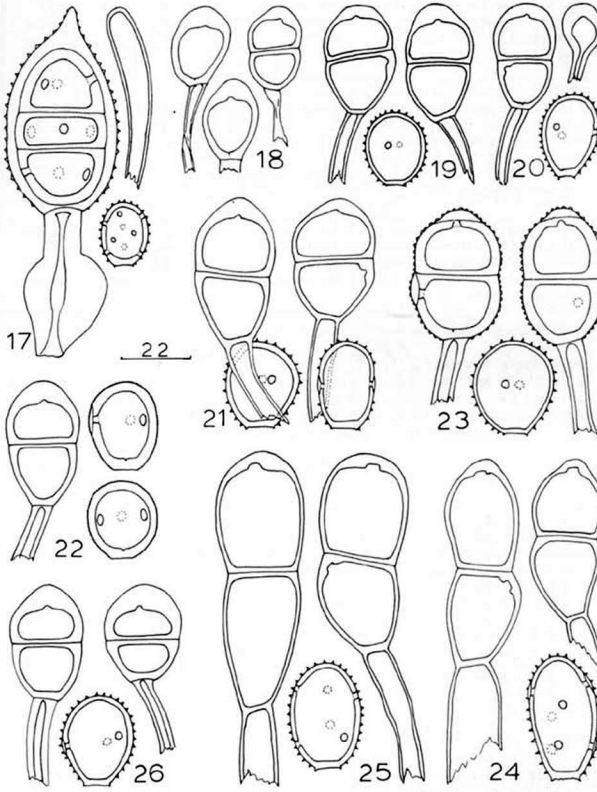
CARTHAMUS (Compositae)

Puccinia calcitrapae DC. var. *centaureae* (DC) Cumm.; see addendum.

CASSIA (Leguminosae)

Ravenelia mesillana Ellis & Barth. Fig. 8.
Life cycle macrocyclic, autoecious. Aecia uredinoid, spores as the urediniospores; urediniospores (19-)22-26(-29) x (15-)17-19(-21), brown; teliospore heads (60-)80-115(-150) diam, (5)6-9(10) cells across; cysts pendent, multiseriate. Distribution: Arizona and Sonora on *Cassia covesii* Gray.

Ravenelia spinulosa Diet. & Holw. var. *papillifera* (Syd.) Cumm. & J. W. Baxt. Fig. 7.
Life cycle macrocyclic, autoecious. Aecia uredinoid, spores as the urediniospores; urediniospores (18-)19-22(-24) x (14-)16-19(-20), golden brown; teliospore heads (60-)75-110(-120) diam, 6-9 cells across; cysts pendent, multiseriate. Distribution: Sonora on *C. covesii* Gray (with uredinia only).



Figures 17-26. Species of *Phragmopyxis* and *Puccinia*; teliospores and urediniospores. 17. *Phrag. noelii*. 18. *Puccinia heterospora*. 19. *P. sonorae*. 20. *P. sonorica*. 21. *P. franseriae*. 22. *P. aristidae* v. *chaetariae*. 23. *P. aniseacanthae*. 24. *P. baccharidis*. 25. *P. evadens*. 26. *P. cacabata*.

CENTAUREA (Compositae)

Puccinia acroptili Syd. Fig. 35.
Life cycle unknown. Urediniospores (21-)23-26(-29) x (18-)19-23 (-24), brown; teliospores (30-)35-40(-50) x (18-)22-27(-30), brown. Distribution: Arizona on *Centaurea picris* Pall. Both host and fungus adentive to North America.

CHLORIS (Gramineae)

Puccinia dietelii Sacc. & Syd. Fig. 34.
Life cycle macrocyclic, heteroecious. Aecia aecidioid, on *Acalypha* spp. but not known in the area; urediniospores 17-26 x 15-21, colorless; teliospores 24-35 x 17-24, brown. Distribution: Arizona and Sonora on *C. virgata* Swartz.

CHRYSANTHEMUM (Compositae)

Puccinia tanaceti DC. var. *tanaceti*; see addendum.

CIRSIUM (Compositae)

Puccinia californica Diet. & Holw. Fig. 36.
Life cycle unknown. Urediniospores (25-)27-32(-36) x (20-)23-27 (-30), brown; teliospores (33-)37-53(-59) x (21-)25-30(-33), brown. Distribution: Arizona on *C. arizonicum* (Gray) Petr., upper limits of the desert.

CONVOLVULUS (Convolvulaceae)

Puccinia convolvuli Cast.; see addendum.

COURSETIA (Leguminosae)

Phragmopyxis acuminata (Long) Syd.
Life cycle microcyclic. Teliospores as in *P. noelii*. Distribution: Arizona on *C. glandulosa* Gray.

Phragmopyxis noelii J. W. Baxt. Fig. 17.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores (15-)18-22(-25) x (13-)15-18(-20), golden brown; urediniospores as the aeciospores; teliospores (50-)56-75(-95) x (30-)33-40(-45), dark brown. Distribution: Arizona and Sonora on *C. glandulosa* Gray.

CRESSA (Convolvulaceae)

Puccinia tuyutensis Speg. Fig. 40.
Life cycle macrocyclic, autoecious. Aecia aecidioid, systemic; aeciospores 18-26 x 15-22, colorless; urediniospores (25-)27-31(-33) x (18-)20-23(-25), brown; teliospores (30-)33-42(-45) x (19-)21-24 (-26), golden brown. Distribution: Arizona, Baja California, and Sonora on *C. truxillensis* H.B.K.

CROTON (Euphorbiaceae)

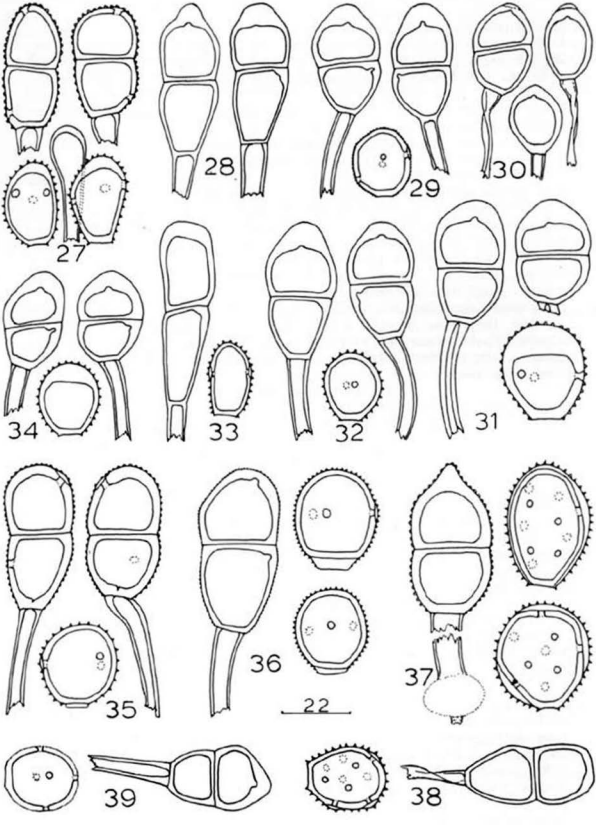
Phakopsora crotonis (Burr.) Arth. Fig. 51.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores as the urediniospores; urediniospores 22-32 x 16-21, yellowish; teliospores 24-40 x 10-15, brown. Distribution; Arizona on *C. texensis* (Klotz.) Muel.-Arg.

CYNODON (Gramineae)

Puccinia cynodontis Lacr. ex Desm. Fig. 41.
Life cycle macrocyclic, heteroecious. Aecia aecidioid, not known in N. America; urediniospores 20-26 x 19-23, brown; teliospores 30-55 x 16-22, brown. Distribution: Arizona, California, and Sonora on *C. dactylon* (L.) Pers.

CYPERUS (Cyperaceae)

Puccinia canaliculata (Schw.) Lager. Fig. 33.
Life cycle macrocyclic, heteroecious. Aecia aecidioid on genera of Heliantheae but not recorded in the desert, aeciospores (13-)15-18 (-20) x 13-15(-17), colorless; urediniospores (18-)21-26(-28) x (13-)14-17(-19), brown; teliospores (40-)45-62(-65) x (14-)16-20(-22) in



Figures 27-39. Species of *Tranzschelia* and *Puccinia*; teliospores and urediniospores. 27. *T. cohaesa*. 28. *P. cnici-oleracei*. 29. *P. guillemineae*. 30. *P. arechavaletae*. 31. *P. vexans*. 32. *P. oenotherae*. 33. *P. canaliculata*. 34. *P. dietelii*. 35. *P. acroptili*. 36. *P. californica*. 37. *P. velata*. 38. *P. blasdalei*. 39. *P. submitens*.

stromatic locules, brown. Distribution: Sonora on *C. esculentus* L.

DICHELOSTEMMA (Liliaceae)

Puccinia nodosa Ell. & Hark. Fig. 42.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 26-32(-36) x (20-)22-27(-32), colorless; urediniospores (26-)28-33 (-38) x (22-)24-28(-30), brownish; teliospores (40-)44-54(-60) x (25-)28-32, dark brown, opaque. Distribution: Arizona and Baja California on *D. pulchellum* (Salisb.) Hell., *Triteleiopsis palmeri* (Wats.) Hoov.

DICLIPTERA see *Tetramerium*

DISTICHLIS (Gramineae)

Puccinia subnitens Diet. Fig. 39.
Life cycle macrocyclic, heteroecious. Aecia aecidioid on several families but not recorded in the desert, aeciospores 15-23 x 13-21, colorless; urediniospores (19-)20-24(-26) x 19-24(-25), brownish; teliospores (30-)36-46(-55) x (17-)19-24(-27), brown. Distribution: Arizona on *D. stricta* (Torr.) Rydb.

ERAGROSTIS (Gramineae)

Uromyces eragrostidis Tracy. Fig. 81.
Life cycle macrocyclic, heteroecious. Aecia aecidioid, on *Antheri-cum* but above the desert; urediniospores (20-)21-29(-31) x (16-)18-23(-26), pale brown; teliospores (22-)23-31(-34) x (16-)18-23(-25), brown. Distribution: Arizona on *E. intermedia* Hitch. but usually above the desert.

ERIASTRUM (Polemoniaceae)

Puccinia giliae Hark. Fig. 44.
Life cycle unknown. Urediniospores (21-)24-27(-30) x (18-)19-22 (-24), brown; teliospores (38-)42-58(-62) x (18-)20-26(-29), brown. Distribution: Arizona on *E. diffusum* (Gray) Mason.

ERIOCHLOA (Gramineae)

Uromyces setariae-italicae Yosh. Fig. 85.
Life cycle macrocyclic, heteroecious. Aecia aecidioid, on *Cordia* but not known in the region; urediniospores (25-)27-33(-35) x (20-)22-28(-30), brown; teliospores (16-)18-26(-30) x (14-)16-20, brown. Distribution: Sonora on *E. gracilis* (Fourn.) Hitch.

ERIOGONUM (Polygonaceae)

Uromyces intricatus Cooke. Fig. 82.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 19-25(-29) x (14-)16-21(-24), colorless; urediniospores (27-)30-33 x (24-)26-30, brown; teliospores (26-)30-40(-44) x (20-)24-30(-33), brown. Distribution: Arizona on *E. deflexum* Torr., *E. fasciculatum* Benth., *E. wrightii* Torr.

EUPATORIUM (Compositae)

Puccinia eupatorii Diet. Fig. 45.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores (30-)33-40(-43) x (26-)28-33, dark brown; urediniospores as the aeciospores but 28-34(-38) x 25-30(-32); teliospores (38-)40-52(-56) x (28-)30-34, golden brown. Distribution: Sonora on *E. sagittatum* Gray.

EUPHORBIA (Euphorbiaceae)

Puccinia velata Arth. Fig. 37.
Life cycle unknown. Urediniospores (28-)30-38(-40) x (20-)22-26 (-28), golden; teliospores (42-)45-60(-65) x (24-)27-32(-34), dark brown. Distribution: Baja California and Sonora on *E. californica* Benth., *E. leucophylla* Benth., *E. misera* Benth.

Uromyces euphorbiae Cooke & Peck. Fig. 84.
Life cycle macrocyclic, autoecious. Aecia systemic, aecidioid, aeciospores 15-19 x 12-16, colorless; urediniospores (16-)18-21 x (15-)16-18(-20), brown; teliospores (19-)21-24(-26) x (15-)17-19 (-21), brown. Distribution: Arizona and Sonora on *E. albomarginata* Torr. & Gray, *E. chamaesyce* L., *E. micromeria* Boiss., *E. polycarpa* Benth.

Uromyces tranzschelii Syd. Fig. 83.
Life cycle microcyclic. Telia systemic, teliospores (15-)20-26(-30) x (13-)17-20(-23), brown. Distribution: Arizona and Baja California on *E. lurida* Engelm., *E. palmeri* Engelm. but usually above the desert.

EVOLVULUS (Convolvulaceae)

Puccinia lithospermi Ell. & Kell. Fig. 47.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 16-21 x 13-16, colorless; urediniospores (20-)22-26 x (16-)18-21 (-23), brownish; teliospores (33-)40-60(-64) x (16-)18-24(-28), brown. Distribution: Sonora on *E. alsinoides* L. var. *acapulcensis*.

EYSENHARDTIA (Leguminosae)

Uropyxis daleae (Diet. & Holw.) Magn. var. *eysenhardtiae* (Diet. & Holw.) J. W. Baxt. Fig. 15.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores as urediniospores; urediniospores 15-21 x 14-17, brownish; teliospores 35-45 x 22-28, brown. Distribution: Sonora on *E. orthocarpa* (Gray) Wats.

FOUQUIERIA (Fouquieriaceae)

Puccinia vexans aecial stage; see *Bouteloua*.

FRANSERIA = *Ambrosia*, which see.

FUNASTRUM = *Sarcostemma*, which see.

GOSSYPIUM (Malvaceae)

Puccinia cacabata aecial stage; see *Bouteloua*.

GOUANIA (Rhamnaceae)

Puccinia invaginata Arth. & J. R. John. Fig. 46.
Life cycle unknown. Urediniospores (24-)26-31(-33) x 17-24(-26), brown; teliospores (30-)34-40(-45) x (24-)27-30(-33), brown. Distribution: Baja California Sur on *G. rosei* Wigg.

GUTIERREZIA see *Haplopappus*

HAPLOPAPPUS (Compositae)

Puccinia grindeliae Peck ssp. *grindeliae*. Fig. 54.
Life cycle microcyclic. Teliospores (34-)40-58(-64) x (18-)20-26 (-28), brown. Distribution: Arizona on *Gutierrezia californica* (DC.) Torr. & Gray, *G. sarothrae* (Pursh) Britt. & Rusby, *H. spinulosus* (Pursh) DC.

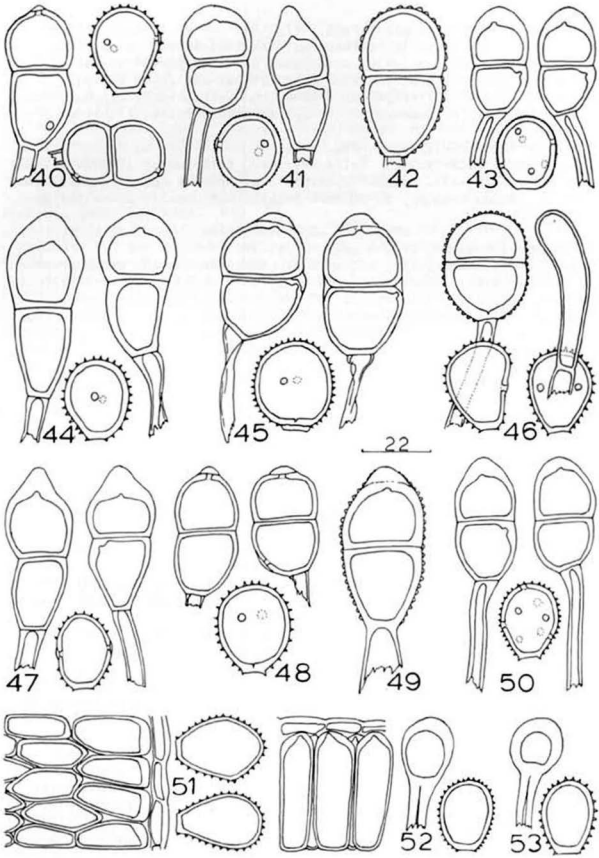
HELIANTHUS (Compositae)

Puccinia helianthi Schw. Fig. 69.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (16-)20-25(-30) x (13-)16-21(-23), colorless; urediniospores (23-) 26-33(-38) x (14-)18-28(-32), brown; teliospores (33-)38-60(-70) x (18-)21-30(-33), brown. Distribution: Arizona, California, and Sonora on *H. annuus* L., *H. petiolaris* Nutt.

HERISSANTIA see *Abutilon*

HYDROCOTYLE (Umbelliferae)

Puccinia hydrocotyles Cooke. Fig. 48.
Life cycle unknown. Urediniospores (24-)26-31(-35) x (20-)22-27 (-30), brown; teliospores (32-)35-40(-44) x 20-23(-25), golden brown. Distribution: Arizona on *Hydrocotyle verticillata* Thunb.



Figures 40-53. Species of *Puccinia*, *Phakopsora* and *Melampsora*; teliospores and urediniospores. 40. *Puccinia tuyutensis*. 41. *P. cynodontis*, 42. *P. nodosa*. 43. *P. leptochloae*. 44. *P. giliae*. 45. *P. eupatorii*. 46. *P. invaginata*. 47. *P. lithospermi*. 48. *P. hydrocotyles*. 49. *P. megalospora*. 50. *P. diplachnis*. 51. *Phakopsora crotonis*. 52. *Melampsora lini*. 53. *M. paradoxa*.

HYMENOCLEA (Compositae)

Puccinia franseriae Syd., see under *Ambrosia*.

Puccinia splendens Vize. Fig. 55.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (22-)24-32 x (19-)21-25(-27), colorless; urediniospores (24-)26-33 (-36) x (22-)24-27(-29), brown; teliospores mostly on stem galls, (40-)44-65(-68) x (26-)29-35(-40), brown. Distribution: Arizona, Baja California, California, and Sonora on *H. monogyra* Torr. & Gray, *H. salsola* Torr. & Gray.

HYPTIS (Labiatae)

Puccinia distorta Holw. Fig. 57.
Life cycle microcyclic. Teliospores, often on galls or distortions, (28-)32-40(-44) x (18-)22-25(-27), brown. Distribution: Arizona, California, and Sonora on *H. emoryi* Torr.

INDIGOFERA (Leguminosae)

Uromyces indigoferae Diet. & Holw. Fig. 86.
Life cycle unknown. Urediniospores (20-)23-28 x (16-)18-20(-22), brown; teliospores (22-)25-30(-33) x (15-)17-21(-23), brown. Distribution: Sonora on *I. laevis* Rydb.

IPOMOEA (Convolvulaceae)

Puccinia megalospora (Orton) Arth. & J. R. John. Fig. 49.
Life cycle demicyclic, autoecious. Aecia aecidioid, aeciospores (22-)25-30(-34) x (19-)21-25(-28), colorless; teliospores (42-)46-64(-68) x (23-)25-33(-35), dark brown. Distribution: Sonora on *I. arborescens* (Humb. & Bonpl.) G. Don.

JACOBINIA see *Tetramerium*

KECKIELLA (Scrophulariaceae)

Puccinia confraga Arth. & Cumm. Fig. 56.
Life cycle microcyclic. Teliospores 26-29(-31) x (31-)33-37(-40), dark brown. Distribution: Arizona on *K. antirrhinoides* (Benth.) Straw ssp. *microphylla* (Gray) Straw.

LAGASCEA (Compositae)

Puccinia praetermissa J. Parm. Fig. 59.
Life cycle unknown. Urediniospores (19-)21-26(-28) x (17-)20-23 (-25), brown; teliospores (32-)35-45(-53) x (20-)23-30(-35), dark brown. Distribution: Sonora on *L. decipiens* Hemsl.

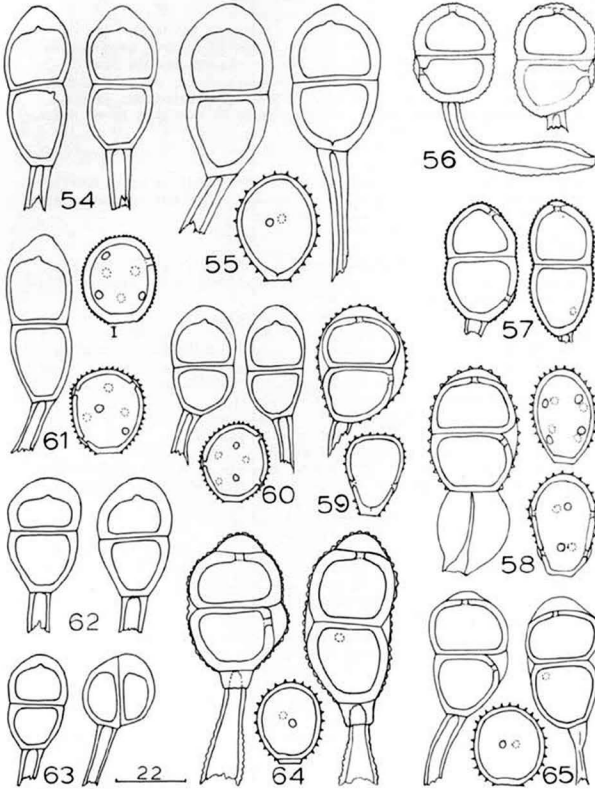
LEPTOCHLOA (Gramineae)

Puccinia diplachnis Arth. Fig. 50.
Life cycle macrocyclic, heteroecious. Aecia aecidioid on *Bouvardia glaberrima* Engl., aeciospores 20-26(-28) x (17-)19-23, colorless; urediniospores (20-)22-26(-28) x (18-)20-24(-26), colorless; teliospores (28-)32-40(-44) x (16-)19-25(-28), brown. Distribution: Arizona on *L. dubia* (H.B.K.) Nees at the upper limit of the desert.

Puccinia leptochloae Arth. & Fromme. Fig. 43.
Life cycle macrocyclic, heteroecious. Aecia aecidioid on *Talinum paniculatum* (Jacq.) Gaert., aeciospores 17-21(-24) x 14-16(-18), colorless; urediniospores 19-26 x (16-)18-24, brown; teliospores (24-)27-33(-38) x (16-)18-22(-25), brown. Distribution: Sonora on *L. filiformis* (Lam.) Beauv.

LIMONIUM (Plumbaginaceae)

Uromyces limonii (DC.) Lév. Fig. 87.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (22-)24-30(-33) x (19-)21-25(-27), colorless; urediniospores (25-)29-33(-38) x (20-)22-28(-31), brown; teliospores (26-)28-38(-40) x (17-)19-26(-28), brown. Distribution: Arizona and Baja California on *L. californicum* (Boiss.) Hell.



Figures 54-65. Species of *Puccinia* teliospores and urediniospores. 54. *P. grindeliae* ssp. *grindeliae*. 55. *P. splendens*. 56. *P. confraga*. 57. *P. distorta*. 58. *P. globosipes*. 59. *P. praetermissa*. 60. *P. schedonnardi*. 61. *P. grindeliae* ssp. *riddelliae*. 62. *P. lobaba*. 63. *P. obliqua*. 64. *P. tetramerii*. 65. *P. invelata*.

LINUM (Linaceae)

Melampsora lini (Ehren.) Lev. Fig. 52.
Life cycle macrocyclic, autoecious. Aecia caeomoid, aeciospores 21-28 x 19-27, colorless; urediniospores 15-25 x 13-20, colorless; teliospores 42-50 x 10-20, brown. Distribution: Arizona on *L. lewisii* Pursh.

LOLIUM (Gramineae)

Puccinia graminis Pers.; see addendum.

LYCIUM (Solanaceae)

Puccinia globosipes Peck. Fig. 58.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores as the urediniospores; urediniospores (18-)20-25(-27) x (27-)30-42(-46), brown; teliospores (30-)34-40(-46) x (24-)27-34(-37), dark brown. Distribution: Arizona, Baja California, California and Sonora on *L. andersonii* Gray., *L. berlandieri* Dunal, *L. brevipes* Benth., *L. exsertum* Gray, *L. fremontii* Gray, *L. parishii* Gray.

LYCURUS see *Muhlenbergia*.

LYSILOMA (Leguminosae)

Ravenelia bajacalensis Cumm. & J. W. Baxt. Fig. 9.
Life cycle unknown. Urediniospores (15-)16-19(-21) x (11-)13-16 (-17), yellowish; teliospore heads (74-)80-110(-120) diam, (6)7-9 (10) cells across, brown; cysts pendent, multiseriate. Distribution: Baja California Sur on *L. candida* Brand.

Ravenelia lysilomae Arth. Fig. 10.
Life cycle unknown. Urediniospores (24-)27-33(-37) x (11-)13-17(-19), brown; teliospore heads (75-)80-110(-120), diam, (6)7-9 cells across, brown; cysts appressed. Distribution: Baja California and Sonora on *L. divaricata* (Jacq.) Macb., *L. candida* Brand.

MALVELLA (Malvaceae)

Puccinia lobata Berk. & Curt. Fig. 62.
Life cycle microcyclic. Teliospores (28-)33-40(-44) x (16-)19-26 (-29), golden to brown. Distribution: Arizona, California, and Sonora on *M. lepidota* (Gray) Fryx., *M. leprosa* (Ort.) Krap.

MEDICAGO (Leguminosae)

Uromyces striatus Schroet.; see addendum.

MERREMIA (Convolvulaceae)

Uromyces sonorensis Hennen & Cumm. Fig. 89.
Life cycle unknown. Urediniospores (28-)30-38(-42) x (20-)21-24(-26), golden brown; teliospores (28-)30-40(-43) x 24-30(-32), dark brown. Distribution: Sonora on *M. palmeri* (Wats.) House.

MIMOSA (Leguminosae)

Ravenelia fragrans Long var. *evernia* (Syd.) J. W. Baxt. Fig. 13.
Life cycle unknown. Urediniospores (15-)18-23(-26) x (13-)15-19 (-21), golden; teliospore heads (55-)60-100(-110) diam, (4)5-7(8) cells across; cysts pendent. Distribution: Arizona and Sonora on *M. laxiflora* Benth.

Ravenelia fragrans Long var. *fragrans* is similar to var. *evernia* except the teliospore heads have bead-like warts, especially on the peripheral cells.

MUHLENBERGIA (Gramineae)

Puccinia schedonnardi Kell. & Swing. Fig. 60.
Life cycle macrocyclic, heteroecious. Aecia aecidioid on Malvaceae but unknown in the desert; urediniospores (18-)21-26(-30) x (15-)18-24(-28), brown; teliospores (24-)28-36(-45) x (16-)18-25(-29), brown. Distribution: Arizona and Sonora on *Lycurus phleoides* H.B.K., *M. porteri* Scrib., *M. repens* (Presl.) Hitch. but usually above the

desert.

NISSOLIA (Leguminosae)

Uropyxis nissoliae (Diet. & Holw.) Magn. Fig. 16.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores (14-)15-18(-20) x (12-)14-16(-17), yellowish; urediniospores as the aeciospores. Teliospores (30-)33-38(-42) x (19-)21-24(-26), brown. Distribution: Sonora on *N. schottii* (Torr.) Gray.

OENOTHERA see *Camissonia*.

PARTHENICE (Compositae)

Puccinia invelata H. S. Jack. Fig. 65.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 19-30 x 16-24, colorless; urediniospores (19-)23-28(-30) x (16-)18-22(-24), brown; teliospores (32-)35-45(-50) x (20-)23-28(-30), brown. Distribution: Arizona on *P. mollis* Gray.

PELARGONIUM (Geraniaceae)

Puccinia pelargonii-zonalis Doidge; see addendum.

PENSTEMON see *Keckiella*.

PHASEOLUS (Leguminosae)

Uromyces appendiculatus (Pers.) Unger. Fig. 88.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (18-)20-28(-33) x (16-)18-20(-24), colorless; urediniospores (20-)24-30(-33) x (18-)20-25(-27), brown; teliospores (24-)28-33(-35) x (20-)22-27(-29), brown. Distribution: Sonora on *P. atropurpureus* DC. and widely distributed on garden bean, *P. vulgaris* L.

PHRYGILANTHUS (Loranthaceae)

Uromyces ornatipes Arth. Fig. 76.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 24-27 x 18-23, colorless; urediniospores (26-)30-40(-44) x (19-)21-24(-26), yellowish; teliospores (24-)28-34(-37) x (20-)22-26, dark brown. Distribution: Baja California Sur on *P. sonorae* Stand.

PISCIDIA (Leguminosae)

Ravenelia piscidiae Long. Fig. 14.
Life cycle unknown. Urediniospores (18-)20-22(-24) x (14-)16-20, brown; teliospore heads (60-)75-110(-120) diam, (3-)4-6 cells across, brown; cysts appressed. Distribution: Sonora on *P. mollis* Rose.

PLUCHEA (Compositae)

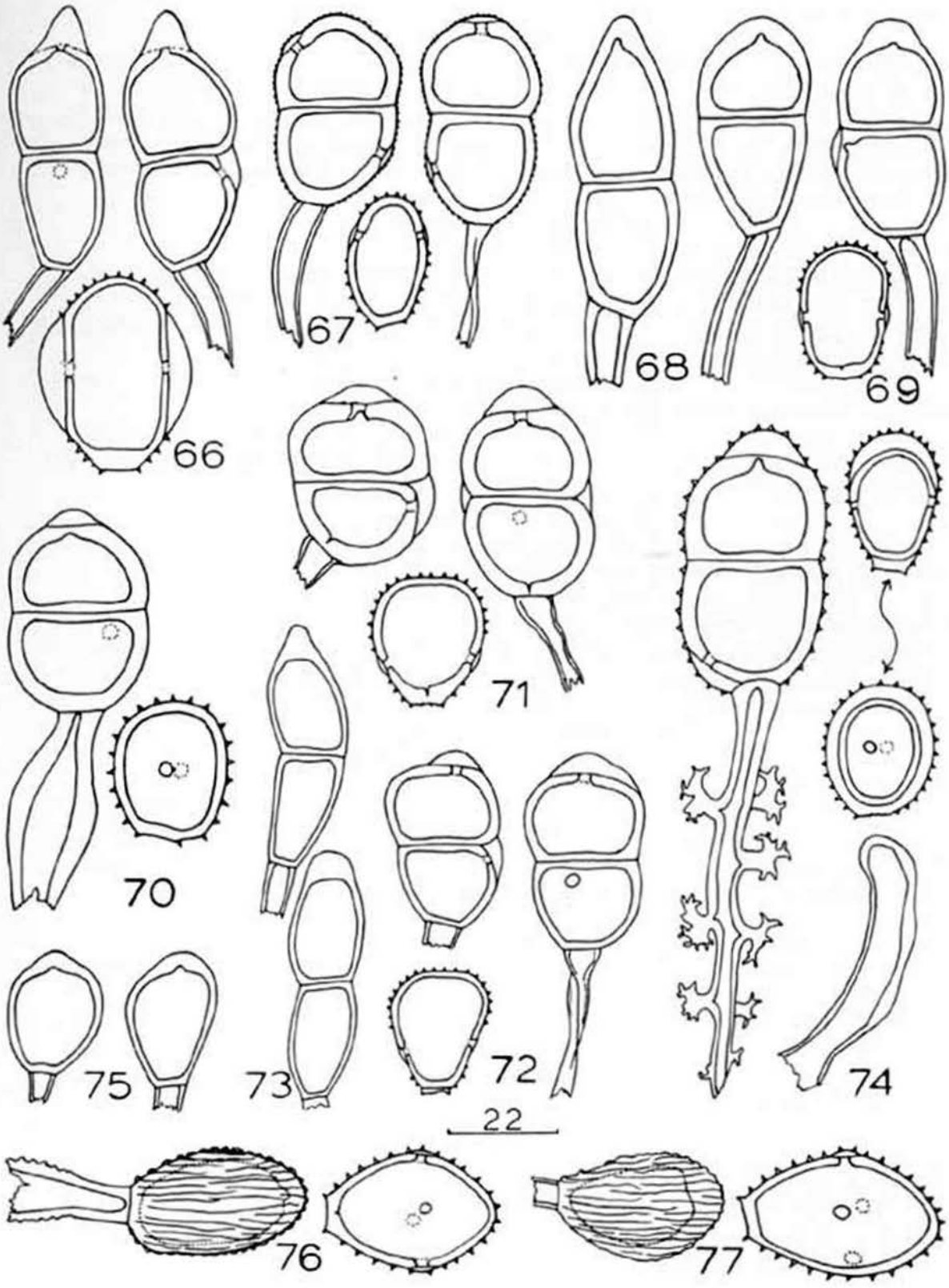
Puccinia ocellifera Cumm. Fig. 66.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 13-17 diam, colorless; urediniospores (24-)28-33(-35) x (22-)24-27, brown; teliospores (40-)43-55(-67) x (16-)18-24(-26), golden brown. Distribution: Baja California on *P. purpurascens* (SW.) DC.

PROSOPIS (Leguminosae).

Ravenelia arizonica Ell. & Ever. Fig. 12.
Life cycle macrocyclic, autoecious. Aecia on woody galls, uredinoid, aeciospores (25-)28-42(-44) x (15-)18-22, brown; urediniospores (30-)33-46(-50) x (16-)17-22(-24), brown; teliospore heads (60-)75-100(-110) diam, (5-)6-8(9) cells across, brown; cysts pendent, multiseriate. Distribution: Arizona and Sonora on *Prosopis glandulosa* Torr.

PSILOSTROPHE (Compositae)

Puccinia grindeliae ssp. *riddelliae* (Griff.) stat. nov. Fig. 61. (*Gymnoconia riddelliae* Griff. Bull. Torrey Bot. Club 29:296. 1902).
Life cycle macrocyclic, autoecious, unstable (?). Aecia aecidioid, aeciospores (24-)26-30(-34) x (19-)22-25(27), yellowish; urediniospores uncommon, 24-30 x 23-25, yellowish; teliospores (40-)44-58



Figures 66-77. Species of *Puccinia*, *Prospodium* and *Uromyces*; teliospores and urediniospores. 66. *Puccinia ocellifera*. 67. *P. hieracii* v. *harknessii*. 68. *P. sherardiana*. 69. *P. helianthi*. 70. *P. turgidipes*. 71. *P. abrupta*. 72. *P. enceliae*. 73. *P. xanthii*. 74. *Prospodium appendiculatum*. 75. *Uromyces shearianus*. 76. *U. ornatipes*. 77. *U. socius*.

(-64) x (18-)21-26(-29), brown. Distribution: Arizona on *Baileya multiradiata* Harv. & Gray, *P. cooperi* (Gray) Greene.

RAFINESQUIA (Compositae)

Puccinia hieracii (Roeh.) Mart. var. *harknessii* (Vize) Cumm. Fig. 67. Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores (22-)23-26(-30) x (16-)19-24(-26), brown; urediniospores as the aeciospores; teliospores (30-)33-40(-46) x (18-)21-25(-28), brown. Distribution: Arizona on *R. neomexicana* Gray, *Stephanomeria pauciflora* (Torr.) A. Nels.

SALIX (Salicaceae)

Melampsora paradoxa Diet. & Holw. Fig. 53. Life cycle macrocyclic, heteroecious. Aecia caeomoid on *Larix* but not in the desert; urediniospores 17-24 x 15-19, colorless; teliospores 29-43 x 11-14, brown. Distribution: Arizona on *S. gooddingii* Ball, usually above the desert.

SARCOSTEMMA (Asclepiadaceae)

Puccinia obliqua Berk. & Curt. Fig. 63. Life cycle microcyclic. Teliospores (20-)25-33(-40) x (15-)19-22 (-24), brown. Distribution: Arizona, California, and Sonora on *S. cynanchoides* Decn., *S. hirtellum* (Gray) R. Holm.

SIDA (in part), see *Malvella*.

SORGHUM (Gramineae)

Puccinia purpurea Cooke; see addendum.

SPHAERALCEA (Malvaceae)

Puccinia sherardiana Koern. Fig. 68. Life cycle microcyclic. Teliospores (30-)44-64(-70) x (17-)20-28 (-31), brown. Distribution: Arizona and California on *S. ambigua* Gray, *S. angustifolia* (Cav.) G. Don, *S. emoryi* Woot. & Stand.

STEPHANOMERIA see *Rafinesquia*.

STRUTHANTHUS (Loranthaceae)

Uromyces socius Arth. & Holw. Fig. 77. Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 26-35 x 23-27, colorless; urediniospores (35-)40-50(-55) x (16-)19-25(-27), golden; teliospores (27-)30-40(-44) x (17-)19-24, brown. Distribution: Sonora on *S. haenkeanus* (Presl) Stand.

SUAEDA (Chenopodiaceae)

Uromyces giganteus Speg. Fig. 90. Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 24-27 x 18-20, colorless; urediniospores (24-)26-30(-32) x (17-)19-24, golden; teliospores (24-)26-35(-40) x (16-)18-24(-25), golden brown. Distribution: Arizona on *S. torreyana* Wats.

TALINUM (Portulacaceae)

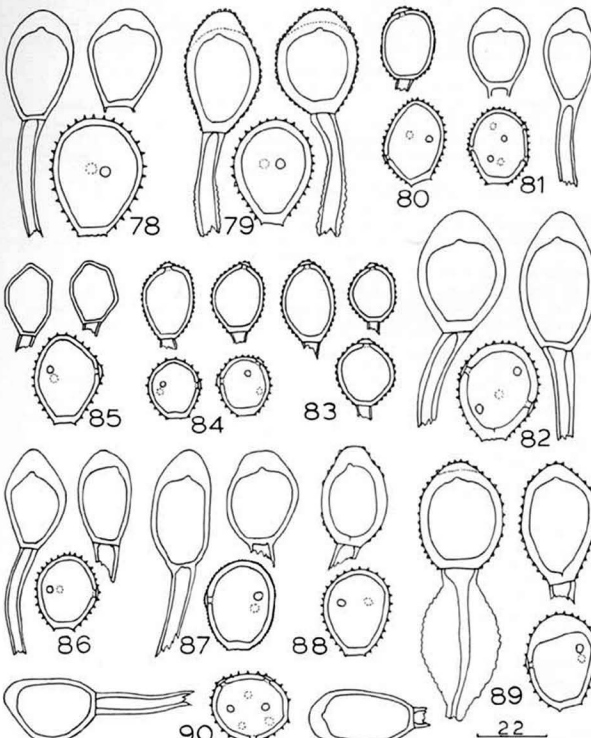
Puccinia leptochloae aecial stage, see *Leptochloa*.

TECOMA (Bignoniaceae)

Prospodium appendiculatum (Wint.) Arth. Fig. 74. Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores 24-34 x 21-26, brown; urediniospores 21-26 x 15-18, brown; teliospores 39-55 x 23-32, dark brown. Distribution: Baja California Sur on *T. stans* (L.) Juss.

TEPHROSIA (Leguminosae)

Ravenelia epiphylla (Schw.) Diet. Fig. 11. Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores as the urediniospores; urediniospores (23-)27-33(-38) x (17-)19-22(-24), golden; teliospore heads (75-)80-125(-140) diam, 5-8(9) cells across, brown. Distribution: Sonora on *T. purpurea* (L.) Pers.



Figures 78-91. Species of *Uromyces;* teliospores and urediniospores. 78. *U. compactus*. 79. *U. beloperones*. 80. *U. punctatus*. 81. *U. eragrostidis*. 82. *U. intricatus*. 83. *U. tranzschelii*. 84. *U. euphorbiae*. 85. *U. setariae-italicae*. 86. *U. indigoferae*. 87. *U. limonii*. 88. *U. appendiculatus*. 89. *U. sonorensis*. 90. *U. giganteus*.

TETRAMERIUM (Acanthaceae)

Puccinia tetramerii Seym. Fig. 64.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 20-26 x 18-22, colorless; urediniospores (22-)24-28(-30) x (17-)19-23(-24), brown; teliospores (33-)38-44(-57) x (23-)26-30(-33), dark brown. Distribution: Arizona and Sonora on *Dicliptera resupinata* (Vahl) Juss., *Jacobinia mexicana* Seem., *T. hispidum* Nees. Some host identities uncertain.

TITHONIA (Compositae)

Puccinia enceliae Diet. & Holw. Fig. 72.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 18-24(-27) x (13-)16-21(-23), colorless; urediniospores (18-)20-24 (-28) x (17-)19-23(-25), brown; teliospores (32)36-46(-52) x (-19-) 22-26(-29), brown. Distribution: Arizona and Sonora on *T. thurberi* Gray.

TRITELEIOPSIS see *Dichelostemma*.

TRITICUM (Gramineae)

Puccinia graminis Pers.; see addendum.
Puccinia recondita Roberge ex Desm.; see addendum.

VIGUIERA (Compositae)

Puccinia abrupta Diet. & Holw. Fig. 71.
Life cycle unknown. Urediniospores (18-)20-25(-28) x (16-)18-22 (-24), brown; teliospores (30-)35-44(-50) x (21-)26-31(-35), brown. Distribution: Arizona and Sonora on *V. dentata* (Cav.) Spreng. and vars.
Puccinia turgidipes H. S. Jack. Fig. 70.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (20-)23-27(-30) x (16-)18-22, colorless; urediniospores (24-)26-31 (-33) x (15-)17-25(-28), brown; teliospores (36-)38-44(-48) x (29-) 30-35, dark brown. Distribution: Arizona on *V. deltoidea* Gray.

XANTHIUM (Compositae)

Puccinia xanthii Schw. Fig. 73.
Life cycle microcyclic. Teliospores (30-)36-60(-70) x 13-19, brownish. Distribution: Arizona and Sonora on *X. strumarium* L., *X.* sp.

ZEA (Gramineae)

Puccinia sorghi Schw.; see addendum.

ADDENDUM

The following fungi occur occasionally on cultivated plants but are not considered to be elements of the desert flora although they are included in the index: *Puccinia antirrhini* (snapdragon rust), *P. asparagi* (asparagus rust), *P. calcitrapae* var. *centaureae* (safflower rust), *P. convolvuli* (morning-glory rust), *P. graminis* (black stem rust), *P. malvacearum* (hollyhock rust), *P. pelargonii-zonalis* ("geranium" rust), *P. purpurea* (sorghum rust), *P. recondita* (wheat leaf rust), *P. sorghi* (corn rust), *P. tanaceti* var. *tanaceti* (chrysanthemum rust), *Uromyces betae* (beet rust), *U. striatus* (alfalfa rust).

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MYCOTAXON

Vol. X, No. 1, pp. 21-28 October-December 1979

COMPARATIVE ASCOSPORE MORPHOLOGY OF CERTAIN STRAINS OF ROLLANDINA BY SCANNING ELECTRON MICROSCOPY

GOURI RANI GHOSH
Department of Science
Regional College of Education, Bhubaneswar
Orissa, India

G. F. ORR
Test Design and Analysis Division
U. S. Army Dugway Proving Ground
Dugway, Utah 84022 U. S. A.

A. C. PIER AND J. E. GALLAGHER
National Animal Disease Center
Ames, Iowa 50010 U. S. A.

SUMMARY

SEM studies of ascospore morphology of the type strains of *Pseudoarachniotus punctuatus*, *P. marginosporus*, *P. hyalinosporus* and *Narasimhella poonensis* have provided definitive evidence in support of positive relationships for these strains. Justification is given for accepting *P. marginosporus*, *P. punctatus* and *N. poonensis* as synonyms of *Rollandina capitata*. *R. hyalinospora* differs distinctly from *R. capitata* on the sole basis of ascospore morphology. *R. capitata* produces ascospores that are lenticular with a prominent longitudinal rim; *R. hyalinospora* produces spherical to oval ascospores without rims.

INTRODUCTION

Thirumalachar and Mathur (9) established the genus *Narasimhella* for a single isolate from soil in India. They described the species, *N. poonensis*, as producing lenticular, ridged ascospores. Orr and Kuehn (5) examined the type culture and determined that it was a strain of *Pseudoarachniotus marginosporus* Kuehn & Orr described earlier. Arx (2) accepted *N. poonensis* as legitimate and included both *P. marginosporus* and *P. hyalinosporus* Kuehn, Orr & Ghosh in the synonomy. Arx (3) also included this synonomy in his report on genera of fungi sporulating in pure culture. That synonomy is incorrect because two species that differ morphologically are involved.

Roy et al. (8), in studying numerous related isolates, determined that two distinct species were present. They also determined that the two species were of the genus *Rollandina* Pat. For clarification, synonomy of the two species is noted below:

Rollandina capitata Pat. 1905. Bull. Soc. Mycol.France 21.83.

= *Pseudoarachniotus marginosporus* Kuehn & Orr. 1963. Mycopathol. Mycol. Appl. 19:257.

= *Pseudoarachniotus punctatus* Dutta & Ghosh. 1961. Mycologia 56:153.

= *Narasimhella poonensis* Thirum. & Mathur. 1965. Sydowia 20:185.

= *Arachniotus marginosporus* (Kuehn & Orr) Udagawa. 1970. Trans. Mycol. Soc. Japan 10:103.

= *Narasimhella hyalinospora* (Kuehn, Orr & Ghosh) von Arx. 1971. Persoonia 6:374. (in part).

Rollandina hyalinospora (Kuehn, Orr & Ghosh) Roy, Orr, & Ghosh. comb. nov. 1978. *In*, Proceedings of the International Symposium on Taxonomy of Fungi, Madras, India P. 221.

= *Arachniotus hyalinosporus* (Kuehn, Orr & Ghosh) Apinis, 1964. Mycol. Pap. 96:41.

= *Narasimhella hyalinospora* (Kuehn, Orr & Ghosh) von Arx. 1971. Persoonia 6:374. (in part).

Arx (4), however, disagreed with the placement of these species stating that *Rollandina* was a nomen confusum. He also stated that *Rollandina* sensu Apinis (1) is synonymous with *Nannizzia* Stockdale. We have agreed with the latter consideration (6, 8). We do not agree with the placement as given by Arx (2, 3, 4) nor with the synonomy noted for these two species.

The purpose of this communication is to demonstrate that the two species under consideration are distinct and that Scanning Electron Microscopy (SEM) provides an additional technique in studies of morphology for taxonomic purposes.

MATERIALS AND METHODS

Rollandina strains:

0-3237, type strain, *Pseudoarachniotus punctatus* Dutta & Ghosh (= *Rollandina capitata* Pat.)

0-729, type strain, *Pseudoarachniotus marginosporus* Kuehn & Orr (= *Rollandina capitata* Pat.)

0-733, type strain, *Pseudoarachniotus hyalinosporus* Kuehn, Orr & Ghosh (= *Rollandina hyalinospora* (Kuehn, Orr & Ghosh) Roy, Orr & Ghosh)

0-3540, type strain, *Narasimhella poonensis* Thirum. & Mathur (= *Rollandina capitata* Pat.)

Specimen preparation: Sporulating cultures of the selected strains were prepared for study in the SEM by the method described by Pier et al. (7).

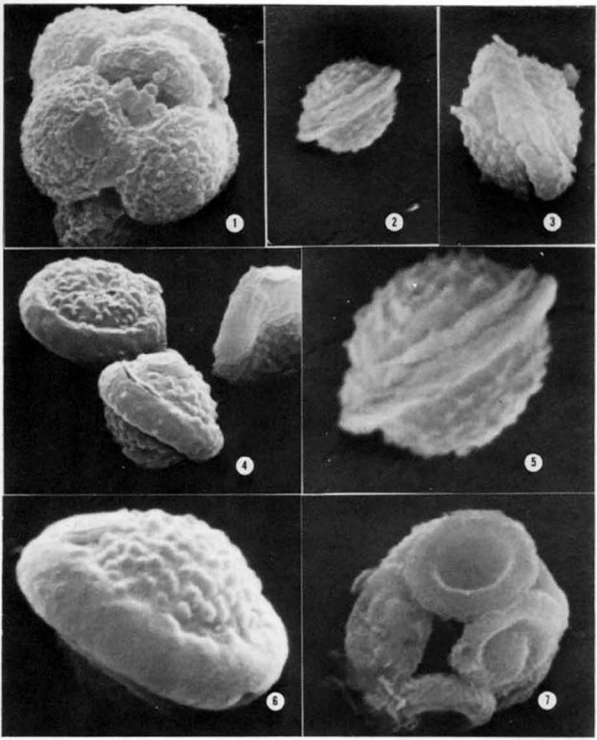
RESULTS AND DISCUSSION

Scanning Electron Microscope (SEM) studies of the ascospore morphology of the type strains of *P. punctatus*, *P. marginosporus*, *P. hyalinosporus* and *N. poonensis* have provided definitive evidence supporting our contention regarding the relationships of these strains. Our observations support the inclusion of *P. marginosporous*, *P. punctatus* and *N. poonensis* as synonyms of *R. capitata*,

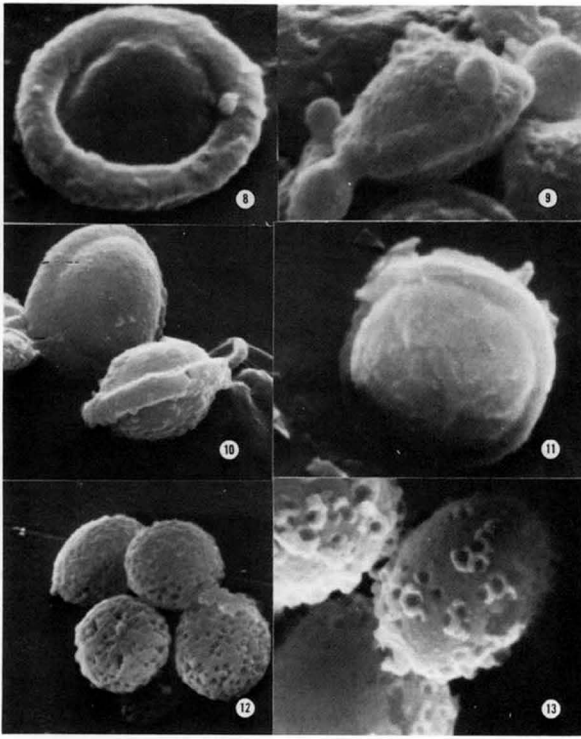
while *R. hyalinospora* is distinct from *R. capitata* on the sole basis of ascospore morphology. These results are at variance with those of Arx (4) who considered *P. hyalinosporus* similar to *N. poonensis*. The latter has no peridial hyphae, but the ascospores are hyaline to pale yellow with a rim around the longitudinal axis.

The SEM study also confirms previous observations of ascospore morphology for *P. punctatus* (Figs. 1-6). The ovoid to lenticular spores have definite and prominent punctations, often with spine-like protrusions (Figs. 5-6). The longitudinal rim is wide, very distinct and prominent (Figs. 2-4). In the original description of *P. punctatus*, punctations on the outer walls of the ascospores were described, as well as the presence of a prominent rim on the longitudinal axis. Roy et al. (8) stated that the punctations on the ascospores are very difficult to observe with a light microscope and are not satisfactory as a taxonomic character. In this study, the oval to lenticular ascospores of *P. marginosporus* (0-729) appear almost smooth walled and possess a narrow polar rim (Figs. 7-9). In *N. poonensis* (0-3540), the ascospores are similar with an almost smooth surface and a prominent longitudinal rim (Figs. 10-11). This study appears to support our previous observations (5, 8). The presence of deposits may give the appearance of rough spots on the sprore wall (Figs. 10-11). Contrary to the observations of Arx (2), the spores are not "inequilateral lenticular" and the equatorial edge is not fringed. These characteristics apparently suggested a spiny wall to Arx.

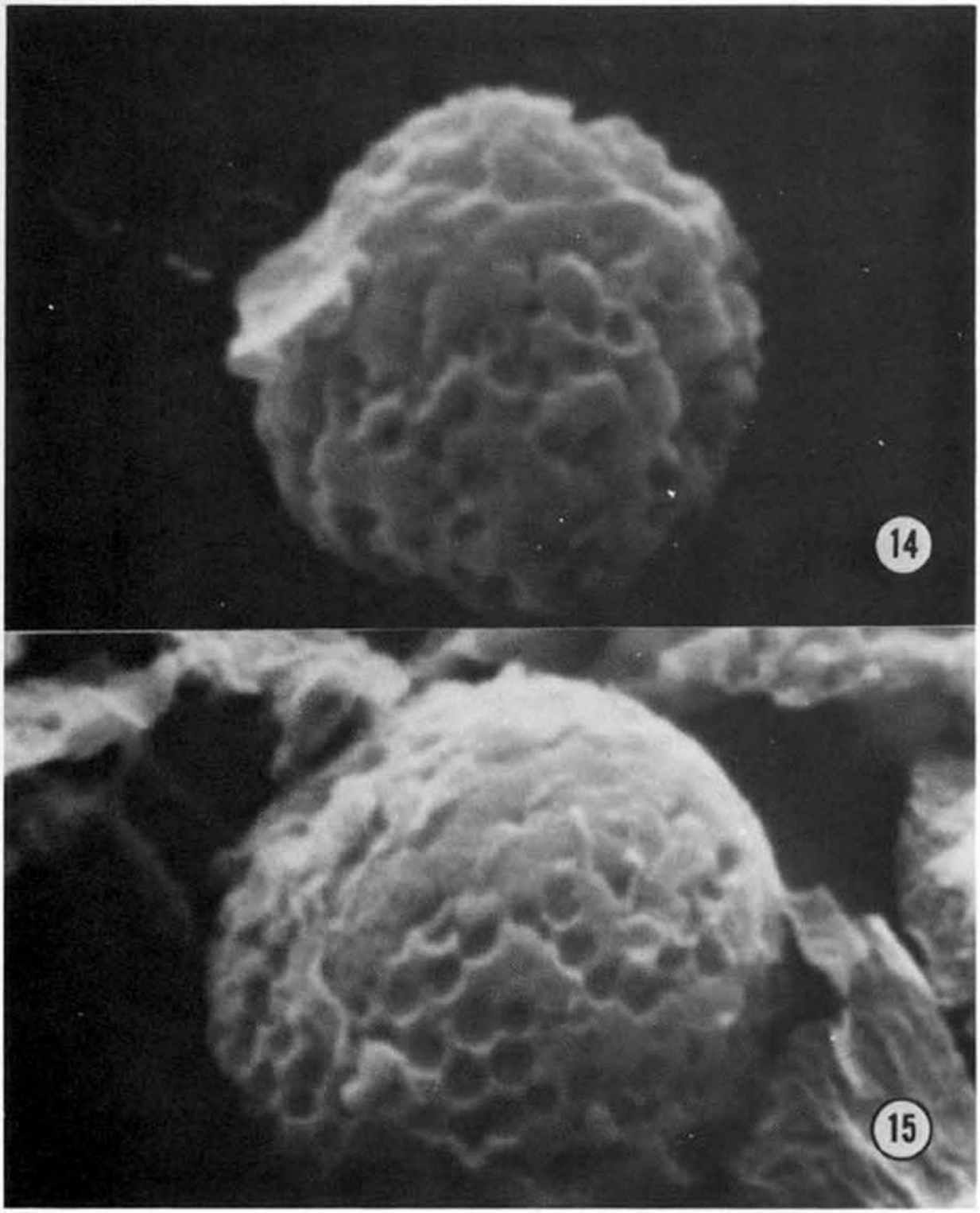
Our SEM studies show that the ascospores of *R. hyalinospora* are almost spherical and their surfaces are pitted rather than smooth. The spores were originally described as smooth-walled. Roy et al. (8) made specific comments on certain strains. In strain 0-287, they noted that the ascospores often appeared roughened due to crystals or other materials laid down on the surface. Figs. 12-15 present evidence that deposits of some kind are present on the spore surface. When the pits are completely covered, the spores may look smooth (Figs. 12-15); when the deposits are removed, the pits are distinct and cause the spore surface to appear roughened or punctuate (Fig. 14). The origin of the pits on the surface of the ascospore walls of *R. hyalinospora* may have originated from small spheres as suggested by the appearance of the wall in Fig. 15. The wall as shown in Fig. 13, however, suggest that vesicles



Figures 1-6. *Pseudoarachniotus punctatus*. Figure 1. Ascocarp cluster. x 9400. Figures 2-4. Ascospores showing longitudinal rim and roughened surfaces. x 8100, x 9400, x 9200. Figures 5-6. Ascospores with spine-like and tubercle-like projections. x 18,000. Figure 7. *Pseudoarachniotus marginosporus*. Ascospore cluster, x 9200 (Figures 2 and 5, same ascospore).



Figures 8-9. *Pseudoarachniotus marginosporus*. Ascospores appear almost smooth-walled with prominent rims. x 10,000, x 9400. Figures 10-11. *Narasimhella poonensis*. Ascospores showing narrow polar rim and nearly smooth surface. x 9000, x 16,000. Figures 12-13. *Pseudoarachniotus hyalinosporus*. Fig. 12. Ascospore cluster. x 8200. Fig. 13. Ascospores showing pitted surface. x 16,000.



Figures 14-15. *Pseudoarachniotus hyalinosporus*. Ascospores showing the pitted surface and deposited material.
x 24,000, x 25,000

were present and had lost their tops. Similar vesiculation as shown in Figs. 8 and 9 were noted by Pier et al. (7) for macroconidia of *Microsporum*. Additional strains with similar rough or punctate surfaces are 0-821, 0-963 and 0-3265.

Arx (2) transferred *P. punctatus* to *Arachniotus*, combining it as *A. punctatus* and stating that it closely resembled *A. dankaliensis* (Cast.) Van Beyma because of the presence of a very prominent equatorial rim around the ascospores in both species. He mentioned the orange coloration of the colony, but overlooked the green coloration of the mature colony. The latter is a distinct diagnostic character for most strains of *Rollandina*. Moreover, the ascospores of *P. roseus* Kuehn (= *A. dankaliensis* (Cast.) Van Beyma) are larger, pale yellow, spherical and banded in surface view (6). Our results do not support the inclusion of *P. punctatus* in *Arachniotus* sensu von Arx nor any relationship with *A. dankaliensis*.

ACKNOWLEDGEMENTS

This work was supported in part by an ARS, USDA Grant authorized by PL-480, Grant No. FG-IN-531, Project No. A7-ADP-43, by the governments of Orissa and India, and in part by a U. S. Army Test and Evaluation Command In-House Independent Research Project No. 7-CO-IL8-DPI-001 through Dugway Proving Ground.

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MYCOTAXON

Vol. X, No. 1, pp. 29-36 October-December 1979

COMPARATIVE PHYSIOLOGY OF SOME STRAINS OF ROLLANDINA[1]

RATNAKAR MOHANTY

School of Life Sciences, Sambalpur University
Burla, Orissa, India

AND

GOURI RANI GHOSH

Department of Science, Life Sciences Laboratory
Regional College of Education,
Bhubaneswar-751007, Orissa, India

SUMMARY

A comparative physiological study on four strains of Rollandina Pat. was undertaken to ascertain whether or not nutritional parity exists between taxonomically related species and between strains of the same species isolated from saprophytic and clinical sources. The dry weight and quantity of cellular protein produced by the saprophytic strains was greater than that of the clinical strains at their respective peak periods of growth. All the three strains of Rollandina capitata behaved alike and differed distinctly from R. hyalinospora in their R.N.A. make-up. Results of the 't' test conducted on the D.N.A. content of the mycelia/mg of dry weight indicates that all four fungi belong to the genus Rollandina.

On a comparative basis Ghosh (1960) studied the nutritional aspects of six species of Gymnoascaceae with respect to their carbon, nitrogen, vitamin and trace element requirements. She observed that Ctenomyces serratus Eidam, Gymnoascus reessii Baranetzky, and Arachniotus reticulatus Kuehn (= Amauroascus kuehnii) (Kuehn) von Arx) had nutritional requirements more similar to those of the Trichophytoneae than to the Aspergillaceae. Other members (Myxotrichum uncinatum Eidam (=Gymnoascus uncinatus Eidam), and Penicillium spiculisporum Lehman demonstrated requirements more

1. Presented at the Second International Mycological Congress, Tampa, Florida, Aug.-Sept, 1977.

similar to the Aspergillaceae than to the Trichophytoneae. She could not, however, present any clear cut physiological evidence which would better support a classification which related the Gymnoascaceae more closely to Aspergillaceae or to the Trichophytoneae than has been suggested by morphological studies. C. serratus, G. reessii and species of Amauroascus Schroeter are keratinophilic and similar nutritional requirements are probable. Several members of the Trichophytoneae are known to produce Gymnoascaceous perfect stages. Strains of Gymnoascaceae isolated from clinical sources have been reported (Orr et al 1977 a, b ; Roy et al 1978). Further more many dermatophytes are geophilic and become "opportunistic" by chance. The aim of the present investigation was to determine whether or not nutritional parity exists between similar taxonomic strains and between strains of the same species isolated from saprophytic and clinical sources.

The fungi chosen for the present study were Pseudoarachniotus marginosporus Kuehn and Orr; P. punctatus Dutta and Ghosh; P. hyalinosporus Kuehn, Orr & Ghosh and Narasimhella poonensis Thirum & Mathur. These are closely related fungi which have posed numerous taxonomic problems. Recently, they have been placed in the genus Rollandina by Roy, Ghosh and Orr (1978). A comparative study of their biochemical behaviour and specifically on nitrogen metabolism was undertaken in order to aid in clarifying this taxonomic confusion.

MATERIALS AND METHODS

The strains of Rollandina capitata used in this study were; (i) Rollandina capitata Pat. (GR-6, O-112), isolated from cat dung, Jagatsingpur, Cuttack, Orissa, India (= type strains of Pseudoarachniotus marginosporous Kuehn and Orr 1963); (ii) Rollandina capitata (GR-29, O-962, STM F 223), isolated from a Tinea corporis lesion of a male patient at the School of Tropical Medicine, Calcutta (= type strain of Pseudoarachniotus punctatus Dutta and Ghosh, 1964); (iii) Rollandina capitata Pat. (GR-42, O-3540), isolated from soil in Poona, India (type strain of Narasimhella poonesis Thirum and Mathur, 1965); (iv) Rollandina hyalinospora (Kuehn, Orr & Ghosh) Roy, Orr and Ghosh (GR-52, O-1247, STM F 231), isolated from a ring-worm lesion of a human male patient at the School of Tropical Medicine, Calcutta, India (= type strain of Pseudoarachniotus hyalinosporous Kuehn, Orr & Ghosh, 1961).

Glucose-asparagine liquid medium of Lilly & Barnett (1951) with pH adjusted to 6.5 was used as the basal medium throughout this investigation. Experimental

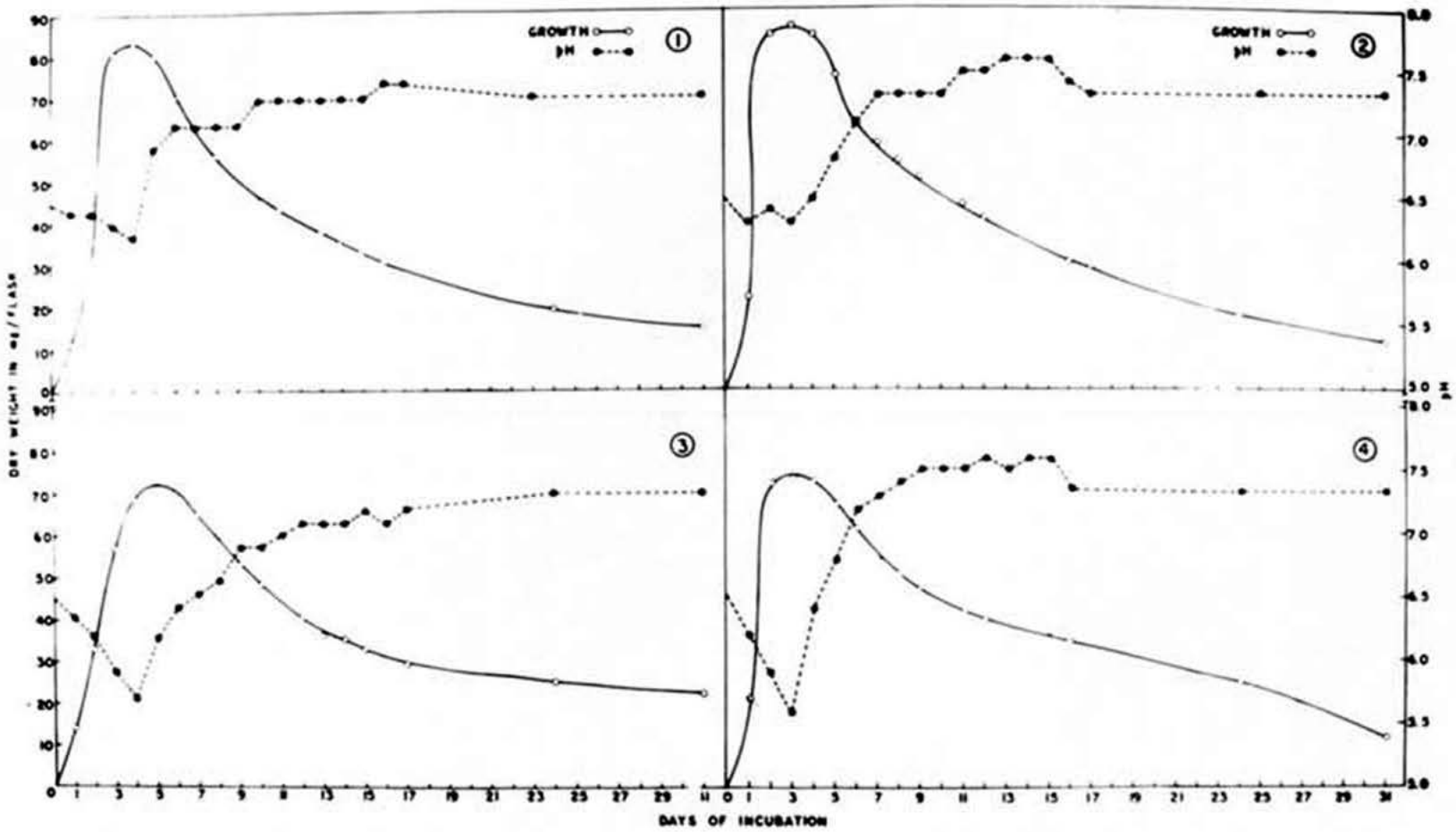
procedures of Ghosh (1960) were followed. Growth was recorded up to 31 days of incubation according to the technique of Kashyap et al (1972). The pH of the culture filtrates was recorded immediately after filtration in each case. Based on the growth profiles thus obtained, five growth phases on the 1st, 3rd, 5th, 7th and 9th days were chosen for analytical studies.

Fresh mycelia harvested at different phases of growth were processed for separation of the macromolecules according to Schneider (1945). The macromolecules were precipitated in the homogenate by 10% TCA, RNA hydrolysis was accomplished by a modification of the Schmidt and Thannauser method (1945). RNA, DNA and proteins thus separated were quantified by various colorimetric reactions. The protein concentration was measured employing Folin-Ciocalteu reaction of Lowry et al (1951); RNA content was determined by Orcinol method of Ceriotti (1955); DNA content was assayed by Dische's method (1930).

RESULTS AND DISCUSSION

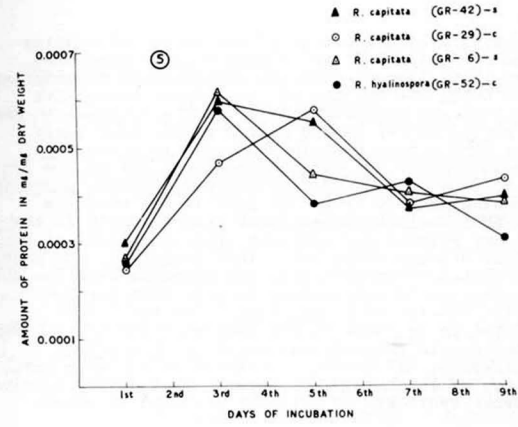
The growth profiles of GR-6 (saprophytic) and GR-52 (clinical) are similar (Figs.2&4), with maximum growth on the 3rd day. However GR-29 (clinical) resembles GR-42 (saprophytic) in demonstrating a slower growth rate (Figs.3&1). All the four profiles were similar in lacking a lag phase. Some differences were observed between the behaviour of the saprophytic and the clinical strains : (a) the dry weights of saprophytic strains were greater than the clinical strains at their respective maximum growth phases. (b) A sudden drop of pH was observed in clinical strains while the drop was gradual in saprophytic strains. In general, the pH demonstrated a decline value as growth proceeded and drifted to alkalinity during autolysis (Figs.1-4).

It was observed that the cellular protein contents increased in all four isolates during their active growth phase and decreased during autolysis (Fig.5). The quantities of cellular protein in the saprophytic strains were greater than in the clinical strains at their respective peak periods of growth. Increase in cellular protein is apparently similar to the increase in dry weights (Figs.1-4). Readings indicate that the protein make-up of the saprophytic strains was greater than that of the clinical ones. It appears that the saprophytic strains may be better adapted in nature than the clinical strains. The pattern of cellular protein synthesis, however, was similar in all the four fungi tested.



Figs.1-4. Growth profiles in glucose-asparagine medium.

1. Rollandina capitata, GR-42, Saprophytic
2. R. capitata, GR-6, Saprophytic
3. R. capitata, GR-29, Clinical
4. R. hyalinospora, GR-52, Clinical



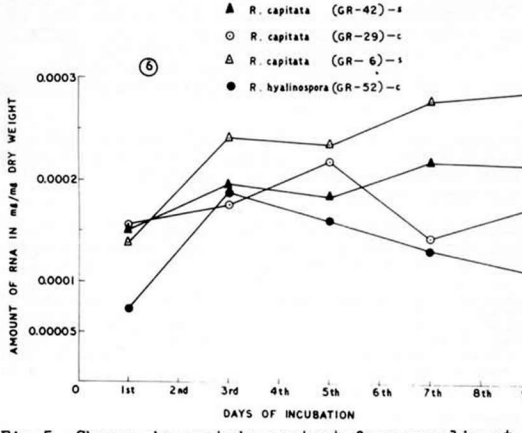


Fig.5. Change in protein content from mycelia at different stages of growth.

Fig.6. Change in R.N.A. content from mycelia at different stages of growth.

The quantity of RNA per mg of dry weight of mycelia increased up to the 3rd day of growth in strains GR-6, GR-42 and GR-52 (Fig.6) while in strain GR-29 the increase continued until the 5th day of incubation. Respective growth curves are similar (Figs.1-4). The increase in RNA content during active growth period of all four fungi indicates that active protein synthesis is occurring. After production of the maximum amount of RNA on the 3rd day (GR-6, GR-42 and GR-52) and 5th day (GR-29), a decline in RNA content/mg dry weight of mycelia was observed (Fig.6). This decline corresponded with the drop in the mycelial dry weights and cellular protein content of each of the four strains (Figs.1-4). This decline in RNA content suggests that protein synthesis was affected with the onset of autolysis. It is interesting to note that the two saprophytic strains of R. capitata (GR-6 and GR-42) demonstrated an increase in RNA content after the 5th day of incubation. In the clinical strain of R.capitata (GR-29) however, RNA content continued to increase until the 7th day of incubation. It appears that during autolysis simultaneous synthesis of cellular proteins occurred.

R. hyalinospora (GR-52) differed from the above three strains in demonstrating a continuous and steady drop of RNA content after the 3rd day of incubation. The curve shown in Fig.6 indicates that protein synthesis was occurring in spite of autolysis. Thus, the metabolic utilization of RNA in the mycelia occurred rapidly during growth.

Results recorded in Fig.6 show that three strains of Rollendina capitata (GR-6, GR-29 and GR-42) behaved alike and differed distinctly from R. hyalinospora (GR-52) in their RNA make-up during growth.

The quantity of DNA/mg dry weight of mycelia of the four fungal strains was also analysed at the five stages of growth. The values obtained are compared in Table I.

For comparative purposes the 't' test was performed with following results. The calculated 't' value for the means of GR-6 and GR-42 is 1.16; for GR-6 and GR-29 is 1.182; for GR-29 and GR-42, the value is 2.626; for GR-6 and GR-52 it is 0.84; for GR-42 and GR-52 the 't' value is 1.53 and for GR-52 and GR-29 it is 2.41.

From these values it can be concluded that the quantities of DNA in GR-6 and GR-42 and GR-6 and GR-29 are not significantly different at the 0.05 level. Though the 't' value for GR-29 and GR-42 at the 0.05 level is marginally significant, yet at the 0.01 level the value is not significant. Moreover, as discussed above, these two strains have shown similarities in their biochemical

TABLE - I

Comparison of total DNA contents in R. capitata and R. hyalinospora
(All values are in mg per mg of dry weight of mycelia)

Days of incubation	R.capitata (GR-42)	R.capitata (GR-29)	R.capitata (GR-6)	R.hyalinospora (GR-52)
1st	0.0002205	0.0000692	0.000106	0.000048
3rd	0.000144	0.000156	0.000159	0.000169
5th	0.000128	0.000102	0.000156	0.000176
7th	0.000157	0.00011	0.000139	0.000104
9th	0.000174	0.00011	0.000155	0.000110
*	0.0001647	0.0001094	0.000143	0.0001214
	±	±	±	±
	0.0000158	0.0000138	0.0000098	0.000024

* Mean ± S.E.M.

behaviour analysed during this investigation. On the basis of like biochemical behaviour of GR-29 and GR-42 the marginally significant 't' value at the 0.05 level can be overlooked and possibly be attributed to strain variation. The results suggest that GR-6, GR-29 and GR-42 are merely strains of the same species and are not different species.

From the calculated 't' value of the means of the DNA quantities it can be concluded that strain GR-52 (Rollandina hyalinospora) is closely allied to the strains GR-6 and GR-42 (R. capitata) but the value differs slightly for strain GR-29 (R. capitata) at the 0.05 level and insignificantly at the 0.01 level. This close affinity of R. capitata and R. hyalinospora based on the calculated 't' values of the means would indicate that they originated from the same genetic stock and represent species of the same genus.

ACKNOWLEDGEMENT

The authors wish to thank Dr.M.V.Ramji of Regional College of Education, Bhubaneswar, Orissa, India for the photographic work and Prof. M.C.Das of Sambalpur University for critical suggestions.

The work was supported by an ARS, USDA grant authorised by PL-480, grant no.FG-IN-531, Project A7-ADP-43, and by the Governments of Orissa and India.

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MYCOTAXON

Vol. X, No. 1, pp. 37-40 October-December 1979

NOTES ON MYCOLOGICAL HISTORY.

II. SOME DISBURSEMENTS OF SCHWEINITZ'S FUNGI.

Ronald H. Petersen

Botany Department, University of Tennessee
Knoxville, TN 37916

The two major mycological publications on North American fungi by Schweinitz (1822, 1832) resulted from his collections and observations in Pennsylvania and North Carolina. Together with some exotic fungi (mostly from Surinam), these North American specimens made up his fungus herbarium, which subsequently became part of the herbarium of the Philadelphia Academy of Natural Sciences. Both during his lifetime and after his death, however, Schweinitz's fungus herbarium was liberally scattered. Shear & Stevens (1917) reported on no less than 14 disbursements of specimens, but provided few details of the transactions. Recently I have been able to read the correspondence between M.J. Berkeley and M.A. Curtis, which has furnished dates and circumstances not previously reported. The purpose of this paper is to document certain disbursements of Schweinitz's fungi in order both to clarify the history of these events, and to indicate the probable present residences of these specimens.

1. Between 6 July and 13 Sept 1824 Schweinitz dispatched a box containing "nearly 1000 Phaenog. & Cryp. for Prof. Hooker" to John Torrey, who forwarded the lot to Hooker in Glasgow (Shear & Stevens, 1921: 217-220). Later, when Hooker became director of the Royal Botanic Gardens at Kew, this cache of Schweinitz specimens became part of the herbarium. It was acknowledged by Berkeley (Berkeley & Curtis, 1856) in the introduction to his "Commentary".

2. Berkeley (ibid.) also mentioned that Torrey presented "us" his collection of Schweinitz specimens. It was Curtis who received this collection (letter from Curtis to Peck, 2.ix.70): "When I commenced the study of these things, Dr. Torrey gave me all his Schweinitzian Fungi, which were of great service."

It must be mentioned, however, that the fungi enumerated in Schweinitz's (1822, 1832) publications were, of course, not the only fungi in his herbarium. Moreover, he kept at least five duplicate specimens of each taxon on hand "in order to send to friends who wish to have them" (letter, Schweinitz to Torrey, 24.vi.1820; Shear & Stevens, 1921).

If such collections which became depleted were augmented with new material, the possibility grows of mixed or incongruous taxa under individual numbers. This, in turn, could account for Berkeley's later comment (letter to Curtis, 29.vi.58): ". . . You cannot conceive what an irksome [task] the going thro' the Schweinitzians is. Scarcely a species named right, and a mass of the greatest trash. It is really quite painful to have to submit such a comment to the public. He seems to have forgotten his own species."

3. Curtis spent a few days in Philadelphia examining Schweinitz material as early as March, 1851, and was allowed permission to liberally split the collections where possible. Afterward, he immediately offered the splits to Berkeley for his comments. "I shall be delighted to have the scraps of Schweinitz fungi however small" (Berkeley to Curtis, 29.iii.51). It was these specimens which formed the cornerstone of Berkeley's enumeration of fungi from herb. Schweinitz. The material was composed, apparently of both unicates and duplicates, and I find no record that the material was returned.

4. After the appearance of Berkeley's paper (Berkeley & Curtis, 1853) on Schweinitz's exotic fungi Curtis apparently intended to send both offprints of the paper and voucher specimens to Fries at Uppsala. Curtis wrote (to Berkeley, 30.iii.53): ". . . as I shall soon send Boxes to Geneva & Upsal [sic], I will send copies of the Surinam Fungi to Fries and Duby. I have many specimens of the Fungi to send to Fries, probably more than half the species." Conversely, two months later he sent a box to Berkeley, including twelve copies of "our Fungi Surinamensis. These last did not reach me in season for my parcels to Sweden & Switzerland." Berkeley was to supply Fries and Duby with offprints, but Curtis had already posted the boxes, which, at least in Fries's case, were to contain Schweinitz Surinam specimens. Shear & Stevens (1917) reported that such specimens were in fact in herb. Fries at Uppsala.

5. In February, 1855, Curtis forwarded to Berkeley over 300 specimens "which were incapable of division." First mention of these by Curtis was in a letter (to Berkeley, 9.v.54): "I ought to have sent them before, but last year I forgot it." This surely refers to a box sent Berkeley in July, 1853, in which Berkeley acknowledged "notes on fungi in Schweinitzian herbarium and also . . . the sketches." It may be concluded, therefore, that some Schweinitz material came to Berkeley in mid-1853, and the final, indivisible specimens in early 1855. The entire lot laid the foundation for Berkeley's (Berkeley & Curtis, 1856) "Commentary", only one installment of which was published, that on Basidiomycetes.

Berkeley was critical of the condition of the collection he received, and wrote as much in his manuscript (Berkeley & Curtis, 1856) but he allowed Curtis to change the paper as needed. Curtis replied (3.v.55):

> "You have given me license to 'alter any of your remarks without sample.' This will be sometimes necessary, as in such cases where you mark that the specimens are too imperfect, & the like, which is true only of what we ourselves possess. There sometimes remain in Herb. Schwein. very tolerable specimens, which I could appropriate to myself but a meager fragment. This is however but a small matter, & I shall not materially disturb your writing. I wish, however, to be cautious about publishing to the world the liberality of the Academy to me, lest it provoke to similar applications from others, & the herbarium be subjected to injurious depredations. This has been the case in reference to the Musci & Hepaticae . . . Tulasne has, I know, been stimulated by your success to make enquiries in his own behalf but I am very anxious that no more facilities of this kind be offered, until we get through our work. Besides, there is no member of the Academy who has any knowledge of Fungi, & who could select specimens from the Herbarium, or who would superintend such a process & always leave good specimens. For myself, I conscientiously left the best specimens."

With the final shipment, Curtis twice stipulated that these indivisible specimens be returned to him. Berkeley returned a portion of them in March, 1856 (letter, Berkeley to Curtis, 13.iii.56), and their receipt was acknowledged by Curtis 21.v.56. Berkeley continued his study of Schweinitz fungi, sending "notes on the Pezizae etc. up to Hymenella" 29.iv.58, "the commentary on Schweinitz to the end of Sphaeria" 3.vi.59, and stating (same date) that there were "remaining Schweinitzians" still to be analyzed. In 1860, the American Civil War interrupted correspondence, and the only subsequent mention of Schweinitz fungi was in 1870, when Curtis expressed (letter to Berkeley, 3.xii.70): ". . . that you could devote your leisure hour to working up an American Mycology, or, at least, to completing your review of the Schweinitzian fungi." Indeed, an additional handwritten list of identifications is to be found in the Curtis memorabilia,* but no other publications came from it, to my knowledge.

6. In his final years, Curtis split his specimens, making up sets for Mr. Olney (a correspondent from Rhode Island), bequeathed to Brown University (Snell & Dick, 1953), Prof. Bessey, left to the University of Nebraska, and C.H. Peck, The New York State Museum, Albany. Another set was at least started for a "Dr. Allen of N. York." Apparently, at least in the case of Peck, some Schweinitz specimens were included. In a letter to Peck (2.ix.70), Curtis alluded to them, and sent some after forwarding the bulk of his duplicates. Peck (letter to Curtis, 9.xii.70) acknowledged receipt of them: "It does me good to see specms from

*Southern Historical Collection, University Library, University of North Carolina, Chapel Hill, NC.

the hands of Fries and The Herb[m] of Schweinitz." These Schweinitz specimens remain with the Peck herbarium in Albany.

7. After Curtis's death, his herbarium was sold to W.G. Farlow at Harvard, and became part of the "Farlow Herbarium", where it is cased separate from all other collections. Included are numerous Schweinitz specimens, both from Salem (Schweinitz's early collections and probably part of the set sent to Torrey, thence to Curtis) and from Bethlehem (probably gleaned from his herbarium directly by Curtis). They are arranged alphabetically with all others in Curtis's collections.

Pennell (1934) has stated: "But the end of the century [since Schweinitz's death] finds Schweinitz's herbarium of fungi kept together, as illustrating his greatest contribution to science." This is not the case, as summarized above, and the student of American mycology has farther to look than Philadelphia.

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[Author's note: Ravenel, perhaps prompted by Curtis, gleaned about 150 Schweinitz specimens on a visit in 1853. These should now reside at Kew, for the Ravenel herbarium was sold to the British Museum after his death (cf. Stevens, N. 1932. Isis 18: 133-149.)]

MYCOTAXON

Vol. X, No. 1, pp. 41-45 October-December 1979

RHYTIDOSPORA AND PTERIDIOSPERMA, GEN. NOV. (MELANOSPORACEAE)[1]

J.C. KRUG and R.S. JENG

Department of Botany, University of Toronto, Toronto, Ontario, Canada M5S 1A1

SUMMARY

Rhytidospora bispora sp. nov. is described and illustrated, from cow dung collected in Mexico, and *R. inordinata* comb. nov. (*Microthecium inordinatum* Malloch & Cain) is proposed. A key to the species of *Rhytidospora* is presented. *Pteridiosperma* gen. nov. is erected for two species of *Microthecium* possessing an unusual ornamentation on the ascospores. The combinations *P. ciliata* (*M. ciliatum* Udagawa & Takada) and *P. foveolata* (*M. foveolatum* Udagawa & Horie) are proposed. *M. hypomyces* (von Höhnel) von Höhnel, although somewhat atypical for *Microthecium*, is retained in that genus.

INTRODUCTION

Recently Jeng and Cain (1977) erected *Rhytidospora* based on *R. tetraspora* Jeng & Cain. This genus is essentially characterized by the pale cephalothecoid cleistothecia and the dark wrinkled ascospores. In addition to the type, these authors were aware of a Mexican collection which differed only in the number of ascospores. From further study of this collection, a slightly different structure of the peridial plates was observed as well as somewhat larger ascospores. In view of these differences this collection is being described here as a new species.

Our attention has also been drawn to *Microthecium inordinatum* Malloch & Cain (1972). This taxon was described as possessing wrinkled ascospores and appeared to be somewhat atypical for *Microthecium*. A study of the type material indicated that the fungus would be more naturally placed within *Rhytidospora*.

Microthecium hypomyces (von Höhnel) von Höhnel (1914), originally published by von Höhnel (1907) as *Sphaeroderma hypomyces*, was described by Udagawa and Cain (1969) as possessing wrinkled ascospores. Accordingly, we suspected a relationship with *Rhytidospora*. However, a study

[1] Supported by grants from the National Sciences and Engineering Research Council of Canada.

of the type revealed a different peridial structure, clavate asci, and not nearly so well defined markings on the spore wall as is found in *Rhytidospora*. It would appear that this species is more closely related to *Microthecium* than to *Rhytidospora* and, for the present, it is better retained in that genus.

In a paper on *Microthecium*, Hawksworth and Udagawa (1977) included *M. foveolatum* Udagawa & Horie. This taxon along with *M. ciliatum* Udagawa & Takada (1974) constitute a rather atypical pair of species. In both taxa the spores are ornamented with longitudinal wing-like ridges, which anastomose to form a reticulum, giving the spore a stellate appearance in section. In *M. ciliatum* the spores are wrinkled while those in *M. foveolatum* are pitted between the ridges. We feel that such ascospore ornamentations are unique enough within the Melanosporaceae, and even the Ascomycota in general, that these two taxa must be segregated into a new genus.

RHYTIDOSPORA

Rhytidospora bispora Krug & Jeng, sp. nov. Figs. 1-4.

Ascocarpia dispersa, superficialia, non ostiolata, globosa, circa 270-330 um diametro crassa, pallide armeniaca, glabra, e peridio membranaceo, translucenti, cephalothecoideo composita. Asci unitunicati, iodo non caerulescentes, irregulariter dispersi, bispori, globosi vel subglobosi, 14-15x10-12 um magni, parietibus tenuibus, evanescentes. Paraphyses nullae. Ascosporae unicellulares, ellipsoideae, 12-14x7-10 um magnae, primum hyalinae, deinde pallide brunneae vel olivaceo-brunneae, maturitate confirmata atro-brunneae, parietibus crassis, rugulosae, foramen germinale in utroque apice exhibentes. Conidia incognita.

HOLOTYPUS: In vaccarum fimo lectus est, apud Cuidad del Maiz, in San Luis Potosi provincia, in finibus reipublicae Mexicanae, 19 Sext. 1960, *Cain*, TRTC 36559. In Torontoensis universitatis Cryptogamarum herbario.

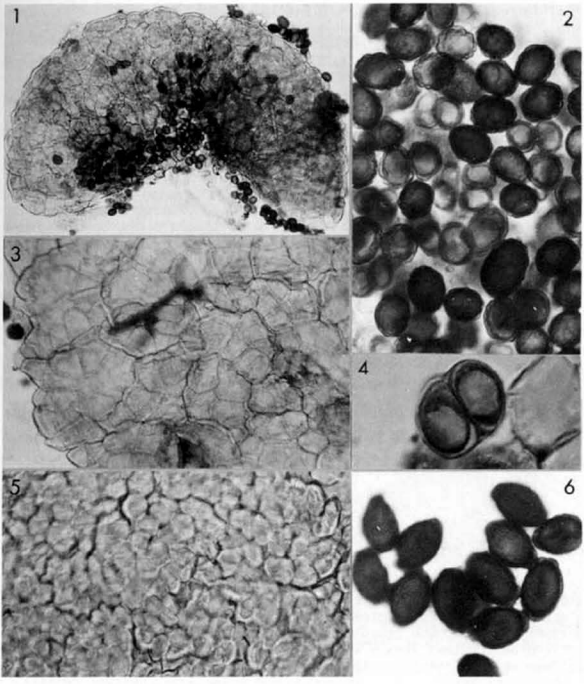
ETYMOLOGY: Latin, *bi* = two and *spora* = seed, referring to the two-spored asci.

Ascocarps scattered, superficial, non-ostiolate, globose, about 270-330 um in diameter, light orange, glabrous; peridium membranaceous, translucent, cephalothecoid in surface view, consisting of a number of regular plates of polygonal, light orange, thin-walled cells measuring 12-24x9-15 um. *Asci* unitunicate, non-amyloid, irregularly disposed, 2-spored, globose to subglobose, 14-15x10-12 um, thin-walled, evanescent. *Paraphyses* lacking. *Ascospores* one-celled, ellipsoidal, 12-14x7-10 um, at first hyaline, ranging in colour from light brown to olivaceous brown, dark brown at maturity, thick-walled, wrinkled, with a germ pore measuring about 1.5 um in diameter at each end of the spore. *Conidia* unknown.

HABITAT: on burro dung.

SPECIMEN EXAMINED: Mexico: San Luis Potosi: Cd. del Maiz, cow dung, 19 Aug. 1960, *Cain*, TRTC 36559 (TRTC).

Unlike *R. tetraspora*, the peridial plate in *R. bispora* is simply



Figs. 1-4. *Rhytidospora bispora*. 1. Ascocarp. x235. 2. Ascospores. x1000. 3. Peridium in surface view, showing the characteristic dehiscence line. x385. 4. Ascus and ascospores. x1600. Figs. 5-6. *Rhytidospora inordinata*. 5. Peridium in surface view, showing the dehiscence line. x450. 6. Ascospores. x1000.

composed of several relatively large, thin-walled cells. These become thick-walled at the periphery of each plate thereby resulting in a continuous dehiscence line.

This relatively simple peridial plate and the two-spored asci are the diagnostic features of the species. It differs from *R. tetraspora* and *R. inordinata* primarily in the number of spores.

Rhytidospora inordinata (Malloch & Cain) Krug & Jeng, comb. nov.
Figs. 5-6
= *Microthecium inordinatum* Malloch & Cain, Can. J. Bot. *50*: 64. 1972.

This taxon was first described and illustrated by Malloch and Cain (1972). In this paper they point out that *M. inordinatum* differs from all other species of *Microthecium* in having irregularly disposed asci, but otherwise it is typical of this genus. However, closer examination reveals that the structure of the peridium and the type of ascospore ornamentation are typical of *Rhytidospora*. According, *M. inordinatum* is transferred to this genus.

The peridium of *R. inordinata* is composed of numerous regular plates, which appear somewhat rugulose or reticulate under low magnification (100x). Upon closer examination each plate was seen to consist of a number of polygonal, thick-walled cells forming a dehiscence line at the periphery. These thick-walled peridial plates and the eight-spored asci are the diagnostic features of the taxon.

Key to the Species

1. Peridial plates composed of radiating and polyhedral cells; asci 4-spored; ascospores 10-13x7-9 um .. *R. tetraspora*
1. Peridial plates of polyhedral cells only; asci otherwise 2
   2. Asci 2-spored; ascospores 12-14x7-10 um ..... *R. bispora*
   2. Asci 8-spored; ascospores 14.5-18.5x10.5-12.5 um .... *R. inordinata*

PTERIDIOSPERMA

Pteridiosperma Krug & Jeng, gen. nov.

Ascocarpia dispersa, sine stromate nec ostiolo, globosa vel subglobosa, flavo-aurantiaca vel flavo-brunnea, glabra aut tenue pilosa, e peridio membranaceo, luteolo, cellulis polyedricis composita. Asci unitunicati, iodo non caerulescentes, in apice late clavati, fasciculati, evanescentes. Paraphyses nullae. Ascosporae unicellulares, ellipsoideae vel fusiformes, primum hyalinae, maturitate confirmata atrobrunneae vel paene nigrae, rugulosae aut foveolatae, cristas crassas, aliformes, anastomoses, irregulariter reticulatas et foramen germinale in utroque apice exhibentes. Conidiophora erecta, simplicia, breves aut nulla. Phialides singulares, lageniformes, hyalinae. Conidia (phialosporae) unicellularia, hyalina, levia, ovata vel pyriformia, ex apice phialidium in capita, globosa, parva aggregata.

TYPUS GENERIS: *Microthecium foveolatum* Udagawa & Horie.

ETYMOLOGY: Greek, *pteridion*, dim., from *pteros* = wing and *sperma* = seed, referring to the wing-like ridges on the ascospores.

Ascocarps scattered, non-stromatic, non-ostiolate, globose to subglobose, yellowish orange to yellowish brown, glabrous or finely hairy; peridium membranaceous, pale yellowish, composed of polyhedral cells.

Asci unitunicate, non-amyloid, broadly clavate, arising in fascicles, evanescent. *Paraphyses* lacking. *Ascospores* one-celled, ellipsoidal to fusiform, at first hyaline, dark brown to nearly black at maturity, ornamented with thick, wing-like ridges frequently anastomosing to form an irregular reticulum, stellate in section, wrinkled or pitted in convex surfaces, with two germ pores. *Conidiophores* lacking or when present erect, simple, short. *Phialides* borne singly on aerial hyphae or rarely on conidiophores, lageniform, hyaline. *Conidia* (phialospores) one-celled, hyaline, smooth, ovate to pyriform, aggregated in small globose heads at the apices of phialides.

The essential distinguishing features of the genus are the ascospores, which are ornamented with longitudinal, wing-like ridges that often anastomose to form an irregular reticulum. This type of ornamentation reminds one of *Emericellopsis* van Beyma (Pseudeurotiaceae), but that genus differs in the type of peridium, asci, absence of germ pores and the *Acremonium* conidial state. Such fundamental differences clearly differentiate *Pteridiosperma*, a member of the Melanosporaceae, from *Emericellopsis*.

New Combinations

Pteridiosperma ciliata (Udagawa & Takada) Krug & Jeng, comb. nov.

= *Microthecium ciliatum* Udagawa & Takada, Trans. Mycol. Soc. Japan *15:* 23. 1974.

Pteridiosperma foveolata (Udagawa & Horie) Krug & Jeng, comb. nov.

= *Microthecium foveolatum* Udagawa & Horie, Trans. Mycol. Soc. Japan *18:* 149. 1977.

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_____and M. Takada. 1974. Notes on some Japanese Ascomycetes XI. Trans. Mycol. Soc. Japan *15:*23-29.

MYCOTAXON

Vol. X, No. 1, pp. 46-48 October-December 1979

PHYSALACRIA SUBPELTATA SP. NOV. FROM HAWAII

SCOTT A. REDHEAD

Biosystematics Research Institute
Research Branch, Agriculture Canada
Ottawa, Canada
K1A 0C6

Dried senescent monocot leaves from the Oahu dump in Hawaii were remoistened and incubated at room temperature at the University of British Columbia. One of a number of minute basidiomycetes which sporulated on these leaves was a species of *Physalacria* which appeared to be undescribed. After consulting a number of mycologists familiar with tropical basidiomycetes (G.E. Baker, E.J.H. Corner, R.W.G. Dennis, D. Reid and R. Singer) I have decided that it is unnamed.

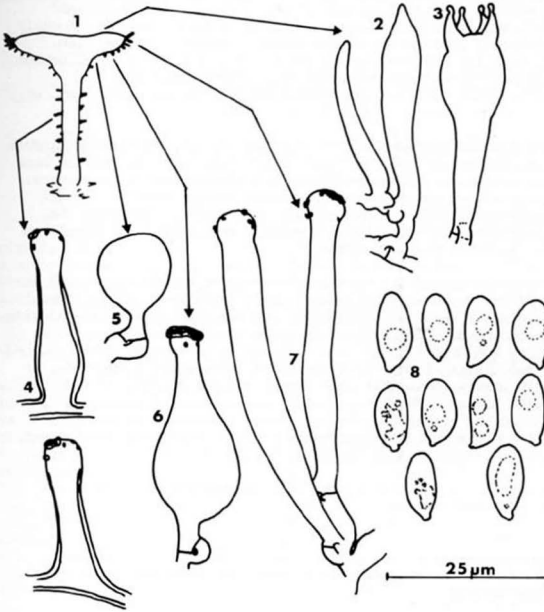
Physalacria subpeltata Redhead, sp. nov. Figs. 1-9

Capitula disciformia, alba, solide, 0.5-1.25 *mm diam., margine puberula. Pseudostipes usque ad* 1 *mm alti, albi, puberuli. Hyphae fibulatae. Hymenia laevia epigena. Cystidia caulis fimbriaeque, capitata, resinacea, usque ad* 50 *µm alti*, 4-5 *µm diam. Basidia* (2)-4 *sporis*, 32-33 x 9-9.5 *µm. Basidiosporae hyalinae, ovoidea-ellipsoideae*, 10-12.5 x 4.5-5 *µm.*

BASIDIOMES: 1-2 mm high, gregarious superficial on leaf surfaces.

CLAVULA: 0.5-1.25 mm wide, discoid to lense-shaped, centrally stipitate, upper surface fertile, concave to convex, smooth, becoming rugose in time, fringed with minute hairs, fleshy, white and somewhat translucent, becoming reddish brown where handled and on drying. STIPE: up to 1 mm long, 125 µm wide, equal, minutely pubescent, white, becoming pale brown from the base upwards with time, becoming reddish brown on handling, insitutuous.

BASIDIA: subacerose when young, becoming prominently clavate at maturity (2-) or 4-spored, hyaline, 32-37 x 9-9.5 µm; sterigmata 4-5 µm long. CYSTIDIOLES: abundant, narrowly mucronate-clavate, 32-34 x 4-7 µm. BASIDIOSPORES: ellipsoid to ovoid, 10-12.5 x 4.5-5 µm, hyaline, white in mass, smooth, thin-walled, nonamyloid, inequilateral, 1-2-guttulate. CYSTIDIA: marginal oleocystidia longer than other forms, up to 50 µm long, 4-5 µm diam., cylindrical or elongate-fusoid, capitate, exuding a hyaline resin-like incrustation on the apex which becomes reddish brown in ammonia solution but dissolves in KOH solution; intergrading with



Figs. 1-9. *Physalacria subpeltata* (type collection). 1. Diagramatic outline of a magnified basidiome with arrows indicating the relative positions of the following. 2. Basidioles. 3. Basidium. 4. Caulocystidia. 5-7. Sterile elements on the capitulum. 8. Basidiospores. 9. Fresh basidiomes on a leaf surface silhouetted by back lighting (X ca. 5).

sphaeropedunculate cells and broadly capitate-ventricose oleocystidia on the abhymenial surface, up to 18 µm diam.; caulocystidia similar to the marginal oleocystidia but shorter, often thick-walled and often not subtended by a septum, up to 40 µm long. HYPHAE: loosely interwoven and thin-walled in the clavula, clamped, 4-6 µm diam., smooth, parallel and with pronounced walls in the stipe, hyaline but becoming pale brown from the stipe base upwards with age. HOLOTYPUS: DAOM 189451, on senescent monocot leaves, Aug., 1st. wk., 1972, by G.H.N. Towers. ISOTYPI: K, F, BPI.

The distinctive features of this species are the discoid clavula which are fringed by long capitate oleocystidia and the sterile base. No other species of *Physalacria* has this combination of characters. Apparently a basidiomycetous culture from Hawaii which Dr. Singer had previously examined may have been this species, although the basidiomes formed in Dr. Singer's culture were sterile or nearly so (Singer, personal communication).

The dried basidiomes have a reddish brown glazed appearance due mainly to the discoloured, hardened resin from the cystidia. When fresh the resin readily dissolved in KOH solution but after hardening it resisted dissolution. Multiple spore isolates were obtained on malt agar, and grew well at 20°C. Irregular basidiomes were produced on the inoculating blocks in subcultures. These basidiomes were initially short-stalked but soon became sessile convoluted and brain-like masses. Often the stalks were forked, no oleocystidia were formed and sterile patches of hyphal ends were frequently produced on this mass. All of these indicated abnormal development. Unfortunately this culture has since been lost.

Singer (1976: 302, 311) made this species the type for *Physalacria* sect. *Pileolina*.

The assistance of Drs. D.B.O. Savile, J. Ginns, R. Singer and R.A. Shoemaker is gratefully acknowledged in addition to those consulted earlier.

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MYCOTAXON

Vol. X, No. 1, pp. 49-92 October-December 1979

INDEXES TO W. G. SOLHEIM'S MYCOFLORA SAXIMONTANENSIS EXSICCATA[1]

R. L. GILBERTSON, G. B. CUMMINS, AND ELIZABETH D. DARNALL

Department of Plant Pathology
University of Arizona, Tucson 85721

Over a period of 45 years Wilhelm G. (Bill) Solheim issued 17 centuries of his Mycoflora Saximontanensis Exsiccata. The first 15 schedae accompanying these sets were published in the University of Wyoming Publications and the last two in Mycotaxon. These indexes are presented to make this monumental contribution to knowledge of Rocky Mountain fungi more readily available to mycologists throughout the world.

Bill Solheim was above all an out-of-doors mycologist, a field man, a collector and, incidentally, an avid fisherman. Often, his co-collector was Ragnhild, his wife. There is no record, but he must have logged several thousand miles on foot in the Rocky Mountain states. We were privileged, in his later years, to accompany Bill on collecting trips in southern Arizona. The privilege entailed hard work; he was a rugged man still. The exsiccata set ended with No. 1700. The number looks simple, but represents only part of his collections, the part that he could gather in good condition and in quantities sufficient to assemble 25 or more sets. Number 1 is *Albugo bliti*, collected in 1931; No. 1700 is *Uromyces viciae-fabae*, and most intervening numbers also represent parasites. The latest Solheim collections included in the Mycoflora were made in 1974 by W. G. and Ragnhild. Bill's last collection probably was made the last day that he was able to get out of his home. The Mycoflora is an appropriate monument to a dedicated mycologist and an admirable gentleman.

The 17 centuries were published as follows:

I(1-100); University of Wyoming Publications in Science (Botany) 1(8):219-232. 1934.		
II(101-200); University of Wyoming Publications	3(3):89-99.	1937.
III(201-300)	" 7(3):29-42.	1940.
IV(301-400)	" 10(4):33-46.	1943.
V(401-500)	" 15(1):1-27.	1950.
VI(501-600)	" 18(2):71-82.	1954.
VII(601-700)	" 21(4):142-155.	1957.
VIII(701-800)	" 21(5):156-167.	1957.
IX(801-900)	" 23(3):23-37.	1959.

[1] University of Arizona Agricultural Experiment Station Journal article no. 2988.

X(901-1000); University of Wyoming Publications 23(4):38-51. 1959.
XI(1001-1100) " 24(3):22-33. 1960.
XII(1101-1200) " 24(4):34-55. 1960.
XIII(1201-1300) " 36(3):37-50. 1970.
XIV(1301-1400) " 36(4):51-67. 1970.
XV(1401-1500) " 36(5):69-80. 1970.
XVI(1501-1600); Mycotaxon 8(2):385-394. 1979.
XVII(1601-1700); Mycotaxon 8(2):395-401. 1979.

The index to fungi gives the exsiccati number, state where collected, literature citation, and host, respectively, for each specimen. Abbreviations for states are those of the U.S. Postal Service as follows: AZ, Arizona; CO, Colorado; ID, Idaho; NM, New Mexico; NV, Nevada; MT, Montana; UT, Utah, and WY, Wyoming. Abbreviations for Canadian provinces are AT, Alberta and BC, British Columbia. The host index lists only the fungus species represented on each host plant. Varietal names are not included in the indexes. Authorities for names have been omitted to conserve space. All literature citations refer to the University of Wyoming Publications except those preceded by M, which are in Mycotaxon.

INDEX TO FUNGI

BIFUSELLA LINEARIS 1331 CO 36(4):56 on Pinus flexilis.
BIFUSELLA PINI 1332 NV 36(4):56 on Pinus monophylla.
BIFUSELLA SACCATA 1333 CO 36(4):56 on Pinus flexilis.
BOLETUS EDULIS 374 CO 10(4):40 on ground.
BOLETUS VERSIPELLIS 375 CO 10(4):41 on ground.
CALDESIA SABINA 104 WY 3(3):2 on Juniperus scopulorum.
CALVATIA CYATHIFORMIS 1555 CO M8(2):390 on ground.
CANTHARELLUS CIBARIUS 378 CO 10(4):41 on ground.
CERCOSEPTORIA CREPIDIS 1190 WY 24(4):51 on Crepis runcinata.
CERCOSEPTORIA RIBIS 1191 WY 24(4):51 on Ribes viscosissimum.
CERCOSEPTORIA VALERIANAE 1192 WY 24(4):52 on Valeriana edulis.
CERCOSPORA BETICOLA 1574 CO M8(2):392, 1575 CO M8(2):392 on Beta vulgaris.
CERCOSPORA CLAVATA 1393 WY 36(4):66 on Asclepias speciosa.
CERCOSPORA FRASERAE 1577 ID M8(2):392 on Swertia radiata; 1576 WY M8(2):392 on Frasera speciosa.
CERCOSPORA GERANII 1578 WY M8(2):392 on Geranium richardsonii; 1579 WY M8(2):392 on G. viscosissimum.
CERCOSPORA ITHACENSIS 1394 WY 36(4):66 on Geranium sp; 1193 WY 24(4):53, 1580 WY M8(2):392 on G. viscosissimum.
CERCOSPORA MANITOBANA 1395 ID 36(4):67 on Elaeagnus commutata.
CERCOSPORA ROSICOLA 1581 CO M8(2):392 on Rosa sp.
CERCOSPORA SEPTORIOPSIS 1396 WY 36(4):67 on Ribes viscosissimum.
CERCOSPORA SQUALIDULA 1397 WY 36(4):67 on Clematis hirsutissima; 1398 WY 36(4):67 on Clematis ligusticifolia.
CERCOSPORA SYMPHORICARPI 1582 WY M8(2):392 on Symphoricarpos sp.; 1194 WY 24(4):53 on S. vaccinioides.
CERCOSPORA THERMOPSIDIS 1399 WY 36(4):67 on Thermopsis divaricarpa; 1583 WY M8(2):392 on T. rhombifolia.
CHRYSOMYXA ARCTOSTAPHYLI 501 WY 21(5):156, 701 MT 21(5):156, 1601 WY M8(2):395 on Arctostaphylos uva-ursi; 1401 WY 36(5):69 on Picea engelmannii.
CHRYSOMYXA LEDI 502 MT 18(2):71 on Ledum glandulosum.
CHRYSOMYXA LEDICOLA 1602 AT M8(2):395 on Ledum groenlandicum.
CHRYSOMYXA PIROLATA 625 WY 21(4):146, 1001 WY 24(3):22, 1603 WY M8(2):395 on Pyrola asarifolia; 1604 WY M8(2):395 on P. chlorantha.
CIBORINIA CONFUNDENS 1534 WY M8(2):388 on Populus tremuloides.
CICINNOBOLUS MAJOR 1357 WY 36(4):59 on Erysiphe cichoracearum.
CINTRACTIA CARICIS 131 CO 3(3):92 on Carex sp.; 439 WY 15(1):9 on C. festivella; 436 WY 15(1):9 on C. filifolia; 437 WY 15(1):9 on C. praegracilis; 438 WY 15(1):9 on C. reynoldsii.
CINTRACTIA CARPOPHILA 1139 WY 24(4):40 on Carex vallicola.
CINTRACTIA SUBINCLUSA 212 WY 7(3):30 on Carex rostrata.
CLAVARIA FLAVA 356 CO 10(4):39 on ground.
CLAVARIA PISTILLARIS 357 CO 10(4):39 on ground.
CLAVARIA PURPUREA 358 CO 10(4):39 on ground.
CLAVICEPS PURPUREA 122 WY 3(3):91 on Agropyron dasystachyum; 1344 WY 36(4):57 on A. desertorum; 121 WY 3(3):91 on A. pauciflorum; 24 WY 1(8):222 on A. smithii; 120 WY 3(3):91 on Elymus condensatus; 123 WY 3(3):91 on E. glaucus.
CLITOCYBE INFUNDIBULIFORMIS 379 CO 10(4):41 on ground.
COLEOSPORIUM ASTERUM 702 MT 21(5):156 on Aster conspicuus; 1201 MT 36(3):37 on Solidago missouriensis.
COLEOSPORIUM CROWELLII 313 NM 10(4):35, 901 AZ 23(4):38 on Pinus edulis.
COLEOSPORIUM EUPATORII 902 AZ 23(4):38 on Brickellia californica.

COLEOSPORIUM JONESII 904 AZ 23(4):39, 626 CO 21(4):146 on Pinus edulis; 905 AZ 23(4):39 on Ribes cereum; 903 AZ 23(4):39 on R. inebrians; 627 WY 21(4):146 on R. inerme; 906 AZ 23(4):39 on R. leptanthum; 907 AZ 23(4):39 on R. pinetorum; 314 CO 10(4):35 on R. saxosum; 908 AZ 23(4):39 on R. velutina.
COLEOSPORIUM SOLIDAGINIS 137 WY 3(3):92 on Aster lindleyanus.
COLEOSPORIUM VIGUIERAE 1605 AZ M8(2):395, 1631 AZ M8(2):397 on Viguiera dentata.
COLEROA CHAETOMIUM 427 CO 15(1):6 on Rubus sp.
COLEROA RUBICOLA 1523 AZ M8(2):387 on Rubus strigosus.
CONIOPHORA CORRUGIS 347 WY 10(4):38 on Abies lasiocarpa; 1551 WY M8(2):390 on Pinus contorta; 348 CO 10(4):38 on P. flexilis; 1550 WY M8(2):390 on wood.
CONIOTHYRIUM CONCENTRICUM 83 CO 1(8):228 on Yucca glauca.
CORTICIUM BYSSINUM 349 WY 10(4):38 on wood.
CORTINARIUS FLAVIFOLIUS 380 CO 10(4):41 on ground.
CORTINARIUS GLAUCOPOIDES 381 CO 10(4):41 on ground.
CORTINARIUS MUCIFLUUS 382 CO 10(4):41 on ground.
CRANDALLIA JUNCICOLA 303 WY 10(4):33, 386 WY 10(4):42 on Juncus drummondii.
CRONARTIUM COLEOSPORIOIDES 910 AZ 23(4):40 on Castilleja linariaefolia; 703 MT 21(5):156 on C. miniata; 909 AZ 23(4):40 on C. patriotica; 1002 WY 24(3):22 on Pinus contorta; 704 MT 21(5):157 on Rhinanthus kyrollae.
CRONARTIUM COMANDRAE 705 MT 21(5):157, 1005 WY 24(3):23, 1402 WY 36(5):69 on Comandra pallida; 1003 WY 24(3):23, 1004 WY 24(3):23 on Pinus contorta.
CRONARTIUM CONIGENUM 913 AZ 23(4):40 on Pinus chihuahuana; 911 AZ 23(4):40, 1403 AZ 36(5):69 on Quercus emoryi; 912 AZ 23(4):40 on Q. grisea; 914 AZ 23(4):40 on Q. hypoleucoides.
CRONARTIUM OCCIDENTALE 628 WY 21(4):146 on Ribes aureum.
CRONARTIUM PYRIFORME 38 WY 1(8):224 on Comandra pallida.
CUMMINSIELLA MIRABILISSIMA 636 UT 21(4):147, 714 MT 21(5):158, 715 MT 21(5):158, 927 AZ 23(4):42, 1022 ID 24(3):25, 1023 WY 24(3):25, 1217 UT 36(3):39, 1269 WY 36(3):46, 1423 AZ 36(5):72, 1618 WY M8(2):396, 1619 BC M8(2):396, 1620 AZ M8(2):396 on Berberis repens.
CUMMINSIELLA SANGUINEA 227 WY 7(3):32, 513 CO 18(2):72, 514 NM 18(2):73 on Berberis aquifolium.
CYLINDROSPORIUM BALSAMORHIZAE 1370 WY 36(4):61 on Balsamorhiza sagittata.
CYLINDROSPORIUM CONSERVANS 1568 WY M8(2):391 on Salix lasiandra.
CYLINDROSPORIUM CONSOCIATUM 176 WY 3(3):96, 192 WY 3(3):98, 388 WY 10(4):42, 1371 MT 36(4):62 on Acer glabrum; 690 UT 21(4):153 on A. grandidentatum.
CYLINDROSPORIUM CORNI 488 WY 15(1):23 on Cornus stolonifera.
CYLINDROSPORIUM FILIPENDULAE 1163 WY 24(4):45 on Spiraea splendens.
CYLINDROSPORIUM HERACLEI 1372 WY 36(4):62 on Heracleum lanatum; 1373 WY 36(4):62 on Ligusticum porteri; 389 WY 10(4):42 on L. simulans.
CYLINDROSPORIUM HYDROPHYLLI 1168 WY 24(4):46 on Hydrophyllum capitatum.
CYLINDROSPORIUM MONTENEGRINUM 295 WY 7(3):41 on Trollius albiflorus.
CYLINDROSPORIUM OCULATUM 489 NM 15(1):24 on Populus angustifolia.
CYLINDROSPORIUM SAXIMONTANENSE 490 CO 15(1):24, 491 NM 15(1):24, 691 WY 21(4):153 on Populus angustifolia.
CYLINDROSPORIUM SMILACINAE 1374 WY 36(4):62 on Smilacina stellata.
CYLINDROSPORIUM SPIRAEICOLUM 296 WY 7(3):41 on Spiraea lucida.
CYLINDROSPORIUM TRIFLORI 1164 WY 24(4):45 on Potentilla gracilis.

CYLINDROSPORIUM UMBELLIFERARUM 492 CO 15(1):24 on Heracleum lanatum.
CYLINDROSPORIUM URTICAE 493 WY 15(1):25 on Urtica gracilis.
CYLINDROSPORIUM UTAHENSES 1375 UT 36(4):62 on Betula occidentalis.
CYLINDROSPORIUM VERATRINUM 1376 UT 36(4):63 on Veratrum californicum.
CYLINDROSPORIUM WYETHIAE 1380 ID 36(4):64 on Wyethia amplexicaulis.
CYTOSPORA CHRYSOSPERMA 288 WY 7(3):38 on Populus sp.; 1155 WY 24(4):42 on P. tremuloides; 468 WY 15(1):16 on Salix babylonica.
CYTOSPORA CORNI 1558 CO, 1559 WY M8(2):390 on Cornus stolonifera.
DARLUCA FILUM 1358 AZ 16(4):59 on Cronartium conigenum; 664 WY 21(4): 150 on Puccinia substerilis.
DASYSCYPHA ARIDA 403 CO 15(1):1 on wood; 1535, 1536 WY M8(2):388 on Abies lasiocarpa; 1131 WY 24(4):39 on Pinus contorta.
DASYSCYPHA FUSCOSANGUINEA 1537 WY M8(2):388 on Pinus contorta.
DASYSCYPHA OBLONGISPORA 1538 WY M8(2):389 on Pinus contorta.
DIATRYPE ALBOPRUINOSA 621 CO 21(4):145 on Quercus gambelii.
DIBOTRYON MORBOSUM 622 CO 21(4):145 on Prunus virginiana.
DIDYMARIA CLEMATIDIS 494 CO 15(1):25, 1584 WY M8(2):392 on Clematis ligusticifolia.
DIDYMARIA CONFERTA 392 WY 10(4):44, 1167 WY 24(4):46 on Wyethia amplexicaulis.
DIDYMARIA HYDROPHYLLI 1168 WY 24(4):46 on Hydrophyllum capitatum.
DIDYMARIA WYETHIAE 1380 ID 36(4):64 on Wyethia amplexicaulis.
DIDYMOBOTRYOPSIS CERASTII 1200 WY 24(4):54 on Cerastium arvense.
DIDYMOSPHAERIA CLEMENTSII 126 WY 3(3):91 on Yucca glauca.
DIMEROSPORIUM COLLINSII 22 WY 1(8):222 on Amelanchier alnifolia.
DISCELLA PILOSULA 91 CO 1(8):230 on Acer glabrum.
DISCINA ANCILIS 1539 WY M8(2):389 on Pinus contorta.
DOASSANSIA ALISMATIS 1143 ID 24(4):41 on Alisma plantago-aquatica.
DUPLICARIA ACUMINATA 303 WY 10(4):33 on Juncus drummondii.
EMERICELLOPSIS STOLKIAE 1522 WY M8(2):387 on cornmeal agar.
ENDOPHYLLUM TUBERCULATUM 1424 WY 36(5):72 on Althaea rosea; 515 CO 18(2):72 on Sidalcea neomexicana.
ENTYLOMA ARNICALE 447 WY 15(1):10 on Arnica chamissonis; 30 WY 1(8): 223 on A. cordifolia; 448 WY 15(1):10 on A. subplumosa.
ENTYLOMA CALENDULAE 1144 WY 24(4):41 on Arnica chamissonis; 1145 WY 24(4):41, 1146 ID 24(4):41 on A. cordifolia; 1147 WY 24(4):41, 1346 WY 36(4):57 on A. mollis; 1148 WY 24(4):41 on Senecio triangularis.
ENTYLOMA COMPOSITARUM 1149 WY 24(4):42, 1347 ID 36(4):57 on Aster foliaceus; 449 WY 15(1):10 on Erigeron salsuginosus; 1150 WY 24(4): 42, 1544 WY M8(2):389 on E. speciosus.
ENTYLOMA PHYSALIDIS 31 WY 1(8):223 on Solanum triflorum.
ENTYLOMA SEROTINUM 133 WY 3(3):92 on Mertensia ciliata.
ENTYLOMA VERONICAE 623 WY 21(4):145 on Veronica americana.
ENTYLOMA WINTERI 1545 WY M8(2):389 on Delphinium occidentale.
ENTYLOMA WYOMINGENSE 450 WY 15(1):11 on Delphinium barbeyi.
ERYSIPHE CICHORACEARUM 107 WY 3(3):89 on Ambrosia trifida; 1524 WY M8(2):387 on Aster adscendens; 108 WY 3(3):89 on A. adsurgens; 12 WY 1(8):221 on A. fluviatilis; 1116 WY 24(4):37 on A. foliaceus; 1117 WY 24(4):37 on A. integrifolius; 11 WY 1(8):221 on Chrysothamnus pumilus; 109 WY 3(3):90 on Cynoglossum officinale; 406 CO 15(1): 2 on Erigeron subtrinervis; 205 WY 7(3):29 on Grindelia perennis; 407 CO 15(1):2 on Gutierrezia sarothrae; 110 WY 3(3):90 on Lactuca scariola; 604 WY 21(4):143 on Mentha arvensis; 1118 WY 24(4):37 on Mertensia sp.; 105 WY 3(3):89 on M. ciliata; 111 WY 3(3):90 on Plantago major; 304 WY 10(4):33 on Solidago sp.; 106 WY 3(3):89 on Valeriana furfurescens.

ERYSIPHE GALEOPSIDIS 13 WY 1(8):221 on Stachys palustris.
ERYSIPHE GRAMINIS 1319 WY 36(4):54 on Agropyron dasystachyum; 605 CO 21(4):143 on A. repens; 606 CO 21(4):143 on A. riparium; 1119 WY 24(4):37 on A. trachycaulum; 607 WY 21(4):143 on Bromus marginatus; 1120 WY 24(4):37, 1318 WY 36(4):54 on Poa ampla; 206 WY 7(3):29 on P. canbyi; 1121 WY 24(4):37 on P. pratensis.
ERYSIPHE HORRIDULA 1320 AZ 36(4):54 on Amsinckia intermedia; 1525 AZ M8(2):388 on Cryptantha barbigera; 1526 AZ M8(2):388 on Lappula redowskii.
ERYSIPHE POLYGONI 15 WY 1(8):221 on Aquilegia caerulea; 14 WY 1(8):221 on Astragalus alpinus; 608 WY 21(4):143 on A. canadensis; 408 WY 15(1):2 on A. decumbens; 409 NM 15(1):2 on Clematis ligusticifolia; 1122 WY 24(4):37 on Lupinus argenteus; 112 WY 3(3):90 on Polygonum aviculare; 305 WY 10(4):33 on P. buxaforme; 207 WY 7(3):30 on P. exsertum; 113 WY 3(3):90 on Thermopsis divaricarpa; 1123 WY 24(4):38 on Trifolium longipes.
EXIDIA GLANDULOSA 679 CO 21(4):151 on Quercus gambelii.
EXIDIA SACCHARINA 1152 WY 24(4):42 on wood.
EXOBASIDIUM UVAE-URSI 1354 WY 36(4):58 on Arctostaphylos uva-ursi.
EXOBASIDIUM VACCINII 452 CO 15(1):11 on Arctostaphylos uva-ursi; 287 WY 7(3):38 on Menziesia ferruginea; 1355 WY 36(4):58, 451 WY 15(1):11 on Vaccinium scoparium.
EXOBASIDIUM VACCINII-ULIGINOSI 1153 WY 24(4):42 on Vaccinium membranaceum; 1154 WY 24(4):42 on V. scoparium.
FABRAEA MACULATA 404 CO 15(1):1 on Amelanchier oreophila.
FOMES IGNIARIUS 1552 WY M8(2):390 on Populus tremuloides.
FOMES NIGROLIMITATUS 360 CO 10(4):39 on Picea engelmannii.
FOMES PINI 361 CO 10(4):39, 362 WY 10(4):39 on Picea engelmannii; 363 WY 10(4):39 on wood.
FOMES PINICOLA 364 CO 10(4):40 on Picea engelmannii.
FUSICLADIUM DEPRESSUM 199 WY 3(3):99 on Angelica ampla.
GANODERMA APPLANATUM 365 CO 10(4):40 on Populus tremuloides.
GASTEROCYBE LATERITIA 1556 WY M8(2):390 on ground.
GEOPYXIS CUPULARIS 1540 WY M8(2):389 on ground.
GLOEOSPORIUM BETULICOLA 1377 UT 36(4):63 on Betula occidentalis.
GLOEOSPORIUM BOREALE 487 AZ 15(1):23 on Salix sp.; 191 WY 3(3):98 on S. glaucops; 190 WY 3(3):98 on S. monticola.
GLOEOSPORIUM RIBIS 1569 WY M8(2):391 on Ribes inerme; 483 WY 15(1):20 on R. saxosum.
GUEPINIOPSIS ALPINUS 680 WY 21(4):152, 1549 WY M8(2):389 on wood.
GYMNOSPORANGIUM BETHELII 716 MT 12(5):158, 1024 WY 24(3):25 on Crataegus douglasii; 637 UT 21(4):147 on C. rivularis; 638 CO 21(4):147 on C. succulenta.
GYMNOSPORANGIUM CLAVARIAEFORME 717 CO 21(5):158, 1025 WY 24(3):25, 1218 WY 36(3):40 on Amelanchier alnifolia; 228 WY 7(3):32 on Juniperus communis.
GYMNOSPORANGIUM CORNUTUM 1219 WY 36(3):40 on Sorbus scopulina.
GYMNOSPORANGIUM INCONSPICUUM 170 CO 3(3):95 on Amelanchier alnifolia; 929 AZ 23(4):42 on A. bakeri; 928 UT 23(4):42 on A. utahensis; 1220 UT 36(3):40 on Juniperus osteosperma.
GYMNOSPORANGIUM JUVENESCENS 639 UT 21(4):147 on Amelanchier alnifolia.
GYMNOSPORANGIUM KERNIANUM 1621 AZ M8(2):396 on Juniperus deppeana; 1425 AZ 36(5):72 on J. monosperma.
GYMNOSPORANGIUM NELSONII 40 WY 1(8):224, 171 WY 3(3):95, 718 MT 21(5):158, 720 CO 21(5):158 on Amelanchier alnifolia; 41 CO 1(8):224, 930 AZ 23(4):42 on A. bakeri; 1221 WY 36(3):40 on A. pumila 931 AZ

23(4):42 on A. oreophila; 932 AZ 23(4):42 on A. utahensis; 933 AZ 23(4):42, 934 NM 23(4):42 on Juniperus monosperma; 39 WY 1(8):224, 719 MT 21(5):158, 1222 UT 36(3):40 on J. scopulorum.

GYMNOSPORANGIUM NIDUS-AVIS 1622 CO M8(2):396 on Amelanchier alnifolia; 1223 WY 36(3):40 on Juniperus scopulorum.

GYMNOSPORANGIUM SPECIOSUM 935 AZ 23(4):42 on Fendlera rupicola; 936 AZ 23(4):43 on Juniperus deppeana; 1426 AZ 36(5):72 on J. monosperma;

GYMNOSPORANGIUM TREMELLOIDES 1026 WY 24(3):25 on Juniperus communis; 229 AZ 7(3):32 on Philadelphus rugosus; 640 CO 21(4):147 on Sorbus scopulina; 1224 WY 36(3):40 on S. sitchensis.

HADROTRICHUM GLOBIFERUM 1585 UT M8(2):392 on Lupinus argenteus; 1586 WY M8(2):392 on L. parviflorus; 700 WY 21(4):155 on L. sericeus.

HADROTRICHUM LUPINI 498 CO 15(1):26 on Lupinus sp.; 81 WY 1(8):228 on L. alpestris; 198 WY 3(3):99 on L. argenteus.

HELVELA INFULA 302 10(4):33 on ground.

HEMIPHACIDIUM PLANUM 1335 CO 36(4):56 on Pinus ponderosa.

HENDERSONIA CALAMOVILFAE 1156 WY 24(4):42 on Calamagrostis canadensis.

HERPOBASIDIUM DEFORMANS 1356 WY 36(4):59 on Lonicera involucrata.

HERPOTRICHIA NIGRA 620 CO 21(4):145, 26 WY 1(8):222 on Abies lasiocarpa; 124 WY 3(3):91 on Picea engelmannii.

HETEROSPORIUM AVENAE 98 WY 1(8):231 on Triticum aestivum.

HETEROSPORIUM ECHINULATUM 1195 WY 24(4):53 on Cerastium arvense.

HETEROSPORIUM GRACILE 395 WY 10(4):45 on Iris sp.

HYALOPSORA POLYPODII 315 WY 10(4):35, 915 AZ 28(4):40 on Cystopteris fragilis.

HYDNUM IMBRICATUM 359 CO 10(4):39 on ground.

HYGROPHORUS CALOPHYLLUS 383 CO 10(4):41 on ground.

HYPODERMA SACCATUM 617 CO 21(4):145 on Pinus flexilis.

HYPOXYLON PRUINATUM 1137 WY 24(4):40 on Populus tremuloides.

KABATIA FRAGARIAE 482 WY 15(1):19 on Fragaria ovalis.

KABATIA LONICERAE 1368 UT 36(4):61, 1369 WY 36(4):61 on Lonicera involucrata.

KABATIA MIRABILIS 387 WY 10(4):42 on Lonicera involucrata.

KELLERMANNIA ANOMALA 1560 CO M8(2):390 on Yucca glauca.

KELLERMANNIA MAJOR 470 NV 15(1):17 on Yucca brevifolia.

KELLERMANNIA YUCCAEGENA 471 NM 15(1):17 on Yucca elata; 181 WY 3(3):97 on Y. glauca.

KUNKELIA NITENS 721 MT 21(5):159 on Rubus pubescens.

LACHNELLULA CHRYSOPHTHALMA 1541 WY M8(2):389 on Abies lasiocarpa; 1132 WY 24(4):39 on wood.

LACTARIUS DELICIOSUS 384 CO 10(4):41 on ground.

LASIOBOLUS PILOSUS 1134 WY 24(4):39 on cow dung.

LASIOBOTRYS LONICERAE 23 ID 1(8):222 on Symphoricarpos occidentalis.

LENZITES SAEPIARIA 385 CO 10(4):41 on Picea engelmannii.

LEPTOTHYRIUM PERICLYMENI 292 WY 7(3):40 on Lonicera utahensis.

LEPTOTHYRIUM PETRAKII 689 WY 21(4):153 on Elymus cinereus.

LOPHIONEMA APOCLASTOSPORA 430 WY 15(1):7 on Salix sp.

LOPHODERMELLA ARCUATA 1336 CO 36(4):56 on Pinus flexilis.

LOPHODERMELLA CERINA 1337 AZ 36(4):56, 1338 CO 36(4):56, 1338 CO 36(4):56 on Pinus ponderosa.

LOPHODERMELLA MONTIVAGA 1339 CO 36(4):57, 1340 WY 36(4):57 on Pinus contorta.

LOPHODERMIUM DECORUM 1341 CO 36(4):57 on Abies concolor.

MARSSONIA GALII 92 AZ 1(8):230 on Galium asperrimum.

MARSSONIA KRIEGERIANA 293 WY 7(3):40 on Salix exigua.

MARSSONIA POTENTILLAE 294 NM 7(3):41 on Fragaria sp.

MARSSONINA BRUNNEA 484 WY 15(1):20, 1570 AZ M8(2):391 on Populus tremuloides.
MARSSONINA CHRYSOTHAMNI 1378 WY 36(4):63 on Chrysothamnus parryi.
MARSSONINA KRIEGERIANA 487 AZ 15(1):23 on Salix sp; 1165 WY 24(4):45 on S. drummondiana; 293 WY 7(3):40 on S. exigua; 191 WY 3(3):98 on S. glaucops; 190 WY 3(3):98 on S. monticola; 692 WY 21(4):154 on S. subcoerulea.
MARSSONINA POPULI 485 WY 15(1):23 on Populus sp; 486 WY 15(1):23 on P. angustifolia.
MARSSONINA POTENTILLAE 1571 WY M8(2):391 on Potentilla fissa.
MELAMPSORA ABIETI-CAPRAEARUM 1202 WY 36(3):38 on Abies lasiocarpa; 1203 WY 36(3):38 on Salix sp; 916 AZ 23(4):40 on S. bebbiana; 503 CO 18(2):71 on S. exigua; 138 WY 3(3):92 on S. subcoerulea.
MELAMPSORA ALBERTENSIS 141 WY 3(3):93 on Populus sp.; 140 WY 3(3):92, 629 CO 21(4):146 on P. angustifolia; 34 WY 1(8):223, 139 CO 3(30):92 on P. tremuloides.
MELAMPSORA AMERICANA 142 WY 3(3):93 on Salix amygdaloides; 35 WY 1(8):223 on S. bebbiana.
MELAMPSORA ARCTICA 1204 WY 36(3):38 on Salix anglorum.
MELAMPSORA BIGELOWII 316 WY 10(4):35 on Salix bebbiana; 37 WY 1(8):223 on S. exigua; 36 WY 1(8):223 on S. fluviatilis; 143 WY 3(3):93 on S. nelsonii; 144 WY 3(3):93 on S. scouleriana.
MELAMPSORA CONFLUENS 145 WY 3(3):93 on Salix sp.
MELAMPSORA EPITEA 1404 UT 36(5):69 on Ribes inerme; 1408 WY 36(5):70, 1409 WY 36(5):70, 1606 WY M8(2):396 on Salix sp.; 1406 WY 36(5):70 on S. amygdaloides; 1407 AZ 36(5):70 on S. bonplandiana; 1405 UT 36(5):70 on S. drummondiana; 1608 WY M8(2):396 on S. geyeriana; 1607 AZ M8(2):396 on S. scouleriana.
MELAMPSORA LINI 216 WY 7(3):31, 917 AZ 23(4):40, 1410 UT 36(5):70, 1411 AZ 36(5):70, 1412 AZ 36(5):70, 1609 UT M8(2):396 on Linum lewisii.
MELAMPSORA MEDUSAE 1206 WY 36(3):38, 1207 WY 36(3):38, 1610 AZ M8(2): 396 on Populus tremuloides; 1205 WY 36(3):38 on Pseudotsuga menziesii.
MELAMPSORA MONTICOLA 918 AZ 23(4):41 on Euphorbia incisa; 919 CO 23 (4):41 on E. robusta.
MELAMPSORA OCCIDENTALIS 504 MT 18(2):70 on Populus angustifolia; 706 MT 21(5):157 on Pseudotsuga taxifolia.
MELAMPSORA PARADOXA 1008 WY 24(3):23, 1413 CN 36(5):70, 630 WY 21(4): 146 on Salix amygdaloides; 1611 WY M8(2):396 on S. bebbiana; 1006 WY 24(3):23, 1007 WY 24(3):23 on S. geyeriana; 1613 WY M8(2):396 on S. lutea; 1414 WY 36(5):71, 1612 WY M8(2):396 on S. myrtillifolia; 1009 WY 24(3):23 on S. pseudocordata.
MELAMPSORA RIBESII-PURPUREAE 1010 WY 24(3):23 on Ribes inerme; 1011 WY 24(3):23 on R. lacustre; 217 WY 7(3):31, 505 CO 18(2):72, 506 NM 18(2):72, 507 ID 18(2):72, 1014 WY 24(3):24, 1209 WY 36(3):38, 1415 UT 36(5):71 on Salix sp.; 1208 WY 36(3):38 on S. amygdaloides; 317 WY 10(4):35 on S. bebbiana; 508 WY 18(2):72 on S. drummondiana; 1013 WY 24(3):24 on S. geyeriana; 920 AZ 23(4):41 on S. laevigata; 509 ID 18(2):72 on S. ligulifolia; 631 UT 21(4):146 on S. lutea; 218 WY 7(3):31 on S. nuttallii; 1015 WY 24(3):24, 510 WY 18(2):72 on S. pseudocordata; 1012 WY 24(3):23 on S. scouleriana; 921 CO 23(4):41 on S. subcoerulea.
MELAMPSORELLA CARYOPHYLLACEARUM 632 UT 21(4):146, 707 CO 21(5):157, 1210 UT 36(3):39, 1416 ID 36(5):71 on Abies lasiocarpa; 633 UT 21(4):146, 922 AZ 23(4):41 on Picea engelmannii; 1016 WY 24(3):24, 1017 WY 24(3):24 on Picea pungens.

MELAMPSORELLA CERASTII 219 WY 7(3):31, 220 WY 7(3):31 on Abies lasiocarpa; 222 WY 7(3):31 on Cerastium arvense; 221 WY 7(3):31 on Picea engelmannii.
MELASMIA IMITANS 90 WY 1(8):230 on Pteridium aquilinum.
MICROSPHAERA ALNI 609 WY 21(4):143 on Lonicera utahensis; 410 CO 15(1):2, 411 NM 15(1):3 on Quercus gambelii; 117 WY 3(3):90 on Vaccinium oreophilum; 16 WY 1(8):221 on Vicia trifida.
MICROSPHAERA DIFFUSA 118 WY 3(3):90 on Symphoricarpos occidentalis.
MICROSPHAERA LONICERAE 1321 WY 36(4):54 on Lonicera involucrata.
MYCOSPHAERELLA FRAGARIAE 1138 ID 24(4):40 on Fragaria ovalis.
MYCOSPHAERELLA FRAXINICOLA 431 NM 15(1):8 on Fraxinus macropetala; 432 ID 15(1):8 on F. velutina.
NECTRIA CINNABARINA 1527 AZ M8(2):388 on Acer glabrum; 426 CO 15(1):5 on A. negundo.
NEOPECKIA COULTERI 309 WY 10(4):34 on Picea engelmannii; 125 WY 3(3):91 on Pinus contorta.
NYSSOPSORA CLAVELLOSA 1623 AZ M8(2):397 on Aralia racemosa.
NYSSOPSORA ECHINATA 1624 WY M8(2):397 on Ligusticum porteri.
OIDIUM AMBROSIAE 1587 AZ M8(2):393 on Ambrosia confertifolia.
OPHIOBOLUS FESTUCAE 1528 WY M8(2):388 on Festuca idahoensis.
OVULARIA ASTERIS 297 WY 7(3):41, 1169 WY 24(4):46 on Aster engelmannii.
OVULARIA BISTORTAE 1381 WY 36(4):65 on Polygonum bistortoides.
OVULARIA BULBIGERA 693 ID 21(4):154 on Sanguisorba sitchensis.
OVULARIA COMPACTA 1170 WY 24(4):46, 1382 WY 36(4):65 on Agoseris glauca.
OVULARIA DECIPIENS 393 WY 10(4):44 on Ranunculus macounii.
OVULARIA DELPHINII 394 WY 10(4):44 on Delphinium barbeyi; 1171 WY 24(4):46 on D. bicolor; 1383 WY 36(4):65 on D. burkei.
OVULARIA MONOSPORIA 1588 M8(2):399 on Rumex crispus; 1589 AZ M8(2):399 on R. hymenosepalus.
OVULARIA OBLIQUA 93 CO 1(8):231 on Rumex crispus.
PASSALORA DEPRESSA 1196 WY 24(4):54 on Angelica pinnata; 1400 WY 36(4):67 on Perideridia gairdneri.
PASSALORA GRAMINIS 1197 WY 24(4):54 on Bromus anomalus; 1198 WY 24(4):54 on B. marginatus; 1199 WY 24(4):54 on Hordeum brachyantherum.
PERIDERMIUM FILAMENTOSUM 923 NM 23(4):41, 924 AZ 23(4):41 on Pinus ponderosa.
PERIDERMIUM HOLWAYI 1300 WY 36(3):49 on Abies lasiocarpa.
PERONOSPORA ARBORESCENS 1503 WY M8(2):386 on Argemone polyanthemos.
PERONOSPORA ARTHURI 1308 AZ 36(4):52 on Epilobium minutum; 1504 AZ M8(2):386 on Camissonia chamaenerioides; 1309 AZ 36(4):52, 1573 AZ M8(2):393 on Oenothera primiveris.
PERONOSPORA CORYDALIS 1505 AZ M8(2):386 on Corydalis aurea.
PERONOSPORA ECHINOSPERMI 1310 AZ 36(4):52 on Amsinckia intermedia; 1506 AZ M8(2):386 on Lappula redowskii.
PERONOSPORA EFFUSA 5WY 1(8):220 on Chenopodium album.
PERONOSPORA FARINOSA 1311 AZ 36(4):53, 1312 WY 36(4):53 on Chenopodium album.
PERONOSPORA FICARIAE 1507 WY M8(2):386 on Ranunculus acriformis.
PERONOSPORA FLOERKEAE 1109 WY 24(4):35 on Floerkea prosperinacoides.
PERONOSPORA LEPIDII 1508 AZ M8(2):386 on Lepidium medium; 1509 AZ M8(2):386 on L. thurberi.

PERONOSPORA PARASITICA 1517 AZ M8(2):387 on Arabis drummondii; 1110 ID 24(4):36 on A. holboellii; 1313 AZ 36(4):53, 1511 AZ M8(2):386, 1512 AZ M8(2):386 on Descurainia pinnata; 1513 WY M8(2):387 on D. richardsonii; 1514 AZ M8(2):387 on Draba cuneifolia; 202 WY 7(3):29 on D. nemorosa; 1515, 1516 AZ M8(2):387 on Lepidium lasiocarpum; 1517 AZ M8(2):387 on L. medium; 1314 AZ 36(4):53 on Lesquerella gordonii; 1518 AZ M8(2):387, 1519 AZ M8(2):387 on L. purpurea; 6 WY 1(8):220 on Sophia procera; 1315 AZ 36(4):53 on Streptanthus arizonicus; 1316 AZ 36(4):53 on Thelypodium lasiophyllum.

PERONOSPORA POTENTILLAE 1111 WY 24)4):36 on Potentilla gracilis; 203 WY 7(3):29 on P. nuttallii; 1112 WY 24(4):36 on P. pulcherrima.

PERONOSPORA TABACINA 1317 AZ 36(4):54 on Nicotiana trigonophylla.

PERONOSPORA TRIFOLIORUM 1520 WY M8(2):387 on Astragalus alpinus; 7 WY 1(8):220 on Medicago sativa.

PHLEOSPORA ACERIS 682 UT, 683 WY, 684 CO 21(4):152 on Acer negundo.

PHLEOSPORA BALSAMORHIZAE 1157 WY 24(4):43 on Balsamorhiza sagittata.

PHLEOSPORA CARAGANAE 685 WY 21(4):152 on Caragana arborescens.

PHLEOSPORA DEARNESSII 477 NM 15(1):18 on Alnus oblongifolia.

PHLEOSPORA LUNELLIANA 1359 WY 36(4):59 on Carex platylepis.

PHLEOSPORA MUHLENBERGIAE 478 AZ 15(1):18 on Muhlenbergia arizonica.

PHLEOSPORA OSMORRHIZAE 291 WY 7(3):40 on Osmorhiza divaricata; 479 WY 15(1):19, 480 CO 15(1);19, 1158 WY 24(4):43 on O. obtusa; 1159 WY 24(4):43 on O. occidentalis; 481 WY 15(1):19 on Pseudocymopteris montanus.

PHLEOSPORA PSEUDOPLATANI 460 CO 15(1):14 on Acer negundo.

PHRAGMIDIUM ANDERSONII 230 WY 7(3):32, 722 CO 21(5):159, 1225 WY 36(3):40 on Potentilla fruticosa.

PHRAGMIDIUM FUSIFORME 516 CO 18(2):73 on Rosa sp; 723 MT 21(5):159, 1625 MT M8(2):397, 1626 WY M8(2):397 on R. acicularis; 517 MT 18(2):73 on R. engelmannii; 1427 MT 36(5):72, 1428 WY 36(5):72 on R. woodsii.

PHRAGMIDIUM IVESIAE 724 WY 21(5):159 on Potentilla concinna; 1226 WY 36(3):40 on P. diversifolia; 518 WY 18(2):73 on P. flabelliformis; 231 WY 7(3):32, 725 MT 21(5):159, 1028 WY 24(3):25, 1627 WY M8(2):397 on P. gracilis; 232 WY 7(3):32 on P. nuttallii; 726 CO 21(5):159, 1027 WY 24(3):25 on P. pulcherrima.

PHRAGMIDIUM MONTIVAGUM 42 WY 1(8):224 on Rosa sp.; 728 CO 21(5):159, 1029 WY 24(3):25, 1629 WY M8(2):397 on R. acicularis; 519 CO 18(2):73, 938 AZ 23(4):43 on R. fendleri; 937 AZ 23(4):43 on R. manca; 520 ID 18(2):73, 521 WY 18(2):73, 1030 WY 24(3):25, 1429 UT 36(5):72, 1430 WY 36(5):72, 1628 MT M8(2):397 on R. woodsii.

PHRAGMIDIUM OCCIDENTALE 146 WY 3(3):93, 522 MT 18(2):73, 1031,WY 24 (3):25, 1431 MT 36(5):72 on Rubus parviflorus.

PHRAGMIDIUM PECKIANUM 318 CO 19(4):35, 1032 WY 24(3):26 on Rubus deliciosus; 939 AZ 23(4):43, 940 AZ 23(4):43 on R. neomexicanus.

PHRAGMIDIUM POTENTILLAE 641 WY 21(4):147, 727 CO 21(5):159 on Potentilla pennsylvanica , 253 WY 7(3):33 on P. strigosa.

PHRAGMIDIUM ROSAE-ACICULARIS 147 WY 3(3):93, 319 CO 10(4):35 on Rosa acicularis.

PHRAGMIDIUM ROSAE-ARKANSANAE 148 WY 3(3):93 on Rosa sp.

PHRAGMIDIUM ROSAE-PIMPINELLIFOLIAE 1432 WY 36(5):73 on Rosa foetida.

PHRAGMIDIUM RUBI-IDAEI 523 CO 18(2):73 on Rubus sp; 1227 WY 36(3):40, 1433 MT 36(5):73, 1630 WY M8(2):388 on R. idaeus; 729, 730 MT 21(5):159 on R. leucodermus; 941 AZ 23(4):43, 1033 WY 24(3):26 on R. strigosus.

PHRAGMODOTHIS CONSPICUA 83 CO 1(8):228 on Yucca glauca.
PHRAGMOPYXIS ACUMINATA 1434 AZ 36(5):73 on Coursetia microphylla.
PHRAGMOPYXIS DEGLUBENS 1435 AZ 36(5):73 on Cracca edwardsii.
PHYLLACHORA EPICAMPIS 433 AZ 15(1):8 on Muhlenbergia emerslyi; 434 AZ 15(1):8 on M. longiligula; 1529 NM M8(2):388 on M. metcalfii; 1530 AZ M8(2):388 on M. ringens.
PHYLLACHORA GRAMINIS 211 WY 7(3):30 on Bromus anomalus.
PHYLLACHORA HERACLEI 25 WY 1(8):222 on Heracleum lanatum.
PHYLLACHORA VULGATA 435 AZ 15(1):9 on Muhlenbergia glauca.
PHYLLACHORA WITTROCKII 1330 WY 36(4):56 on Linnaea borealis.
PHYLLACTINIA CORYLEA 412 CO 15(1):3, 613 WY 21(4):144 on Acer negundo; 308 WY 10(4):34, 413 NM 15(1):3 on Alnus tenuifolia; 417 CO 15(1):4 on Amelanchier oreophila; 414 NM 15(1):3 on Fraxinus macropetala; 415 UT 15(1):3 on F. velutina; 418 NM 15(1):4 on Populus angustifolia; 416 AZ 15(1):3 on Robinia neomexicana; 419 NM 15(1):4 on Rudbeckia laciniata.
PHYLLOSTICTA SP. 1199 WY 24(4):54 on Bromus marginatus.
PHYLLOSTICTA ALPINICOLA WY 454 15(1):11 on Trifolium parryi.
PHYLLOSTICTA ANGELICAE 173 WY 3(3):95 on Angelica ampla.
PHYLLOSTICTA ARNICAE 174 WY 3(3):96, 1360 WY 36(4):59, 1361 WY 36(4):6 on Arnica cordifolia.
PHYLLOSTICTA BRUNNEA 455 CO 15(1):12, 456 NM 15(1):12 on Populus angustifolia; 1561 AZ M8(2):390 on P. fremontii.
PHYLLOSTICTA CARPINI 457 NM 15(1):12, 477 NM 15(1):18 on Alnus oblongifolia.
PHYLLOSTICTA CINEREA 458 AZ 15(1):14 on Rhamnus betulaefolia.
PHYLLOSTICTA DECIDUA 1179 WY 24(4):48,1362 WY 36(4):6 on Mentha arvensis.
PHYLLOSTICTA DELPHINII 1383 WY 36(4):65 on Delphinium burkei.
PHYLLOSTICTA FERAX 498 CO 15(1):26 on Lupinus sp.; 81 WY 1(8):228 on L. alpestris; 198 WY 3(3):99, 1363 WY 36(4):6, 1585 UT M8(2):392 on L. argenteus; 700 WY 21(4):155 on L. sericeus.
PHYLLOSTICTA GARRETTII 175 WY 3(3):96 on Senecio triangularis.
PHYLLOSTICTA MELANOCARPA 1376 UT 36(4):63 on Veratrum californicum.
PHYLLOSTICTA MINUTISSIMA 176 WY 3(3):96, 459 CO 15(1):14, 1371 MT 36 (4):62 on Acer glabrum; 690 UT 21(4):153 on A. grandidentata.
PHYLLOSTICTA PEDICULARIDIS 1160 WY 24(4):44 on Pedicularis paysoniana.
PHYLLOSTICTA PLATANOIDIS 460 CO 15(1):14, 461 NM 15(1):14 on Acer negundo.
PHYLLOSTICTA RAGNHILDAE 462 WY 15(1):14 on Antennaria pulcherrima.
PHYLLOSTICTA ROSICOLA 463 CO 15(1):15 on Rosa sp.
PHYLLOSTICTA SAXIFRAGARUM 177 WY 3(3):96 on Saxifraga arguta.
PHYLLOSTICTA SMILACINAE 464 CO 15(1):15 on Smilacina amplexicaulis.
PHYLLOSTICTA SOLIDAGINIS 178 WY 3(3):96 on Solidago canadensis; 465 CO 15(1):15 on S. petradoria.
PHYLLOSTICTA TETONENSIS 1364 WY 36(4):60 on Clematis hirsutissima.
PHYLLOSTICTA TROLLII 179 WY 3(3):96, 295 WY 7(3):41 on Trollius albiflorus.
PHYLLOSTICTA VIRGINIANA 467 NM 15(1):16 on Prunus sp.; 466 AZ 15(1):16 on P. virens.
PHYLLOSTICTA WYOMINGENSIS 180 WY 3(3):96 on Epilobium angustifolium.
PHYSALOSPORA ASTRAGALI 29 WY 1(8):223 on Astragalus bisulcatus.
PHYSODERMA MENYANTHIS 201 WY 7(3):29, 1301 CO 36(4):51 on Menyanthes trifoliata.
PHYSODERMA PLURIANNULATUM 1103 WY 24(4):35 on Angelica pinnata.
PILEOLARIA BREVIPES 1436 AZ 36(5):73 on Rhus radicans.
PILEOLARIA PATZCUARENSIS 524 NM 18(2):74 on Rhus trilobata.

PLASMOPARA GERANII 1113 WY 24(4):36, 1521 WY M8(2):387 on Geranium richardsonii.
PLASMOPARA HALSTEDII 4 WY 1(8):220 on Franseria discolor; 3 WY 1(8):220 on Helianthus annuus; 402 WY 15(1):1 on H. nuttallii.
PLASMOPARA PYGMAEA 1114 WY 24(4):36 on Aconitum columbianum.
PODOSPHAERA OXYACANTHAE 17 WY 1(8):221 on Prunus melanocarpa; 119 WY 3(3):90 on Spiraea lucida.
POLYPORUS ABIETINUS 366 CO 10(4):40 on wood.
POLYPORUS ADUSTUS 1553 WY M8(2):390 on Populus tremuloides.
POLYPORUS ALBOLUTEUS 367 CO 10(4):40 on Picea engelmannii.
POLYPORUS CIRCINATUS 368 CO 10(4):40, 681 CO 21(4):152 on ground.
POLYPORUS DICHROUS 1554 WY M8(2):390 on Pinus contorta.
POLYPORUS LEUCOSPONGIA 370 CO 10(4):40 on Picea engelmannii.
POLYPORUS OVINUS 369 CO 10(4):40 on ground.
POLYPORUS TOMENTOSUS 681 CO 21(4):52 on ground.
POLYSTIGMA ASTRAGALI 1136 WY 24(4):40 on Astragalus agrestis.
POLYTHRINCIUM TRIFOLII 97 WY 1(8):231 on Trifolium hybridum.
PSEUDOPEZIZA MEDICAGINIS 8 CO 1(8):220,1542 AZ M8(2):389 on Medicago sativa.
PSEUDOPEZIZA REPANDA 616 WY 21(4):144, 1328 WY 36(4):55 on Galium boreale.
PSEUDOPEZIZA RIBIS 405 WY 15(1):2 on Ribes cereum; 1133 WY 24(4):39 on R. inerme.
PSEUDOPLECTANIA NIGRELLA 1543 WY M8(2):389 on ground.
PUCCINIA ABERRANS 642 WY 21(4):147 on Smelowskia calycina.
PUCCINIA ABRUPTA 942 AZ 23(4):43, 1631 AZ M8(2):397 on Viguiera dentata.
PUCCINIA ABSINTHII 235 WY 7(3):33 on Artemisia aromatica; 234 WY 7(3):33 on A. cana; 525 AZ 18(2):74, 526 UT 18(2):74 on A. dracunculoides; 527 NM 18(2):74 on A. ludoviciana; 149 CO 3(3):93, 528 NM 18(2):74 on A. tridentata; 529 WY 10(2):74 on A. tripartita.
PUCCINIA ACROPHILA 1632 WY M8(2):397 on Syntheris pinnatifida.
PUCCINIA ADOXAE 1437 CO 36(5):73 on Adoxa moschatellina.
PUCCINIA AEMULANS 530 CO 18(2):74, 531 WY 18(2):74; 943 AZ 23(4):43, 944 AZ 23(4):43, 1034 WY 24(3):26 on Viguiera multiflora.
PUCCINIA ALLENII 43 WY 1(8):224 on Shepherdia canadensis.
PUCCINIA AMPHIGENA 643 WY 21(4):147 on Calamovilfa longifolia.
PUCCINIA ANDROPOGONIS 801 CO 23(3):23, 803 NM 23(3):24 on Andropogon hallii; 805 NM 23(3):24 on A. scoparius; 804 NM 23(3):24 on Penstemon alpinus; 802 NM 23(3):23 on Petalostemon purpureus.
PUCCINIA ANGUSTATA 1633 WY M8(2):397 on Mentha arvensis.
PUCCINIA ANISACANTHI 532 AZ 18(2):74 on Anisacanthus thurberi.
PUCCINIA APOCRYPTA 46 WY 1(8):224 on Hydrophyllum fendleri.
PUCCINIA ARISTIDAE 533 WY 18(2):74 on Distichlis spicata; 806 MT 23(3):24 on D. stricta; 236 WY 7(3):33 on Sarcobatus vermiculatus; 237 WY 7(3):33 on Triglochin maritima.
PUCCINIA ARNICALIS 1228 WY 36(3):41 on Arnica chamissonis; 320 WY 10(4):35, 731 CO 21(5):160 on A. cordifolia; 732 CO 21(5):160, 1438 WY 36(5):73 on A. mollis.
PUCCINIA ASTERIS 1229 WY 36(3):41 on Aster conspicuus; 733 MT 21(5):160 on A. falcatus; 44 WY 1(8):224 on A. glaucus; 1230 WY 36(3):41 on Erigeron elatior.
PUCCINIA ATRA 534 NM 18(2):75, 535 AZ 18(2):75 on Panicum bulbosum; 536 AZ 18(2):75 on Setaria grisebachii.
PUCCINIA ATROFUSCA 734 MT 21(5):160 on Artemisia dracunculoides; 537 MT 18(2):75, 945 AZ 23(4):44 on Carex douglasii; 736 MT 21(5):160 on

C. eleocharis; 735 WY 21(5):160, 1439 WY 36(5):73 on C. filifolia; 538 WY 18(2):75 on C. geyeri; 1231 WY 36(3):41 on C. hoodii; 946 CO 23(4):44 on C. rossii.

PUCCINIA BACCHARIDIS 1440 AZ 36(5):73 on Baccharis glutinosa.

PUCCINIA BALSAMORHIZAE 47 ID 1(8):225, 238 WY 7(3):33, 737 MT 21(5): 160 on Balsamorhiza sagittata; 738 CO 21(5):160 on Wyethia arizonica.

PUCCINIA BIPORULA 947 AZ 23(4):44, 948 AZ 23(4):44 on Salvia lemmonii.

PUCCINIA BISTORTAE 539 MT 18(2):75 on Bistorta bistortoides; 48 WY 1(8):225, 739 CO 21(5):160, 740 CO 21(5):160, 1035 WY 24(3):26 on Polygonum bistortoides; 239 WY 7(3):33 on P. viviparum.

PUCCINIA BLASDALEI 741 CO 21(5):161 on Allium cernuum; 1441 AZ 36(5): 73 on A. macropetalum.

PUCCINIA BRACHYPODII 1232 WY 36(3):41 on Deschampsia caespitosa; 1233 WY 36(3):41 on Phleum pratense; 1234 WY 36(3):41 on Poa alpina; 1235 WY 36(3):42, 1442 WY 36(5):74, 1634 CO M8(2):397 on P. interior; 1443 WY 36(5):74 on P. leptocoma; 1236 WY 36(3):42 on P. reflexa.

PUCCINIA CACABATA 1445 AZ 36(5):74 on Bouteloua aristidoides; 1446 AZ 36(5):74 on B. barbata; 1447 AZ 36(5):74 on B. rothrockii; 1444 AZ 36(5):74 on Gossypium hirsutum.

PUCCINIA CALANTICARIAE 1448 AZ 36(5):74 on Viguiera dentata.

PUCCINIA CALCITRAPAE 1237 WY 36(3):42 on Arctium minus; 1449 WY 36(5):74 on Cirsium centaureae; 1450 WY 36(5):74 on C. undulatum.

PUCCINIA CALOCHORTI 742 MT 21(5):161 on Calochortus apiculatus; 1635 WY M8(2):397 on C. gunnisonii.

PUCCINIA CANALICULATA 950 AZ 23(4):44 on Cyperus rusbyi; 949 AZ 23(4):44 on Heliopsis parvifolia.

PUCCINIA CARICINA 1239 UT 36(3):42 on Carex sp; 1637 WY M8(2):397 on C. aquatilis; 743 MT 21(5):161 on C. hepburnii; 1451 WY 36(5):75, 1638 WY M8(2):397 on C. nebraskensis; 644 WY 21(4):148, 952 CO 23 (4):45, 1038 ID 24(3):26, 1238 WY 36(3):42 on C. rostrata; 953 AZ 23(4):45 on C. senta; 1036 WY 24(3):26 on Ribes inerme; 1636 WY M8 (2):397 on R. setosum; 951 CO 23(4):44 on Urtica dioica; 1037 WY 24(3):26 on U. gracilis.

PUCCINIA CARICIS 540 WY 18(2):75 on Carex aquatilis; 150 WY 3(3):93 on C. rostrata; 321 WY 10(4):35 on Urtica gracilis.

PUCCINIA CARTHAMI 1452 AZ 36(5):75 on Carthamus tinctorius.

PUCCINIA CICUTAE 954 AZ 23(4):45 on Cicuta douglasii; 49 WY 1(8):225 on C. occidentalis.

PUCCINIA CIRSII 322 WY 10(4):35 on Cirsium americanum; 955 23(4):45 on C. arizonicum; 1240 WY 36(3):42 on C. canescens; 744 MT 21(5): 161 on C. edule; 151 WY 3(3):93 on C. engelmannii; 645 WY 21(4):148 on C. foliosum; 956 AZ 23(4):45 on C. nidulum; 745 MT 21(5):161 on C. undulatum.

PUCCINIA CLAYTONIICOLA 541 WY 18(2):75 on Claytonia lanceolata.

PUCCINIA CLEMATIDIS 50 WY 1(8):225 on Thalictrum occidentale.

PUCCINIA CLINTONII 1241 BC 36(3):42 on Pedicularis bracteosa; 746 CO 21(5):161 on P. groenlandica; 240 WY 7(3):33, 1039 WY 24(3):26 on P. paysoniana.

PUCCINIA CNICI 542 UT 18(2):76 on Cirsium scariosum.

PUCCINIA CONFERTA 152 WY 3(3):94 on Artemisia ludoviciana.

PUCCINIA CONOCLINII 1639 AZ M8(2):398 on Eupatorium pycnocephalum.

PUCCINIA CONSIMILIS 52 WY 1(8):225 on Schoenocrambe linifolia.

PUCCINIA CONSPICUA 808 AZ 21(3):24 on Agrostis scabra; 807 AZ 21(3):24 on Helenium hoopesii.

PUCCINIA CORONATA 1245 WY 36(3):43, 647 WY 21(4):148 on Agropyron trachycaulum; 544 UT 18(2):76, 648 WY 21(4):148, 813 MT 23(3):25

on Agrostis alba; 1248 WY 36(3):43 on Bromus anomalus; 545 WY 18(2):76 on B. ciliatus; 649 WY 21(4):148 on B. porteri; 546 MT 18(2):76 on Calamagrostis sp.; 547 WY 18(2):76, 810 MT 23(3):25, 1041 WY 24(3):27, 1042 WY 24(3):27 on C. canadensis; 548 WY 18(2):76 on C. inexpansa; 812 MT 23(3):25, 1044 WY 24(3):27, 1243 WY 36(3):42, 1247 WY 36(3):43, 1453 WY 36(5):75 on C. rubescens; 650 WY 21(4):148 on Deschampsia caespitosa; 1242 WY 36(3):42, 1244 WY 36(3):43, 1246 WY 36(3):43 on Elaeagnus canadensis; 814 AZ 23(3):25 on Holcus lanatus; 241 WY 7(3):33 on Koeleria cristata; 549 WY 18(2):76 on Phalaris arundinacea; 809 WY 23(3):24, 1040 WY 24(3):26 on Rhamnus alnifolia; 543 MT 18(2):76, 646 WY 21(4):148, 811 MT 23(3):25, 1043 WY 24(3):27 on Shepherdia canadensis.

PUCCINIA CRANDALLII 818 MT 23(3):26 on Festuca idahoensis; 824 MT 23(3):27 on F. ovina; 820 MT 23(3):26 on F. scabrella; 816 CO 23(3):26, 1250 WY 36(3):43, 1252 WY 36(3):44, 1454 WY 36(5):75 on Hesperochloa kingii; 822 AZ 23(3):25, 957 CO 23(4):45, 1642 AZ M8(2):398 on Poa fendleriana; 823 AZ 23(3):27 on Poa longiligula; 815 CO 23(3):25, 1640 MT M8(2):398, 1641 WY M8(2):398 on Symphoricarpos albus; 242 WY 7(3):33, 817 MT 23(3):26, 819 MT 36(3):43, 1249 WY 36(3):43, 1251 WY 36(3):44 on S. occidentalis; 821 AZ 23(3):26 on S. oreophilus; 243 WY 7(3):34 on S. racemosus; 651 WY 21(4):148, 1045 WY 24(3):27 on S. vaccinioides.

PUCCINIA CREPIDIS-MONTANAE 550 WY 18(2):77 on Crepis glauca; 747 MT 21(5):161 on C. runcinata.

PUCCINIA CRUCIFERARUM 652 WY 21(4):148 on Cardamine cordifolia.

PUCCINIA DESCHAMPSIAE 825 CO 23(3):27 on Deschampsia caespitosa.

PUCCINIA DIOICAE 958 MT 23(4):45, 1046 WY 24(3):27, 1047 WY 24(3):27 1253 WY 36(3):44, 1455 WY 36(5):75 on Agoseris glauca; 960 AZ 23(4); 46 on Artemisia carruthii; 748 MT 21(5):161, 1456 WY 36(5):75, 1643 WY M8(2):398 on Aster foliaceus; 1050 ID 24(3):27 on Carex eastwoodii; 959 MT 23(4):46 on C. filifolia; 1051 WY 24(3):28 on C. hoodii; 1255 WY 36(3):44 on C. petasata; 963 AZ 23(4):46 on C. praegracilis; 961 AZ 23(4):46 on C. rusbyi; 1254 WY 36(3):44 on C. vernacula; 1457 CO 36(5):75 on Erigeron speciosus; 1048 WY 24(3):27 on Hieracium cusickii; 964 CO 23(4):46 on Oenothera caespitosa; 749 MT 21(5):161, 962 AZ 23(4):46 on Solidago missouriensis; 965 CO 23(4):46, 1458 WY 36(5):75 on Valeriana edulis; 1049 WY 24(3):27 on V. occidentalis.

PUCCINIA DISTORTA 1644 AZ M8(2):398 on Hyptis emoryi.

PUCCINIA DOUGLASII 244 WY 7(3):34 on Phlox glabrata.

PUCCINIA DRABAE 1256 WY 36(3):44 on Draba incerta.

PUCCINIA DURANGENSIS 1645 AZ M8(2):398 on Stipa pringlei.

PUCCINIA ELLISII 1459 WY 36(5):75 on Angelica arguta.

PUCCINIA ENCELIAE 1646 CO M8(2):398 on Viguiera multiflora.

PUCCINIA ERIOPHYLLI 1052 ID 24(3):28 on Eriophyllum lanatum.

PUCCINIA EVADENS 551 AZ 18(2):77 on Baccharis sarothroides.

PUCCINIA EXPANSA 1257 WY 36(3):44 on Senecio integerrimus.

PUCCINIA EXTENSICOLA 247 WY 7(3):34 on Agoseris glauca; 245 WY 7(3):34 on Aster sp.; 552 ID 18(2):77 on A. foliaceus; 323 WY 10(4):36 on A. frondeus; 324 WY 10(4):36 on Carex sp.; 248 WY 7(3):34 on C. festivella; 553 WY 18(2):77 on C. geyeri; 554 ID 18(2):77 on C. gravida; 246 WY 7(3):34 on Erigeron salsuginosus.

PUCCINIA FRANSERIAE 1649 AZ M8(2):398 on Ambrosia deltoidea; 1460 AZ 36(5):76, 1461 AZ 36(5):76 on Franseria deltoidea; 1647 AZ M8(2):398 on Hymenoclea monogyra; 1648 AZ M8(2):398 on H. pentalepis.

PUCCINIA FRASERI 1650 MT M8(2):398 on Hieracium albiflorum.

PUCCINIA GAYOPHYTI 249 WY 7(3):34 on Gayophytum racemosum; 250 MT

7(3):34 on G. ramosissimum.
PUCCINIA GENTIANAE 53 NM 1(8):225 on Gentiana affinis; 251 WY 7(3):34, 653 CO 21(4):149 on G. bigelovii; 750 CO 21(5):161 on G. parryi
PUCCINIA GIGANTISPORA 555 WY 18(2):77, 966 CO 23(4):47, 1053 WY 24 (3):28 on Anemone globosa; 1651 WY M8(2):398 on A. multifida.
PUCCINIA GLOBOSIPES 1462 AZ 36(5):75 on Lycium berlandieri; 556 AZ 18(2):77 on L. californicum; 1463 AZ 36(5):75 on L. exsertum; 1652 AZ M8(2):398 on L. fremontii.
PUCCINIA GRAMINIS 654 WY 21(4):149 on Agropyron smithii; 252 WY 7(3): 35 on A. subsecundum; 655 WY 21(4):149 on A. trachycaulum; 1653 MT M8(2):399 on Phleum pratense.
PUCCINIA GRANULISPORA 751 MT 21(5):161 on Allium cernuum.
PUCCINIA GRINDELIAE 1654 AZ M8(2):398 on Baileya multiradiata; 967 AZ 23(4):47 on Chrysopsis villosa; 557 CO 18(2):77, 558 NM 18(2):77, 752 MT 21(5):162 on Chrysothamnus nauseosus; 1258 WY 36(3):45 on C. viscidiflorus; 753 CO 21(5):162 on Erigeron caespitosus; 1656 WY M8(2):399 on E. eatonii; 1657 WY M8(2):399 on E. nematophyllus; 253 UT 7(3):35 on Grindelia sp.; 754 NM 21(5):162 on G. squarrosa; 1658 WY M8(2):399 on Gutierrezia sarothrae; 1655 AZ M8(2):399 on Haplopappus spinulosa; 1659 AZ M8(2):399 on Psilostrophe cooperi; 1259 WY 36(3):45 on Solidago elongata; 1260 WY 36(3):45 on S. multiradiata; 559 CO 18(2):77 on S. petradoria; 325 WY 10(4):31 on Stenotus acaulis; 54 WY 1(8):225 on Xylorrhiza glabriuscula; 55 WY 1(8):225, 1464 WY 36(5):75 on X. parryi.
PUCCINIA GROSSULARIAE 153 WY 3(3):94 on Carex variabilis; 154 WY 3(3): 94 on Ribes saxosum.
PUCCINIA GRUMOSA 155 WY 3(3):94 on Zygadenus elegans; 560 WY 18(2):78, 755 CO 21(5):162 on Z. gramineus.
PUCCINIA GUILLEMINEAE 968 AZ 23(4):47 on Brayulinea densa.
PUCCINIA HALENIAE 1261 WY 36(3):45 on Gentiana calycosa.
PUCCINIA HARKNESSII 326 AZ 10(4):36 on Ptiloria runcinata; 561 UT 18(2):78 on Stephanomeria tenuifolia.
PUCCINIA HELIANTHI 56 WY 1(8):226 on Helianthus annuus; 156 WY 3(3):94 on H. fascicularis.
PUCCINIA HELIANTHELLAE 1262 WY 36(3):45, 1660 WY M8(2):399 on Helianthella quinquenervis; 254 WY 7(3):35 on H. uniflora.
PUCCINIA HETEROSPORA 1465 AZ 36(5):75 on Abutilon californicum; 1466 AZ 36(5):76 on Bogenhardia crispa.
PUCCINIA HEUCHERAE 757 CO 21(5):162 on Heuchera bracteata; 157 WY 3(3):94, 756 CO 21(5):162, 1054 WY 24(3):28, 1263 WY 36(3):45 on Mitella pentandra; 1056 WY 24(3):28 on M. stauropetala; 158 WY 3(3): 94, 1055 WY 24(3):28, 1661 WY M8(2):399 on Saxifraga arguta; 758 MT 21(5):162 on S. lyallii; 759 MT 21(5):162 on S. rhomboidea.
PUCCINIA HIERACII 562 WY 18(2):78, 760 CO 21(5):162, 1089 WY 24(3):32, 1264 WY 36(3):45 on Agoseris glauca; 58 UT 1(8):226 on A. parviflora; 1662 CO M8(2):399 on Crepis acuminata; 761 MT 21(5):163 on Hieracium albertinum; 1467 WY 36(5):76 on H. albiflorum; 1663 WY M8(2):399 on Lygodesmia juncea; 57 CO 1(8):226, 159 WY 3(3):94, 563 ID 18(2):78, 1057 WY 24(3):28, 1468 MT 24(3):28 on Taraxacum officinale; 762 MT 21(5):163 on T. vulgare.
PUCCINIA HOLBOELLII 255 WY 7(3):35 on Arabis lignipes; 59 CO 1(8):226, 160 WY 3(3):94 on Schoenocrambe linifolia.
PUCCINIA HYDROPHYLLI 1265 UT 36(3):45 on Hydrophyllum fendleri; 1664 WY M8(2):399 on Mertensia ciliata.
PUCCINIA INANIPES 1665 AZ M8(2):399 on Eupatorium solidaginifolium.
PUCCINIA INTERMIXTA 60 WY 1(8):226, 1469 ID 36(5):77 on Iva axillaris.

PUCCINIA IRIDIS 564 CO 18(2):78, 1470 AZ 36(5):77 on Iris missouriensis; 256 WY 7(3):35 on I. pelogonus.
PUCCINIA JONESII 763 MT 21(5):163 on Leptotaenia multifida; 257 WY 7(3):35 on Ligusticum simulans; 1266 WY 36(3):45 on Lomatium dissectum.
PUCCINIA KOELERIAE 1058 WY 24(3):28 on Berberis repens.
PUCCINIA KUHNIAE 1471 AZ 36(5):77 on Brickellia amplexicaulis; 565 AZ 18(2):78, 969 AZ 23(4):47 on B. lemmonii; 566 AZ 18(2):78 on Kuhnia rosmarinifolia.
PUCCINIA LASCHII 1666 AZ M8(2):399 on Cirsium sp.
PUCCINIA LEVEILLEI 258 WY 7(3):35 on Geranium fremontii.
PUCCINIA LIATRIDIS 826 AZ 23(3):27 on Brickellia grandiflora; 827 AZ 23(3):27 on Koeleria cristata.
PUCCINIA LIGUSTICI 1267 UT 36(3):46 on Angelica pinnata; 259 WY 7(3): 35 on Conioselinum scopulorum; 260 WY 7(3):35 on Ligusticum simulans; 1667 CO M8(2):399 on Oxypolis fendleri.
PUCCINIA MCCLATCHIEANA 45 WY 1(8):224 on Scirpus microcarpus.
PUCCINIA MALVACEARUM 261 WY 7(3):36 on Althaea rosea; 161 WY 3(3):94 on Malva rotundifolia.
PUCCINIA MENTHAE 62 WY 1(8):226 on Mentha canadensis; 971 AZ 23(4):47 on M. spicata; 656 WY 21(4):149 on Monarda fistulosa; 61 CO 1(8):226, 567 NM 18(2):78, 764 MT 21(5):163, 970 AZ 23(4):47 on M. menthaefolia.
PUCCINIA MESOMAJALIS 765 MT 21(5):163 on Clintonia uniflora.
PUCCINIA MICRANTHA 828 CO 23(3):27 on Oryzopsis micrantha.
PUCCINIA MILLEFOLII 657 WY 21(4):149 on Achillea millefolium; 262 NM 7(3):36 on Artemisia dracunculoides, 51 WY 1(8):225 on A. gnaphalodes.
PUCCINIA MINUSSENSIS 766 MT 21(5):163, 1059 WY 24(3):29, 1060 WY 24(3):29, 1472 WY 36(5):77, 1668 WY M8(2):399 on Lactuca pulchella.
PUCCINIA MONOICA 327 CO 10(4):36 on Arabis sp.; 328 WY 10(4):36 on A. drummondii; 830 MT 23(3):28, 1061 WY 24(3):29 on A. holboellii; 831 MT 23(3):28, 832 CO 23(3):28 on Koeleria cristata; 833 AZ 23(3): 28 on Oryzopsis hymenoides; 1268 WY 36(3):46 on Poa secunda; 63 WY 1(8):226 on Schoenocrambe linifolia; 1669 CO M8(2):399 on Thlaspi montanum; 829 CO 23(3):27 on Trisetum spicatum.
PUCCINIA MONTANENSIS 1473 WY 36(5):77 on Agropyron smithii; 1270 WY 36(3):46 on A. spicatum; 659 WY 21(4):149, 658 WY 21(4):149 on A. trachycaulum; 1269 WY 36(3):46 on Berberis repens; 834 AZ 23(3):28 on Sitanion hystrix.
PUCCINIA MUSENII 1271 WY 36(3):46 on Lomatium montanum.
PUCCINIA MUTABILIS 767 MT 21(5):163 on Allium rubrum.
PUCCINIA NEOCORONATA 835 AZ 23(3):28 on Piptochaetium fimbriatum.
PUCCINIA NODOSA 1474 AZ 36(5):77 on Dichelostemma pulchellum.
PUCCINIA OBTECTA 64 WY 1(8):226 on Scirpus americanus.
PUCCINIA OENOTHERAE 1670 AZ M8(2):399 on Camissonia californica; 1062 WY 24(3):29 on Oenothera heterantha.
PUCCINIA PALLIDISSIMA 1671 AZ M8(2):400 on Stachys coccinea.
PUCCINIA PALMERI 568 ID 18(2):78 on Penstemon sp.; 768 MT 21(5):163 on P. confertus; 769 MT 21(5):163 on P. ellipticus; 1272 WY 36(3): 46, 1063 WY 24(3):29 on P. procerus.
PUCCINIA PARKERAE 770 MT 21(5):163 on Ribes lacustre.
PUCCINIA PARNASSIAE 771 MT 21(5):163 on Parnassia fimbriata.
PUCCINIA PATTERSONIANA 569 MT 18(2):79 on Agropyron spicatum.
PUCCINIA PENTSTEMONIS 972 AZ 23(4):47 on Penstemon bridgesii; 263 AZ 7(3):36 on P. connatifolius; 1273 WY 36(3):46 on P. deustus;

1672 AZ M8(2):400 on P. pinifolius.
PUCCINIA PIMPINELLAE 264 WY 7(3):36, 1064 WY 24(3):29 on Osmorhiza obtusa; 1065 WY 24(3):29 on O. occidentalis.
PUCCINIA PLUMBARIA 329 ID 10(4):36, 1066 WY 24(3):29 on Phlox longifolia; 265 WY 7(3):36 on P. multiflora.
PUCCINIA POAE-NEMORALIS 1067 WY 24(3):29 on Catabrosa aquatica; 836 AZ 23(3):28 on Festuca ovina; 1068 WY 24(3):29 on Phleum pratense; 837 CO 23(3):29 on Poa interior; 838 CO 23(3):29 on P. leptocoma; 1069 WY 24(3):30 on P. palustris; 839 AZ 23(3):29 on P. pratensis; 840 CO 23(3):29 on P. reflexa.
PUCCINIA POAE-SUDETICAE 570 WY 18(2):79 on Poa palustris.
PUCCINIA POARUM 1673 UT M8(2):400 on Helenium hoopesii.
PUCCINIA POCULIFORME 66 CO 1(8):227 on Agropyron tenerum; 65 CO 1(8):226 on Avena fatua.
PUCCINIA POLYGONI-AMPHIBII 162 WY 3(3):94 on Polygonum sp.
PUCCINIA PORPHYROGENITA 571 MT 18(2):79 on Cornus canadensis.
PUCCINIA PSEUDOCYMOPTERI 266 WY 7(3):36, 572 CO 18(2):79, 973 AZ 23(4):47 on Pseudocymopterus montanus; 330 WY 10(4):36 on P. sylvaticus.
PUCCINIA PULVERULENTA 1070 WY 24(3):30, 1071 WY 24(3):30 on Epilobium paniculatum; 772 CO 21(5):164, 1072 WY 24(3):30 on Gayophytum nuttallii; 974 AZ 23(4):48 on G. racemosum; 975 AZ 23(4):48 on G. ramosissimum.
PUCCINIA PUNCTATA 773 MT 21(5):164 on Galium triflorum.
PUCCINIA PUNCTIFORMIS 660 WY 21(4):149, 774 MT 21(5):164, 1674 WY M8(2):400 on Cirsium arvense.
PUCCINIA PYGMAEA 841 CO 23(3):29 on Berberis repens; 842 CO 23(3):29; 843 AZ 23(3):29 on Koeleria cristata.
PUCCINIA RECONDITA 1082 WY 24(3):31 on Agropyron albicans; 855 AZ 23(3):31 on A. arizonicum; 850 MT 23(3):30 on A. dasystachyum; 1279 WY 36(3):47 on A. griffithsii; 1477 WY 36(5):77 on A. inerme; 856 CO 23(3):31 on A. pseudorepens; 849 MT 23(3):30, 1281 WY 36(3):48, 1678 CO M8(2):400 on A. spicatum; 662 UT 21(4):150, 845 CO 23(3):30, 847 CO 23(3):30, 852 CO 23(3):31, 854 CO 23(3):31, 857 AZ 23(3):31, 1083 WY 24(3):31 on A. trachycaulum; 976 CO 23(4):48 on Anemone cylindrica; 844 CO 23(3):29, 1073 WY 23(3):30, 1074 WY 24(3):30, 1274 WY 36(3):46 on Aquilegia coerulea; 977 MT 23(4):48, 1075 ID 24(3):30 on A. formosa; 1248 WY 36(3):43 on Bromus anomalus; 859 CO 23(3):31, 860 CO 23(3):32, 861 AZ 23(3):32, 862 AZ 23(3):32, 1084 WY 24(3):31, 1280 WY 36(3):47 on B. ciliatus; 863 AZ 23(3):32, 864 AZ 23(3):32 on B. frondosus; 1085 WY 24(3):31 on B. marginatus; 865 CO 23(3):32 on B. polyanthus; 846 CO 23(3):30, 1076 WY 24(3):30 on Clematis hirsutissima; 848 MT 23(3):30, 866 MT 23(3):32, 868 CO 23(3):32, 1675 CO M8(2):400 on C. ligusticifolia; 1676 CO M8(2):400 on Delphinium sp.; 851 CO 23(3):30 on D. geyeri; 1077 WY 24(3):30, 1078 ID 24(3):30 on D. occidentale; 878 CO 23(3):34 on Elymus canadensis; 663 WY 21(4):150, 867 MT 23(3):32, 869 CO 23(3):33 on E. cinereus; 871 CO 23(3):33, 873 CO 23(3):33, 875 CO 23(3):33, 877 MT 23(3):34, 1086 WY 24(3):31, 1276 WY 36(3):47, 1278 WY 36(3):47 on E. glaucus; 880 CO 23(3):34 on Festuca thurberi; 1079 WY 24(3):31, 1475 UT 36(5):77, 1677 WY M8(2):400 on Hydrophyllum capitatum; 853 CO 23(3):31, 870 CO 23(3):33 on H. fendleri; 1080 WY 24(3):31 on Phacelia heterophylla; 881 AZ 23(3):34 on Sitanion hystrix; 661 UT 21(4):150, 858 CO 23(3):31, 872 CO 23(3):33, 879 CO 23(3):34, 978 AZ 23(4):48, 1476 ID 36(5):77 on Thalictrum fendleri;

874 CO 23(3):33, 976 MT 23(3):34, 1081 WY 24(3):31, 1275 WY 36(3): 47, 1277 WY 36(3):47 on T. occidentale; 882 CO 23(3):34, 979 WY 23(4):48, 1087 WY 24(3):32 on Trisetum spicatum.

PUCCINIA REDFIELDIAE 883 CO 23(3):35 on Oenothera nuttallii; 884 CO 23(3):35 on Redfieldia flexuosa.

PUCCINIA RETECTA 775 CO 21(5):164, 1282 CO 36(3):48, 1283 WY 36(3):48 on Anemone zephyra.

PUCCINIA RUBEFACIENS 776 CO 21(5):164, 777 MT 21(5):164, 1284 WY 36(3):48, 1285 WY 36(3):48 on Galium boreale.

PUCCINIA RUBELLA 163 WY 3(3):95 on Phragmites communis.

PUCCINIA RUBIGO-VERA 574 WY 18(2):79 on Agropyron subsecundum; 575 CO 18(2):79 on A. trachycaulum; 267 WY 7(3):36 on Aquilegia coerulea; 576 WY 18(2):79 on Bromus carinatus; 333 WY 10(4):37, 577 AZ 18(2): 79 on B. ciliatus; 268 WY 7(3):36 on Clematis ligusticifolia; 331 WY 10(4):36 on Delphinium geyeri; 578 ID 18(2):79 on Elymus condensatus; 270 WY 7(3):36, 579 CO 18(2):80 on E. glaucus; 573 WY 18(2): 79 on Phacelia leucophylla; 332 WY 10(4):36 on Ranunculus cymbalaria; 580 CO 18(2):80 on Sitanion hystrix; 269 WY 7(3):36 on Thalictrum occidentale; 581 WY 18(2):80 on Trisetum spicatum.

PUCCINIA RUFESCENS 1478 AZ 36(5):78 on Pedicularis centranthera.

PUCCINIA SARCOBATI 67 WY 1(8):227 on Distichlis spicata.

PUCCINIA SCABER 582 CO 18(2):80 on Stipa robusta;

PUCCINIA SCHEDONNARDI 583 AZ 18(2):80, 885 AZ 23(3):35 on Lycurus phleoides; 584 NM 18(2):80 on Muhlenbergia asperifolia; 886 CO 23 (3):35 on M. montana; 980 CO 23(4):48 on Sphaeralcea coccinea.

PUCCINIA SENECIONIS 1679 CO on Senecio crassulus.

PUCCINIA SHERARDIANA 1286 WY 36(3):48 on Althaea rosea; 271 WY 7(3):37 on Malvastrum coccineum; 1479 AZ 36(5):78 on Sphaeralcea angustifolia; 981 NM 23(4):48 on S. coccinea; 1481 AZ 36(5):79 on S. coulteri; 585 NM 18(2):80, 1480 AZ 36(5):78 on S. emoryi; 982 AZ 23(4):48 on S. fendleri; 1482 AZ 36(5):78 on S. laxa; 68 NM 1(8): 227 on S. lobata; 586 AZ 18(2):80 on S. marginata.

PUCCINIA SPARGANIOIDES 1483 WY 36(5):78 on Spartina pectinata.

PUCCINIA SPLENDENS 587 NV 18(2):80 on Hymenoclea fasciculata; 588 AZ 18(2):81, 1484 AZ 36(5):78 on H. monogyra.

PUCCINIA SPOROBOLI 887 CO 23(3):35 on Calamovilfa longifolia.

PUCCINIA STIPAE 889 MT 23(3):36 on Chrysopsis villosa; 1680 WY M8(2): 400 on Chrysothamnus visidiflorus; 888 MT 23(3):35 on Erigeron corymbosus; 891 CO 23(3):36 on Gutierrezia sarothrae; 334 WY 10(4): 37 on Senecio integerrimus; 272 WY 7(3):37 on S. perplexus; 893 AZ 23(3):36 on Solidago nana; 273 WY 7(3):37, 890 MT 23(3):36, 892 CO 23(3):36, 894 AZ 23(3):36, 1088 WY 24(3):32 on Stipa comata; 589 AZ 18(2):81 on S. pringlei.

PUCCINIA SUBCIRCINATA 335 WY 10(4):37, 983 CO 23(4):48 on Senecio crassulus.

PUCCINIA SUBDECORA 1681 WY M8(2):400 on Brickellia grandiflora.

PUCCINIA SUBNITENS 164 CO 3(3):95 on Plantago eriopoda.

PUCCINIA SUBSTERILIS 895 CO 23(3):36, 1287 WY 36(3):48 on Oryzopsis hymenoides; 664 WY 21(4):150 on Stipa columbiana; 896 AZ 23(3):36, 897 CO 23(3):37 on S. lettermanii; 984 NM 23(4):49 on S. scribneri; 898 CO 23(3):37 on S. viridula.

PUCCINIA SUKSDORFII 274 WY 7(3):37, 778 CO 21(5):164, 779 MT 21(5): 164, 1089 WY 24(3):32 on Agoseris glauca.

PUCCINIA SWERTIAE 780 CO 21(5):165 on Swertia perennis.

PUCCINIA SYMPHORICARPI 590 MT 18(2):81 on Symphoricarpos albus; 781 MT 21(5):165 on S. occidentalis.

PUCCINIA TANACETI 1486 WY 36(5):78, 1487 WY 36(5):78 on Artemisia cana; 782 CO 21(5):165, 985 AZ 23(4):49 on A. dracunculoides; 665 WY 21(4):150 on A. dracunculus; 666 WY 21(4):150 on A. ludoviciana; 667 UT 21(4):150, 668 CO 21(4):150, 783 MT 21(5):165, 986 AZ 23(4): 49, 1485 ID 36(5):78 on A. tridentata.
PUCCINIA TETRAMERII 1682 AZ M8(2):400 on Tetramerium hispidum.
PUCCINIA THLASPEOS 1288 WY 36(3):48 on Arabis drummondii; 784 MT 21 (5):165, 1090 WY 24(3):32, 1289 WY 36(3):48 on A. holboellii; 1091 WY 24(3):32 on A. lignifera; 785 MT 21(5):165 on A. lyallii; 786 MT 21(5):165 on A. microphylla.
PUCCINIA TRELEASIANA 787 CO 21(5):165, 1290 WY 36(3):48 on Caltha leptosepala.
PUCCINIA TUMIDIPES 591 CO 18(2):81, 1488 AZ 36(5):79 on Lycium pallidum.
PUCCINIA URTICATA 275 WY 7(3):37 on Carex nebraskensis; 276 WY 7(3): 37 on C. rostrata.
PUCCINIA VAGANS 1489 WY 36(5):79 on Epilobium paniculatum.
PUCCINIA VERATRI 788 MT 21(5):165 on Epilobium alpinum; 1683 CO M8(2):400 on Veratrum californicum.
PUCCINIA VERSICOLOR 1490 AZ 36(5):79 on Heteropogon contortus.
PUCCINIA VERTISEPTA 277 AZ 7(3):37 on Salvia pinguifolia.
PUCCINIA VEXANS 592 AZ 18(2):81, 900 AZ 23(3):37 on Bouteloua curtipendula; 899 AZ 23(3):37 on Fouquieria splendens.
PUCCINIA VIOLAE 789 CO 21(5):165 on Viola sp.; 593 NM 18(2):81, 1291 UT 36(3):49 on V. canadensis; 165 WY 3(3):95 on V. rydbergii.
PUCCINIA WULFENIAE 1292 WY 36(3):49 on Veronica wormskjoldii.
PUCCINIA XANTHII 1684 AZ M8(2):400 on Ambrosia confertifolia; 1685 AZ M8(2):400 on A. psilostachya; 69 WY 1(8):227 on Xanthium echinatum.
PUCCINIASTRUM EPILOBII 1211 WY 36(3):39 on Abies lasiocarpa; 1417 WY 36(5):71 on Epilobium sp.; 1614 WY M8(2):396 on E. adenocaulon; 1212 WY 36(7):39, 1418 WY 36(5):71, 1419 AT 36(5):71 on E. angustifolium; 1213 WY 36(3):39 on E. glandulosum; 1018 WY 24(3):24, 1019 ID 24(3):24 on E. hornemannii.
PUCCINIASTRUM GOEPPERTIANUM 223 WY 7(3):32, 1020 WY 24(3):24, 1214 WY 36(3):39, 1420 ID 36(5):71 on Abies lasiocarpa; 634 CO 21(4):146 on Vaccinium sp.; 1615 WY M8(2):396 on V. caespitosum; 224 WY 7(3): 32, 511 ID 18(2):72, 1421 ID 36(5):71 on V. membranaceum; 134 WY 3(3):92, 635 UT 21(4):147, 1021 WY 24(3):24, 1215 WY 36(3):39 on V. scoparium.
PUCCINIASTRUM MYRTILLI 225 WY 7(3):32 on Vaccinium membranaceum; 135 WY 3(3):92 on V. oreophilum; 512 WY 18(2):72 on V. scoparium.
PUCCINIASTRUM PUSTULATUM 136 WY 3(3):92 on Epilobium adenocaulon.
PUCCINIASTRUM PYROLAE 708 MT 21(5):157 on Chimaphila umbellata; 226 WY 7(3):32 on Pyrola secunda; 1616 WY M8(2):396 on P. virens.
PUCCINIASTRUM VACCINII 1422 WY 36(5):71 on Vaccinium caespitosum; 709 MT 21(5):157 on V. membranaceum; 1216 WY 36(3):39 on V. scoparium.
PYRENOPHORA PHAEOSPORA 127 WY 3(3):91 on Arenaria sajanensis.
RAMULARIA ACTAEAE 1172 WY 24(4):47 on Actaea arguta.
RAMULARIA ADOXAE 1590 CO M8(2):393 on Adoxa moschatellina.
RAMULARIA ANGELICAE 1173 WY 24(4):47, 1384 WY 36(4):65 on Angelica arguta.
RAMULARIA ARVENSIS 396 WY 10(4):45, 694 CO 21(4):154 on Potentilla arguta; 94 WY 1(8):231 on P. gracilis; 1591 WY M8(2):393 on P. norvegica; 1174 WY 24(4):47 on P. pulcherrima.
RAMULARIA ASTERIS 1175 WY 24(4):47, 1176 WY 24(4):47 on Aster folia-

ceus; 298 WY 7(3):42 on A. fremontii.
RAMULARIA CASTILLEJAE 1177 WY 24(4):47 on Castilleja miniata.
RAMULARIA CERCOSPOROIDES 194 WY 3(3):99 on Epilobium angustifolium.
RAMULARIA DECIPIENS 95 WY 1(8):231 on Rumex sp.; 299 WY 7(3):42 on R. venosus.
RAMULARIA GAYOPHYTI 1178 WY 24(4):48 on Gayophytum diffusum.
RAMULARIA GEI 495 WY 15(1):25 on Geum macrophyllum.
RAMULARIA HELIANTHI 1385 WY 36(4):65 on Helianthella quinquenervis.
RAMULARIA HERACLEI 195 WY 3(3):99, 300 WY 7(3):42 on Heracleum lanatum.
RAMULARIA IONOPHILA 397 WY 10(4):45 on Viola linguaefolia; 1592 UT M8(2):393, 1593 ID M8(2):393 on V. nuttallii; 1386 WY 36(4):65 on V. vallicola.
RAMULARIA LONICERAE 695 WY 21(4):154 on Lonicera utahensis.
RAMULARIA LOPHANTHI 696 WY 21(4):154, 697 ID 21(4):154 on Agastache urticifolia.
RAMULARIA MENTHICOLA 1179 WY 24(4):48, 1362 WY 36(4):6, 1595 ID M8(2):393 on Mentha arvensis; 398 WY 10(4):45 on M. canadensis.
RAMULARIA NIVOSA 1387 ID 36(4):65 on Penstemon sp.
RAMULARIA OBDUCENS 1180 WY 24(4):48 on Pedicularis paysoniana.
RAMULARIA PHACELIAE 496 WY 15(1):26 on Phacelia leucophylla.
RAMULARIA PRUINOSA 698 WY 21(4):154 on Senecio rapifolius; 1388 WY 36(4):66 on S. serra; 96 WY 1(8):231 on S. triangularis.
RAMULARIA PUNCTIFORMIS 1181 WY 24(4):48-50 on Epilobium adenocaulon; 1389 WY 36(4):66, 1390 UT 36(4):66, 1594 ID M8(2):393 on E. angustifolium.
RAMULARIA RUDBECKIAE 196 WY 3(3):99 on Rudbeckia laciniata; 1182 WY 24(4):50 on R. occidentalis.
RAMULARIA SAXIMONTANENSIS 399 WY 10(4):45, 1183 WY 24(4):50 on Clematis columbiana.
RAMULARIA SENECIONIS 1184 WY 24(4):50 on Senecio hydrophiloides; 1185 WY 24(4):50 on S. integerrimus.
RAMULARIA SEROTINA 1596 WY M8(2):393 on Solidago canadensis; 699 WY 21(4):154, 1186 WY 24(4):50 on S. lepida; 1391 WY 36(4):66 on S. missouriensis; 197 WY 3(3):99 on S. serotina.
RAMULARIA SHELDONII 1187 WY 24(4):51, 1597 ID M8(2):393 on Delphinium occidentale.
RAMULARIA SILVESTRIS 1598 UT M8(2):394 on Dipsacus silvestris.
RAMULARIA SMILACINAE 400 WY 10(4):46 on Smilacina amplexicaulis.
RAMULARIA TARAXACI 497 CO 15(1):26, 1188 WY 24(4):51 on Taraxacum officinale.
RAMULARIA TRIFOLII 1189 WY 24(4):51 on Trifolium longipes; 1392 WY 36(4):66 on T. rydbergii.
RAVENELIA CASSIAE-COVESII 1491 AZ 36(5):79 on Cassia covesii.
RAVENELIA INDIGOFERAE 1492 AZ 36(5):79 on Indigofera sphaerocarpa.
RAVENELIA RETICULATAE 1686 AZ M8(2):400 on Calliandra reticulata.

RAVENELIA VERSATILIS 1493 AZ 36(5):79 on Acacia greggii.
RHABDOCLINE PSEUDOTSUGAE 1135 ID 24(4):40 on Pseudotsuga taxifolia.
RHABDOGLOEUM PSEUDOTSUGAE 1379 WY 36(4):64 on Pseudotsuga menziesii.
RHYTISMA PUNCTATUM 618 UT 21(4):145 on Acer grandidentatum.
RHYTISMA SALICINUM 1342 ID 36(4):57 on Salix sp.; 1204 WY 36(3):38 on S. anglorum; 619 WY 21(4):145 on S. exigua; 9 WY 1(8):220 on S. fluviatilis; 1343 WY 36(4):57 on S. monticola; 10 WY 1(8):220 on S. scouleriana.
SCAPHIDIUM BOUTELOUAE 1562 NM M8(2):390 on Bouteloua curtipendula.
SCHIZONELLA MELANOGRAMMA 213 WY 7(3):30 on Carex aquatilis; 310 WY

10(4):34 on C. nigricans; 311 WY 10(4):34 on C. pseudoscirpoidea.
SCLEROTINIA CARICIS-AMPULLACEAE 204 WY 7(3):29 on Carex aquatilis.
SCLEROTIUM BIFRONS 100 WY 1(8):232 on Populus tremuloides.
SCOLECOTRICHUM GRAMINIS 200 WY 3(3):99 on Hordeum jubatum; 500 NM 15(1):27 on Sitanion hystrix.
SECOTIUM AGARICOIDES 1557 CO M8(2):390 on ground.
SELENOPHOMA DONACIS 469 CO 15(1):16 on Agropyron inerme.
SEPTOGLOEUM HEDYSARI 390 WY 24(4):45 on Hedysarum marginatum.
SEPTOGLOEUM OXYSPORUM 1166 WY 24(4):45 on Calamagrostis sp.; 1156 WY 24(4):42 on C. canadensis.
SEPTOGLOEUM RHOPALOIDEUM 1572 WY M8(2):391 on Populus tremuloides.
SEPTOGLOEUM SALICIS-FENDLERIANAE 391 WY 10(4):43 on Salix lasiandra.
SEPTORIA AGROPYRI 85 WY 1(8):229 on Agropyron spicatum.
SEPTORIA APII 86 CO 1(8):229 on Apium graveolens.
SEPTORIA ARABIDIS 87 WY 1(8):229, 182 CO 3(3):97 on Arabis exilis.
SEPTORIA ASTRAGALICOLA 183 WY 3(3):97 on Astragalus nitidus.
SEPTORIA AVENAE 686 CO 21(4):153 on Glyceria striata.
SEPTORIA BAUDYSIANA 185 WY 3(3):97 on Carex aquatilis; 184 WY 3(3):97 on C. vesicaria.
SEPTORIA COMMERSONIANA 1195 WY 24(4):53 on Cerastium arvense
SEPTORIA CONVOLVULI 88 WY 1(8):230 on Convolvulus arvensis.
SEPTORIA GUARINA 472 AZ 15(1):17 on Zauschneria californica.
SEPTORIA HELIANTHI 186 WY 3(3):98 on Helianthus annuus.
SEPTORIA MENTHICOLA 89 WY 1(8):230 on Mentha canadensis.
SEPTORIA OEDOSPORA 1365 WY 36(4):61 on Symphoricarpos oreophilus.
SEPTORIA PETROSELINI 473 WY 15(1):17 on Coniosselinum scopulorum.
SEPTORIA POLEMONII 1366 WY 36(4):61 on Polemonium occidentale.
SEPTORIA POLYGONORUM 687 WY 21(4):153 on Polygonum persicaria.
SEPTORIA POPULI 187 WY 3(3):98 on Populus tacamahaca.
SEPTORIA PURPURASCENS 1161 WY 24(4):44 on Potentilla gracilis.
SEPTORIA RIBIS 188 WY 3(3):98 on Ribes saxosum.
SEPTORIA RUMICIS 289 WY 7(3):39 on Rumex venosus.
SEPTORIA SAMBUCINA 474 CO 15(1):18 on Sambucus sp.
SEPTORIA SCUTELLARIAE 1563 ID M8(2):391 on Scutellaria galericulata.
SEPTORIA SIBERICA 1564 WY M8(2):391 on Ribes inerme.
SEPTORIA SIGNALENSIS 1565 WY M8(2):391 on Symphoricarpos albus; 290 WY 7(3):39 on S. oreophilus; 1566 ID M8(2):391 on S. vaccinioides.
SEPTORIA SII 189 WY 3(3):98 on Cicuta occidentalis.
SEPTORIA URTICAE 1567 AZ M8(2):391 on Urtica gracilenta.
SEPTORIA VERBENAE 475 AZ 15(1):18 on Verbena scabra.
SEPTORIA VIOLAE 476 NM 15(1):18 on Viola sp.
SEPULTARIA AURANTIA 301 CO 10(4):33 on ground.
SOROSPORIUM ASTRAGALI 132 WY 3(3):92 on Lupinus plattensis.
SOROSPORIUM CONSANGUINEUM 440 AZ 15(1):9 on Aristida orcuttiana.
SPHACELOTHECA INFLORESCENTIAE 441 WY 15(1):9 on Polygonum viviparum.
SPHACELOTHECA SORGHI 442 AZ 15(1):10 on Sorghum halepense.
SPHAEROTHECA FULIGINEA 1531 CO M8(2):388 on Pedicularis bracteosa.
SPHAEROTHECA HUMULI 612 WY 21(4):144 on Agoseris glauca; 1322 AZ 36(4):54 on Allophyllum gilioides; 115 WY 3(3):90 on Arnica foliosa; 19 WY 1(8):221, 1125 WY 24(4):38 on Astragalus alpinus; 1126 WY 24(4):38 on Castilleja miniata; 1127 WY 24(4):38 on Collinsia parviflora; 306 WY 10(4):34, 1323 WY 36(4):55 on Collomia liniaris; 208 WY 7(3):30 on Geranium fremontii; 610 UT 21(4):143, 1324 ID 36(4):55 on G. nervosum; 1128 WY 24(4):39 on G. viscosissimum; 420 CO 15(1):4 on Geum macrophyllum; 307 WY 10(4):34 on Pedicularis paysoniana; 1124 WY 24(4):38 on Phlox longifolia; 209 WY 7(3):30

on Plantago eriopoda; 114 WY 3(3):90 on Saxifraga arguta; 424 UT 15(1):5 on Senecio spartioides; 116 WY 3(3):90 on S. triangularis; 423 WY 15(1):5 on Synthyris wyomingensis; 421 CO, 422 nm 15(1):4, 1325 WY 36(4):55 on Taraxacum officinale; 18 WY 1(8):221 on Viola canadensis; 611 WY 21(4):143 on V. rugulosa; 1129 WY 24(4):39 on Wyethia helianthoides.

SPORONEMA PUNCTIFORME 1162 WY 24(4):44, 1367 WY 36(4):61 on Galium boreale.

STAGONOSPORA FOLICOLA 1156 WY 24(4):42 on Calamagrostis canadensis.

STAGONOSPORA MELILOTI 688 ID 21(4):153 on Melilotus alba.

STEREUM HIRSUTUM 350 WY 10(4):38, 453 CO 15(1):11 on Alnus tenuifolia.

STEREUM RUFUM 351 WY 10(4):38, 352 CO 10(4):38 on Populus tremuloides.

STEREUM RUGISPORUM 353 WY 10(4):39 on Picea engelmannii.

STEREUM SANGUINOLENTUM 354 WY 10(4):39 on wood.

SYNCARPELLA TUMEFACIENS 1532 WY M8(2):388 on Artemisia tridentata.

SYNCHYTRIUM SP. 1101 WY 24(4):34 on Collinsia parviflora.

SYNCHYTRIUM EPILOBII 1102 WY 24(4):34 on Epilobium lactiflorum.

TAPHRINA CAERULESCENS 103 WY 3(3):89 on Quercus gambellii.

TAPHRINA CONFUSA 1115 WY 24(4):36 on Prunus virginiana.

TEICHOSPORA NEGUNDINIS 27 CO 1(8):222 on Acer glabrum.

THELEPHORA CARYOPHYLLEA 355 CO 10(4):39 on ground.

TILLETIA ASPERIFOLIA 215 WY 7(3):31 on Muhlenbergia asperifolia.

TILLETIA ELYMI 1348 WY 36(4):58 on Elymus glaucus.

TITAEOSPORA DETOSPORA 193 WY 3(3):98 on Equisetum laevigatum.

TORULA HERBARUM 1599 CO M8(2):394 on Yucca sp.

TRAMETES HISPIDA 371 CO 10(4):40 on Populus tremuloides.

TRAMETES ISABELLINA 372 CO 10(4):40 on Picea engelmannii.

TRAMETES MOLLIS 373 WY 10(4):40 on wood.

TRANZSCHELIA COHAESA 1687, 1688, 1689 AZ M8(2):400 on Anemone tuberosa.

TRANZSCHELIA PRUNI-SPINOSAE 1494 AZ 36(5):79 on Prunus virens.

TRANZSCHELIA THALICTRI 669 UT 21(4):150, 790 CO 21(5):166 on Thalictrum fendleri.

TUBERCULINA PERSICINA 1600 NV M8(2):394 on Puccinia aristidae.

TYPHULOCHAETA JAPONICA 1326 AZ 36(4):55 on Quercus arizonica.

UNCINULA SALICIS 425 CO 15(1):5, 1130 WY 24(4):39 on Populus balsamifera; 20 WY 1(8):222 on P. tremuloides; 614 WY 21(4):144 on Salix amygdaloides; 1327 WY 36(4):55 on S. monticola; 615 WY 21(4):144 on S. pseudocordata; 21 WY 1(8):222 on S. scouleriana.

UREDINOPSIS GLABRA 925 AZ 23(4):41 on Cystopteris fragilis.

UREDINOPSIS PTERIDIS 710 MT 21(5):157 on Abies grandis; 711 MT 21(5):157, 1617 AZ M8(2):396 on Pteridium aquilinum.

UREDINOPSIS STRUTHIOPTERIDIS 712 MT 21(5):158, 713 MT 21(5):158 on Abies lasiocarpa.

UROCYSTIS AGROPYRI 1349 WY 36(4):58 on Elymus glaucus.

UROMYCES ACUMINATUS 670 WY 21(4):151 on Smilacina stellata.

UROMYCES AEMULUS 1495 ID 36(5):79 on Allium brandegei; 791 WY 21(5):166, 1092 WY 24(3):32, 1093 WY 24(3):32 on A. brevistylum.

UROMYCES AMOENUS 792 MT 21(5):166 on Anaphalis margaretacea.

UROMYCES CARNEUS 70 WY 1(8):227 on Astragalus alpinus.

UROMYCES COLORADENSIS 278 WY 7(3):37, 793 MT 21(5):166, 1293 UT 36(3):49 on Vicia americana.

UROMYCES DACTYLIDIS 987 CO 23(4):49 on Festuca ovina; 1094 WY 24(3):32 on Poa canbyi.

UROMYCES EPICAMPIS 988 AZ 23(4):49 on Muhlenbergia ringens.

UROMYCES ERAGROSTIDIS 594 AZ 18(2):81 on Eragrostis intermedia.
UROMYCES EUPHORBIAE 671 WY 21(4):151, 989 AZ 23(4):49 on Euphorbia glyptosperma.
UROMYCES FABAE 990 AZ 23(4):50 on Lathyrus arizonicus; 336 NM 10(4):37 on L. decaphyllus; 991 AZ 23(4):50 on L. eucosmus; 992 AZ 23(4):50 on L. laetivirens; 672 UT 21(4):151 on L. lanswertii; 673 WY 21(4): 151 on L. polymorphus; 794 MT 21(5):166 on Vicia americana.
UROMYCES GLYCYRRHIZAE 71 WY 1(8):227, 337 NM 10(4):37, 993 CO 23(4): 50, 1294 WY 36(3):49, 1496 MT 36(5):79, 1690 UT M8(2):401 on Glycyrrhiza lepidota.
UROMYCES HEDYSARI-OBSCURI 795 MT 21(5):166 on Hedysarum boreale; 279 WY 7(3):37 on H. marginatum; 595 WY 18(2):81, 1095 WY 24(3):32, 1096 WY 24(3):33 on H. occidentale; 72 WY 1(8):227 on H. pabulare; 796 MT 21(5):166, 1295 WY 36(3):49 on H. sulphurescens
UROMYCES HEDYSARI-PANICULATI 338 AZ 10(4):37 on Desmodium sp.
UROMYCES HETERODERMUS 797 MT 21(5):166, 1097 ID 24(3):33 on Erythronium grandiflorum; 73 WY 1(8):227 on E. parviflorum.
UROMYCES HYALINUS 280 NM 7(3):38 on Sophora sericea.
UROMYCES INTRICATUS 1497 WY 36(5):80, 1691 WY M8(2):401 on Eriogonum brevicaule; 281 WY 7(3):38, 674 CO 21(4):151 on E. campanulatum; 675 WY 21(4):151 on E. effusum; 798 MT 21(5):166 on E. flavum; 676 UT 21(4):151 on E. heracleoides; 1498 WY 36(5):80 on E. jamesii; 799 MT 21(5):166 on E. ovalifolium; 994 AZ 23(4):50 on E. racemosum.
UROMYCES JONESII 995 CO 23(4):50, 1692 WY M8(2):401 on Ranunculus alismaefolius; 282 WY 7(3):38 on R. calthaeflorus.
UROMYCES JUNCI 1098 WY 24(3):33 on Arnica chamissonis; 677 WY 21(4): 151 on Helianthus nuttallii; 74 WY 1(8):227 on Juncus balticus; 166 WY 3(3):95 on J. parryi.
UROMYCES JUNCI-EFFUSI 678 WY 21(4):151 on Juncus balticus; 1693 AZ M8(2):401 on J. saximontanensis;
UROMYCES LAPPONICUS 1099 WY 24(3):33 on Astragalus alpinus; 596 WY 18(2):81 on A. campestris; 283 WY 7(3):38 on Oxytropis gracilis; 996 CO 23(4):50 on O. sericea.
UROMYCES LUPINI 597 CO 18(2):81 on Lupinus sp.; 1499 WY 36(5):80 on L. plattensis.
UROMYCES LYCOCTONI 598 WY 18(2):82 on Aconitum columbianum.
UROMYCES MEXICANUS 1695 AZ M8(2):401 on Desmodium procumbens; 1694 AZ M8(2):401 on D. rosei.
UROMYCES MINOR 339, 340 WY 10(4):37, 349 WY 10(4):37 on Trifolium anemophilum; 1296 CO 36(3):49, 1297 WY 36(3):49 on T. dasyphyllum; 1100 WY 24(3):33, 1298 UT 36(3):49 on T. longipes; 284 WY 7(3):38, 285 WY 7(3):38, 1696 CO M8(2):401 on T. parryi.
UROMYCES PECKIANUS 341 WY 10(4):37 on Plantago lanceolata.
UROMYCES PHASEOLI 1299 WY 36(3):49 on Phaseolus sp.
UROMYCES PLUMBARIUS 75 ID 1(8):227 on Pachylophus marginatus.
UROMYCES PROEMINENS 343 NM 10(4):38 on Euphorbia marginata; 342 WY 10(4):37 on E. serphyllifolia.
UROMYCES PSORALEAE 997 AZ 23(4):50, 1697 CO M8(2):401, 1698 WY M8(2): 401 on Psoralea lanceolata; 76 WY 1(8):228 on P. tenuiflora.
UROMYCES PUNCTATUS 1699 AZ M8(2):401 on Astragalus lentiginosus; 77 WY 1(8):228 on Oxytropis saximontanus.
UROMYCES RICKERIANUS 78 ID 1(8):228 on Polygonum alpinum; 998 CO 23(4):50 on Rumex pauciflorus.
UROMYCES RUDBECKIAE 167 WY 3(3):95, 599 NM 18(2):82 on Rudbeckia

laciniata.
UROMYCES SUKSDORFII 999 AZ 23(4):50 on Silene scouleri.
UROMYCES TRANZSCHELII 169 AZ 3(3):95 on Euphorbia lucida; 168 WY 3(3):95 on E. robusta.
UROMYCES UNITUS 800 MT 21(5):167 on Lewisia columbiana.
UROMYCES VICIAE-FABAE 1700 WY M8(2):401 on Lathyrus leucanthus.
UROMYCES ZYGADENI 344 WY 10(4):38 on Zygadenus gramineus.
UROPHLYCTIS PLURIANNULATUS 102 WY 3(3):89 on Ligusticum simulans.
UROPYXIS AMORPHAE 1000 AZ 23(4):51 on Amorpha californica; 286 AZ 7(3):38 on A. fragrans; 79 WY 1(8):228, 600 AZ 18(2):82 on A. fruticosa; 345 NM 10(4):38 on Parryella filifolia.
UROPYXIS DALEAE 1500 AZ 36(5):80 on Eysenhardtia polystachya.
UROPYXIS SANGUINEA 80 WY 1(8):228 on Berberis aquifolium.
USTILAGO BROMIVORA 443 WY 15(1):10 on Bromus marginatus; 32 WY 1(8): 223 on B. polyanthus; 445 NV 15(1):10 on B. rubens; 128 WY 3(3):91, 444 CO 15(1):10 on B. tectorum.
USTILAGO BULLATA 624 WY 21(4):145 on Bromus carinatus; 1140 WY 24(4): 40 on B. marginatus; 1351 UT 36(4):58 on B. polyanthus; 1546 AZ M8(2):389 on B. rubens; 1350 AZ 36(4):58 on B. tectorum.
USTILAGO CRUS-GALLI 129 WY 3(3):91 on Echinochloa crus-galli.
USTILAGO HYPODYTES 1352 AZ 36(4):58 on Oryzopsis hymenoides; 312 MT 10(4):34, 1547 WY M8(2):389 on Stipa comata.
USTILAGO LEVIS 33 WY 1(8):223 on Avena sativa.
USTILAGO LORENTZIANA 214 WY 7(3):30 on Hordeum jubatum.
USTILAGO NEGLECTA 1548 AZ M8(2):389 on Bouteloua aristidoides.
USTILAGO RESIDUA 1141 WY 24(4):40 on Danthonia unispicata.
USTILAGO STRIAEFORMIS 1142 WY 24(4):41 on Phleum pratense.
USTILAGO VILFAE 1353 NM 36(4):58 on Hilaria jamesii.
USTILAGO VINOSA 446 WY 15(1):10 on Oxyria digyna.
USTILAGO VIOLACEA 130 WY 3(3):92 on Lychnis drummondii.
VALSA NIVEA 1533 CO M8(2):388 on Populus tremuloides.

HOST INDEX

ACTAEA ARGUTA
Ramularia actaeae
ADOXA MOSCHATELLINA
Puccinia adoxae
Ramularia adoxae
AGASTACHE URTICIFOLIA
Ramularia lophanthi
AGOSERIS GLAUCA
Ovularia compacta
Puccinia hieracii
Puccinia dioicae
Puccinia extensicola
Puccinia suksdorfii
Sphaerotheca humuli
AGOSERIS PARVIFLORA
Puccinia hieracii
AGROPYRON ALBICANS
Puccinia recondita
AGROPYRON ARIZONICUM
Puccinia recondita
AGROPYRON DASYSTACHYUM
Claviceps purpurea
Erysiphe graminis
Puccinia recondita
AGROPYRON DESERTORUM
Claviceps purpurea
AGROPYRON GRIFFITHSII
Puccinia recondita
AGROPYRON INERME
Ascochyta utahensis
Puccinia recondita
Selenophoma donacis
AGROPYRON PAUCIFLORUM
Claviceps purpurea
AGROPYRON PSEUDOREPENS
Puccinia recondita
AGROPYRON REPENS
Erysiphe graminis
AGROPYRON RIPARIUM
Erysiphe graminis
AGROPYRON SMITHII
Claviceps purpurea
Puccinia graminis
Puccinia montanensis
AGROPYRON SPICATUM
Puccinia montanensis
Puccinia pattersoniana
Puccinia recondita
Septoria agropyri
AGROPYRON SUBSECUNDUM
Puccinia graminis
Puccinia rubigo-vera
AGROPYRON TENERUM
Puccinia poculiforme
AGROPYRON TRACHYCAULUM
Erysiphe graminis
Puccinia coronata
Puccinia graminis
Puccinia montanensis
Puccinia recondita
Puccinia rubigo-vera
AGROSTIS ALBA
Puccinia coronata
AGROSTIS SCABRA
Puccinia conspicua
ALISMA PLANTAGO-AQUATICA
Doassansia alismatis
ALLIUM BRANDEGEI
Uromyces aemulus
ALLIUM BREVISTYLUM
Uromyces aemulus
ALLIUM CERNUUM
Puccinia blasdalei
Puccinia granulispora
ALLIUM MACROPETALUM
Puccinia blasdalei
ALLIUM RUBRUM
Puccinia mutabilis
ALLOPHYLLUM GILIOIDES
Sphaerotheca humuli
ALNUS OBLONGIFOLIA
Phleospora dearnessii
Phyllosticta carpini
ALNUS TENUIFOLIA
Phyllactinia corylea
Stereum hirsutum
ALTHAEA ROSEA
Endophyllum tuberculatum
Puccinia malvacearum
Puccinia sherardiana
AMARANTHUS GRAECIZANS
Albugo bliti
AMARANTHUS RETROFLEXUS
Albugo bliti
AMBROSIA CONFERTIFOLIA
Albugo tragopogonis
Oidium ambrosiae
Puccinia franseriae
Puccinia xanthii
AMBROSIA DELTOIDEA
Puccinia franseriae
AMBROSIA PSILOSTACHYA
Puccinia xanthii
AMBROSIA TRIFIDA
Erysiphe cichoracearum
AMELANCHIER ALNIFOLIA
Apiosporina collinsii
Dimerosporium collinsii
Gymnosporangium clavariaeforme
Gymnosporangium inconspicuum

Gymnosporangium juvenescens
Gymnosporangium nelsonii
Gymnosporangium nidus-avis
AMELANCHIER BAKERI
Gymnosporangium inconspicuum
Gymnosporangium nelsonii
AMELANCHIER OREOPHILA
Fabraea maculata
Gymnosporangium nelsonii
Phyllactinia corylea
AMELANCHIER PUMILA
Gymnosporangium nelsonii
AMELANCHIER UTAHENSIS
Gymnosporangium inconspicuum
Gymnosporangium nelsonii
AMORPHA CALIFORNICA
Uropyxis amorphae
AMORPHA FRAGRANS
Uropyxis amorphae
AMORPHA FRUTICOSA
Uropyxis amorphae
AMSINCKIA INTERMEDIA
Erysiphe horridula
Peronospora echinospermi
ANAPHALIS MARGARETACEA
Uromyces amoenus
ANDROPOGON HALLII
Puccinia andropogonis
ANDROPOGON SCOPARIUS
Puccinia andropogonis
ANEMONE CYLINDRICA
Puccinia recondita
ANEMONE GLOBOSA
Puccinia gigantispora
ANEMONE MULTIFIDA
Puccinia gigantispora
ANEMONE TUBEROSA
Tranzschelia cohaesa
ANEMONE ZEPHYRA
Puccinia retecta
ANGELICA AMPLA
Fusicladium depressum
Phyllosticta angelicae
ANGELICA ARGUTA
Puccinia ellisii
Ramularia angelicae
ANGELICA PINNATA
Passalora depressa
Physoderma pluriannulatum
Puccinia ligustici
ANISACANTHUS THURBERI
Puccinia anisacanthi
ANTENNARIA PULCHERRIMA
Phyllosticta ragnhildae
APIUM GRAVEOLENS
Septoria apii
AQUILEGIA COERULEA
Erysiphe polygoni
Puccinia recondita
Puccinia rubigo-vera
AQUILEGIA FORMOSA
Puccinia recondita
ARABIS SP.
Puccinia monoica
ARABIS DRUMMONDII
Peronospora parasitica
Puccinia monoica
Puccinia thlaspeos
ARABIS EXILIS
Septoria arabidis
ARABIS HOLBOELLII
Peronospora parasitica
Puccinia thlaspeos
ARABIS LIGNIFERA
Puccinia thlaspeos
ARABIS LIGNIPES
Puccinia holboellii
Puccinia thlaspeos
ARABIS LYALLII
Puccinia thlaspeos
ARABIS MICROPHYLLA
Puccinia thlaspeos
ARALIA RACEMOSA
Nyssopsora clavellosa
ARCTIUM MINUS
Puccinia calcitrapae
ARCTOSTAPHYLOS UVA-URSI
Chrysomyxa arctostaphyli
Exobasidium uvae-ursi
Exobasidium vaccinii
ARENARIA SAJANENSIS
Pyrenophora phaeospora
ARGEMONE POLYANTHEMOS
Peronospora arborescens
ARISTIDA ORCUTTIANA
Sorosporium consanguineum
ARNICA CHAMISSONIS
Entyloma arnicale
Entyloma calendulae
Puccinia arnicalis
Uromyces junci
ARNICA CORDIFOLIA
Entyloma arnicale
Entyloma calendulae
Phyllosticta arnicae
Puccinia arnicalis
ARNICA FOLIOSA
Sphaerotheca humuli
ARNICA MOLLIS

Entyloma calendulae
Puccinia arnicalis
ARNICA SUBPLUMOSA
Entyloma arnicale
ARTEMISIA AROMATICA
Puccinia absinthii
ARTEMISIA CANA
Puccinia absinthii
Puccinia tanaceti
ARTEMISIA CARRUTHII
Puccinia dioicae
ARTEMISIA DRACUNCULOIDES
Puccinia absinthii
Puccinia atrofusca
Puccinia millifolii
Puccinia tanaceti
ARTEMISIA DRACUNCULUS
Puccinia tanaceti
ARTEMISIA GNAPHALODES
Puccinia millefolii
ARTEMISIA LUDOVICIANA
Puccinia absinthii
Puccinia conferta
Puccinia tanaceti
ARTEMISIA TRIDENTATA
Puccinia absinthii
Puccinia tanaceti
Syncarpella tumefaciens
ARTEMISIA TRIPARTITA
Puccinia absinthii
ASCLEPIAS SPECIOSA
Cercospora clavata
ASTER SP.
Puccinia extensicola
ASTER ADSCENDENS
Erysiphe cichoracearum
ASTER ADSURGENS
Erysiphe cichoracearum
ASTER CHILENSIS
Basidiophora entospora
ASTER CONSPICUUS
Coleosporium asterum
Puccinia asteris
ASTER ENGELMANNII
Ovularia asteris
Puccinia asteris
ASTER FALCATUS
Puccinia asteris
ASTER FLUVIATILIS
Erysiphe cichoracearum
ASTER FOLIACEOUS
Entyloma compositarum
Erysiphe cichoracearum
Puccinia asteris
Puccinia dioicae
Puccinia extensicola
Ramularia asteris
ASTER FREMONTII
Ramularia asteris
ASTER FRONDEUS
Puccinia extensicola
ASTER GLAUCUS
Puccinia asteris
ASTER INTEGRIFOLIUS
Erysiphe cichoracearum
ASTER LINDLEYANUS
Coleosporium solidaginis
ASTRAGALUS ALPINUS
Erysiphe polygoni
Peronospora trifoliorum
Sphaerotheca humuli
Uromyces carneus
Uromyces lapponicus
ASTRAGALUS AGRESTIS
Polystigma astragali
ASTRAGALUS BISULCATUS
Physalospora astragali
ASTRAGALUS CAMPESTRIS
Uromyces lapponicus
ASTRAGALUS CANADENSIS
Erysiphe polygoni
ASTRAGALUS DECUMBENS
Erysiphe polygoni
ASTRAGALUS LENTIGINOSUS
Uromyces punctatus
ASTRAGALUS NITIDUS
Septoria astragalicola
AVENA FATUA
Puccinia poculiforme
AVENA SATIVA
Ustilago levis

BACCHARIS GLUTINOSA
Puccinia baccharidis
BACCHARIS SAROTHROIDES
Puccinia evadens
BAILEYA MULTIRADIATA
Puccinia grindeliae
BALSAMORHIZA SAGITTATA
Cylindrosporium balsamorhizae
Phleospora balsamorhizae
Puccinia balsamorhizae
BERBERIS AQUIFOLIUM
Cumminsiella sanguinea
Uropyxis sanguinea
BERBERIS REPENS
Cumminsiella mirabilissima
Puccinia koeleriae
Puccinia montanensis
Puccinia pygmaea

BETA VULGARIS
  Cercospora beticola
BETULA OCCIDENTALIS
  Cylindrosporium utahense
  Gloeosporium betulicola
BISTORTA BISTORTOIDES
  Puccinia bistortae
BOERHAAVIA SP.
  Albugo platensis
BOGENHARDIA CRISPA
  Puccinia heterospora
BOUTELOUA ARISTIDOIDES
  Puccinia cacabata
  Ustilago neglecta
BOUTELOUA BARBATA
  Puccinia cacabata
BOUTELOUA CURTIPENDULA
  Puccinia vexans
  Scaphidium boutelouae
BOUTELOUA ROTHROCKII
  Puccinia cacabata
BRASSICA RAPA
  Alternaria herculea
BRAYULINEA DENSA
  Puccinia guillemineae
BRICKELLIA AMPLEXICAULIS
  Puccinia kuhniae
BRICKELLIA CALIFORNICA
  Coleosporium eupatorii
BRICKELLIA GRANDIFLORA
  Puccinia liatridis
  Puccinia subdecora
BRICKELLIA LEMMONII
  Puccinia kuhniae
BROMUS ANOMALUS
  Passalora graminis
  Phyllachora graminis
  Puccinia coronata
  Puccinia recondita
BROMUS CARINATUS
  Puccinia rubigo-vera
  Ustilago bullata
BROMUS CILIATUS
  Puccinia coronata
  Puccinia recondita
  Puccinia rubigo-vera
BROMUS FRONDOSUS
  Puccinia recondita
BROMUS MARGINATUS
  Erysiphe graminis
  Passalora graminis
  Phyllosticta sp.
  Puccinia recondita
  Ustilago bromivora
  Ustilago bullata
BROMUS POLYANTHUS
  Puccinia recondita
  Ustilago bromivora
  Ustilago bullata
BROMUS PORTERI
  Puccinia coronata
BROMUS RUBENS
  Ustilago bromivora
  Ustilago bullata
BROMUS TECTORUM
  Ustilago bromivora
  Ustilago bullata
CALAMAGROSTIS SP.
  Puccinia coronata
  Septogloeum oxysporum
CALAMAGROSTIS CANADENSIS
  Hendersonia calamovilfae
  Puccinia coronata
  Septogloeum oxysporum
  Stagonospora follicola
CALAMAGROSTIS INEXPANSA
  Puccinia coronata
CALAMAGROSTIS RUBESCENS
  Puccinia coronata
CALTHA LEPTOSEPALA
  Puccinia treleasiana
CALAMOVILFA LONGIFOLIA
  Puccinia amphigena
  Puccinia sporoboli
CALLIANDRA RETICULATA
  Ravenelia reticulatae
CALOCHORTUS APICULATUS
  Puccinia calochorti
CALOCHORTUS GUNNISONII
  Puccinia calochorti
CAMISSONIA CALIFORNICA
  Puccinia oenotherae
CAMISSONIA CHAMAENERIOIDES
  Peronospora arthuri
CAPSELLA BURSA-PASTORIS
  Albugo candida
CARAGANA ARBORESCENS
  Phleospora caraganae
CARDAMINE CORDIFOLIA
  Puccinia cruciferarum
CAREX SP.
  Cintractia caricis
  Puccinia caricina
  Puccinia extensicola
CAREX AQUATILIS
  Puccinia caricina
  Puccinia caricis
  Schizonella melanogramma
  Sclerotinia caricis-ampullaceae
  Septoria baudysiana
CAREX DOUGLASII
  Puccinia atrofusca

CAREX EASTWOODII
Puccinia dioicae
CAREX ELEOCHARIS
Puccinia atrofusca
CAREX FESTIVELLA
Cintractia caricis
Puccinia extensicola
CAREX FILIFOLIA
Cintractia caricis
Puccinia atrofusca
Puccinia dioicae
CAREX GEYERI
Puccinia atrofusca
Puccinia extensicola
CAREX GRAVIDA
Puccinia extensicola
CAREX HEPBURNII
Puccinia caricina
CAREX HOODII
Puccinia atrofusca
Puccinia dioicae
CAREX NEBRASKENSIS
Puccinia caricina
Puccinia urticata
CAREX NIGRICANS
Schizonella melanogramma
CAREX PETASATA
Puccinia dioicae
CAREX PLATYLEPIS
Phleospora lunelliana
CAREX PRAEGRACILIS
Cintractia caricis
Puccinia dioicae
CAREX PSEUDOSCIRPOIDEA
Schizonella melanogramma
CAREX REYNOLDSII
Cintractia caricis
CAREX ROSSII
Puccinia atrofusca
CAREX ROSTRATA
Cintractia subinclusa
Puccinia caricina
Puccinia caricis
Puccinia urticata
CAREX RUSBYI
Puccinia dioicae
CAREX SENTA
Puccinia caricina
CAREX SIMULATA
Arthrocoidea eleocharidis
CAREX VALLICOLA
Cintractia carpophila
CAREX VARIABILIS
Puccinia grossulariae
CAREX VERNACULA
Puccinia dioicae
CAREX VESICARIA
Septoria baudysiana
CARTHAMUS TINCTORIUS
Puccinia carthami
CASSIA COVESII
Ravenelia cassiae-covesii
CASTILLEJA LINARIAEFOLIA
Cronartium coleosporioides
CASTILLEJA MINIATA
Cronartium coleosporioides
Ramularia castillejae
Sphaerotheca humuli
CASTILLEJA PATRIOTICA
Cronartium coleosporioides
CATABROSA AQUATICA
Puccinia poae-nemoralis
CERASTIUM ARVENSE
Didymobotryopsis cerastii
Heterosporium echinulatum
Melampsorella cerastii
Septoria commersoniana
CHENOPODIUM ALBUM
Peronospora effusa
Peronospora farinosa
CHENOPODIUM CAPITATUM
Albugo occidentalis
CHIMAPHILA UMBELLATA
Pucciniastrum pyrolae
CHRYSOPSIS VILLOSA
Puccinia grindeliae
Puccinia stipae
CHRYSOTHAMNUS NAUSEOSUS
Puccinia grindeliae
CHRYSOTHAMNUS PARRYI
Marssonina chrysothamni
CHRYSOTHAMNUS PUMILUS
Erysiphe cichoracearum
CHRYSOTHAMNUS VISCIDIFLORUS
Puccinia grindeliae
Puccinia stipae
CICUTA DOUGLASII
Puccinia cicutae
CICUTA OCCIDENTALIS
Puccinia cicutae
Septoria sii
CIRSIUM SP.
Puccinia laschii
CIRSIUM AMERICANUM
Puccinia cirsii
CIRSIUM ARIZONICUM
Puccinia cirsii
CIRSIUM ARVENSE
Puccinia punctiformis
CIRSIUM CANESCENS
Puccinia cirsii
CIRSIUM CENTAUREAE

Puccinia calcitrapae
CIRSIUM EDULE
Puccinia cirsii
CIRSIUM ENGELMANNII
Puccinia cirsii
CIRSIUM FOLIOSUM
Puccinia cirsii
CIRSIUM NIDULUM
Puccinia cirsii
CIRSIUM SCARIOSUM
Puccinia cnici
CIRSIUM UNDULATUM
Puccinia calcitrapae
Puccinia cirsii
CLAYTONIA LANCEOLATA
Puccinia claytoniicola
CLEMATIS COLUMBIANA
Ramularia saximontanensis
CLEMATIS HIRSUTISSIMA
Cercospora squalidula
Phyllosticta tetonensis
Puccinia recondita
CLEMATIS LIGUSTICIFOLIA
Cercospora squalidula
Didymaria clematidis
Erysiphe polygoni
Puccinia recondita
Puccinia rubigo-vera
CLINTONIA UNIFLORA
Puccinia mesomajalis
COLLINSIA PARVIFLORA
Sphaerotheca humuli
Synchytrium sp.
COLLOMIA LINEARIS
Sphaerotheca humuli
COMANDRA PALLIDA
Absidia spinosa
Cronartium comandrae
Cronartium pyriforme
CONIOSELINUM SCOPULORUM
Puccinia ligustici
Septoria petroselini
CONVOLVULUS ARVENSIS
Septoria convolvuli
CORNUS CANADENSIS
Puccinia porphyrogenita
CORNUS STOLONIFERA
Cylindrosporium corni
Cytospora corni
CORYDALIS AUREA
Peronospora corydalis
COURSETIA MICROPHYLLA
Phragmopyxis acuminata
CRACCA EDWARDSII
Phragmopyxis deglubens

CRATAEGUS DOUGLASII
Gymnosporangium bethelii
CRATAEGUS RIVULARIS
Gymnosporangium bethelii
CRATAEGUS SUCCULENTA
Gymnosporangium bethelii
CREPIS ACUMINATA
Puccinia hieracii
CREPIS GLAUCA
Puccinia crepidis-montanae
CREPIS RUNCINATA
Cercoseptoria crepidis
Puccinia crepidis-montanae
CRONARTIUM CONIGENUM
Darluca filum
CRYPTANTHA BARBIGERA
Erysiphe horridula
CYNOGLOSSUM OFFICINALE
Erysiphe cichoracearum
CYPERUS RUSBYI
Puccinia canaliculata
CYSTOPTERIS FRAGILIS
Hyalopsora polypodii
Uredinopsis glabra

DANTHONIA UNISPICATA
Ustilago residua
DELPHINIUM SP.
Puccinia recondita
DELPHINIUM BARBEYI
Entyloma wyomingense
Ovularia delphinii
DELPHINIUM BICOLOR
Ovularia delphinii
DELPHINIUM BURKEI
Ovularia delphinii
Phyllosticta delphinii
DELPHINIUM GEYERI
Puccinia recondita
Puccinia rubigo-vera
DELPHINIUM OCCIDENTALE
Entyloma winteri
Puccinia recondita
Ramularia sheldonii
DESCHAMPSIA CAESPITOSA
Puccinia brachypodii
Puccinia coronata
Puccinia deschampsiae
DESCURAINIA PINNATA
Albugo candida
Peronospora parasitica
DESCURAINIA RICHARDSONII
Peronospora parasitica
DESCURAINIA SOPHIA
Albugo candida

DESMODIUM SP.
Uromyces hedysari-paniculati
DESMODIUM PROCUMBENS
Uromyces mexicanus
DESMODIUM ROSEI
Uromyces mexicanus
DICHELOSTEMMA PULCHELLUM
Puccinia nodosa
DIPSACUS SILVESTRIS
Ramularia silvestris
DISTICHLIS SPICATA
Puccinia aristidae
Puccinia sarcobati
DISTICHLIS STRICTA
Puccinia aristidae
DRABA CUNEIFOLIA
Peronospora parasitica
DRABA INCERTA
Puccinia drabae
DRABA NEMOROSA
Albugo candida
Peronospora parasitica

ECHINOCHLOA CRUS-GALLI
Ustilago crus-galli
ELAEAGNUS CANADENSIS
Puccinia coronata
ELAEAGNUS COMMUTATA
Cercospora manitobana
ELYMUS CANADENSIS
Puccinia recondita
ELYMUS CINEREUS
Leptothyrium petrakii
Puccinia recondita
ELYMUS CONDENSATUS
Claviceps purpurea
Puccinia rubigo-vera
ELYMUS GLAUCUS
Claviceps purpurea
Puccinia recondita
Puccinia rubigo-vera
Tilletia elymi
Urocystis agropyri
EPILOBIUM SP.
Pucciniastrum epilobii
EPILOBIUM ADENOCAULON
Pucciniastrum epilobii
Pucciniastrum pustulatum
Ramularia punctiformis
EPILOBIUM ALPINUM
Puccinia veratri
EPILOBIUM ANGUSTIFOLIUM
Phyllosticta wyomingensis
Pucciniastrum epilobii
Ramularia cercosporoides
Ramularia punctiformis
EPILOBIUM GLANDULOSUM
Pucciniastrum epilobii
EPILOBIUM HORNEMANNII
Pucciniastrum epilobii
EPILOBIUM LACTIFLORUM
Synchytrium epilobii
EPILOBIUM MINUTUM
Peronospora arthuri
EPILOBIUM PANICULATUM
Puccinia pulverulenta
Puccinia vagans
EQUISETUM LAEVIGATUM
Titaeospora detospora
ERAGROSTIS INTERMEDIA
Uromyces eragrostidis
ERIGERON CAESPITOSUS
Puccinia grindeliae
ERIGERON CORYMBOSUS
Puccinia stipae
ERIGERON EATONII
Puccinia grindeliae
ERIGERON ELATIOR
Puccinia asteris
ERIGERON NEMATOPHYLLUS
Puccinia grindeliae
ERIGERON SALSUGINOSUS
Entyloma compositarum
Puccinia extensicola
ERIGERON SPECIOSUS
Entyloma compositarum
Puccinia dioicae
ERIGERON SUBTRINERVIS
Erysiphe cichoracearum
ERIOGONUM BREVICAULE
Uromyces intricatus
ERIOGONUM CAMPANULATUM
Uromyces intricatus
ERIOGONUM EFFUSUM
Uromyces intricatus
ERIOGONUM FLAVUM
Uromyces intricatus
ERIOGONUM HERACLEOIDES
Uromyces intricatus
ERIOGONUM JAMESII
Uromyces intricatus
ERIOGONUM OVALIFOLIUM
Uromyces intricatus
ERIOGONUM RACEMOSUM
Uromyces intricatus
ERIOPHYLLUM LANATUM
Puccinia eriophylli
ERYSIPHE CICHORACEARUM
Cicinnobolus major
ERYTHRONIUM GRANDIFLORUM
Uromyces heterodermus

ERYTHRONIUM PARVIFLORUM
Asteroma tennerimum
Uromyces heterodermus
EUPATORIUM PYCNOCEPHALUM
Puccinia conoclinii
EUPATORIUM SOLIDAGINIFOLIUM
Puccinia inanipes
EUPHORBIA GLYPTOSPERMA
Uromyces euphorbiae
EUPHORBIA INCISA
Melampsora monticola
EUPHORBIA LUCIDA
Uromyces tranzschelii
EUPHORBIA MARGINATA
Uromyces proeminens
EUPHORBIA ROBUSTA
Melampsora monticola
Uromyces tranzschelii
EUPHORBIA SERPHYLLIFOLIA
Uromyces proeminens
EYSENHARDTIA POLYSTACHYA
Uropyxis daleae
FENDLERA RUPICOLA
Gymnosporangium speciosum
FESTUCA IDAHOENSIS
Ophiobolus festucae
Puccinia crandallii
FESTUCA OVINA
Puccinia crandallii
Puccinia poae-nemoralis
Uromyces dactylidis
FESTUCA SCABRELLA
Puccinia crandallii
FESTUCA THURBERI
Puccinia recondita
FLOERKEA PROSPERINACOIDES
Peronospora floerkeae
FOUQUIERIA SPLENDENS
Puccinia vexans
FRAGARIA SP.
Marssonia potentillae
FRAGARIA OVALIS
Kabatia fragariae
Mycosphaerella fragariae
FRANSERIA DELTOIDEA
Puccinia franseriae
FRANSERIA DISCOLOR
Plasmopara halstedii
FRASERA SPECIOSA
Cercospora fraserae
FRAXINUS MACROPETALA
Mycosphaerella fraxinicola
Phyllactinia corylea
FRAXINUS VELUTINA
Mycosphaerella fraxinicola
Phyllactinia corylea
GALIUM ASPERRIMUM
Marssonia galii
GALIUM BOREALE
Pseudopeziza repanda
Puccinia rubefaciens
Sporonema punctiforme
GALIUM TRIFLORUM
Puccinia punctata
GAYOPHYTUM DIFFUSUM
Ramularia gayophyti
GAYOPHYTUM NUTTALLII
Puccinia pulverulenta
GAYOPHYTUM RACEMOSUM
Puccinia gayophyti
Puccinia pulverulenta
GAYOPHYTUM RAMOSISSIMUM
Puccinia gayophyti
Puccinia pulverulenta
GENTIANA AFFINIS
Puccinia gentianae
GENTIANA BIGELOVII
Puccinia gentianae
GENTIANA CALYCOSA
Puccinia haleniae
GENTIANA PARRYI
Puccinia gentianae
GERANIUM SP
Cercospora ithacensis
GERANIUM FREMONTII
Puccinia leveillei
Sphaerotheca humuli
GERANIUM NERVOSUM
Sphaerotheca humuli
GERANIUM RICHARDSONII
Cercospora geranii
Plasmopara geranii
GERANIUM VISCOSISSIMUM
Cercospora geranii
Cercospora ithacensis
Sphaerotheca humuli
GEUM MACROPHYLLUM
Ramularia gei
Sphaerotheca humuli
GLYCERIA STRIATA
Septoria avenae
GLYCYRRHIZA LEPIDOTA
Uromyces glycyrrhizae
GOSSYPIUM HIRSUTUM
Puccinia cacabata
GRINDELIA SP.
Puccinia grindeliae
GRINDELIA PERENNIS
Erysiphe cichoracearum
GRINDELIA SQUARROSA
Puccinia grindeliae

GUTIERREZIA SAROTHRAE
Erysiphe cichoracearum
Puccinia grindeliae
Puccinia sarothrae
Puccinia stipae
HAPLOPAPPUS SPINULOSUS
Puccinia grindeliae
HEDYSARUM BOREALE
Uromyces hedysari-obscuri
HEDYSARUM MARGINATUM
Septogloeum hedysari
Uromyces hedysari-obscuri
HEDYSARUM OCCIDENTALE
Uromyces hedysari-obscuri
HEDYSARUM PABULARE
Uromyces hedysari-obscuri
HEDYSARUM SULPHURESCENS
Uromyces hedysari-obscuri
HELENIUM HOOPESII
Puccinia conspicua
Puccinia poarum
HELIANTHELLA QUINQUENERVIS
Puccinia helianthellae
Ramularia helianthi
HELIANTHELLA UNIFLORA
Puccinia helianthellae
HELIANTHUS ANNUUS
Plasmopara halstedii
Puccinia helianthi
Septoria helianthi
HELIANTHUS FASCICULARIS
Puccinia helianthi
HELIANTHUS NUTTALLII
Plasmopara halstedii
Uromyces junci
HELIOPSIS PARVIFOLIA
Puccinia canaliculata
HERACLEUM LANATUM
Cylindrosporium heraclei
Cylindrosporium umbelliferarum
Phyllachora heraclei
Ramularia heraclei
HESPEROCHLOA KINGII
Puccinia crandallii
HETEROPOGON CONTORTUS
Puccinia versicolor
HEUCHERA BRACTEATA
Puccinia heucherae
HIERACIUM ALBERTINUM
Puccinia hieracii
HIERACIUM ALBIFLORUM
Puccinia fraseri
Puccinia hieracii
HIERACIUM CUSICKII
Puccinia dioicae
HILARIA JAMESII
Ustilago vilfae
HOLCUS LANATUS
Puccinia coronata
HORDEUM BRACHYANTHERUM
Passalora graminis
HORDEUM JUBATUM
Scolecotrichum graminis
Ustilago lorentziana
HYDROPHYLLUM CAPITATUM
Cylindrosporium hydrophylli
Didymaria hydrophylli
Puccinia recondita
HYDROPHYLLUM FENDLERI
Puccinia apocrypta
Puccinia hydrophylli
Puccinia recondita
HYMENOCLEA FASCICULATA
Puccinia splendens
HYMENOCLEA MONOGYRA
Puccinia franseriae
Puccinia splendens
HYMENOCLEA PENTALEPIS
Puccinia franseriae
HYPTIS EMORYI
Puccinia distorta

INDIGOFERA SPHAEROCARPA
Ravenelia indigoferae
IRIS SP.
Heterosporium gracile
IRIS MISSOURIENSIS
Puccinia iridis
IRIS PELOGONUS
Puccinia iridis
IVA AXILLARIS
Puccinia intermixta

JUNCUS BALTICUS
Uromyces junci
Uromyces junci-effusi
JUNCUS DRUMMONDII
Crandallia juncicola
Duplicaria acuminata
JUNCUS PARRYI
Uromyces junci
JUNCUS SAXIMONTANENSIS
Uromyces junci-effusi
JUNIPERUS COMMUNIS
Gymnosporangium clavariaeforme
Gymnosporangium tremelloides
JUNIPERUS DEPPEANA
Gymnosporangium kernianum
Gymnosporangium speciosum
JUNIPERUS MONOSPERMA
Gymnosporangium kernianum
Gymnosporangium nelsonii

Gymnosporangium speciosum
JUNIPERUS OSTEOSPERMA
Gymnosporangium inconspicuum
JUNIPERUS SCOPULORUM
Caldesia sabina
Gymnosporangium nelsonii
Gymnosporangium nidus-avis

KOELERIA CRISTATA
Puccinia coronata
Puccinia liatridis
Puccinia monoica
Puccinia pygmaea
KUHNIA ROSMARINIFOLIA
Puccinia kuhniae

LACTUCA PULCHELLA
Puccinia minussensis
LACTUCA SCARIOLA
Erysiphe cichoracearum
LAPPULA REDOWSKII
Erysiphe horridula
Peronospora echinospermi
LATHYRUS ARIZONICUS
Uromyces fabae
LATHYRUS DECAPHYLLUS
Uromyces fabae
LATHYRUS EUCOSMUS
Uromyces fabae
LATHYRUS LAETIVIRENS
Uromyces fabae
LATHYRUS LANSWERTII
Uromyces fabae
LATHYRUS LEUCANTHUS
Uromyces viciae-fabae
LATHYRUS POLYMORPHUS
Uromyces fabae
LEDUM GLANDULOSUM
Chrysomyxa ledi
LEDUM GROENLANDICUM
Chrysomyxa ledicola
LEPIDIUM DENSIFLORUM
Albugo candida
LEPIDIUM LASIOCARPUM
Peronospora parasitica
LEPIDIUM MEDIUM
Peronospora lepidii
Peronospora parasitica
LEPIDIUM THURBERI
Peronospora lepidii
LEPTOTAENIA MULTIFIDA
Puccinia jonesii
LESQUERELLA GORDONII
Peronospora parasitica
LESQUERELLA PURPUREA
Peronospora parasitica

LEWISIA COLUMBIANA
Uromyces unitus
LIGUSTICUM PORTERI
Cylindrosporium heraclei
Nyssopsora echinata
Peronospora echinata
LIGUSTICUM SIMULANS
Cylindrosporium heraclei
Puccinia jonesii
Puccinia ligustici
Urophlyctis pluriannulatus
LINNAEA BOREALIS
Phyllachora wittrockii
LINUM LEWISII
Melampsora lini
LOMATIUM DISSECTUM
Puccinia jonesii
LOMATIUM MONTANUM
Puccinia musenii
LOMATIUM NUDICAULE
Asperisporium peucedani
LONICERA INVOLUCRATA
Herpobasidium deformans
Kabatia lonicerae
Kabatia mirabilis
Microsphaera lonicerae
LONICERA UTAHENSIS
Leptothyrium periclymeni
Microsphaera alni
Ramularia lonicerae
LUPINUS SP.
Hadrotrichum lupini
Phyllosticta ferax
Uromyces lupini
LUPINUS ALPESTRIS
Hadrotrichum lupini
Phyllosticta ferax
LUPINUS ARGENTEUS
Erysiphe polygoni
Hadrotrichum globiferum
Hadrotrichum lupini
Phyllosticta ferax
LUPINUS PARVIFLORUS
Hadrotrichum globiferum
LUPINUS PLATTENSIS
Sorosporium astragali
Uromyces lupini
LUPINUS SERICEUS
Hadrotrichum globiferum
Phyllosticta ferax
LYCHNIS DRUMMONDII
Ustilago violacea
LYCIUM BERLANDIERI
Puccinia globosipes
LYCIUM CALIFORNICUM
Puccinia globosipes

LYCIUM EXSERTUM
Puccinia globosipes
LYCIUM FREMONTII
Puccinia globosipes
LYCIUM PALLIDUM
Puccinia tumidipes
LYCURUS PHLEOIDES
Puccinia schedonnardi
LYGODESMIA JUNCEA
Puccinia hieracii

MALVA ROTUNDIFOLIA
Puccinia malvacearum
MALVASTRUM COCCINEUM
Puccinia sherardiana
MATRICARIA MATRICARIOIDES
Albugo tragopogonis
MEDICAGO SATIVA
Peronospora trifoliorum
Pseudopeziza medicaginis
MELILOTUS ALBA
Stagonospora meliloti
MENTHA ARVENSIS
Erysiphe cichoracearum
Phyllosticta decidua
Puccinia angustata
Ramularia menthicola
MENTHA CANADENSIS
Puccinia menthae
Ramularia menthicola
Septoria menthicola
MENTHA SPICATA
Puccinia menthae
MENYANTHES TRIFOLIATA
Physoderma menyanthis
MENZIESIA FERRUGINEA
Exobasidium vaccinii
MERTENSIA SP.
Erysiphe cichoracearum
MERTENSIA CILIATA
Entyloma serotinum
Erysiphe cichoracearum
Puccinia hydrophylli
Puccinia mertensiae
MIRABILIS LONGIFLORA
Aecidium mirabilis
MITELLA PENTANDRA
Puccinia heucherae
MITELLA STAUROPETALA
Puccinia heucherae
MONARDA FISTULOSA
Puccinia menthae
MONARDA MENTHAEFOLIA
Puccinia menthae
MUHLENBERGIA ARIZONICA
Phleospora muhlenbergiae

MUHLENBERGIA ASPERIFOLIA
Puccinia schedonnardi
Tilletia asperifolia
MUHLENBERGIA EMERSLEYI
Phyllachora epicampis
MUHLENBERGIA GLAUCA
Phyllachora vulgata
MUHLENBERGIA LONGILIGULA
Phyllachora epicampis
MUHLENBERGIA METCALFII
Phyllachora epicampis
MUHLENBERGIA MONTANA
Puccinia schedonnardi
MUHLENBERGIA RINGENS
Phyllachora epicampis
Uromyces epicampis

NICOTIANA TRIGONOPHYLLA
Peronospora tabacina

OENOTHERA CAESPITOSA
Puccinia dioicae
OENOTHERA HETERANTHA
Puccinia oenotherae
OENOTHERA NUTTALLII
Puccinia redfieldiae
OENOTHERA PRIMIVERIS
Alternaria tenuis
Peronospora arthuri
ORYZOPSIS HYMENOIDES
Puccinia monoica
Puccinia substerilis
Ustilago hypodytes
ORYZOPSIS MICRANTHA
Puccinia micrantha
OSMORHIZA DIVARICATA
Phleospora osmorhizae
OSMORHIZA OBTUSA
Phleospora osmorhizae
Puccinia pimpinellae
OSMORHIZA OCCIDENTALIS
Phleospora osmorhizae
Puccinia pimpinellae
OXYPOLIS FENDLERI
Puccinia ligustici
OXYRIA DIGYNA
Ustilago vinosa
OXYTROPIS GRACILIS
Uromyces lapponicus
OXYTROPIS SAXIMONTANUS
Uromyces punctatus
OXYTROPIS SERICEA
Uromyces lapponicus
PACHYLOPHUS MARGINATUS
Uromyces plumbarius

PANICUM BULBOSUM
Puccinia atra
PARNASSIA FIMBRIATA
Puccinia parnassiae
PARRYELLA FILIFOLIA
Uropyxis amorphae
PEDICULARIS BRACTEOSA
Apiosporella alpina
Puccinia clintonii
Sphaerotheca fuliginea
PEDICULARIS CENTRANTHERA
Puccinia rufescens
PEDICULARIS GROENLANDICA
Puccinia clintonii
PEDICULARIS PAYSONIANA
Phyllosticta pedicularidis
Puccinia clintonii
Ramularia obducens
Sphaerotheca humuli
PENSTEMON SP.
Puccinia palmeri
Ramularia nivosa
PENSTEMON ALPINUS
Puccinia andropogonis
PENSTEMON BRIDGESII
Puccinia pentstemonis
PENSTEMON CONFERTUS
Puccinia palmeri
PENSTEMON CONNATIFOLIUS
Puccinia pentstemonis
PENSTEMON DEUSTUS
Puccinia pentstemonis
PENSTEMON ELLIPTICUS
Puccinia palmeri
PENSTEMON PINIFOLIUS
Puccinia pentstemonis
PENSTEMON PROCERUS
Puccinia palmeri
PERIDERIDIA GAIRDNERI
Passalora depressa
PETALOSTEMON PURPUREUS
Puccinia andropogonis
PHACELIA HETEROPHYLLA
Puccinia recondita
PHACELIA LEUCOPHYLLA
Puccinia rubigo-vera
Ramularia phaceliae
PHALARIS ARUNDINACEA
Puccinia coronata
PHASEOLUS SP.
Uromyces phaseoli
PHILADELPHUS RUGOSUS
Gymnosporangium tremelloides
PHLEUM PRATENSE
Puccinia brachypodii
Puccinia graminis
Puccinia poae-nemoralis
Ustilago striaeformis
PHLOX GLABRATA
Puccinia douglasii
PHLOX LONGIFOLIA
Puccinia plumbaria
Sphaerotheca humuli
PHLOX MULTIFLORA
Puccinia plumbaria
PHRAGMITES COMMUNIS
Puccinia rubella
PICEA ENGELMANNII
Chrysomyxa arctostaphyli
Fomes nigrolimitatus
Fomes pini
Fomes pinicola
Herpotrichia nigra
Lenzites saepiaria
Melampsorella caryophyllacearum
Melampsorella cerastii
Neopeckia coulteri
Polyporus alboluteus
Polyporus leucospongia
Stereum rugisporum
Trametes isabellina
PICEA PUNGENS
Melampsorella caryophyllacearum
PINUS CHIHUAHUANA
Cronartium conigenum
PINUS CONTORTA
Coniophora corrugis
Cronartium coleosporioides
Cronartium comandrae
Dasycypha arida
Dasycypha fuscosanguinea
Dasycypha oblongispora
Discina ancilis
Lophodermella montivaga
Neopeckia coulteri
Polyporus dichrous
PINUS EDULIS
Coleosporium crowellii
Coleosporium jonesii
PINUS FLEXILIS
Bifusella linearis
Bifusella saccata
Coniophora corrugis
Hypoderma saccatum
Lophodermella arcuata
PINUS MONOPHYLLA
Bifusella pini
PINUS PONDEROSA
Davisomycella ponderosae
Hemiphacidium planum
Lophodermella cerina
Peridermium filamentosum

PIPTOCHAETIUM FIMBRIATUM
Puccinia neocoronata
PLANTAGO ERIOPODA
Puccinia subnitens
Sphaerotheca humuli
PLANTAGO LANCEOLATA
Uromyces peckianus
PLANTAGO MAJOR
Erysiphe cichoracearum
POA ALPINA
Puccinia brachypodii
POA AMPLA
Erysiphe graminis
POA CANBYI
Erysiphe graminis
Uromyces dactylidis
POA FENDLERIANA
Puccinia crandallii
POA INTERIOR
Puccinia brachypodii
Puccinia poae-nemoralis
POA LEPTOCOMA
Puccinia brachypodii
Puccinia poae-nemoralis
POA LONGILIGULA
Puccinia crandallii
POA PALUSTRIS
Puccinia poae-nemoralis
Puccinia poae-sudeticae
POA PRATENSIS
Erysiphe graminis
Puccinia poae-nemoralis
POA REFLEXA
Puccinia brachypodii
Puccinia poae-nemoralis
POA SECUNDA
Puccinia monoica
POLEMONIUM OCCIDENTALE
Septoria polemonii
POLYGONUM SP.
Puccinia polygoni-amphibii
POLYGONUM ALPINUM
Uromyces rickerianus
POLYGONUM AVICULARE
Erysiphe polygoni
POLYGONUM BISTORTOIDES
Ovularia bistortae
Puccinia bistortae
POLYGONUM BUXAFORME
Erysiphe polygoni
POLYGONUM EXSERTUM
Erysiphe polygoni
POLYGONUM PERSICARIA
Septoria polygonorum
POLYGONUM VIVIPARUM
Puccinia bistortae
Sphacelotheca inflorescentiae
POPULUS SP.
Cytospora chrysosperma
Marssonina populi
Melampsora albertensis
POPULUS ANGUSTIFOLIA
Amphisphaeria separans
Cylindrosporium oculatum
Cylindrosporium saximontanense
Marssonina populi
Melampsora albertensis
Melampsora occidentalis
Phyllactinia corylea
Phyllosticta brunnea
POPULUS BALSAMIFERA
Uncinula salicis
POPULUS FREMONTII
Phyllosticta brunnea
POPULUS TACAMAHACA
Septoria populi
POPULUS TREMULOIDES
Armillaria mellea
Ciborinia confundens
Cytospora chrysosperma
Fomes igniarius
Ganoderma applanatum
Hypoxylon pruinatum
Marssonina brunnea
Melampsora albertensis
Melampsora medusae
Polyporus adustus
Sclerotium bifrons
Septogloeum rhopaloideum
Stereum rufum
Trametes hispida
Uncinula salicis
Valsa nivea
POTENTILLA ARGUTA
Ramularia arvensis
POTENTILLA CONCINNA
Phragmidium ivesiae
POTENTILLA DIVERSIFOLIA
Phragmidium ivesiae
POTENTILLA FISSA
Marssonina potentillae
POTENTILLA FLABELLIFORMIS
Phragmidium ivesiae
POTENTILLA FRUTICOSA
Phragmidium andersonii
POTENTILLA GRACILIS
Cylindrosporium triflori
Peronospora potentillae
Phragmidium ivesiae
Ramularia arvensis
Septoria purpurascens

POTENTILLA NORVEGICA
  Ramularia arvensis
POTENTILLA NUTTALLII
  Peronospora potentillae
  Phragmidium ivesiae
POTENTILLA PENNSYLVANICA
  Phragmidium potentillae
POTENTILLA PULCHERRIMA
  Peronospora potentillae
  Phragmidium ivesiae
  Ramularia arvensis
POTENTILLA STRIGOSA
  Phragmidium potentillae
PRUNUS SP.
  Phyllosticta virginiana
PRUNUS MELANOCARPA
  Podosphaera oxyacanthae
PRUNUS VIRENS
  Phyllosticta virginiana
  Tranzschelia pruni-spinosae
PRUNUS VIRGINIANA
  Dibotryon morbosum
  Taphrina confusa
PSEUDOCYMOPTERUS MONTANUS
  Phleospora osmorhizae
  Puccinia pseudocymopteri
PSEUDOCYMOPTERUS SYLVATICUS
  Puccinia pseudocymopteri
PSEUDOTSUGA MENZIESII
  Melampsora medusae
  Rhabdogloeum pseudotsugae
PSEUDOTSUGA TAXIFOLIA
  Melampsora occidentalis
  Rhabdocline pseudotsugae
PSILOSTROPHE COOPERI
  Puccinia grindeliae
PSORALEA LANCEOLATA
  Uromyces psoraleae
PSORALEA TENUIFLORA
  Uromyces psoraleae
PTERIDIUM AQUILINUM
  Melasmia imitans
  Uredinopsis pteridis
PTILORIA RUNCINATA
  Puccinia harknessii
PUCCINIA ARISTIDAE
  Tuberculina persicina
PUCCINIA SUBSTERILIS
  Darluca filum
PYROLA ASARIFOLIA
  Chrysomyxa pirolata
PYROLA CHLORANTHA
  Chrysomyxa pirolata
PYROLA SECUNDA
  Pucciniastrum pyrolae
PYROLA VIRENS
  Pucciniastrum pyrolae

QUERCUS ARIZONICA
  Typhulochaeta japonica
QUERCUS EMORYI
  Cronartium conigenum
QUERCUS GAMBELII
  Diatrype albopruinosa
  Exidia glandulosa
  Microsphaera alni
  Taphrina caerulescens
QUERCUS GRISEA
  Cronartium conigenum
QUERCUS HYPOLEUCOIDES
  Cronartium conigenum

RANUNCULUS ACRIFORMIS
  Peronospora ficariae
RANUNCULUS ALISMAEFOLIUS
  Uromyces jonesii
RANUNCULUS CALTHAEFLORUS
  Uromyces jonesii
RANUNCULUS CYMBALARIA
  Puccinia rubigo-vera
RANUNCULUS MACOUNII
  Ovularia decipiens
RAPHANUS SATIVA
  Albugo candida
RATIBIDA TAGETES
  Anthostomella ratibidea
REDFIELDIA FLEXUOSA
  Puccinia redfieldiae
RHAMNUS ALNIFOLIA
  Puccinia coronata
RHAMNUS BETULAEFOLIA
  Phyllosticta cinerea
RHINANTHUS KYROLLAE
  Cronartium coleosporioides
RHUS RADICANS
  Pileolaria brevipes
RHUS TRILOBATA
  Pileolaria patzcuarensis
RIBES AUREUM
  Cronartium occidentale
RIBES CEREUM
  Coleosporium jonesii
  Pseudopeziza ribis
RIBES INEBRIANS
  Coleosporium jonesii
RIBES INERME
  Coleosporium jonesii
  Gloeosporium ribis
  Melampsora epitea
  Melampsora ribesii-purpureae
  Pseudopeziza ribis
  Puccinia caricina

Septoria siberica
RIBES LACUSTRE
Melampsora ribesii-purpureae
Puccinia parkerae
RIBES LEPTANTHUM
Coleosporium jonesii
RIBES PINETORUM
Coleosporium jonesii
RIBES SAXOSUM
Coleosporium jonesii
Gloeosporium ribis
Puccinia grossulariae
Septoria ribis
RIBES SETOSUM
Puccinia caricina
RIBES VELUTINA
Coleosporium jonesii
RIBES VISCOSISSIMUM
Cercoseptoria ribis
Cercospora septoriopsis
ROBINIA NEOMEXICANA
Phyllactinia corylea
ROSA SP.
Cercospora rosicola
Phragmidium fusiforme
Phragmidium montivagum
Phragmidium rosae-arkansanae
Phyllosticta rosicola
ROSA ACICULARIS
Phragmidium fusiforme
Phragmidium montivagum
Phragmidium rosea-acicularis
ROSA ENGELMANNII
Phragmidium fusiforme
ROSA FENDLERI
Phragmidium montivagum
ROSA FOETIDA
Phragmidium rosae-pimpinellifoliae
ROSA MANCA
Phragmidium montivagum
ROSA WOODSII
Phragmidium fusiforme
Phragmidium montivagum
RUBUS SP.
Coleroa chaetomium
Phragmidium ribi-idaei
RUBUS DELICIOSUS
Phragmidium peckianum
RUBUS IDAEUS
Phragmidium rubi-idaei
RUBUS LEUCODERMUS
Phragmidium rubi-idaei
RUBUS NEOMEXICANUS
Phragmidium peckianum
RUBUS PARVIFLORUS
Phragmidium occidentale
RUBUS PUBESCENS
Kunkelia nitens
RUBUS STRIGOSUS
Coleroa rubicola
Phragmidium rubi-idaei
RUDBECKIA LACINIATA
Phyllactinia corylea
Ramularia rudbeckiae
Uromyces rudbeckiae
RUDBECKIA OCCIDENTALIS
Ramularia rudbeckiae
RUMEX SP.
Ramularia decipiens
RUMEX CRISPUS
Ovularia monosporia
Ovularia obliqua
RUMEX HYMENOSEPALUS
Ovularia monosporia
RUMEX PAUCIFLORUS
Uromyces rickerianus
RUMEX VENOSUS
Ramularia decipiens
Septoria rumicis
SALIX SP.
Gloeosporium boreale
Lophionema apoclastospora
Marssonina kriegeriana
Melampsora abieti-capraearum
Melampsora confluens
Melampsora epitea
Melampsora ribesii-purpureae
Rhytisma salicinum
SALIX AMYGDALOIDES
Melampsora americana
Melampsora epitea
Melampsora paradoxa
Melampsora ribesii-purpureae
Uncinula salicis
SALIX ANGLORUM
Melampsora arctica
Rhytisma salicinum
SALIX BABYLONICA
Cytospora chrysosperma
SALIX BEBBIANA
Melampsora abieti-capraearum
Melampsora americana
Melampsora bigelowii
Melampsora paradoxa
Melampsora ribesii-purpureae
SALIX BONPLANDIANA
Melampsora epitea
SALIX DRUMMONDIANA
Marssonina kriegeriana
Melampsora epitea
Melampsora ribesii-purpureae

Rhytisma salicinum
SALIX EXIDUA
Marssonia kriegeriana
Marssonina kriegeriana
Melampsora abieti-capraearum
Melampsora bigelowii
Rhytisma salicinum
SALIX FLUVIATILIS
Melampsora bigelowii
Rhytisma salicinum
SALIX GEYERIANA
Melampsora epitea
Melampsora paradoxa
Melampsora ribesii-purpureae
SALIX GLAUCOPS
Gloeosporium boreale
Marssonina kriegeriana
SALIX LAEVIGATA
Melampsora ribesii-purpureae
SALIX LASIANDRA
Cylindrosporium conservans
Septogloeum salicis-fendlerianae
SALIX LIGULIFOLIA
Melampsora ribesii-purpureae
SALIX LUTEA
Melampsora paradoxa
Melampsora ribesii-purpureae
SALIX MONTICOLA
Gloeosporium boreale
Marssonina kriegeriana
Rhytisma salicinum
Uncinula salicis
SALIX MYRTILLIFOLIA
Melampsora paradoxa
SALIX NELSONII
Melampsora bigelowii
SALIX NUTTALLII
Melampsora ribesii-purpureae
SALIX PSEUDOCORDATA
Melampsora paradoxa
Melampsora ribesii-purpureae
Uncinula salicis
SALIX SCOULERIANA
Melampsora bigelowii
Melampsora epitea
Melampsora ribesii-purpureae
Rhytisma salicinum
Uncinula salicis
SALIX SUBCOERULEA
Marssonina kriegeriana
Melampsora abieti-capraearum
Melampsora ribesii-purpureae
SALVIA LEMMONII
Puccinia biporula
SALVIA PINGUIFOLIA
Puccinia vertisepta
SAMBUCUS SP.
Septoria sambucina
SANGUISORBA SITCHENSIS
Ovularia bulbigera
SARCOBATUS VERMICULATUS
Puccinia aristidae
SAXIFRAGA ARGUTA
Phyllosticta saxifragarum
Puccinia heucherae
Sphaerotheca humuli
SAXIFRAGA LYALLII
Puccinia heucherae
SAXIFRAGA RHOMBOIDEA
Puccinia heucherae
SCHOENOCRAMBE LINIFOLIA
Puccinia consimilis
Puccinia holboellii
Puccinia monoica
SCIRPUS AMERICANUS
Puccinia obtecta
SCIRPUS MICROCARPUS
Puccinia mcclatchieana
SCUTELLARIA GALERICULATA
Septoria scutellariae
SENECIO CRASSULUS
Puccinia senecionis
Puccinia subcircinata
SENECIO HYDROPHILOIDES
Ramularia senecionis
SENECIO INTEGERRIMUS
Puccinia expansa
Puccinia stipae
Ramularia senecionis
SENECIO PERPLEXUS
Puccinia stipae
SENECIO RAPIFOLIUS
Ramularia pruinosa
SENECIO SERRA
Ramularia pruinosa
SENECIO SPARTIOIDES
Sphaerotheca humuli
SENECIO TRIANGULARIS
Entyloma calendulae
Phyllosticta garrettii
Ramularia pruinosa
Sphaerotheca humuli
SETARIA GRISEBACHII
Puccinia atra
SHEPHERDIA CANADENSIS
Puccinia allenii
Puccinia coronata
SIDALCEA NEOMEXICANA
Endophyllum tuberculatum
SILENE SCOULERI
Uromyces suksdorfii

SISYMBRIUM ALTISSIMUM
  Albugo candida
SISYMBRIUM IRIO
  Albugo candida
SISYMBRIUM LINIFOLIUM
  Albugo candida
SITANION HYSTRIX
  Puccinia montanensis
  Puccinia recondita
  Puccinia rubigo-vera
  Scolecotrichum graminis
SMELOWSKIA CALYCINA
  Puccinia aberrans
SMILACINA AMPLEXICAULIS
  Phyllosticta smilacinae
  Ramularia smilacinae
SMILACINA STELLATA
  Cylindrosporium smilacinae
  Uromyces acuminatus
SOLANUM TRIFLORUM
  Entyloma physalidis
SOLIDAGO SP.
  Erysiphe cichoracearum
SOLIDAGO CANADENSIS
  Phyllosticta solidaginis
  Ramularia serotina
SOLIDAGO ELONGATA
  Puccinia grindeliae
SOLIDAGO LEPIDA
  Ramularia serotina
SOLIDAGO MISSOURIENSIS
  Coleosporium asterum
  Puccinia dioicae
  Ramularia serotina
SOLIDAGO MULTIRADIATA
  Puccinia grindeliae
SOLIDAGO NANA
  Puccinia stipae
SOLIDAGO PETRADORIA
  Phyllosticta solidaginis
  Puccinia grindeliae
SOLIDAGO SEROTINA
  Ramularia serotina
SOPHIA PROCERA
  Peronospora parasitica
SOPHORA SERICEA
  Uromyces hyalinus
SORBUS SITCHENSIS
  Gymnosporangium tremelloides
SORBUS SCOPULINA
  Gymnosporangium tremelloides
  Gymnosporangium cornutum
SORGHUM HALEPENSE
  Sphacelotheca sorghi
SPARTINA PECTINATA
  Puccinia sparganioides
SPHAERALCEA ANGUSTIFOLIA
  Puccinia sherardiana
SPHAERALCEA COCCINEA
  Puccinia schedonnardi
  Puccinia sherardiana
SPHAERALCEA COULTERI
  Puccinia sherardiana
SPHAERALCEA EMORYI
  Puccinia sherardiana
SPHAERALCEA FENDLERI
  Puccinia sherardiana
SPHAERALCEA LAXA
  Puccinia sherardiana
SPHAERALCEA LOBATA
  Puccinia sherardiana
SPHAERALCEA MARGINATA
  Puccinia sherardiana
SPIRAEA LUCIDA
  Cylindrosporium spiraeicolum
  Podosphaera oxyacanthae
SPIRAEA SPLENDENS
  Cylindrosporium filipendulae
STACHYS COCCINEA
  Puccinia pallidissima
STACHYS PALUSTRIS
  Erysiphe galeopsidis
STENOTUS ACAULIS
  Puccinia grindeliae
STEPHANOMERIA TENUIFOLIA
  Puccinia harknessii
STIPA COLUMBIANA
  Darluca filum
  Puccinia substerilis
STIPA COMATA
  Puccinia stipae
  Ustilago hypodytes
STIPA LETTERMANII
  Puccinia substerilis
STIPA PRINGLEI
  Puccinia durangensis
  Puccinia stipae
STIPA ROBUSTA
  Puccinia scaber
STIPA SCRIBNERI
  Puccinia substerilis
STIPA VIRIDULA
  Puccinia substerilis
STREPTANTHUS ARIZONICUS
  Peronospora parasitica
SWERTIA RADIATA
  Cercospora fraserae
SWERTIA PERENNIS
  Puccinia swertiae
SYMPHORICARPOS SP.
  Cercospora symphoricarpi
  Puccinia symphoricarpi

SYMPHORICARPOS ALBUS
- Puccinia crandallii
- Puccinia symphoricarpi
- Septoria signalensis

SYMPHORICARPOS OCCIDENTALIS
- Lasiobotrys lonicerae
- Microsphaera diffusa
- Puccinia crandallii
- Puccinia symphoricarpi

SYMPHORICARPOS OREOPHILUS
- Puccinia crandallii
- Septoria oedospora
- Septoria signalensis

SYMPHORICARPOS RACEMOSUS
- Puccinia crandallii

SYMPHORICARPOS VACCINIOIDES
- Cercospora symphoricarpi
- Puccinia crandallii
- Puccinia symphoricarpi
- Septoria signalensis

SYNTHERIS PINNATIFIDA
- Puccinia acrophila

SYNTHYRIS WYOMINGENSIS
- Sphaerotheca humuli

TARAXACUM OFFICINALE
- Puccinia hieracii
- Ramularia taraxaci
- Sphaerotheca humuli

TARAXACUM VULGARE
- Puccinia hieracii

TETRAMERIUM HISPIDUM
- Puccinia tetramerii

THALICTRUM FENDLERI
- Puccinia recondita
- Tranzschelia thalictri

THALICTRUM OCCIDENTALE
- Puccinia clematidis
- Puccinia recondita
- Puccinia rubigo-vera

THELYPODIUM LASIOPHYLLUM
- Peronospora parasitica

THERMOPSIS DIVARICARPA
- Ascochyta thermopsidis
- Cercospora thermopsidis
- Erysiphe polygoni

THERMOPSIS RHOMBIFOLIA
- Cercospora thermopsidis

THLASPI MONTANUM
- Puccinia monoica

TRAGOPOGON PORRIFOLIUS
- Albugo tragopogonis

TRIFOLIUM ANEMOPHILUM
- Uromyces minor

TRIFOLIUM DASYPHYLLUM
- Uromyces minor

TRIFOLIUM HYBRIDUM
- Polythrincium trifolii

TRIFOLIUM LONGIPES
- Erysiphe polygoni
- Ramularia trifolii
- Uromyces minor

TRIFOLIUM PARRYI
- Phyllosticta alpinicola
- Uromyces minor

TRIFOLIUM RYDBERGII
- Ramularia trifolii

TRIGLOCHIN MARITIMA
- Puccinia aristidae

TRISETUM SPICATUM
- Puccinia monoica
- Puccinia recondita
- Puccinia rubigo-vera

TRITICUM AESTIVUM
- Heterosporium avenae

TROLLIUS ALBIFLORUS
- Cylindrosporium montenegrinum
- Phyllosticta trollii

URTICA DIOICA
- Puccinia caricina

URTICA GRACILIS
- Cylindrosporium urticae
- Puccinia caricina
- Puccinia caricis

URTICA GRACILENTA
- Septoria urticae

VACCINIUM SP.
- Pucciniastrum goeppertianum

VACCINIUM CAESPITOSUM
- Pucciniastrum goeppertianum
- Pucciniastrum vaccinii

VACCINIUM MEMBRANACEUM
- Exobasidium vaccinii-uliginosi
- Pucciniastrum goeppertianum
- Pucciniastrum myrtillii
- Pucciniastrum vaccinii

VACCINIUM OREOPHILUM
- Microsphaera alni
- Pucciniastrum myrtillii

VACCINIUM SCOPARIUM
- Exobasidium vaccinii
- Exobasidium vaccinii-uliginosi
- Pucciniastrum goeppertianum
- Pucciniastrum myrtillii
- Pucciniastrum vaccinii

VALERIANA CERATOPHYLLA
- Aecidium sp.

VALERIANA EDULIS
- Cercoseptoria valerianae

Puccinia dioicae
VALERIANA FURFURESCENS
Erysiphe cichoracearum
VALERIANA OCCIDENTALIS
Puccinia dioicae
VERATRUM CALIFORNICUM
Cylindrosporium veratrinum
Phyllosticta melanocarpa
Puccinia veratri
VERBENA SCABRA
Septoria verbenae
VERONICA AMERICANA
Entyloma veronicae
VERONICA WORMSKJOLDII
Puccinia wulfeniae
VICIA AMERICANA
Uromyces coloradensis
Uromyces fabae
VICIA TRIFIDA
Microsphaera alni
VIGUIERA DENTATA
Coleosporium viguierae
Puccinia abrupta
Puccinia calanticariae
VIGUIERA MULTIFLORA
Puccinia aemulans
Puccinia enceliae
VIOLA SP.
Puccinia violae
Septoria violae
VIOLA CANADENSIS
Puccinia violae
Sphaerotheca humuli
VIOLA LINGUAEFOLIA
Ramularia ionophila
VIOLA NUTTALLII
Ramularia ionophila
VIOLA RUGULOSA
Sphaerotheca humuli
VIOLA RYDBERGII
Puccinia violae
VIOLA VALLICOLA
Ramularia ionophila
WYETHIA AMPLEXICAULIS
Cylindrosporium wyethiae
Didymaria conferta
Didymaria wyethiae
WYETHIA ARIZONICA
Puccinia balsamorhizae
WYETHIA HELIANTHOIDES
Sphaerotheca humuli

XANTHIUM ECHINATUM
Puccinia xanthii
XYLORRHIZA GLABRIUSCULA
Puccinia grindeliae
XYLORRHIZA PARRYI
Puccinia grindeliae

YUCCA SP.
Torula herbarum
YUCCA BREVIFOLIA
Kellermannia major
YUCCA ELATA
Kellermannia yuccaegena
YUCCA GLAUCA
Coniothyrium concentricum
Didymosphaeria clementsii
Kellermannia anomala
Kellermannia yuccaegena
Phragmodothis conspicua

ZAUSCHNERIA CALIFORNICA
Septoria gaurina
ZYGADENUS ELEGANS
Puccinia grumosa
ZYGADENUS GRAMINEUS
Puccinia grumosa
Uromyces zygadeni

ON ARTIFICIAL MEDIUM
Emericellopsis stolkiae

ON DUNG
Lasiobolus pilosus

ON GROUND
Amanita muscaria
Boletus edulis
Boletus versipellis
Calvatia cyathiformis
Cantharellus cibarius
Clavaria flava
Clavaria pistillaris
Clavaria purpurea
Clitocybe infundibuliformis
Cortinarius flavifolius
Cortinarius glaucopoides
Cortinarius mucifluus
Gasterocybe lateritia
Geopyxis cupularis
Helvela infula
Hydnum imbricatum
Hygrophorus calophyllus
Lactarius deliciosus
Polyporus circinatus
Polyporus ovinus
Polyporus tomentosus
Pseudoplectania nigrella
Secotium agaricoides
Sepultaria aurantia
Thelephora caryophyllea

ON WOOD
- Auricularia auricula-judae
- Coniophora corrugis
- Corticium byssinum
- Dasyscypha arida
- Exidia saccharina
- Fomes pini
- Guepiniopsis alpinus
- Lachnellula chrysophthalma
- Polyporus abietinus
- Stereum sanguinolentum
- Trametes mollis

MYCOTAXON

Vol. X, No. 1, pp. 93-98 October-December 1979

CONIDIUM ONTOGENY AND MORPHOLOGY OF *CERCOSPORA KIKUCHII*

C.-C. YEH AND J. B. SINCLAIR

Graduate Research Assistant and Professor, Respectively, Department of Plant Pathology, University of Illinois, Urbana, Illinois 61801.

Summary

Conidium development and morphology of an isolate of *Cercospora kikuchii* (American Type Culture Collection 36864) recovered from purple-stained soybean seeds (*Glycine max* (L.) Merr. cv. Amsoy) was studied on carrot leaf-decoction agar (CLDA) and on artificially inoculated soybean tissues. The morphological characters of the isolate did not vary between the two substrates. The conidia developed holoblastically from integrated, sympodial conidiogenous cells within 36 hours (optimum: 4 to 5 days) on CLDA under 12 hours of artificial light at room temperature (23 to 27C). Mature conidia varied in size and septation. The conidiophores attained a length of 2 mm in 7 days on CLDA. The distance between conidial scars on conidiophores varied from 10 to 150 µm.

Introduction

Cercospora kikuchii (Matsumoto & Tomoyasu) Gardner, the causal fungus of purple seed stain of soybean (*Glycine max* (L.) Merr.), was discovered by R. Kikuchii in 1922 and described by Matsumoto and Tomoyasu in 1925 as *Cercosporina kikuchii* (7). Garner (2) transferred the fungus to the genus *Cercospora* in 1926. Sporulation on artificial media was not obtained (1,6,7) until the development of conidia was reported on carrot leaf-decoction agar (CLDA) by Kilpatrick (4) and on dead soybean tissue by Vathokas and Walters (9). Most of the morphological descriptions of *C. kikuchii* were made from infected plant tissues (5,6,7) with a discussion of the

sympodial development but conidium ontogeny was not illustrated. We report on the morphology and development of conidiophores and conidia of an isolate of *C. kikuchii* on CLDA and infected soybean tissues.

Materials and Methods

Cercospora kikuchii, labeled Ck-1 (American Type Culture Collection 36864), was recovered from soybean seeds with symptoms of purple seed stain and maintained on Difco potato-dextrose agar (PDA). Herbarium material of this isolate is preserved in the Illinois Natural History Mycological Herbarium as ILLS 37919. Carrot leaf-decoction agar (CLDA) (4) was prepared for the inoculum multiplication and microscopic studies. Carrot leaf-decoction plates were inoculated by using a soft sterile brush containing a mycelial suspension of the test fungus from PDA cultures incubated under 12 hours of alternating light and dark at room temperature (23 to 27C). The light source consisted of two 20-watt cool white fluorescent bulbs set 30 cm apart. Soybean (cv. Amsoy 71) plants were sprayed with a suspension of mycelia and conidia (ca. 5,000/ml) in the field at early-pod stage (R_6) (3).

The morphology and ontogeny were studied in culture on CLDA and on infected soybean (cv. Amsoy) leaves, stems and seeds. Specimens of the test fungus were prepared and preserved for light microscopy study using Amann's mounting fluid-lactophenol containing 0.05% cotton blue (8). Measurements were taken with a micrometer on an Olympus BHA microscope.

Results and Discussion

ONTOGENY: The Ck-1 isolate of *C. kikuchii* produced conidia and conidiophores on CLDA within 36 hours after inoculation and within 24 hours on infected soybean leaves, stems and seeds. The conidiophores were in fasciles, several to more than 20 stalks on a stroma. Conidiophores were yellowish-brown to dark-brown at the base with a gradual decrease in coloration up the stalk until the tips appeared hyaline. No conidial scars were

observed on newly formed conidiophores (Fig. 1), but were evident on the old conidiophores (Figs. 2 and 3). The distance between scars varied from 10 to 150 µm. Conidiophores reached a length of over 2 mm from CLDA cultures after 7 days.

A holoblastic conidium was produced at the tip of all conidiophores (Fig. 4). As the conidium matured, a crosswall was formed at the attachment site of the conidium to the conidiophore (Fig. 5). Mature conidia were detached easily and the conidiophores proliferated sympodially (Fig. 7) to form another conidiogenous locus at the new apex (Fig. 5). Conidia were hyaline, acicular, truncate, straight or curved, multiseptate and had a thickened hilum (Fig. 8). Conidia may develop in an alternating manner but it is not a persistent feature (Figs. 3 and 6). Five or six conidia may be produced from one conidiophore in 7 days. Conidia germinated in distilled water with one to many germtubes within 2 to 3 hours (Fig. 9).

MORPHOLOGY: The size of conidiophores and conidia did not vary with substrates (Table 1), but were generally larger than those reported from soybean in Japan (7) and smaller than those from soybeans in North Carolina (6). The range and size of conidiophores and conidia *in vitro* from Japan were 4 to 6 x 85 to 200 µm and 4 to 5 x 70 to 164 µm with 0 to 22 septations, respectively; and those from North Carolina were 3.2 to 6.1 x 36 to 286 µm and 1.3 to 6.1 x 38.8 to 445 µm with 2 to 49 septations, respectively. The development and morphology of *C. kikuchii* may be influenced by environmental factors such as substrate, pH and relative humidity (6,7) and this could account for, in part, the differences previously cited and reported in this paper.

.Acknowledgments

The research was supported in part by the Illinois Agricultural Experiment Station and the International Soybean Program (INTSOY). The authors thank J. Lee Crane, Mycologist, Illinois Natural History Survey, Urbana, IL 61801 for critically reviewing the manuscript.

Table 1. Size and occurrence of conidial scars on conidiophores and size and number of septations in conidia of *Cercospora kikuchii* grown on various substrates.

Substrate[1/]	Measurements in µm[2/]		Range in occurrence	
	Conidiophores	Conidia	Scars per conidiophore	Septations per conidia
CLDA	3.2 - 5.0 x 122 - 448	2.5 - 3.2 x 85.8 - 312	0 - 6	1 - 23
Soybean				
Leaves	3.2 - 5.6 x 101 - 644	2.0 - 3.0 x 84 - 267	0 - 2	2 - 19
Stems	2.8 - 5.2 x 78 - 435	1.5 - 2.6 x 72 - 280	0 - 2	2 - 20
Seeds	2.9 - 5.2 x 57 - 464	2.6 - 3.9 x 91.2 - 299	0 - 2	1 - 22

1/ CLDA = Carrot leaf-decoction agar; soybean leaves, stems and seeds from infected soybean plants grown in the field.

2/ Averages based on 50 measurements.

Figures 1-9. *Cercospora kikuchii* grown on carrot leaf-decoction agar and inoculated soybean tissues. 1. Fascicle of young conidiophores arising from a stroma. 2. Fascicle of conidiophores from a stroma showing conidial scars (arrows). 3. Fascicle of mature conidiophores illustrating the geniculate arrangement of the prominant conidial scars. 4. Holoblastic development of a conidium at the apex of a conidiophore. 5. Delimitation of a septum between developing conidium and conidiophore. 6. Conidiophore illustrating the alternate arrangement of the conidial scars. 7. Sympodial development of the conidiophores. 8. Mature conidia. 9. Germination of conidia.

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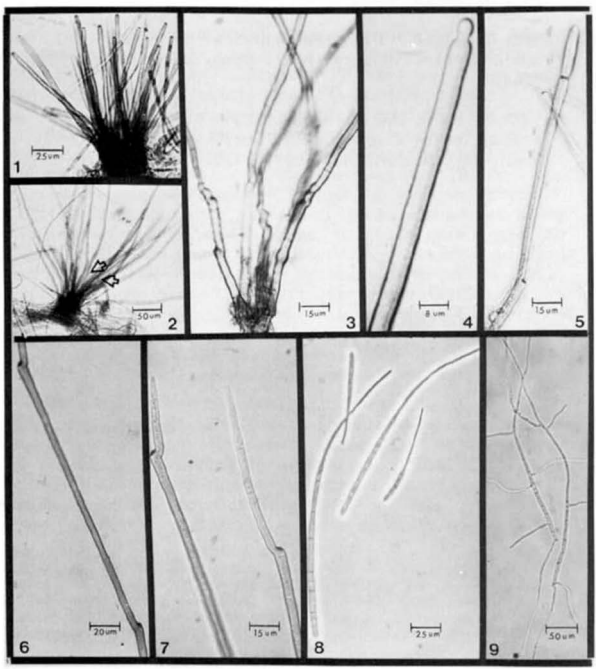

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MYCOTAXON

Vol. X, No. 1, pp. 99-104 October-December 1979

COMPLEXIPES MONILIFORMIS: A NEW GENUS AND SPECIES TENTATIVELY PLACED IN THE ENDOGONACEAE[1/]

CHRISTOPHER WALKER

Forest Pathology Laboratory, Department of Forestry
Iowa State University, Ames, Iowa 50011

While investigating the Endogonaceae of Iowa, I sampled soil from the Ames High School Pinewood, Ames, Iowa. This area is a small plantation of red pine (*Pinus resinosa* Ait.), Scots pine (*P. sylvestris* L.), and eastern white pine (*P. strobus* L.) about 35 years old. The ground cover consists of virginia creeper (*Parthenocissus quinquefolia* (L.) Planch.) in a dense monospecific mat. The soil was sampled for endogonaceous spores with a centrifugation and sugar-flotation technique similar to that of Jenkins (1964). *Glomus fasciculatus* (Thaxter sensu Gerdemann) Gerdemann & Trappe and *G. etunicatus* Becker & Gerdemann were present in great abundance, along with another rather ornate spore, which is here named and placed in the new genus *Complexipes*. Specimens have been deposited in the Oregon State University Herbarium (OSC) and in the Iowa State University Herbarium (ISC). In addition, I have retained some in my personal collection (Walker #27).

Complexipes moniliformis Walker gen. et sp. nov. Fig. 1

Sporocarpia ignota. Chlamydosporae globosae, 55-110 µm in diam, ferruginae vel atrocinnamomeae, tunica stratis tribus: exteriore ± 1 µm, medio usque ad 6 µm, interiore 0.5-1 µm. Pagina sporae rugosa vel papillosa, altitudo ornamenti usque ad 4 µm. Hypha affixa papillosa vel interdum rugosa, bitunicata, septata cellusis usque ad novem, ad septa constricta, cellula ad basim sporae

1/ Journal Paper No. J-9539 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 2294. Taken from a Ph.D. dissertation submitted to the Graduate Faculty of Iowa State University, 1979.

cupulata, usque ad 24 x 24 µm. TYPUS: Ames, Iowa, U.S.A., Walker #27 (OSC).

Sporocarps unknown. *Chlamydospores* borne singly in the soil, terminal on a single hyphal attachment, globose, 55-110 µm in diam, orange-brown to dark red-brown. Spore wall three-layered, with an outer layer 0.5-1 µm thick fused to a middle layer up to 6 µm thick and an inner layer 0.5-1 µm thick. Outer layer often difficult to distinguish even in crushed specimens, ornamented with crowded folds and papillae up to 4 µm high.

Subtending hypha with a thick 2-layered wall and up to nine cells formed by septa derived from the inner wall, the cells slightly constricted at the septa and readily detaching from the spore base to leave a light-colored circular scar; hyaline to pale yellow, the subtending cell usually brown tinted, papillate to occasionally rugose, the ornamentation less dense than on the spore. Subtending cell usually cup-shaped, up to 24 x 24 µm.

Hyphae in the soil pale yellow, thick-walled, sparsely low rugose, coenocytic, up to 6 µm in diam, the walls up to 1 µm thick.

DISTRIBUTION AND HABITAT.

In soils around roots of virginia creeper (*Parthenocissus quinquefolia*) in a pine plantation. Mosse & Bowen (1968) described a fungus that probably is *C. moniliformis* as a "crenulate spore" from soils in New Zealand and Australia, but they gave no details of associated plants. Thapar & Khan (1973) also recorded and figured a similar spore from their survey of some Indian soils. Their records were from forest nurseries on grassland soils in Kerala State, but host species were not identified. Hall (1977) discovered a similar species in a disused garden in New Zealand and, in the same publication,

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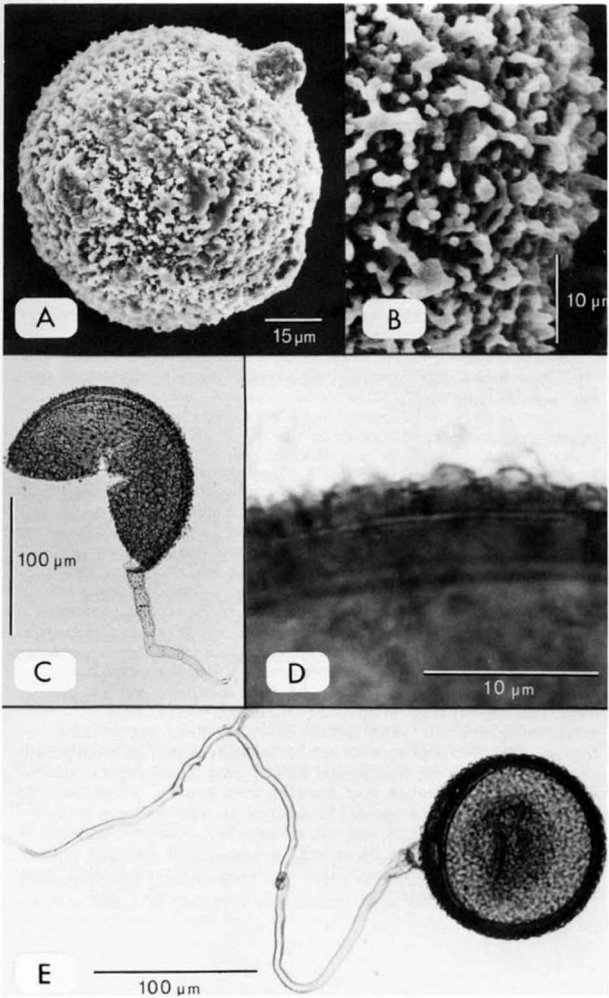
Figure 1. *Complexipes moniliformis*.

(A) Scanning electron micrograph of a mature spore showing cupulate suspensor-cell. (B) Detail of complex outer wall coating. (C) Light micrograph of a mature spore showing moniliform subtending hypha. (D) Detail of wall structure. (E) Mature spore attached to coarse non-septate hypha.


A
15 µm
B
10 µm
100 µm
C
D
10 µm
E
100 µm

cited Dr. Barbara Mosse as having found it in Germany. Wilcox *et al.* (1974) describe and excellently illustrate this fungus (as BDG-58) in detail and also refer to Mikola's "E-57" and "E strain" as the same species. Both "BDG-58" and the "E" fungi were associated with the roots of pine trees.

MYCORRHIZAL ASSOCIATIONS.

Forms ectendomycorrhizae with pines (Wilcox *et al.*, 1974). Associated in the field at the type location with mycorrhizal roots of pines and virginia creeper.

ETYMOLOGY.

Genus - Latin, "complex base" referring to the complex form of the subtending hypha.

Species - Latin, "necklace-like", also referring to the subtending hypha.

DISCUSSION.

Complexipes differs from other genera in the Endogonaceae by having a moniliform subtending hypha and a highly ornamented outer coat, which seemingly is secreted by the middle wall layer and becomes more complex with maturity. *Gigaspora* species have azygospores produced on a bulbous suspensor cell, which often is formed terminally on a septate hypha. *Complexipes* chlamydospores are borne on a cupulate cell and, whereas the hyphae of *Gigaspora* do not break readily at the septa, the moniliform cells of *Complexipes* are readily separable. Individual *Glomus* and *Sclerocystis* chlamydospores have some similarities with those of *Complexipes*, but do not have the cup-shaped suspensor cell and moniliform subtending hypha. When detached from their subtending hypha, *Complexipes* spores could be mistaken for similarly detached spores of *Gigaspora heterogama* (Nicol. & Gerd.) Gerdemann & Trappe or for *Acaulospora* spores. Care should be taken to see that sessile spores in the Endogonaceae are correctly identified. Fortunately, numerous spores are generally present in a soil sample, and careful comparison of all spores from the sample usually will lead to correct conclusions.

Wilcox and his co-workers have shown that *C. moniliformis* is culturable and has septate hyphae. However, the small amount of hyphae found in my field collections is but sparsely septate (Fig. 1E) and is coarse and thick-walled. It appears more akin to the coenocytic hyphae of the Endogonaceae than to the more regularly septate hyphae of most ascomycetes. Hall (1977) suggested that it might be an ascomycete, but in the same paper, he described the hyphae as being aseptate. As far as I can judge from the plates in Wilcox *et al.*, some lengths of hyphae in their cultures were aseptate. Septa are not uncommon in hyphae of the Endogonaceae.

That the BDG-58 fungus of Wilcox *et al.* was ectendomycorrhizal rather than endomycorrhizal does not preclude its membership in the Endogonaceae. Members of the family form endo- and ectomycorrhizae, some species are seemingly saprobic, and the mycorrhizal relationships of yet others are unknown (Gerdemann & Trappe, 1974). The fungus sporulated only when associated with plant roots (Wilcox *et al.*). This also is in line with the behavior of the culturable *Endogone eucalypti* nom. ined. (Warcup, 1975). In addition, the mycorrhizae formed by the BDG-58 fungus (as illustrated by Wilcox *et al.*) are not altogether unlike those formed by *Glomus* or *Gigaspora* under some circumstances, despite the authors' comments to the contrary. The intracellular structures could certainly be considered as arbuscular in general appearance, albeit somewhat coarse. The "Hartig net" is analogous in some ways to the often highly septate intercellular hyphae of vesicular-arbuscular mycorrhizae. The description of the sheath suggests an apparent similarity to that formed on *Eucalyptus* by *Endogone eucalypti*.

I have concluded, therefore, that *Complexipes* sufficiently resembles fungi already placed in the Endogonaceae to be provisionally placed as a new genus in that family.

ACKNOWLEDGEMENTS.

I wish to thank Dr. James M. Trappe for his helpful comments, for preparing the Latin diagnosis, and for suggesting the generic and specific names.

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MYCOTAXON

Vol. X, No. 1, pp. 105-115 October-December 1979

FUNGI OF THE GULF COAST I. TWO NEW SPECIES OF *HYGROPHORUS* SECTION *HYGROCYBE*[1]

WILLIAM G. CIBULA

Department of Biology
University of Southern Mississippi
Hattiesburg, MS 39401

SUMMARY

Two new species of *Hygrophorus* section *Hygrocybe* from the Gulf Coast of Mississippi are described. *Hygrophorus mississippiensis* appears to have affinities with species known from the tropics notably *H. firmus* var. *trinitensis* Dennis and *Hygrocybe mexicana* Singer. *Hygrophorus chamaeleon* possesses a two-layered cuticle. As the deeper stratum has pigmented hyphae, the effects of the presence or absence of water in the interstices of the uppermost layer of hyaline hyphae has a marked effect on the pileus color of this agaric. This property appears to be unique and the optical aspect of this phenomenon is discussed. Also, pigment separations by means of paper chromatography are described and compared with other Hygrocybes. Color data is given in Munsell notation and both ISCC-NBS and Ridgway equivalents are given where possible.

[1] Based in part on a dissertation submitted to the Graduate School of the University of Massachussetts in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

The mycological flora of the Mississippi Gulf Coast has not had much study. The only information on Gulf Coast agarics is that available from studies of Murrill in Florida (for a synopsis of these studies see Weber 1961 and Murrill 1972), that of Thiers (1956, 1957, 1958 and 1959a) from east Texas and Jenkins (1978) who has studied some elements of the *Amanita* flora from the southeast. The Boletaceae have been partially studied by Singer (1945-1947) and Thiers (1956 and 1959b).

There is a greater diversity of vegetation in the Gulf Coastal Plain than in the adjoining piedmont and mountains (Wells, 1928 and 1942), and the plant communities of the Coastal Plain are most highly developed in the lower southern part. Also, this area is an ecotone between the temperate and subtropical climate zones (Watson, 1975).

As a result of the diversity of the higher plant communities and the transitional nature of this area, it is to be expected that the Gulf Coastal Plain might support an endemic agaric population or have Neotropical representatives. This study represents a contribution to an analysis of the higher fungal flora of this region.

Original color data were obtained in Munsell notation through the use of the Munsell Book of Color (Munsell Color Company, Inc., 1967). For the descriptive narrative, the ISCC-NBS color names have been used (Kelly and Judd, 1976, Inter-Society Color Council, 1965). The original Munsell notations are given at the end of the macroscopic portions of the descriptions with the closest Ridgway (Ridgway, 1912) equivalent (Rayner 1970; Cibula, unpublished data) parenthesized immediately after the Munsell notation, e.g. 6.25R 3/12 (carmine).

Hygrophorus mississippiensis Cibula sp. nov.
Fig. 1 A, B, E.

Pileus 5-8 (10) mm latus, tenuis, convexus demum applanatus vel depressus, puniceus, ad marginem luteus demum albus; siccus et squamulosus; caro pilei tenuis, rubella. Lamellae arcuatae, subdistantes, crassae, uncinatae, latae, triangulares, roseobubalinae, salmoneo-pallidae vel ferrugineae. Stipes 2.5-3.0 cm longus, 1.0 mm latus, cylindricus, udus vel siccus, cavus, ruber. Sporae in cumulis

albae, haud amyloideae, ellipsoideae vel subovatae, leves, 7.5-8.4 x 4.7-5.8µm. Basidia tetraspora, clavata hyalinis, 31-38 x 7-9.4µm. Fibula adsunt. Specimen typicum legit prope Saucier, MS, 8 August 1974 in Herb. Mass conservatum est. Wm. Cibula n 485.

Pileus 5-8 (10) mm broad, convex to flattened or becoming broadly convex-depressed; color vivid red to deep red, somewhat lighter near the margin with a very narrow white to yellowish margin in some mature specimens (which contrasts with the deep red of the disc), red color retained well in older basidiocarps, not viscid, but surface dry and composed of radially arranged, highly pigmented hyphae which group together in upturned fascicles giving the pileus a scurfy to squamulose appearance, this aspect more pronounced near the disc where the squamules have a cirumferential arrangement and increase in size towards the center. Context thin, hygrophanous, reddish.

Lamellae convexly arcuate, subdistant, emarginate, with an acuminate decurrent tooth on the stipe, thick, ± triangular, with one tier of lamellulae; color pale yellow to light yellowish brown occasionally with a slight reddish tint giving a light to moderate yellowish pink color.

Stipe 2.5-3 cm long, about 1 mm thick, cylindric, over entire length somewhat lighter in color than pileus, darker near base, lighter near or at apex, not viscid, glabrous with a silken sheen, hollow; interior context fibrous, concolorous with exterior.

Munsell color data: Pileus - 6.25R 3/12 (carmine) to 7.5R 3/12 (sl. deeper than scarlet red), lighter near margin, 7.5R 3.2/10 (no Ridgway equivalent). Lamellae - 7.5YR 7.5/5 (close to "light pinkish cinnamon") to 10YR 9/4 (close to "pale ochraceous-salmon"), occasionally with a slight reddish hue 10R 5/8 (near "vinaceous rufous"). Stipe - 7.5R 4/14 (close to "Nopal red"), 10R 5/10 (sl. darker than Carnelian Red) near juncture with pileus.

Spore deposit chalky white; spores inamyloid, hyaline in water mounts; ellipsoid to subovoid, 7.5-8.4 x 4.7-5.8 µm, thin-walled, apiculus distinct; content of fresh spores (in water) granular. Basidia 31-38 x 7-9.4µm, clavate, 4-spored as far as noted, monomorphic. Pleurocystidia apparently absent; cheilocystidia apparently absent.

Gill trama of parallel hyphae ± 12μm wide, hyaline in water mounts; clamps present. Context hyphae irregularly inflated (the cells 25-40 x ± 25μm), hyaline in water mounts of fresh material. Cuticular hyphae strongly pigmented, thin-walled, the cells 95-205 x 18-19μm, the pigment evenly distributed throughout the cell. The hyphae immediately below the strongly pigmented surface hyphae are similar in size and shape, but when seen individually, appear hyaline; seen in groups a yellow tint is present.

Habit, habitat and distribution: Gregarious beneath mixed hardwood and pine, adjacent to Loblolly Pine, Block IV, Plot 4, Fertilization Study Plots, Harrison Experimental Forest, De Soto National Forest, Saucier, MS: on a raised mound of earth and stumps, and in leaf litter in mixed bottomland hardwoods, Harrison Experimental Forest. One collection (No. 485), consisted of numerous sporophores.

Material Studied: No. 485, De Soto National Forest, Saucier, MS, 8 August 1974; No. 554, De Soto National Forest, Saucier, MS, 16 June 1975; Nos. 608 and 610, De Soto National Forest, Saucier, MS, 9 July 1976; No. 711, De Soto National Forest, Saucier, MS, 8 Sept. 1977.

Observations: Both rhodohygrocybin and flavohygrocybin are abundant (Cibula, 1976; R_f = 0.18 and 0.48, acetone/H_2O 6:4), and additionally another yellow pigment (R_f = 0.24), is moderately abundant. This agaric appears to be closely related to *H. firmus* var. *trinitensis* Dennis (Dennis, 1953; Hesler and Smith, 1963). Basidia lengths agree and spore sizes fall within the range for var. *trinitensis*, but this variety has coral red lamellae, and is at most only slightly scurfy over the pileus. There is also close similarity to *Hygrocybe mexicana* Singer (Singer, 1958) but this species is reported as having a glabrous pileus. Spore and basidia sizes agree. *H. mississippiensis* differs from *H. firmus* Berkeley and Broome var. *firmus* (Berkeley and Broome, 1871; Singer, 1957; Hesler and Smith, 1963) in not having dimorphous basidia and spores. Furthermore, in their original publication, Berkeley and Broome report that the pilei of their collection (No. 880) was yellow and minutely tomentose. In light of this, more recent interpretations of *H. firmus* (and its variatal forms) are probably incorrect. It is necessary to have a magenta pigment (rhodohygrocybin) in addition to yellow to

produce a red color. This represents a significant metabolic difference between yellow and red Hygrocybes. For this reason, this species is not considered as a variety of *H. firmus* in the modern sense and it is certainly different from *H. firmus* sensu Berkeley and Broome. Although apparently related to *H. cantharellus*, (Schw.) Fr. this agaric is distinguished by its more diminutive stature, more saturated red coloration of the pileus and stipe, a probably more southern distribution, as well as the rather strong yellow pigment band at R_f = 0.24 (acetone/water 6:4) noted on chromatograms prepared from crude pigment extracts. Also, this species does not "fit" any of the seventeen Malayan varieties of *H. firmus* described by Corner (1936).

Hygrophorus chamaeleon Cibula sp. nov.
Fig. 1 C, D.

Pileus 1.3-4 cm latus, convexus demum convexo-depressus, postea late depressus; miniatus demum in sicco bubalinus, aliquot pilei cum viridi-flavus; siccus, fibrillosus; caro pilei tenuis, persicinus. Lamellae distantes crassae adnatae demum decurrentes, luteolae, flavovirens vel roseae. Stipes 3-6.5 cm longus, 5-9 mm latus, ruber, cylindraceus, udus, glaber, cavus. Sporae in cumulis albae, haud amyloideae, 12-17 x 7-10µm et 6.5-8.5 x 4.5-5 µm, leves, dimorphae. Basidia 35-40 x 6-9µm, clavata. Cheilocystidia numerosa, clavata, 45-65 x 9.4-12.5µm. Cutis pileorum bistratosus. Fibulae adsunt. Specimen typicum Cibula n. 589 in Herb. Mass conservatum est; legit prope Saucier, MS, 8 August 1974.

Pileus: 1.3-4 cm broad; plano-convex to convex-depressed, becoming depressed; margin finally upturned and then infundibuliform; color very variable from deep red to dark olive buff with some caps showing shades of greenish-yellow, this variability due both to drying and to areas which were covered by debris. When moist, dark red or deep red to dark reddish brown and moderate reddish brown; some at the extreme margin and where the pileus was rimose were a moderate yellow in color. When dry, pileus then light reddish brown to brownish orange, with one very dry pileus a dark grayish-yellow. Where covered by leaves, other debris or adjacent pilei, pale yellow to light olive green with some a light olive gray, others more saturated, moderate yellow and light olive also noted; entire surface

covered with abundant radially arranged hyphae which give a fibrillose to fibrillose-squamulose disc; not viscid; at times rimose; margin even, somewhat eroded to eroded-plicate in older sporophores. Context: thin; hygrophanous; yellowish to reddish in color.

Lamellae: broadly adnate to decurrent becoming decurrent in maturity; also quite variable in color both among differing basidiocarps and on a single specimen; pale yellow observed as well as grayish-reddish-orange, while others exhibit greenish-yellow hues with yellowish-gray, grayish-greenish yellow and pale greenish-yellow all being observed; three tiers of lamellulae; distant to subdistant; the edges, especially in older material, are noticeably eroded, appearing almost serrate.

Stipe: 3-6.5 cm long, 5-9 mm broad, red, upper third, dark red and moderate reddish-orange paling both above and below, becoming yellowish closer to the base, brownish-orange to light yellow while at the base, the color nearly white; interior hygrophanous, light yellow; terete, equal to somewhat enlarged near the apex; not viscid; glabrous with a silken sheen; hollow.

Munsell color data: Pileus when moist, 5R 3/4 (somewhat lighter than "maroon") to 7.5R 2/4 (close to "maroon") to 7.5R 3/10 (between "garnet brown" and "carmine") to 10R 3/6 ("Morocco red") some yellowish areas 2.5Y 7/8 (close to "primuline yellow") at extreme margin and where pileus is rimose. When dry, pileus then 2.5YR 5/4 ("fawn color") to 2.5YR 5/8 (close to "ferruginous"), one very dry pileus 5Y 6/3.2 ("dark olive buff"); where covered by leaves, other debris or adjacent pilei, 2.5Y 8/2 (no equivalent, closest to "pale olive buff") to 2.5Y 6/2 (no equivalent) to 5Y 6/2 (between "light grayish-olive" and "dark olive buff") to 2.5Y 7/8 (close to "primuline yellow") to 5Y 5.4/6 (between "olive lake" and "pyrite yellow"). Lamellae variable, 5Y 9/3 (between "ivory yellow" and "cream colored") to 7.5Y 9/3 (closest to "massicat yellow"), some reddish, 10R 5/6 ("terra cotta") while others are 7.5Y 7/2 (no Ridgway equivalent) to 10Y 7/4 no Ridgway equivalent) to 10Y 9/4 ("sulfur yellow") all being observed. Stipe, upper third 7.5R 2.5/9 (no Ridgway equivalent, closest to "garnet brown") and 10R 5/10 (close to "carnelian red") near the base 5YR 5/8 (no Ridgway equivalent; lighter than "amber brown") to 5Y 8.5/8 (close to "empire yellow"); interior 5Y 8.5/6 ("baryta yellow").

Spores: chalky white in deposit; some 12-17 x 7-10μm, others 6.5-8.5 x 4-5.5μm very variable in size; thin-walled; smooth; ellipsoid to ovate; hyaline in KOH; inamyloid.

Basidia: hyaline; narrowly clavate, 35-40 x 6-9.4μm.

Cheilocystidia: numerous, clavate with a umbonate apex; contents granular; thick-walled, 45-65 x 9.4-12.5μm.

Gill trama: parallel; 115-170 x 14-18.7μm; hyaline.

Cuticle: distinctly two-layered, the uppermost composed of non-pigmented radially arranged hyphae which form a trichodermium; the hyphae 58-150 x 11.5-21μm; this hyaline to very pale yellow layer is 55-115μm deep. Second layer of radially arranged and interwoven hyphae, strongly pigmented a deep red; 47-150 x 16-21μm. Clamp connections: present on hyphae in gill trama.

Habit, habitat, and distribution: gregarious to subcespitose; found in low areas chiefly beneath sweet bay *Magnolia virginiana* in leaf litter, Mississippi Gulf Coast, summer. Materials Studied: No. 489, 20 August 1974; No. 555 and No. 556, 16 June 1975; No. 567, 24 July 1975; No. 571 and No. 572, 10 August 1975; No. 607, 9 July 1976; Nos. 712 and 713, 8 Sept. 1977 and No. 724, 22 Sept. 1977 all collections Harrison Experimental Forest, De Soto National Forest, Saucier, MS.

Observations: The larger spores (12-17 x 7-10μm) and the abundant cheilocystidia, suggest a relationship with *H. appalachianensis* but this *Hygrophorus* differs from this species and all others in the subgenus *Hygrocybe* examined in this study by both the hyaline trichodermium which overlay the pigmented hyphae of the cuticle, and by the extreme variability in spore size. The non-pigmented trichodermium is in part, responsible for the variable color observed in this agaric due to differing optical properties when wet or dry. When the sporophore is wet as for example, after a recent rain, water fills the interstices between these hyphae. Under these conditions, the differences in the index of refraction between the water, cell wall and cell contents (n_1 = 1.33 vs n_2 - 1.3-1.5) are not great. Hence, surface reflections from these hyphae are minimized allowing most of the light to pass through this layer and then

to undergo preferential absorption of selected wavelengths from the pigmented hyphae below. However, when dry, air fills the interstices and now the situation is significantly different (n_1 = 1.00; n_2 = 1.3-1.5). Even at perpendicular incidence,[2] approximately 4% of the total light is reflected back to the observer from each air/cell wall surface for each hyphae encountered. The net result is that most of the illumination falling on the pileus is diffusely reflected back to the observer before preferential spectral absorption from the more deeply buried pigmented hyphae can occur.

This unusual optical property has not been observed in any other *Hygrocybe*. The observed greenish-yellow colors appear to be associated with those areas of the pileus which were occluded by other pileii or debris.

ACKNOWLEDGEMENTS

I thank Dr. Alexander H. Smith for his critical review of this manuscript and help with the Latin diagnoses and Dr. Howard E. Bigelow for his guidance and interest in the overall study of pigments in *Hygrophorus* of which this is a part. Dr. Jean Wooten deserves especial thanks for proof reading this manuscript in the author's absence, as does Mrs. Betty Aultman for preparing the camera-ready manuscript.

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[2] In the special case of perpendicular incidence, the reflection, R, from each surface, is given by:

$$R = \frac{(n_2 - n_1)^2}{(n_2 + n_1)^2}$$

where n_1 = index of refr. of first med. n_2 = index of refr. of 2nd med.

As the angle of incidence deviates more and more from 90°, the reflection increases rapidly. A complete treatment of this optical aspect is given by Wood (1934, p. 406-412).

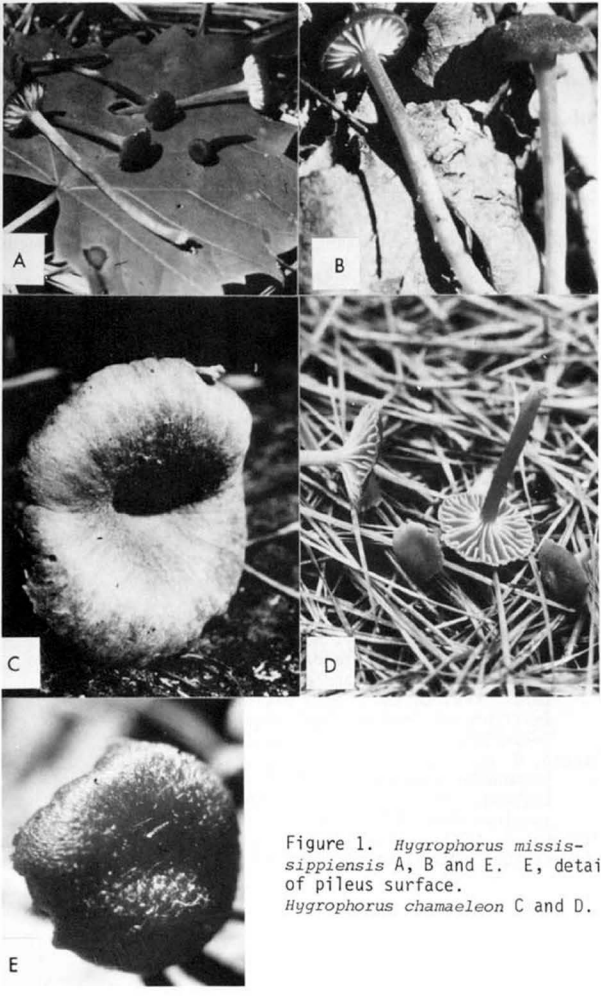

Figure 1. *Hygrophorus mississippiensis* A, B and E. E, detail of pileus surface. *Hygrophorus chamaeleon* C and D.

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MYCOTAXON

Vol. X, No. 1, pp. 116-132 October-December 1979

Mucilopilus, a New Genus of the Boletaceae, with Emphasis on North American Taxa[1]

Carl B. Wolfe, Jr.
Department of Biology
The Pennsylvania State University, Mont Alto, PA 17237

ABSTRACT

Studies of type specimens of *Porphyrellus* taxa revealed the existence of a small group of taxa significantly dissimilar to the type species of the genus. *Mucilopilus*, a new genus of the Boletaceae, is proposed to accomodate these taxa. *Mucilopilus conicus* is proposed as a new combination and *M. conicus* var. *reticulatus* is described as a new variety for North America. New combinations are also proposed for the extralimital taxa studied.

Introduction

Karsten (1881) circumscribed the genus *Tylopilus* as "...*sporae roseae...tubuli stipitati, adnati.*" Gilbert (1931) described the genus *Porphyrellus* as encompassing those taxa with red-brown to purple-brown spores and a dry pileus among other characters. McNabb (1967) proposed *Porphyrellus viscidus*, a taxon whose apparent characters were intermediate between *Tylopilus* and *Porphyrellus*, and based on the strength of the spore characters alone, he proposed Sect. *Pseudotylopili* of *Porphyrellus*.

Fries (1821) in his circumscription of *Boletus felleus*, (type species of *Tylopilus*), indicated that the pileus was dry, and Horak (1968) indicated that the pileus cuticle was composed of cylindric, thin-walled, hyaline, non-gelatinous hyphae. Fries (1835) circumscribed *Boletus porphyrosporus* (type species of *Porphyrellus*) as also exhibiting a dry pileus surface.

Recent studies of the type specimens of species of *Porphyrellus* (Wolfe, 1978) brought to light characters which indicated that *P. viscidus* McNabb (type species of sect. *Pseudotylopili*) was significantly different from *P. porphyrosporus* (Fr.) Gilbert. The character state differences were consistent in the trichodermium, pleurocystidia, and spores. The pileus cuticle of *P. viscidus* was an ixotrichodermium, not a palisade or interwoven trichodermium as in *P. porphyrosporus* . The pleurocystidia of *P. viscidus* are devoid of microchemically reactive contents, a character state not found in *P. porphyrosporus*. Even though the spore deposit color of *P. viscidus* was similar to that of *P. porphyrosporus*, the spore E^m values (length/width ratio) in *Pseudotylopili* and *Porphyrellus* were

[1]Part of a dissertation submitted to the Graduate School of The University of Tennessee in partial fulfillment of the requirements of the Doctor of Philosophy degree.

consistently dissimilar. In *Pseudotylopili* the E^m value was consistently greater than 3.0, whereas in *Porphyrellus* the E^m value was consistently less than 3.0 (Wolfe, 1978). The above characters exhibited by *P. viscidus* violate generic characters as exemplified by *P. porphyrosporus*. *Porphyrellus viscidus* must therefore be removed from *Porphyrellus*. Since *P.viscidus* violates circumscriptional characters of *Tylopilus* as well, it cannot be included in this genus. The character states exhibited by *P. viscidus* and thus sect. *Pseudotylopili* are such that it cannot be conveniently accomodated by any of the genera of the Boletaceae as summarized by Singer (1945, 1947, 1975), Snell & Dick (1970), and Smith & Thiers (1971). It therefore seems justified to recognize a new genus to accommodate those taxa formerly in *Porphyrellus* sect. *Pseudotylopili*.

The color names appearing in quotes are from Ridgway (1912); and the herbaria designations are from Holmgren & Keuken (1974). The term spores as used in this paper refers specifically to basidiospores. The following abbreviations were used for particular measurements: $\underline{D}^m$ = median dimensions; d^m = median diameter or width; $\underline{L}^m$ = median length; $\underline{E}$ = length width ratio; $\underline{E}^m$ = median length/width ratio.

Mucilopilus Wolfe, gen. nov.

≡ *Porphyrellus* sect. *Pseudotylopili* McNabb. 1967. N. Zealand J. Bot. 5: 546.

Pileus viscidus ad mucilaginosus vel siccus, glaber ad tomentosus; cuticula pilei ixotrichodermium. Contextum album, immutatum nocitum. Hymenophorum album immaturum, subcarneum vel violaceum maturatum. Pleurocystidia quandoque praesentia hyalina. Sporae subbrunneae, ferrugineae, ("Russet", "Roods Brown"), *longae, angustae,* E^m *(medium longitudinal/latitudinali proportione) idem vel majus quam 3.0. Species typica Porphyrellus viscidus* McNabb.

Pileus glabrous or floccose-tomentose, viscid to mucilaginous, or dry and scrobiculate; pileus cuticle an ixotrichodermium, in some taxa the gelatin accumulating irregularly among hyphae. Context white to sordid white to brown-white; unchanging on injury; changing or unchanging in KOH. Hymenophore pallid to sordid white young to pallid gray-red, pink, pallid violet at maturity. Tube mouths small (0.25 mm - 1.00 mm diam.), irregularly angular; tubes 5 - 8 mm long; tubes and pores concolorous and unchanging on injury. Stipe equal to tapering above, glabrous, subglabrous, finely velutinate to subpruinose, rarely reticulate, felty; annulus absent. Spore print ferruginous to light brown to "Russet". Spores smooth, subfusiform, E^m 3.0 - 3.5. Pleurocystidia (when present) fusoid-ventricose to lanceolate, rarely 1-septate, void of microchemically reactive contents. Cheilocystidia (when present) equal to subclavate to clavate. Hymenophoral trama bilateral-divergent. Clamp connections absent. Mycorrhizal with Pinaceae and Fagales.

Observations. Taxa of *Mucilopilus* possess similar character states: the pileus cuticle, tube mouths, spore E^m values, and cystidial characters. They are significantly different from those of the type species of *Tylopilus* and *Porphyrellus*. However, taxa of *Tylopilus*, *Porphyrellus*, and *Mucilopilus* share a similar spore print color range: pink-flesh to brown to purple brown. The pileus cuticle of the type species of *Mucilopilus*

is an ixotrichodermium, while the pileus cuticle of the type species of *Tylopilus* and *Porphyrellus* is a palisade to interwoven trichodermium and has not been reported to gelatinize. The tube mouths of the type species of *Mucilopilus*, though small, do not discolor on injury, but the tube mouths of the type species of both *Tylopilus* and *Porphyrellus* (with small and large tube mouths respectively) do so. The spore E^m value of the type species of *Mucilopilus* is consistently greater than 3.0, but in *Porphyrellus* the spore E^m value of the type species is consistently less than 3.0. Spore dimensions of the type species of *Mucilopilus* appear to be similar to those reported for the type species of *Tylopilus* although the E^m values for spores of *Tylopilus* are not known. Pleurocystidia of the type species of *Mucilopilus* are void of microchemically reactive contents and are hyaline. In *Tylopilus* and *Porphyrellus* the type species of each genus have pleurocystidia which have colored contents and are microchemically reactive.

It should be pointed out that *Mucilopilus* has some similarities with taxa of *Suillus*, e.g. the presence of an ixotrichodermium and a mycorrhizal association with Pinaceae (and also Fagales in *Mucilopilus* and one species of *Suillus*). However, spore and pleurocystidial characters are sufficiently different to maintain the generic separation.

The recognition of *Mucilopilus* as a new genus of the Boletaceae was based on the infrataxic character state similarities and intergeneric dissimilarities with *Tylopilus* and *Porphyrellus*. I have hesitated in recognizing this new genus of the Boletaceae because of the great emphasis which historically has been placed on spore print color as a major character of generic importance in the fleshy fungi. Fries (1821) placed great value on spore print color in the fleshy fungi (as well he should have, given the level of technology in his day). Karsten (1881), Quélet (1886), Snell & Dick (1970), Smith & Thiers (1971), Grund & Harrison (1976), Thiers (1975), and, to a lesser extent, Singer (1945, 1947, 1951, 1962, 1967, 1975) also used spore print color as a major unifying generic character state in the boletes. Corner (1972) opined that spore print color was highly variable and thus only of value at the subgenus rank. I have found in these studies character states other than spore print color which unite taxa into natural groups dissimilar from other genera of boletes. It is apparent that the generic value of spore print color may not be necessarily the most natural character state useful in establishing generic concepts.

Key to the Sections

1'. Pileus dry, scrobiculate . . . . . *Scrobiculati*

1". Pileus viscid to mucilaginous . . . . . *Mucilopilus* (no North American representatives).

Section *Scrobiculati* (Singer) Wolfe, comb. nov.
Basionym: *Tylopilus* sect. *Scrobiculati* Singer. 1947. Amer. Midl. Naturalist 37: 95.
≡ *Porphyrellus* sect. *Scrobiculati* (Singer) Singer. 1975. Agaricales in Modern Taxonomy p.748.

Type species: *Boletus conicus* Ravenel *apud* Berkley & Curtis

Similar to type section. Pileus floccose, scrobiculate, dry; pileus cuticle an ixotrichodermium below an interwoven trichodermium. Context white, unchanging on injury; yellow in KOH.

Observations. The decision to include sect. *Scrobiculati* in *Mucilopilus* was not immediately obvious. Wolfe & Petersen (1978) published photomicrographs of the cuticle of *B. conicus* (only species of sect. *Scrobiculati*) which demonstrated the gelatinizing nature of the pileus cuticle. The ixotrichodermium, smooth spores with an E^m value exceeding 3.0, and the hyaline pleurocystidia clearly indicate that *B.conicus* (and thus sect. *Scrobiculati*) clearly belongs in *Mucilopilus*.

Key to North American Taxa

1'. Stipe surface felty to tomentose . . . .1a. *M. conicus* var.*conicus*

1". Stipe surface reticulate . . . . . 1b. *M. conicus* var. *reticulatus*

1. *Mucilopilus conicus* (Rav. apud B. & C.) Wolfe, comb. nov.
Basionym: *Boletus conicus* Ravenel *apud* Berkley & Curtis. 1853. Ann. Mag. Nat. Hist. 12: 430.

Type specimen (holotype):FH - "(2929); *Boletus conicus* Rav. (!); ad terram humidi in Pinetis, Julio 1849; Santee Canal, S.C.; Ravenel (1024)" [!]

Pileus 2.5 - 10 x 1 - 2 cm, convex to plano-conves, surface of comples ridges and excavated pits (scrobiculate); ridges "Sudan Brown", "Raw Sienna", "Yellow Ocher", "Mustard Yellow", "Buffy Brown", "Wood Brown"; the pitted areas pale yellow to white, near the margins "Cream Buff" to "Light Buff"; fibrillose, fasciculate and adpressed; dry. Context to 1 cm thick at disc, white, odor and taste mild. Pores 1.5 - 2 per mm, equal, "Pale Grayish Vinaceous", Pale Vinaceous Fawn", unchanging on injury. Stipe 4 - 7 x 0.6 - 1.5 cm, equal, tapering basally to a point, ventricose, white apically and basally, pale yellow to "Light Pinkish Cinnamon", "Chamois", short felty to reticulate over upper half. Spore print "Roods Brown".

Pileus cuticle an ixotrichodermium; terminal cells 2.5 - 6.5 (-11.5) µm diam. ($\underline{d}^m$ = 4 µm), hyaline in KOH, pale yellow in Melzer's. Tube trama hyphae 2.5 - 10.5 (-11.5) µm diam. ($\underline{d}^m$ = 5 µm), boletoid, gelatinous to subgelatinous, hyaline in KOH, pale yellow in Melzer's. Clamp connections absent.

Basidia 19.5 - 44 x 6.5 - 14.5 µm ($\underline{D}^m$ = 32.5 x 9 µm), thin-walled, clavate, 2 - 4 sterigmate, hyaline and reviving poorly in KOH, pale yellow in Melzer's. Pleurocystidia 28 - 58.5 x 5 - 10.5 µm ($\underline{D}^m$ = 45.5 x 6.5 µm), thin-walled, subventricose to broadly lanceolate, hyaline in KOH,pale yellow and non-reactive in Melzer's, rare, occasionally with a distal secondary septum; cheilocystidia absent; caulocystidia 15.5 - 23.5 x 4.5 - 7 µm ($\underline{D}^m$ = 20 x 5.5 µm), clavate, hyaline in KOH, yellow in Melzer's, rare and inconspicuous.

Spores 12.5 - 18 (-21) x 4 - 6.5 µm ($\underline{D}^m$ = 15.5 x 5 µm; $\underline{E}$ = 2.5 -

4.3 (-4.7); $\underline{E}^m$ = 3.2), narrowly elliptical to elliptical, inequilateral by a broad suprahilar depression and adaxial swelling, pale yellow-cinnamon in Melzer's; surface smooth, walls continuous, surrounded by a hyaline membrane.

Macrochemistry (*per* Singer,]947). Pileus surface: KOH - darker than normal then brown; NH_4OH - darker than normal then brown. Context: KOH - yellow then brown; NH_4OH - negative; Formal - negative. Pores: H_2SO_4 - negative. Tubes: $FeSO_4$ - steel gray.

Habitat and Distribution: Sandy, moist soil under *Pinus sp.*, *Pinus palustris*, and *Pinus taeda;* United States coastal plain from South Carolina to Florida; mycorrhizal affinities unknown.

Observations. This is the only species of the section *Scrobiculati* known to have a floccose, tomentose, and pitted (scrobiculate) pileus surface. Its characters at the microscopic level are the same as the section.

1a. Mucilopilus conicus var. *conicus* (Rav. *apud* B. & C.) Wolfe. 1979. This paper p. 119.

≡ *Boletus conicus* Ravenel *apud* Berkley & Curtis. 1853. Ann. Mag. Nat. Hist. 12: 430.

≡ *Suillus conicus* (Rav. *apud* B. & C.) Kuntze. 1898. Rev. Gen. Pl. 3(2): 535.

≡ *Tylopilus conicus* (Rav. *apud* B. & C.) Beardslee. 1934. Mycologia 26: 253.

≡ *Porphyrellus conicus* (Rav. *apud* B. & C.) Singer. 1975. Agaricales in Modern Taxonomy, 3d ed., p. 748.

[≡ *Ceriomyces conicus* (Rav. *apud* B. & C.) Murrill. 1909. Mycologia 1: 146. nom. illeg.]

Macroscopic characters same as species, but stipe smooth, not reticulate. Macrochemistry same as species.

Microscopic characters vary somewhat between the varieties so they will be presented in detail.

Pileus cuticle an ixotrichodermium; terminal cells 2.5 - 8 (-11.5) µm diam. ($\underline{d}^m$ = 4 µm), hyaline in KOH, pale yellow in Melzer's. Tube trama hyphae 2.5 - 11.5 µm diam. ($\underline{d}^m$ = 5 µm), boletoid, gelatinous to subgelatinous, hyaline in KOH, pale yellow in Melzers. Clamp connections absent.

Basidia 19.5 - 44 x 6.5 - 14.5 µm ($\underline{D}^m$ = 30 x 9 µm), thin-walled, clavate, 2 - 4 sterigmate, hyaline and reviving poorly in KOH, pale yellow in Melzer's. Pleurocystidia 28 - 58.5 x 5 - 6.5 µm ($\underline{D}^m$ = 45.5 x 5 µm), subventricose to broadly lanceolate, hyaline in KOH, pale yellow in Melzer's, rare, occasionally with a distal secondary septum; cheilocystidia 15 - 23.5 x 5 - 6.5 µm ($\underline{D}^m$ = 19.5 x 5 µm), clavate, hyaline in KOH, yellow in Melzer's, rare and inconspicuous.

Spores 12.5 - 18 x 4 - 6 µm ($\underline{D}^m$ = 15.5 x 5 µm; $\underline{E}$ = 2.16 - 3.6; $\underline{E}^m$ =

3.0), narrowly elliptical to elliptical, inequilateral by a broad suprahilar depression and adaxial swelling, pale cream khaki in KOH, pale yellow cinnamon in Melzer's; surface smooth, walls continuous, surrounded by a hyaline membrane.

Habitat and Distribution: Solitary, under *Pinus* sp. and *Pinus palustris;* coastal plain, South Carolina and Florida.

Observations. This variety differs from the species only slightly in sizes of some characters. The stipe is smooth and not prominently reticulate

Specimens Examined

United States

South Carolina: Santee Canal, S.C., ad terram humidi in Pinetis, Julio 1849, Ravenel (1024), Curtis (2929), HOLOTYPE, (FH).

Florida: 1 mi. east of Gainesville, Flatwood under *Pinus palustris,* vii. 1943, R. Singer, (FH no. F2780).

1b. *Mucilopilus conicus* var. *reticulatus* Wolfe, var. nov.

A typus differt: stipes reticulatus. Holotypus: BPI - Prope Highlands Hammock, Florida; V.K. Charles, 13.xii.1938.

Pileus 2 - 6.5 x 1 - 2 cm, convex, tomentose to fibrillose, scrobiculate, pitted, "Buffy Brown" to "Wood Brown" near the margins "Cream Buff". Tubes and pores concolorous; tubes to 1.5 cm long, "Buckthorn Brown", to "Wood Brown" to "Cinnamon"; pores small to 1 mm diam. Stipe 4.5 - 8.5 x 0.7 - 0.8 cm, subobclavate to obclavate, reticulate over upper half broadly so; base pallid cream, mycelial.

Pileus cuticle an ixotrichodermium; terminal cells 2.5 - 6.5 µm diam. ($\bar{d}^m$ = 4 µm), hyaline in KOH, pale yellow in Melzer's. Tube trama hyphae 2.5 - 8 (-10.5) µm diam ($\bar{d}^m$ = 5 µm), boletoid, hyaline in KOH, yellow in Melzer's. Clamp connections absent.

Basidia 26 - 40.5 x 6.5 - 9 µm ($\bar{D}^m$ = 35 x 8 µm), thin-walled, subclavate to subequal, sinuous, 2 - 4 sterigmate, hyaline in KOH, pale yellow in Melzer's. Pleurocystidia 32.5 - 58 x 6.5 - 10.5 µm ($\bar{D}^m$ = 45.5 x 9 µm), thin-walled, narrowly fusoid-ventricose to broadly lanceolate, occasionally 1-septate, hyaline and with refractile inclusions occasionally in KOH, pale yellow in Melzer's, rare; cheilocystidia not observed; caulocystidia 16 - 23 x 4.5 - 6 µm ($\bar{D}^m$ = 21 x 6 µm), thin-walled, clavate, hyaline in KOH, yellow in Melzer's, infrequent.

Spores 13 - 21 x 4 - 5 (-6.5) µm ($\bar{D}^m$ = 15.5 x 5 µm; $\bar{E}$ = 2.5 - 4.7; $\bar{E}^m$ = 3.3), narrowly elliptical, inequilateral by a shallow suprahilar depression and adaxial swelling, pale yellow green in KOH, cinnamon to pale rust (subdextrinoid to dextrinoid) in Melzer's; surface smooth, inner walls cinnamon in KOH, outer wall dark brown in KOH, walls continuous, surrounded by a hyaline membrane.

Macrochemistry: unknown.

Habitat and Distribution: Solitary to gregarious, under *Pinus taeda*; Florida.

Observations. *Mucilopilus conicus* var.*reticulatus* differs only slightly from the species and var. *conicus* in minor size variations of a few taxonomic characters. The stipe in var. *reticulatus* as the name implies is prominently reticulate over the central and upper regions.

Specimens Examined

United States

Florida: Highlands Hammock, 13.xii.1938, V.K. Charles, HOLOTYPE, (BPI); Newnan's Lake, under Pinus Taeda, 24.vi.1930, coll, Bratley and West, (FLAS no. F8976).

Type Studies

Studies of type specimens of the various taxa included in *Mucilopilus* are necessary for several reasons. They provide a basis for understanding the relationships between the North American taxa and those reported for the world. They provide data which in some cases is not available in the literature. Type studies can also indicate the relative position of the type within species parameters. These studies help clarify taxonomic concepts and provide stability in both taxonomy and nomenclature. Type studies may provide data which may require a type specimen status change. Finally, type studies offer the opportunity to clarify and establish new taxonomic concepts of taxa previously poorly understood.

The various type descriptions are arranged alphabetically by the first letter of the last epithet, specific or varietal.

Key to the Type Specimens

1'. Pileus surface floccose, pitted (scrobiculate), dry . . . . . 2'

1". Pileus surface glabrous, mucilaginous, glutinous, or viscid . . . 3'

2'. Stipe felty to tomentose . . . . . *B. conicus* var. *conicus*

2". Stipe reticulate . . . . . *M. conicus* var. *reticulatus*

3'. Spore L^m > 17 µm . . . . . *P. viscidus* var. *macrosporus*

3". Spore L^m 17 µm or less . . . . . 4'

4'. Pleurocystidia absent . . . . . *P. nothofagi*

4". Pleurocystidia present . . . . . 5'

5'. Pleurocystidia L^m > 75 µm . . . . . *T. venezuelae*

5". Pleurocystidia L^m < 60 µm . . . . . 6'

6'. Hymenophore pallid-flesh at maturity . . . . . *P. viscidus*

6". Hymenophore pallid-violet at maturity . . . . *B. violaceiporus*

Boletus conicus Ravenel *apud* Berkley & Curtis. 1853. Ann. Mag. Nat. Hist. 12: 430.

Type specimen (holotype): FH - "(2929); *Boletus conicus* (Rav.) (!); ad terram humidi in Pinetis, Julio 1849; Santee Canal, S.C., Ravenel (1024)." [!]

Fruitbody one and a pileus of a second, glued to paper with fresh collection notes by Ravenel. Pileus 2 x 0.2 cm; surface uneven by small depressions and short elevations, fascicles of short tomentum. Stipe 2 x 0.3 cm, equal, glabrous. Hymenium appears to have been depressed about stipe.

Pileus cuticle an interwoven to repent ixotrichodermium with gelatin accumulating irregularly; terminal cells indeterminable, cuticular cells 2.5 - 11.5 µm diam. ($\underline{d}^m$ = 4 µm), hyaline in KOH, pale yellow in Melzer's. Tube trama hyphae 2.5 - 6.5 µm diam. ($\underline{d}^m$ = 4 µm), bilateral, parallel to subdivergent, hyaline in KOH, pale yellow in Melzer's, gelatinized and barely discernible. Clamp connections absent.

Basidia 19.5 - 30 (-39) x 6.5 - 10.5 µm ($\underline{D}^m$ = 26 x 9 µm), thin-walled, clavate, hyaline and reviving poorly in KOH, pale yellow in Melzer's (Fig. 1). Pleurocystidia 28 - 45.5 x 5 - 6.5 µm ($\underline{D}^m$ = 45.5 x 6.5 µm), subventricose to broadly lanceolate, hyaline in KOH, pale yellow in Melzer's, occasionally with a distal secondary septum, rare (Fig. 2); cheilocystidia and caulocystidia absent.

Spores 12.5 - 18 x 4 - 6 µm ($\underline{D}^m$ = 15.5 x 5 µm; $\underline{E}$ = 2.2 - 3.6; $\underline{E}^m$ = 3.0), elliptical to narrowly elliptical, inequilateral by a suprahilar depression and adaxial swelling, pale yellow, cream khaki with 1 - 3 guttules in KOH, pale yellow cinnamon in Melzer's; surface smooth, walls continuous, surrounded by a hyaline membrane (Fig. 3); in deposit "Roods Brown".

Observations. SEM photos of the spores of this specimen were published by Wolfe & Petersen (1978), demonstrating the smooth spore surface. Photomicrographs of the pileus cuticle were also presented (Wolfe & Petersen, 1978), showing for the first time that the pileus cuticle was an ixotrichodermium. The tube trama hyphae of the type specimen were found to be parallel to inconspicuously subdivergent and gelatinized to some degree. This does not, however, occur in the species *M. conicus*, which has the boletoid arrangement of the tube trama hyphae. One explanation of this descrepancy could be that the tissues did not revive well in 10% KOH. The specimen could have been old when collected and the gelatinized nature of the walls could have given the tube trama hyphae their parallel appearance.

Porphyrellus viscidus var. *macrosporus* McNabb. 1967. New Zealand J. Bot. 5(4): 546.

Type specimen (holotype): PDD - "25186; solitary under *Leptospermum ericoides;* Auckland; Waitakere Filters; 25.v.1966; R.F.R McNabb." [!]

Fruitbody one. Pileus 3 x 0.3 cm, surface glabrous, smooth, uninterrupted, appears to have been viscid when fresh, vinaceous brown, pores gelatinized. Stipe 5 x 0.7 cm, obclavate, yellow-tan to khaki with minute

pruina scattered over the surface.

Pileus cuticle an interwoven ixotrichodermium; terminal cells 2.5 - 5 µm diam. ($\underline{d}^m$ = 4 µm), equal, hyaline in KOH, yellow in Melzer's. Tube trama hyphae 4 - 6.5 µm diam. ($\underline{d}^m$ = 5 µm), boletoid, hyaline in KOH, yellow in Melzer's, some appearing subgelatinous. Clamp connections absent.

Basidia 32.5 - 41.5 x 8 - 10.5 µm ($\underline{D}^m$ = 35 x 9 µm), thin-walled, clavate, 2 - 4 sterigmate, hyaline in KOH, yellow in Melzer's (Fig. 4). Pleurocystidia 43 - 53.5 x 9 - 12 µm ($\underline{D}^m$ = 52 x 9 µm), thin-walled, fusoid-ventricose, hyaline in KOH, yellos in Melzers, rare; cheilocystidia 54.4 - 93.5 x 5 - 8 µm ($\underline{D}^m$ = 65 x 6.5 µm), thin-walled, subclavate to equal, occasionally with a secondary septum, hyaline in KOH, yellow in Melzer's (Fig. 5); caulocystidia 23.5 - 78 x 6.5 - 9 µm ($\underline{D}^m$ = 39 x 8 µm), thin-walled, equal to obclavate, fasciculate, opaque cream in KOH, yellow in Melzer's, occasionally with a recurved distal end.

Spores 15.5 - 24.5 x 4 - 8 µm ($\underline{D}^m$ = 19.5 x 5 µm; $\underline{E}$ = 3 - 4.8; $\underline{E}^m$ = 3.8), elliptical to narrowly elliptical, inequilateral by a narrow suprahilar depression and adaxial swelling, yellow-khaki with green refractile contents in KOH, yellow to yellow-rust (dextrinoid) in Melzer's (Fig. 6); surface smooth (Fig. 19), inner distal wall discontinuity, surrounded by a hyaline membrane; in deposit "Russet", light brown.

Observations. This specimen is very similar to *P. viscidus* var. *viscidus* McNabb by the presence of the ixotrichodermium, basidial and cystidial characters. Spores of this specimen are longer by 5 m (at the upper range limit) and by 2.5 m at the $\underline{L}^m$ value that var. *viscidus*. The spore $\underline{E}^m$ value is also greater than that of var. *viscidus* by 0.3. The spore character differences appear to be sufficiently different for varietal recognition. More studies of general collections will be necessary for confirmation of this conclusion. Because this taxon belongs in the genus *Mucilopilus* the following new combination is proposed.

Mucilopilus viscidus var. *macrosporus* (McNabb) Wolfe, comb. nov.
Basionym: *Porphyrellus viscidus* var. *macrosporus* McNabb. 1967. New Zealand J. Bot. 5: 546.

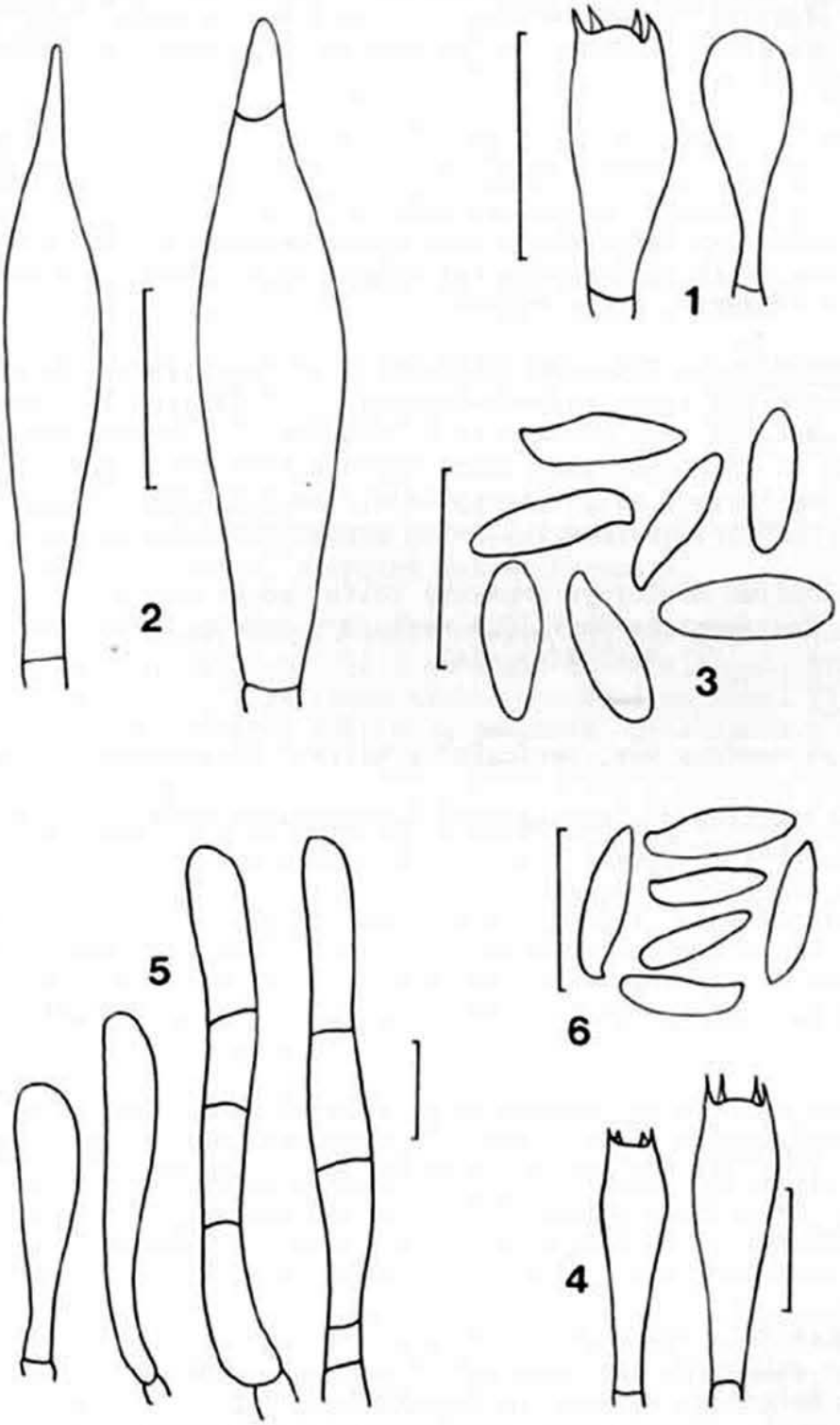
Porphyrellus nothofagi McNabb. 1967. New Zealand J. Bot. 5(4): 543.

Type specimen (holotype):PDD - "25184; on groung under *Nothofagus menziesii;* Otago District, Catlins, Puketiro Reserve; 29.iii.1966; coll and det. R.F.R. McNabb." [!]

Fruitbodies two. Pilei 2 - 3.5 x 0.3 - 0.5 cm, smooth, uninterrupted, light gold. Stipe 5 - 5.2 x 0.2 - 0.4 cm, equal to subobclavate, concolorous with pileus, smooth.

Pileus cuticle an interwoven ixotrichodermium; terminal cells 2.5 - 6.5 µm diam. ($\underline{d}^m$ = 4 µm), hyaline in KOH, yellow in Melzer's. Tube trama hyphae 2.5 - 8 µm diam. ($\underline{d}^m$ = 8 µm), boletoid, hyaline in KOH, yellow in Melzer's. Clamp connections absent.

Basidia 30 - 43 x 10.5 - 13 µm ($\underline{D}^m$ = 32.5 x 11.5 µm), thin-walled, clavate, hyaline in KOH, yellow in Melzer's. Pleurocystidia absent; cheilocystidia 19.5 - 47 x 4 - 8 µm ($\underline{D}^m$ = 34 x 6.5 µm), thin-walled with



Figures 1 - 3. *Boletus conicus* (holotype). Fig. 1. Basidia, mature and immature. Fig. 2. Pleurocystidia. Fig. 3. Basidiospores. Standard line = 20 µm.

Figures 4 - 6. *Porphyrellus viscidus* var. *macrosporus* (holotype). Fig. 4. Basidia. Fig. 5. Cheilocystidia. Fig. 6. Basidiospores. Standard line = 20 µm.

a few becoming thick-walled, equal, hyaline in KOH, yellow in Melzer's, abundant (Fig. 7); caulocystidia 26 - 39 x 5 - 9 µm ($\underline{D}^m$ = 31 x 8 µm), thin-walled, equal to clavate, hyaline to pale yellow in KOH, yellow in Melzer's.

Spores 14 - 19.5 x 4 - 5 µm ($\underline{D}^m$ = 17 x 5 m; $\underline{E}$ = 2.8 - 5.0; $\underline{E}^m$ = 3.5), elliptical to subfusiform, inequilateral by a shallow suprahilar depression and adaxial swelling, pale yellow-cinnamon with green refractile inclusions in KOH, yellow-rust (pale dextrinoid) in Melzer's; surface smooth, walls continuous, surrounded by a hyaline membrane (Fig. 8); in deposit "Russet", light brown.

Observations. The ixotrichodermium of the pileus, the equal cheilocystidia, and the long, narrow spores ($\underline{E}^m$ = 3.5) clearly indicate this specimen as being very similar to *B. conicus, T. venezuelae, B. violaceiporus,* and *P. viscidus;* this taxon differs from the other taxa in this genus by the absence of pleurocystidia. Because this taxon belongs in the genus *Mucilopilus*, the following new combination is proposed.

Mucilopilus nothofagi (McNabb) Wolfe, comb. nov.
Basionym: *Porphyrellus nothofagi* McNabb. 1967. New Zealand J. Bot. 5(4): 543.

Mucilopilus conicus var. *reticulatus* Wolfe. This paper p. 121.

Type specimen (holotype): BPI - "Highlands Hammock, Florida; 13.Dec. 1938; V.K. Charles." [!]

Fruitbody one. Pileus 6.5 x 2 cm, fibrillose to tomentose, "Cream Buff" to "Light Buff", tomentum "Ochraceous Buff". Hymenophore "Buckthorn Brown", "Wood Brown", "Cinnamon". Stipe 8.5 x 0.7 cm, concolorous with pileus, subobclavate to obclavate; base pallid cream to white, mycelial.

Pileus cuticle an interwoven ixotrichodermium with gelatin accumulating irregularly; terminal cells not determinable, cuticular cells 2.5 - 6.5 µm diam. (d^m = 4 µm), hyaline in KOH, pale yellow to dextrinoid in Melzer's. Tube trama hyphae 2.5 - 10.5 µm diam. (d^m = 5 µm), parallel to subdivergent to bilateral, hyaline in KOH, yellow in Melzer's, gelatinous to subgelatinous. Clamp connections not observed.

Basidia 34 - 40.5 x 6.5 - 9 µm ($\underline{D}^m$ = 39 x 8 µm), thin-walled, subclavate to subequal, sinuous, mostly equal to subequal, hyaline in KOH, yellow in Melzer's. Pleurocystidia 40.5 - 58.5 x 6.5 - 10.5 µm ($\underline{D}^m$ = 49.5 x 8.5 µm), thin-walled, fusoid-ventricose, occasionally 1-septate, hyaline in KOH, yellow in Melzer's, occasionally with refractile inclusion; cheilocystidia not observed; caulocystidia 16 - 23 x 4.5 - 6 µm ($\underline{D}^m$ = 20 x 5.5 µm), thin-walled, clavate, hyaline in KOH, yellow in Melzer's, infrequent.

Spores 13 - 21 x 4 - 6.5 µm ($\underline{D}^m$ = 15.5 x 5 µm; $\underline{E}$ = 2.5 - 4.0; $\underline{E}^m$ = 3.2), elliptical to narrowly elliptical, inequilateral by a suprahilar depression and adaxial swelling, pale yellow, cream khaki with 1 - 3 green refractile guttules in KOH, yellow cinnamon in Melzer's; surface smooth, walls continuous, outer wall brown in Melzer's, surrounded by a hyaline membrane; in deposit "Rood's Brown".

Observations. This specimen is very similar to the type specimen of var. *conicus*, but shows a prominently reticulated stipe surface. The spore $\underline{E}^m$ value is 3.2 in this specimen as compared to 3.0 in the type specimen of var. *conicus*. The basidial $\underline{L}^m$ is 13 µm longer in the type of var. *reticulatus* than in the type of var. *conicus*. The characters of these two specimens are otherwise nearly identical

Tylopilus venezuelae Singer *et* Digilio. 1960. Lilloa 30: 163.
≡ *Porphyrellus venezuelae* (Singer et Digilio) Singer. 1970. Flora Neotropica Monograph 5: 19.

Type specimen (holotype): K - "Flora of Venezuelae; no. 1001; 1300m., Los Guayabitos, Est. Miranda; in Jorsted ravine; Coll., R.W.G. Dennis & Goldas; 8.6.'58." [!]

Fruitbody one half. Pileus 1.8 x 0.8 cm, surface glabrous, uninterrupted, light yellow-brown. Hymenium pale yellow-brown. Stipe 3 x 0.3 cm, equal, pale yellow-brown, becoming darker brown.

Pileus cuticle an appressed ixotrichodermium; terminal cells not discernible, cuticular cells 5 - 10.5 µm diam. ($\underline{d}^m$ = 6.5 µm), hyaline in KOH, yellow in Melzer's. Tube trama hyphae 4 - 10.5 µm diam. ($\underline{d}^m$ = 6.5 µm), boletoid, hyaline in KOH, yellow in Melzer's; gelatinous. Clamp connections absent.

Basidia 26 - 36.5 x 9 - 11 µm ($\underline{D}^m$ = 27.5 x 9 µm), thin-walled, clavate to narrowly clavate, some centrally constricted, 2 - 4 sterigmate, hyaline in KOH, yellow in Melzer's (Fig. 9). Pleurocystidia 63.5 - 93.5 x 9 - 13 (-18) µm ($\underline{D}^m$ = 80.5 x 11 µm), thin-walled to moderately thick-walled, fusoid-ventricose to broadly lanceolate, the ventricose portion located in the proximal portion of the cystidium, hyaline in KOH, yellow in Melzer's, frequent (Fig. 10); cheilocystidia absent; caulocystidia absent, but stipe surface appears to have been viscid.

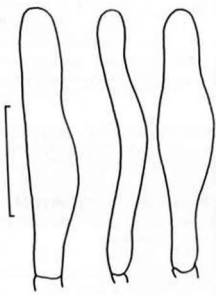
Spores 14 - 18.5 x 4.5 - 5.5 µm ($\underline{D}^m$ = 16 x 5 µm; $\underline{E}$ = 2.5 - 3.6; $\underline{E}^m$ = 3.4), narrowly elliptical, inequilateral by a narrow suprahilar depression and adaxial swelling, pale yellow-tan with green highlights in KOH, pale ochraceous cinnamon in Melzer's (Fig. 11); surface smooth (Fig. 20), walls continuous, surrounded by a hyaline membrane.

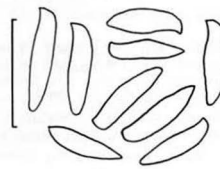
Observations. This specimen has somewhat unusual pleurocystidia; the ventricose portion of the cystidium is located in the proximal region rather than the usual central region. Moreover, the pleurocystidia are unusually long (about 80 µm). Because this taxon belongs in the genus *Mucilopilus* the following new combination is proposed.

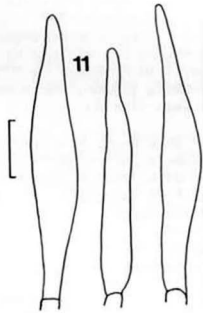
Mucilopilus venezuelae (Singer et Digilio) Wolfe, comb. nov.
Basionym: *Tylopilus venezuelae* Singer et Digilio. 1960. Lilloa 30: 163.

Boletellus violaceiporus Stevenson. 1962. Kew Bull. 15(3): 384.
≡ *Porphyrellus violaceiporus* (Stevenson) McNabb. 1967. New Zealand J. Bot. 5(4): 543.

Type specimen (holotype): K - "Herb. Hort. Bot. Reg. Kew; Maitai,







Figures 7 - 8. *Porphyrellus nothofagi* (holotype). Fig. 7. Cheilocystidia. Fig. 8. Basidiospores. Standard line = 20 µm.

Figures 9 - 11. *Tylopilus venezuelae* (holotype). Fig. 9. Basidia. Fig. 10. Pleurocystidia. Fig. 11. Basidiospores. Standard line = 20 µm.

New Zealand; G.B.C. 1060; 29.4.1956." [!]

Fruitbody one. Pileus 2 x 0.4 cm, light yellow-brown, continuous, glabrous. Hymenium rust-brown. Stipe 4 x 0.3 cm, equal, smooth.

Pileus cuticle a palisade ixotrichodermium; terminal cells 4 - 6.5 µm diam. ($\underline{d}^m$ = 6.5 µm), equal, hyaline in KOH, yellow in Melzer's. Tube trama hyphae 2.5 - 8 µm diam. ($\underline{d}^m$ = 5 µm), boletoid, hyaline in KOH, yellow in Melzer's. Clamp connections absent.

Basidia (19.5-) 26 - 34 x 8 - 10.5 µm ($\underline{D}^m$ = 30 x 9 µm), thin-walled, calvate to narrowly clavate to subequal, hyaline in KOH, yellow in Melzer's, some with a slight central constriction (Fig. 12). Pleurocystidia 52 - 65 x 13 - 17 µm ($\underline{D}^m$ = 58.5 x 13 µm), thin-walled, broadly fusoid-ventricose, hyaline in KOH, yellow in Melzer's, rare (Fig. 13); cheilocystidia 23.5 - 37.5 x 5 - 9 (-11.5) µm ($\underline{D}^m$ = 32.5 x 8 µm), thin-walled, equal to subventricose to clavate, hyaline in KOH, yellow in Melzer's, in chains of 2 - 3 cells (Fig. 14); caulocystidia (19.5-) 26 - 35 (-39) x 5 - 8 µm ($\underline{D}^m$ = 30 x 6.5 µm), thin-walled, clavate, yellow in KOH, gold in Melzer's, some with a thick refractile apex.

Spores 13 - 18 (-21) x 4 - 6.5 µm ($\underline{D}^m$ = 17 x 5 µm; $\underline{E}$ = 2.8 - 3.7; $\underline{E}^m$ = 3.2), fusoid, inequilateral by a distinct suprahilar depression and adaxial swelling, pale ochraceous green in KOH, pale yellow-rust (subdextrinoid) in Melzer's (Fig. 15); surface smooth (Fig. 21), walls continuous, surrounded by a hyaline membrane.

Observations. The violet pallid color of the hymenophore is characteristic of this taxon. Since it belongs in the genus *Mucilopilus*, the following new combination is proposed.

Mucilopilus violaceiporus (Stevenson) Wolfe, comb. nov.
Basionym: *Boletellus violaceiporus* Stevenson. 1962. Kew Bull. 15(3): 384.

Porphyrellus viscidus McNabb. 1967. New Zealand J. Bot. 5(4): 543.

Type specimen (holotype): PDD - "25185; scattered under *Leptospermum scoparium/ericoides;* Auckland, Kerikeri, Opito Bay; 16.v.1966; R.F.R. McNabb." [!]

Fruitbodies two. Pilei 0.8 - 3.0 x 0.3 - 0.5 cm, vinaceous brown to yellow-brown, glabrous, appears to have been viscid when fresh. Stipe 1.8 - 3 x 0.3 - 0.6 cm, obclavate, khaki overall, faintly reticulate at the apex only.

Pileus cuticle an interwoven ixotrichodermium; terminal cells 4 - 6.5 µm diam. ($\underline{d}^m$ = 4 µm), equal to subclavate, hyaline in KOH, yellow in Melzer's. Tube trama hyphae 4 - 9 µm diam. ($\underline{d}^m$ = 6.5 µm), hyaline in KOH, yellow in IKI. Clamp connections absent.

Basidia 23.5 - 36.5 x 9 - 13 µm ($\underline{D}^m$ = 28.5 x 10.5 µm), thin-walled, clavate, 2 - 4 sterigmate, hyaline in KOH, yellow in Melzer's. Pleurocystidia 43 - 58.5 x 8 - 9 µm ($\underline{D}^m$ = 56 x 9 µm), narrowly fusoid-ventricose, hyaline in KOH, yellow in Melzer's (Fig. 16); cheilocystidia 24.5 - 54.5 x 6.5 - 10.5 µm ($\underline{D}^m$ = 41.5 x 8 µm), equal to subclavate, hyaline to

pale yellow-tan in KOH, yellow in Melzer's, with an occasional distal secondary septum, abundant and clustered around the pores (Fig. 17); caulocystidia 39 - 69 x 6.5 - 9 µm ($\bar{D}^m$ = 52 x 8 µm), equal to clavate, scattered, pale yellow in KOH, gold-brown to dingy brown in Melzer's.

Spores 14.5 - 19.5 x 4 - 5 (-6.5) µm ($\bar{D}^m$ = 17 x 5 µm; $\bar{E}$ = 2.4 - 4.6; $\bar{E}^m$ = 3.5), elliptical to fusiform, inequilateral by a broad shallow suprahilar depression and adaxial swelling, yellow green with cinnamon walls in KOH, rust-yellow in Melzer's (Fig. 18); surface smooth, with a small and obscure inner wall discontinuity, surrounded by a hyaline membrane; in deposit "Russet", light brown.

Observations. Wolfe & Petersen (1978) published SEM's of the spores of this specimen which show the spore surface as smooth. Furthermore, the hymenophore at maturity is pallid flesh color. Because this specimen is the type specimen of the type species of the genus *Mucilopilus*, the following new combination is proposed.

Mucilopilus viscidus (McNabb) Wolfe, comb. nov.
Basionym: *Porphyrellus viscidus* McNabb. 1967. New Zealand J. Bot. 5(4): 543.

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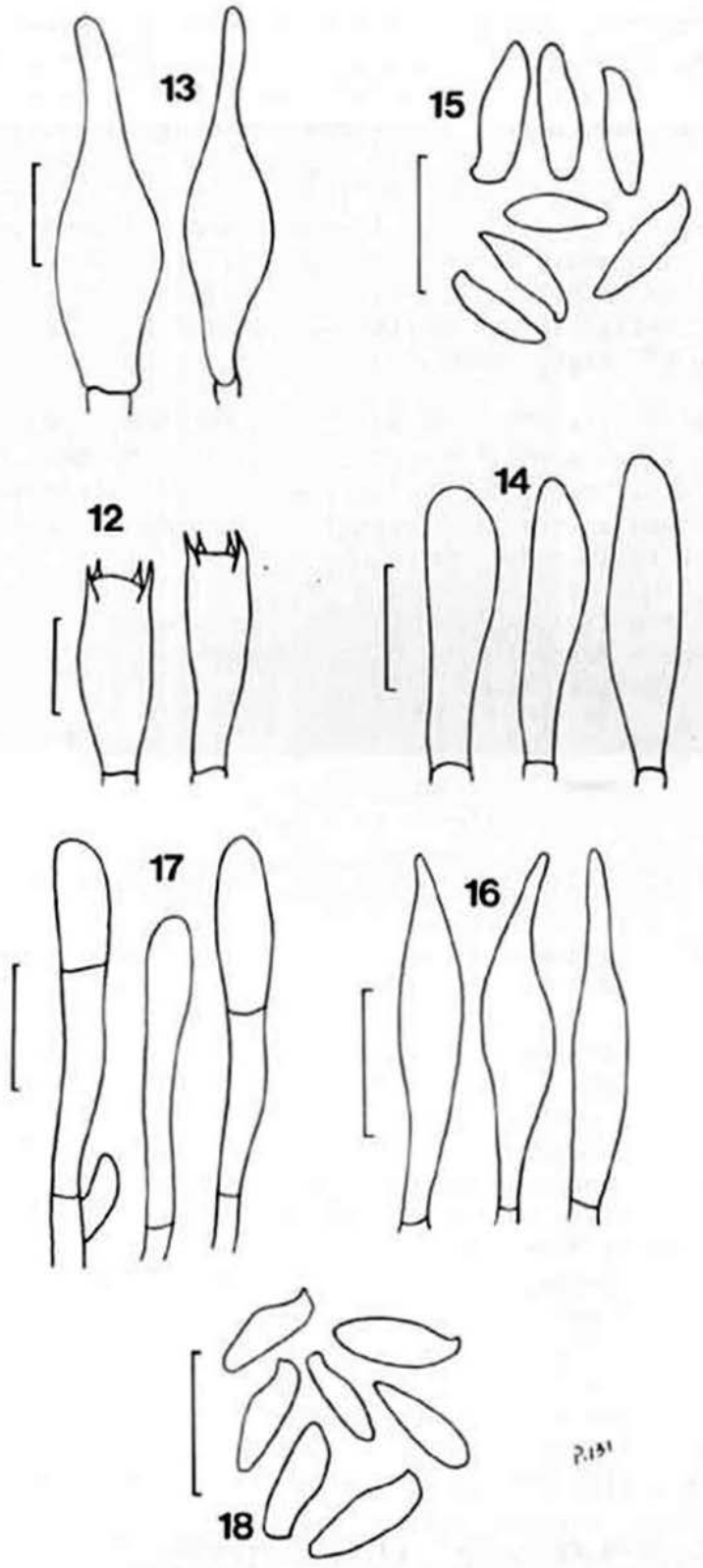
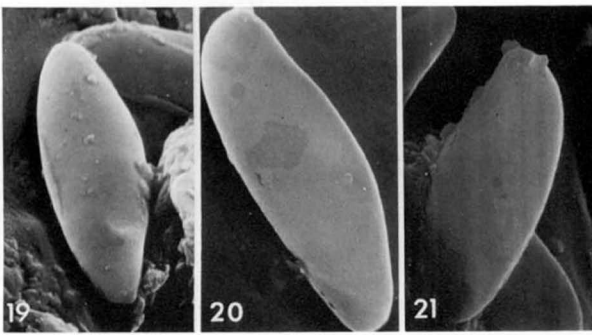


Figures 12 - 15. *Boletellus violaceiporus* (holotype). Fig. 12. Basidia. Fig. 13. Pleurocystidia. Fig. 14. Cheilocystidia. Fig. 15. Basidiospores. Standard line = 20 µm.

Figures 16 - 18. *Porphyrellus viscidus* (holotype). Fig. 16. Pleurocystidia. Fig. 17. Cheilocystidia. Fig. 18. Basidiospores. Standard line = 20 µm.



Figures 19 - 21. Scanning electron micrographs of basidiospores. Fig. 19. *Porphyrellus viscidus* var. *macrosporus*, 3960X. Fig. 20. *Tylopilus venezuelae*, 5960X. Fig. 21. *Boletellus violaceiporus*, 3960X.

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MYCOTAXON

Vol. X, No. 1 pp. 133-141 October-December 1979

RENISPORA FLAVISSIMA, A NEW GYMNOASCACEOUS FUNGUS WITH TUBERCULATE CHRYSOSPORIUM CONIDIA

L. SIGLER[1], P.K. GAUR[2], R.W. LICHTWARDT[2] AND J.W. CARMICHAEL[1]

[1]University of Alberta Mold Herbarium and Culture Collection
Edmonton, Alberta, Canada T6G 2H7

and

[2]Department of Botany, University of Kansas
Lawrence, Kansas 66045, USA

ABSTRACT

During a survey for Ajellomyces capsulatus (Kwon-Chung) McGinnis & Katz (1979) (= Emmonsiella capsulata Kwon-Chung) in south central Kansas, 66 isolates of a fungus microscopically resembling the Chrysosporium state of A. capsulatus were recovered from guano and soil in a barn housing a long-established colony of the bat Myotis velifer. Although the tuberculate conidia of these isolates were almost indistinguishable from those of A. capsulatus, cultures produced a bright yellow pigment and also remained mycelial at 37 C, instead of converting to the Histoplasma (yeast) state. This, and other differences, suggested that the barn isolates represented an undescribed species of Chrysosporium. Mating tests produced the perfect state which is described as a new genus of the Gymnoascaceae.

TAXONOMIC PART

Renispora Sigler et Carmichael, gen. nov.

Ascomycota, Gymnoascaceae.
Mycelium hyalinum. Gymnothecia globosa, parva, ex hyphis pallidis, intertextis, angustis, laevibus vel incrustatis composita. Asci pyriformes, evanescentis, octosporis. Ascosporae pallidae, ellipsoideae vel reniformes vel botuliformes, laeves vel subtiliter notatae.
Typus: Renispora flavissima Sigler, Gaur, Lichtwardt et Carmichael.

Renispora flavissima Sigler, Gaur, Lichtwardt et Carmichael, sp. nov.

Fungus heterothallicus est, cum characteribus generis. Gymnothecia 30-200um in diametro, flava, in mycelio aereo. Ascosporae (2.2)2.5(3) x 4-5.5um, 0-septatae, frequenter biguttulatae, flavae, late ellipsoideae, reniformes vel quando exsicattae botuliformes, minute foveolatae. Status conidicus Chrysosporium Corda est. Conidia globosa, tuberculata, flava, 6-11(13)um in diametro. Typus: UAMH 4205, colonia exsiccata ex cruci UAMH 4140 x UAMH 4188, uterque ex solo et fimo, Kansas, U.S.A., 1976-1977.

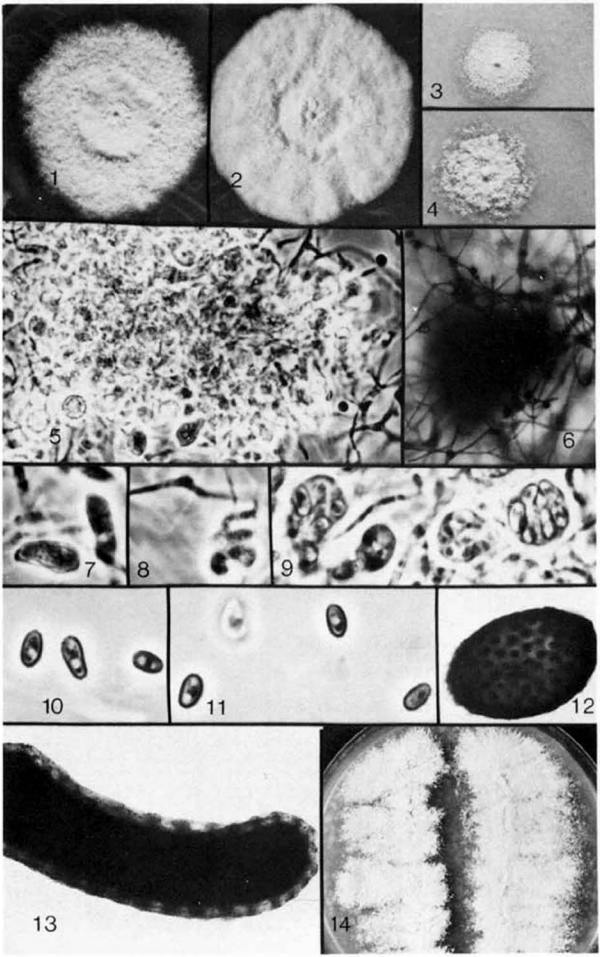
Description

After 28 days at 25 C colonies on cellophane on phytone yeast extract agar (Carmichael, 1962; Sigler and Carmichael, 1976) are 58-63 mm in diameter with an irregular lobate margin. The surface is powdery (Fig. 1) or velvety (Fig. 2), smoother and slightly raised at center, characteristically lemon-yellow with a dark gold reverse. Degenerate strains become pale yellow and floccose. At 37 C on cellophane, growth is greatly restricted (4-6 mm in 28 days), raised, dense, matted, buff, reverse brown. Without cellophane, growth is flatter.

On Pablum cereal agar on cellophane (Sigler and Carmichael, 1976), colonies (Figs. 3,4) are flat, powdery, dense or patchy, yellow with darker yellow surface growth, reverse gold. Aerial growth is sparser than on PYE and growth is slower (29-37 mm after 28 days).

Heterothallic. Gymnothecia (Fig. 5) yellow, spherical, small, 30-200um in diameter (mostly 100-150um), consisting of compactly intertwined, thin-walled, narrow, smooth or encrusted, hyaline or yellow hyphae, without distinct appendages. Peridial hyphae remain poorly differentiated from vegetative hyphae, and gymnothecia (Fig. 6) are surrounded by wefts of hyphae bearing conidia of the Chrysosporium state. Occasionally, hyphae within the gymnothecium break up to produce a few arthroconidia (Fig.

Figs. 1-14. Renispora flavissima. (1,3 - UAMH 4188; 2 - UAMH 4191; 4 - UAMH 4189; 5,6,11 - cross of 4189 x 4191; 7,8 - cross of UAMH 4187 x 4191; 9,14 - cross of UAMH 4140 x 4188; 10,12,13 - cross of UAMH 4184 x 4191). Figs. 1-4. Colonies on cellophane after 28 days at 25 C, x0.7. 1 and 2 on phytone yeast extract agar. 3 and 4 on cereal agar. Fig. 5. Gymnothecium composed of thin-walled, intertwined peridial hyphae, x600. Fig. 6. Gymnothecium on oatmeal agar plate viewed under low power of microscope. Gymnothecium surrounded by hyphae bearing Chrysosporium conidia, x150. Fig. 7. Arthroconidia found in vicinity of gymnothecium, x1680. Fig. 8. Ascomatal initial, x1680. Fig. 9. Clavate asci on short stalks, x1680. Figs. 10,11. Finely roughened, reniform or bacilliform ascospores, x1680. Figs. 12,13. Pitted or convoluted surface of ascospores viewed with an electron microscope. 12, x9200; 13, x23,500. Fig. 14. Region of scant growth between tester strains in cross of 4140 x 4188 on oatmeal agar after 41 days at 28 C, x0.7.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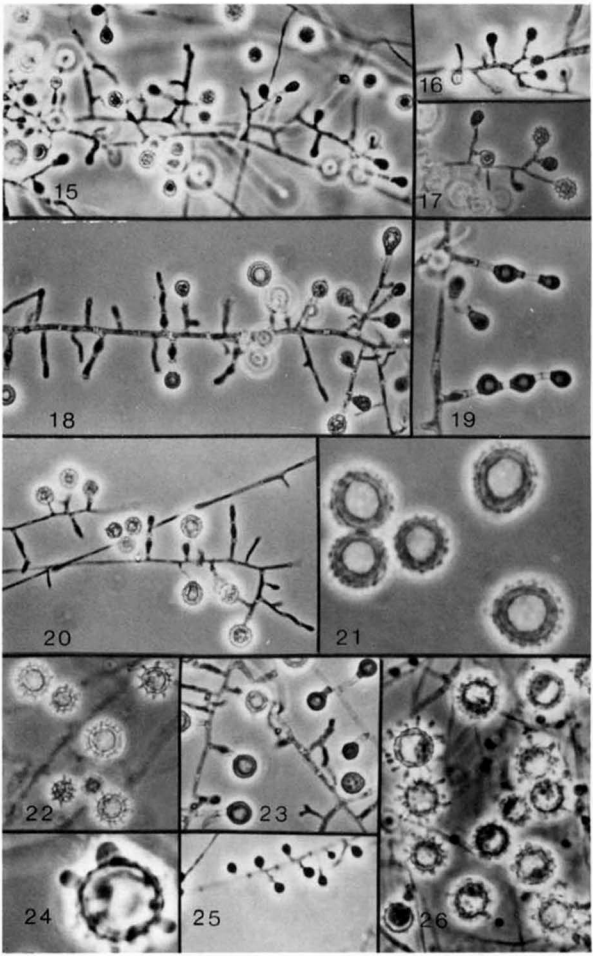
7). Ascomatal initials (Fig. 8) hyaline, consisting of two hyphae coiling about each other. Asci (Fig. 9) on short stalks, clavate, 8-spored, evanescent, hyaline (6 x 10um). Ascospores reniform or bacilliform, surface appearing finely roughened at high magnification on the light microscope (Figs. 10,11) and pitted or convoluted when the surface is viewed with an electron microscope (Figs. 12,13). They are hyaline, yellow at maturity, often having 1 or 2 lipid droplets, and measure (2.2-)2.5(-3) x 4-5.5um.

Aleurioconidia are borne terminally on short or long lateral branches or directly on the sides of the fertile hyphae (Figs. 15-18,20). Rarely, two or three conidia are formed in succession (Fig. 19) The conidiogenous or basal cell is unswollen. Aleurioconidia are initially ellipsoidal to pyriform, later becoming globose or subglobose, spiny (Figs. 15-18) or prominently tuberculate (Fig. 21), yellow, and measure 6-11(13)um in diameter. On potato dextrose agar, conidia measured 5.5-14(15.5)um. The tuberculations are usually less than .5um in length (Fig. 21) but may measure up to 1.8um (Fig. 22). No other conidia were observed in cultures of the conidial state. At 37 C, only mycelium is seen.

Holotype: The type of E. flavissima is a dried culture of UAMH 4140 x 4188 preserved in UAMH as 4205. Duplicates are deposited in the National Mycological Herbarium, Ottawa, Canada and the Commonwealth Mycological Institute, Kew, England. Subcultures of the + (UAMH 4140) and - (UAMH 4188) mating types are deposited in CMI, The American Type Culture Collection, and the Centraalbureau voor Schimmelcultures.

Habitat and activities: With only one exception, all strains were isolated directly from soil or bat guano. The exception (UAMH 4190, KS2-1-2) was isolated from the liver and spleen of a mouse after injection with a soil suspension. E. flavissima does not appear to be pathogenic. Three strains (UAMH 4188, KS2-3-20-1; UAMH 4189, KS2-3-3B-1; UAMH 4141, KS2-3-15-1) represent cultures isolated from spleen and liver of mice injected intravenously with cultures obtained from soil, but no fungal elements could be found in these tissues.

Figs. 15-23. Fenispora flavissima. (15,16 - UAMH 4140; 17 - UAMH 4188; 18,20,21 - UAMH 4184; 19 - UAMH 4191; 22,23 - UAMH 4185). Figs. 24-26. Ajellomyces capsulatus (UAMH 3536). Figs. 15-18,20. Spiny or tuberculate aleurioconidia borne on short or long lateral branches or directly on the sides of the hyphae, x600. Fig. 19. Aleurioconidia formed in short chains, x600. Fig. 21. Tuberculate aleurioconidia, x1680. Fig. 22. Aleurioconidia showing prominent finger-like tuberculations, x600. Fig. 23. Smooth-walled aleurioconidia, x600. Figs. 24-26. Aleurioconidia of Ajellomyces capsulatus. 24, x1680; 25-26, x600.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Using the in vitro method for measuring keratinolytic activity (Sigler and Carmichael, 1976), the strains examined at UAMH were found to be moderately to markedly keratinolytic after 7-14 days. None digested cellophane.

Results of mating tests: Only 10 of 66 isolates were studied at UAMH. These were mated in all possible combinations using the procedures outlined previously (Sigler and Carmichael, 1976; p.353). All crosses were grown on oatmeal agar without cellophane at 25 C. Sterile hair was sprinkled over the surface of the medium, but it had no effect on the formation of gymnothecia.

After 5 weeks, gymnothecia became apparent under the stereoscopic microscope in plates inoculated with mixed conidial suspensions. Gymnothecia are tiny and not visible macroscopically. Most gymnothecia were mature by 6-7 weeks. Two strains (4188 and 4191) were incompatible with each other, but formed gymnothecia when mated with all other strains tested (4140, 4141, 4184, 4185, 4186, 4187, 4189, 4190). Therefore, 4188 and 4191 are designated as - mating types and the others as + mating types. Numerous gymnothecia (usually 50-150) were seen in most crosses. However even after 8 weeks, 4187 and 4190 produced <20 gymnothecia when crossed with either - mating type. Indeed, in the cross of 4190 x 4191, only two gymnothecia were found.

On plates inoculated by parallel inoculation of separate conidial suspensions, growth in the center of the plate was scant (Fig. 14) and compatibility between tester strains at first appeared poor. Gymnothecia developed slowly, only becoming apparent after eight to ten weeks and were fewer in number (usually <10-30) than those formed on plates inoculated with mixed suspensions. The results of crosses were similar except that 4187 and 4189 failed to cross with either - mating type. Also 4190 crossed with 4188 but not with 4191. The zone of scant growth in the center of the streaked plates suggests some inhibitory activity between tester strains.

Microscopic mounts prepared from the crosses of 4185 x 4188 and 4185 x 4191, revealed differences in the surface ornamentation of the aleurioconidia. In mounts from plates of mixed suspensions, aleurioconidia appeared regularly tuberculate. However, in mounts from streaked plates, the surface projections of many of the aleurioconidia were much broader and more variable giving the conidia a star-like appearance.

Notes on electron microscopy: A suspension of ascospores in distilled water was layered on to a 200-mesh, 3 mm copper grid coated on one side with Formvar (Ernest Fullam, N.Y.). The excessive curvature of the ascospore in Fig. 13 is probably the result of shrinkage of one face caused by a tear in the Formvar coating on the grid.

DISCUSSION

Although von Arx (1971, 1977) and Samson (1972) agree that genera of the Gymnoascaceae should be differentiated by the shape of the ascospores, the morphology of the ascomatal initials, and the structure of the asci, it is apparent to us after studying numerous Gymnoascaceae that the structure of the peridium must also be considered in delimitation of the genera. That is, if the gymnothecium is a net-like structure composed of differentiated, dematiaceous hyphae, this characteristic is an important generic feature. The nature of peridial appendages is useful in species delineation.

Renispora is distinct from all other genera of the Gymnoascaceae in having reniform or bacilliform pitted ascospores. In its gymnothecia, composed of poorly differentiated hyphae, it is similar to Arachniotus and Narasimhella. However Renispora regularly forms spherical, discrete gymnothecia, whereas the latter genera bear asci in confluent masses or naked clumps. Furthermore, both genera have oblate or lenticular ascospores which often have an equatorial rim or furrow, or even polar thickenings (von Arx, 1971). Arachniotus differs from Renispora in having spherical asci (von Arx, 1977) and Narasimhella is distinguished by its ring-like initials surrounding a central cell (von Arx, 1977). Finally, both genera are cellulolytic and neither has characteristic conidial states, although poorly differentiated arthroconidia may be present in a few species of Arachniotus.

Another genus lacking well-defined gymnothecia is Petalosporus Ghosh, Orr and Kuehn (1963). Although recently placed in synonymy with Arachniotus by von Arx (1977), Petalosporus differs from Arachniotus in having disarticulating thick-walled peridial hyphae and discoid, oblate ascospores. Petalosporus is better compared with Shanorella Benjamin (1956). The oblate ascospores of Petalosporus rule out the inclusion of Renispora in this genus.

Pseudogymnoascus is distinguished by its ellipsoid or fusiform, smooth ascospores and by its gymnothecium composed of a network of dematiaceous, thick-walled hyphae. The type species, P. roseus, has a Geomyces conidial state. However, the ascomatal initials and structure of asci appear similar to those of Renispora.

Ajellomyces differs from Renispora in having characteristic coiled appendages and globose ascospores (see Kwon-Chung, 1973). However, the Chrysosporium state of R. flavissima resembles the Chrysosporium state of A. capsulatus. The tuberculate aleurioconidia are similar in shape and size- 6-11(13)um in diameter for the Chrysosporium state of R. flavissima compared to 8-14um (Rippon, 1974) for the C. state of A. capsulatus. However, the tubercles of the B (brown) type conidia (Berliner, 1968) of the latter

species are larger, finger-like projections (Figs. 24,26) often measuring 2-4um in length. These projections often show great variation in shape from narrow extensions to broader shapes with bud-like tips (Berliner, 1968; Garrison and Lane, 1973). In contrast, the aleurioconidia of the C. state of R. flavissima are more commonly spiny (Figs. 15-18) or coarsely tuberculate (Fig. 21) or even occasionally smooth-walled (Fig. 23). However, the aleurioconidia (Fig. 22) of one strain (UAMH 4185) formed prominent finger-like tubercles.

The Chrysosporium state of R. flavissima can be differentiated from the C. state of A. capsulatus by its distinctive yellow colonies. The colonies of A. capsulatus are white or buff-brown and usually downy. Furthermore R. flavissima neither produces microaleurioconidia as does A. capsulatus (Fig. 25) nor converts to a yeast phase when grown at 37 C.

The yellow color of the colonies and conidia of R. flavissima suggests the form-genus Sepedonium. Carmichael (1962) differentiated Sepedonium from Chrysosporium by its larger (usually 15-25um), golden-yellow aleurioconidia, by the accessory phialoconidial state present in most species and by sexual states in the Hypocreaceae rather than the Gymnoascaceae. Most Sepedonium species are mycoparasitic and digest cellulose, but not keratin.

In its tuberculate aleurioconidia, R. flavissima resembles some other species of Chrysosporium. The Chrysosporium state of Corynascus sepedonium (see Carmichael, 1962; von Arx, 1975) differs in bearing aleurioconidia on ampulliform swellings and in having orange-buff colonies. The C. state of A. tuberculatum (see Carmichael, 1962) is distinguished by its powdery, buff colonies and aleurioconidia which are pyriform or ovoid rather than globose or subglobose. The colonies of Chrysosporium state of Arthroderma multifidum (see Padhye and Carmichael, 1971) are yellowish to buff, often with a distinctive yellow surface growth. However, its roughened aleurioconidia are pyriform and larger (usually 6-12 x 9-20u) than those of R. flavissima.

Further investigations on the biological nature of this fungus will be reported by Gaur and Lichtwardt.

Cultures examined: UAMH 4140 (KS7-17-6), 4141 (KS2-3-15-1), 4184 (KS7-14-2), 4185 (KS7-13-5), 4186 (KS7-8-2), 4187 (KS7-16-4), 4188 (KS2-3-20-1), 4189 (KS2-3-3B-1), 4191 (KS7-15-7), all from soil in barn housing Myotis velifer, south-central Kansas, isolated by P.K. Gaur, 1976 and 1977. UAMH 4190 (KS2-1-2) isolated from liver and spleen of mouse after injection with soil suspension, by Gaur and Lichtwardt.

ACKNOWLEDGMENTS

We thank R. Sherburne and Dr. R.L.S. Whitehouse for preparing the electronmicrographs; Dr. L. Yung for doing the mating tests and Drs. S.J. Hughes and K.J. Kwon-Chung for reviewing the manuscript. We acknowledge financial support in part from Biomedical Sciences Support Grant RR07037 and University of Kansas General Research allocations 3210 and 3398 (to R.W.L.) and from the Natural Sciences and Engineering Research Council Canada (to J.W.C.).

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MYCOTAXON

Vol. X, No. 1, pp. 142-154 October-December 1979

COMPARATIVE MORPHOLOGY AND TAXONOMIC DISPOSITION OF EBULBOSUS, QUADRIFIDUS, AND VARIEGATUS IN THE GENUS COPRINUS (AGARICALES)

W. W. PATRICK JR.

Matthaei Botanical Gardens, University of Michigan
Ann Arbor, Michigan 48109

SUMMARY

The type collections of three C.H. Peck species from the *Picacei* group in *Coprinus* are critically compared. The results support the placement of *C. ebulbosus* and *C. quadrifidus* in synonymy under *C. variegatus*, a name given the taxon over twenty years earlier. Peck's conceptulization of his species is discussed and holotypic information from his unpublished notes is appended.

Over almost a quarter century period, Charles H. Peck described three taxa in *Coprinus* that would now be considered to be closely related members of the *Picacei* group. The three are large, often fugaciously annulate Coprini sometimes approaching in size *C. comatus* (Müll. ex Fr.) S.F.Gray, but usually more similar in stature to the robust *C. atramentarius* (Bull. ex Fr.) Fr. Other than their size, the dense, matted-fibrillose veil is the most distinctive macroscopic feature of the basidiocarps, particularly as it becomes torn and separated into conspicuous appressed-tomentose patches on

the surface of the pileus. Peck and his associates found (as have subsequent researchers) that with few exceptions the fruiting period for *C. ebulbosus* (Pk.) Pk., *C. quadrifidus* Pk., and *C. variegatus* Pk. is spring and early summer rather than late fall as is most typical for *C. atramentarius* and *C. comatus*.

In Peck's descriptions, *C. ebulbosus*, *C. quadrifidus*, and *C. variegatus* were characterized on the basis of macroscopic features, the only comparable microscopic characteristic (spore size) being non-discriminating. Later mycologists have had difficulty in construing Peck's concepts of these taxa and confirming the presence of the three in their regional investigations of the North American flora. McIlvaine (1902), Hard (1908), and McDougall (1925) report (as variety or species) only *C. ebulbosus*. Bisby (1938), Christensen (1946), Smith (1958), and Groves (1962) mention only *C. quadrifidus*. Kauffman (1918) describes both *C. ebulbosus* and *C. quadrifidus*, as does Graham (1944). Graham, however, only includes *C. quadrifidus* in his key to his descriptions of Coprini. *Coprinus variegatus* evidently has not again been reported.

As an aid toward resolution of the confusion relative to the identity of these species, Peck's type collections have been examined and the results of the hyphal analyses critically evaluated. The recognized taxon is to be considered for North America as a whole after material has been received for study from a wide range of localities.

MATERIALS AND METHODS

For best revival, slide-mounts of herbarium material were hot-plate heated (without boiling) in a 2:1 chloral hydrate:water medium (CH). Spore measurements are given in face view followed by side view (profile). Abbreviations used in descriptions include $\bar{x}$ (mean or range of means), ± (more or less), L:W (ratio of spore length to face-view width), C (percent compression or ad-abaxial flattening of spores based on the percent difference between the mean widths in face and side views), w&c (wall and content), n.d. (not distinctive), and n.o.d. (not otherwise distinctive). When n.d., the wall is smooth, thin and colorless. Peck's descrip-

tions give macroscopic and microscopic dimensions in inches (in.) and/or lines (one-twelfth inch). Bullerian terms for basidiocarp structure such as piloderma, pilocalyptra, cauloderma, and caulocalyptra have been considered elsewhere (Patrick & Barrows, 1979). Spacing cells, so characteristic of the *Coprinus* hymenium, have been called paraphyses, pseudoparaphyses, aborted basidia, basidioles, brachybasidioles, and brachycystidia by various authors. Terming them spacing cells is indicative of my complete agreement with Buller's (1909, p. 7) original assessment of their primary function in the hymenium. [The developing basidioles, of course, serve to support, and in a sense space, the random, enlarged basidia in aequihymeniiferous agarics. But in the inaequihymeniiferous genus *Coprinus*, the spacing cells are clearly not basidioles (i.e., not immature basidia).] The collections studied are from the New York Museum at Albany (NYS).

COMPARISON OF TYPES

For ease of comparison, the descriptions are interpolated in the same order as the names.

Coprinus ebulbosus[1]

Coprinus quadrifidus

Coprinus variegatus

Basidiocarps cespitose and sometimes in large tufts, base of cottonwood stumps or on decayed trunks or branches of trees in woods, June and July.

Basidiocarps gregarious or cespitose, damp vegetable mold or much decayed wood under basswood trees, June.

Basidiocarps densely cespitose, thin soil and decaying leaves covering rocks, with root-like threads

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[1]The macroscopic information includes data from the first full description of the taxon by Peck (1895) when he raised var. *ebulbosus* to species rank. It was based upon a conspecific, Elam Bartholomew collection from Rockport, Kansas.

at the base, June.

Pileus thin, campanulate, 2-3 in. broad, variegated by the cuticle breaking into broad superficial persistent whitish scales, the surface beneath the cuticle somewhat striate, grayish brown, the margin at length revolute, lacerated.

Pileus thin, at first oval, then campanulate, finally ± expanded with the margin revolute, 2-3 in. broad, when young adorned with a superficial floccose-tomentose whitish or slightly yellowish veil which soon separates into evanescent flakes or scales and reveals the finely striate surface of the pileus, whitish becoming grayish or grayish brown with age, the margin often wavy or irregular.

Pileus fleshy, fragile, oblong-ovate, then campanulate, obtuse, 1-1.5 in. broad, hygrophanous, pale watery-brown when moist, whitish or cream color when dry, variegated by scales and patches of a superficial ochraceous tomentum (which peel off in flakes, revealing the smooth pileus beneath), the margin finely striate.

Lamellae narrow, thin, crowded, free, slate color becoming black, with spores 0.0003-0.0004 × 0.0002 inches.

Lamellae broad, thin, crowded, free, at first whitish, then dark purplish brown, finally black, with spores 0.0003-0.0004 × 0.00016-0.0002 inches.

Lamellae lanceolate, crowded, ascending, free, white, then rosy brown, finally black, with spores 0.00033 in. long.

Stipe equal (having no bulb), 3-6 in. long, 2-3 lines thick, hollow, white.

Stipe equal or slightly tapering upward, 3-4 in. long, 3-4 lines thick, hollow, floccose-squamulose, white, sometimes with a slight evanescent floccose ring near the base.

Stipe equal, brittle, 2-4 lines thick (plant 3-5 in. long), hollow, white, at first peronate-annulate, then floccose-pruinose, the slight abrupt annulus soon vanishes. Threads [rhizomorphs] white, branching.

Spores 7-9(9.5) × 4.5-5(5.2) × (4.2)4.5-5 µm ($\bar{x}$ 8.1 × 4.8-4.9 × 4.8), L:W=1.53-1.83 ($\bar{x}$ 1.67), in face view (fig. 1) naviculate-subelliptic, in profile inequilaterally subelliptic, ± terete (C=1-2%); germ pore exactly apical, 1.2 µm diam; wall smooth, rather thin, medium brown with reddish tinge (CH); content none apparent.

Spores 7-9(9.5) × 4.5-5.2(5.5) × 4.5-5(5.2) µm ($\bar{x}$ 7.9-8.4 × 4.9-5.0 × 4.8-4.9), L:W=1.50-1.80 ($\bar{x}$ 1.61-1.69), in face view (fig. 2) rather narrowly subfusoid to subelliptic, in profile inequilaterally narrow subelliptic to almost cylindric, ± terete (C=2-3%); germ pore exactly apical, 1.2 µm diam; wall smooth, relatively thin, medium brown to medium red-brown; content clear.

Spores (7)7.2-9(9.5) × 4.7-5.2 × 4.7-5.2 µm ($\bar{x}$ 8.1-8.3 × 4.9-5.0 × 4.8-4.9), L:W=1.50-1.81 ($\bar{x}$ 1.63-1.65), in face view (fig. 3) naviculate-subelliptic, in profile inequilaterally subelliptic, ± terete (C=1-2%); germ pore exactly apical, 1.2 µm diam; wall smooth, relatively thin, medium brown to medium reddish brown; content clear.

Basidia tetrasporous, dimorphic: utriform, ca. 27-30 × 7-7.5 µm, subpedicellate clavate, ca. 17-20 × 6.5-7.5 µm; w&c n.d.

Basidia tetrasporous, dimorphic: utriform (slightly strangulate above), ca. 24-29 × 7-7.5 µm, subpedicellate clavate, ca. 15-20 × 7-7.5 µm; w&c n.d.

Basidia tetrasporous, dimorphic: strangulate-utriform, ca. 23-30 × 7-7.5 µm, subpedicellate to pedicellate clavate, ca. 16-20 × 7-8 µm; w&c n.d.

Spacing Cells well differentiated in the hymenium, with 3-5 surrounding each basidium ($\bar{x}$ 3.8), rounded subrectangular, 14-18 × 8-16 µm; w&c n.d.

Spacing Cells well differentiated, with 3-5 around each basidium ($\bar{x}$ 4.2), rounded subrectangular, ca. 12-17 × 8-15 µm; w&c n.d.

Spacing Cells well differentiated, with 3-5 around each basidium ($\bar{x}$ 4.1), rounded subrectangular, ca. 10-14 × 8-16 µm; w&c n.d.

Pleurocystidia abundant, very large, 98-206 × 22-35 µm,

elongate obclavate with rounded apex; w&c n.d.

Pleurocystidia abundant but not reviving; w&c n.d.

Pleurocystidia present but not reviving; w&c n.d.

Cheilocystidia lost due to deliquescence of the margin.

Cheilocystidia not preserved.

Cheilocystidia not preserved.

Lamella Trama of interwoven, branching, narrow hyphae, 3-8 µm diam; w&c n.d.

Lamella Trama of branching, tightly interwoven, poorly reviving hyphae, ca. 4-8 µm diam; w&c n.d.

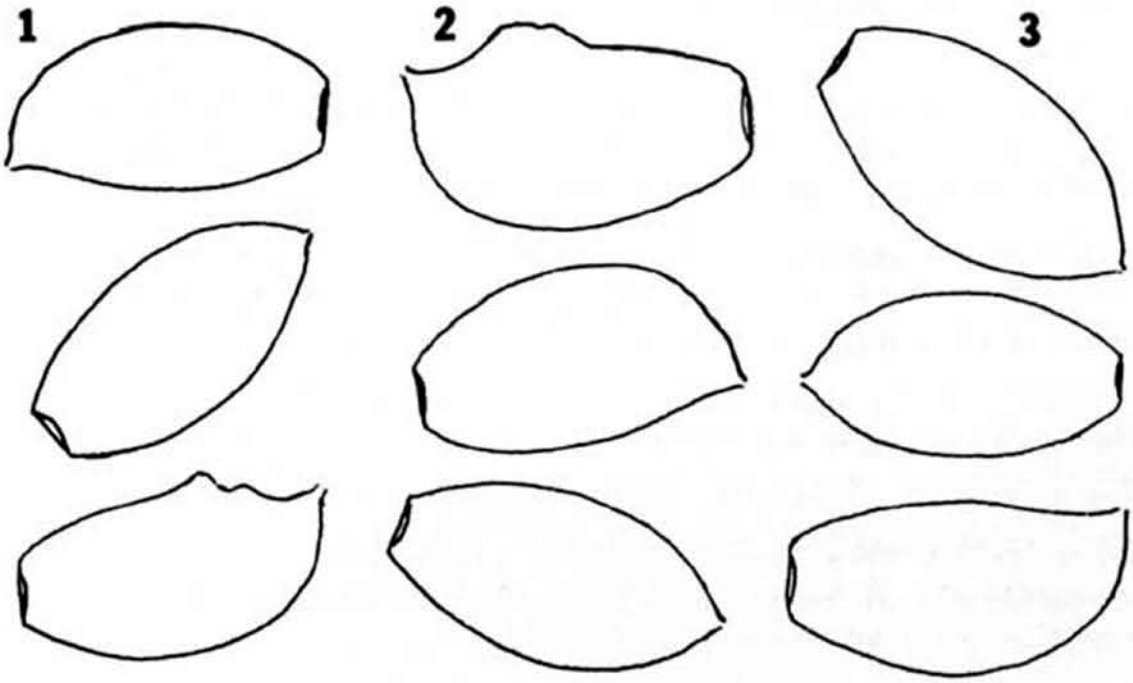
Lamella Trama of intricately and tightly interwoven, frequently branching hyphae, 3-7 µm diam; w&c n.d.

Pilocystidia absent.

Pilocystidia absent.

Pilocystidia absent.

Piloderma not distinctly differentiated from the trama.



Figs. 1-3. Type collection basidiospores (×3500). 1. *Coprinus ebulbosus*. 2. *Coprinus quadrifidus*. 3. *Coprinus variegatus*.

Piloderma not distinctly differentiated.

Piloderma not distinctly differentiated.

Pileus Trama of radially oriented, occasionally branching hyphae, yellowish in mass (CH); cells often huge and broadly elliptic to subfusoid, 4-38 µm diam (to 105 µm long); wall smooth, ± thin, nearly colorless; content n.d.

Pileus Trama of radial, occasionally branching hyphae, in mass light yellow; cells cylindric to often broadly elliptic, 5-39 µm diam, up to 100 µm (or more) long; w&c n.d.

Pileus Trama of poorly reviving, ± radial, occasionally branching hyphae, in mass golden ochraceous; cells cylindric, broadly elliptic, or even subvesiculose, 4-20 µm (or more) diam; w&c ± n.d.

Caulocystidia none found.

Caulocystidia none found.

Caulocystidia none found.

Cauloderma (upper stipe) a thin layer of interwoven, branching, ± non-diverticulate, narrow hyphae, 3-7 µm diam; wall smooth, thin, light yellow; content n.d.

Cauloderma (upper stipe) a thin, sporadically evident zone of intricately and tightly interwoven, branching, narrow hyphae, ca. 3-6 µm diam; w&c n.d.

Cauloderma (upper stipe) a poorly reviving, thin layer of intricately and tightly interwoven, branching hyphae; w&c n.d.

Stipe Trama of vertically parallel, hardly branching hyphae, 4-13 µm diam; w&c ± n.d.

Stipe Trama of parallel, infrequently branching filaments, 5-20 µm diam; w&c ± n.d.

Stipe Trama of parallel filaments, 3-16 µm diam; w&c ± n.d.

Veil Remnants on pileus (pilocalyptra) of much, rather tightly interwoven, branching hyphae, in mass medium ochraceous (CH); cells ± cylindric, 3-7(9) µm diam; wall smooth, ± thin, colorless to refractively ochraceous; content n.d. On lower stipe (caulocalyptra) of

somewhat axially oriented, though interwoven, moderately branching, narrow hyphae, 2.5-6 µm diam; wall light yellow, n.o.d.

Veil Remnants. Pilocalyptra of quite interwoven, moderately branching hyphae; cells cylindric, 4-8(15) µm diam; wall smooth, often ornamented with highly refractive platelets of golden ochraceous material; content n.d. Caulocalyptra of much-interwoven, branching, narrow hyphae, 3-6 µm diam, in mass colorless to yellowish, n.o.d.

Veil Remnants. Pilocalyptra of subradial, very interwoven, moderately branching hyphae; cells cylindric, 3.5-6(8) µm diam; wall smooth to often ornamented with platelets of very refractive golden ochraceous material; content n.d. Caulocalyptra of intricately interwoven, moderately branching, narrow hyphae, 3-6 µm diam, in mass colorless to yellowish, n.o.d.

Clamp Connections abundant throughout the fruiting body.

Clamp Connections abundant throughout.

Clamp Connections abundant throughout.

Collections studied. USA: NEW YORK: ORLEANS CO.: C.E.Fairman s.n. (holotype of *C. ebulbosus*), Lyndonville, June [1890]. LIVINGSTON CO.: C.H.Peck s.n. (holotype of *C. quadrifidus*), Portage, June [1896]. ORANGE CO.: C.H.Peck s.n. (holotype of *C. variegatus*), slope of Crows' Nest near West Point, June [1871].

DISCUSSION

When proposing these three taxa in 1873, 1891, and 1897, respectively, it is evident from his observations and notes that Peck related them to species which are now placed in distinctly separate groups in today's infrageneric classification (Patrick, 1977). *Coprinus ebulbosus* was at first considered a variety of the European *C. picaceus* (Bull. ex Fr.) S.F.Gray, the type of *Coprinus* sect. *Picacei*. Four years hence, Peck described var. *ebulbosus* more fully and raised it to species level, having found it to differ consistently from

C. picaceus in its smaller stature, lack of a bulbous stipe base, and much smaller spores. Obvious additional differences were the American species' very cespitose habit ('about fifty grew in a solid clump, all united at the base') and association with decaying hardwood.

For *C. quadrifidus*, the above differences from *C. picaceus* would be equally applicable. Peck, however, didn't relate *C. quadrifidus* to *C. picaceus*, but rather referred it to "tribe *Tomentosi*", a group now considered for the most part consectional with the *Lanatuli* (Patrick, l.c.). The epithet, *quadrifidus*, is based on a non-specific feature of the type collection where Peck (1897) noted that, "When mature the pileus becomes perforated in the center and soon splits into three to five, commonly four, segments, the division extending a short distance down the stem, allowing the parts of the pileus to droop on the recurved upper parts of the stem." This condition, having to do with the thinness of the pileus trama, subumbilicate-perforating disc, and apically completely hollow stipe, is occasionally seen in other species of *Coprinus*.

As with his *C. quadrifidus*, Peck's *C. variegatus* has the same characteristics of *C. ebulbosus* that distinquish the latter from *C. picaceus*. However, Peck associated *C. variegatus* with a third sectional group in *Coprinus*. It was said to be "allied to *C. atramentarius*", type of the *Atramentarii*.

These relationships that Peck assumed for his species are of interest even though they were only rather tenuously based upon macroscopic aspects of the fruiting bodies. Such Gestaltal catagorization may explain sufficiently Peck's continued recognition of them over the years, whereas the data presented here from critical comparison of the types quite conclusively show *C. ebulbosus*, *C. quadrifidus*, and *C. variegatus* to be synonymous. Even macroscopically, the approximately one hundred year-old type collections appear similar, and the analysis of spore and hyphal structures reveals no significant differences. Peck's descriptions of the freshly collected basidiocarps also indicate equivalence, the color variation, as well as unquantified lamellar differences, being well within the range observed by the author in over twenty personal collections of the species. It's probable, with no keys or

other means of comparison published, that Peck had distinct concepts of *C. ebulbosus*, *C. quadrifidus*, and the much antecedent *C. variegatus*, by having had associated their respective original collections with quite different taxa. Of course there is also the possibility that Peck simply no longer had *C. variegatus* in mind after such a long period (and his tremendous contribution of so many new North American taxa) prior to when the others were described. But with *C. ebulbosus* and *C. quadrifidus*, their close chronology (1891, 1895, 1897) is more suggestive of his having pegged them at first sight to the relatively distantly related *C. picaceus* and *C. tomentosus*[1], rather than having ever critically compared them themselves.

Alexander H. Smith (1948), in his study of many of Peck's types in *Coprinus*, emphasized the importance of first having extensive knowledge from nature of a group as prerequisite to an accurate interpretation of diagnostic characters in what are often old and poorly preserved specimens. Peck's type collections were not preserved well by means of rapid and careful drying and interpretation of the pilear tissues is not easy unless sections are revived adequately in a heated chloral hydrate solution. Smith's distinction between the taxa (in KOH) on the basis of the narrow vs. broad cuticular hyphae was not substantiated since the "cuticle" is actually velar in *C. variegatus* when of filamentous, narrow hyphae. And, the "vesiculose cells" appear representative of outer tramal tissue in the holotypes. This can be readily confirmed in fresh or correctly dried collections whether determined (auct.) as *C. ebulbosus*, *C. quadrifidus*, or *C. variegatus*.

In addition, the "ventral hump" found by Smith (l.c.) on some spores in type material of *C. ebulbosus* and *C. variegatus* appears not to be taxonomically significant. This evident artifact is due to a more or less longitudinal, erumpent fissure in the lower adaxial surface and has been seen in several Coprini (as well as in *Psathyrella*) where the spore wall is relatively thin overall. It was observed by me on some spores in the type of *C. quadrifidus* also. Such adax-

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[1]Ex commentariis ineditis Peckii.

ial rupturing could as well be indicative of over-heating of the specimens when drying as of tardiness in drying them. Germination, of course, occurs through the apical pore.

Original observations by Peck on changes in spore deposit color are noteworthy. When a severed pileus of *C. variegatus* is placed on a slip of white paper and covered, the spore print produced and when at first viewed is a deep brown color with only the slightest reddish tinge. Immediately afterward, however, the exposure to open air effects a rapid blackening of the deposit as it dries. "The spores are not clear black but rather brownish-black at first, becoming black on exposure to the air.[1]" This characteristic of *C. variegatus* isn't unique among Coprini, but is most noticeable in the thinner-walled, phaeosporous species.

CONCLUSIONS

Coprinus variegatus Pk., Bull. Buffalo Soc. Nat. Sci. 1:54. 1873.

=*Coprinus ebulbosus* (Pk.) Pk., Bull. Torrey Bot. Club 22:491. 1895.

≡*Coprinus picaceus* (Bull. ex Fr.) S.F.Gray var. *ebulbosus* Pk., Ann. Rep. New York St. Mus. 44: 20. 1891.

=*Coprinus quadrifidus* Pk., Ann. Rep. New York St. Mus. 50:106. 1897.

ACKNOWLEDGMENTS

Appreciation is expressed to Dr. John Haines for the loan of the type collections and notes on each. Thanks also to Dr. Samuel Mazzer and Dr. Alexander Smith whose comments on the manuscript were very helpful.

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[1]Ibid.

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(Addendum)

Additional information on *Coprinus variegatus* is contained in Peck's unpublished notes (Notebook 4:21; NYS). Quoted below is the actual original, though unpublished, desription of the type collection and it was the basis of Peck's (1873a, 1873b) twice-published account.

"Pileus ovate-campanulate, obtuse, fleshy, thin, at first entirely covered with a floccose coating, soon breaking up into ochraceous scales and separating in large patches, leaving a smooth hygrophanous watery brown pileus which is finely striate on the margin and becomes a creamy-white by drying; lamellae lanceolate, crowded, free, ascending, white, then changing to a rosy brown, then blackish brown color; stem equal, fibrous-fleshy, brittle, hollow, white pruinose-floccu-lent (in the early stage covered by the veil, hence peronate-annulate by the expansion of the pileus), with white branching rootlets at the base; spores blackish-brown.

"About the roots of trees and on this black soil covering rocks in woods. Slope of Crows Nest, June. 3'-5' high, 1'-1.5', stem 3"-4".

"A large densely caespitose species of the size and height of *C. atramentarius*, but very distinct from that species by its floccose seceding veil."

MYCOTAXON

Vol. X, No. 1, pp. 155-174 October-December 1979

THE GENUS COPRINUS IN WESTERN NORTH AMERICA, PART III: SECTION ATRAMENTARII[I]

FRED VAN DE BOGART

Department of Botany
University of Washington
Seattle, Washington, 98195

SUMMARY

This third paper of a series on western North American species of Coprinus considers 4 species and 2 varieties comprising the western representatives of the section Atramentarii. Three new species, Coprinus striatus, C. pinguisporus, and C. depressiceps are described. One new variety, C. atramentarius var. crassivelatus is described. A key to the species and varieties found in western North America is provided.

INTRODUCTION

In this third paper on western North American Coprini, 4 species and 2 varieties are added to those previously reported (Van De Bogart, 1976, 1979). Three species and one variety are described as new.

The materials and methods, terminology and color terminology are as used in the first paper of this series (Van De Bogart, 1976).

I This paper is based in part on a thesis submitted to the Graduate School of the University of Washington in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

All collections examined are deposited in the Mycological Herbarium of the University of Washington (WTU). The collections used for preparing the camera lucida drawings and in obtaining the microscopical data are indicated by an asterisk (*) after the collection number.

Coprinus Pers. per S. F. Gray, Section Atramentarii Fr. Epicrisis, p. 243, 1838.

True pileal surface outside of the apical disk composed of radially oriented, slender, cylindrical hyphae, at least near the apex in young specimens with small, appressed and usually brown, red-brown or yellow-brown colored scales composed of fibrils. The hyphae in these fibrils are aligned in parallel bundles within each scale but are oriented more or less at random to the radially oriented hyphae of the epicutis. These scales and fibrils often become merged with the epicutis in age, giving the pileus a glabrous appearance macroscopically. Universal veil devoid of sphaerocysts, pileocystidia and caulocystidia absent. Many large and characteristic pleurocystidia present as mechanical braces that hold adjacent lamellae apart. No true annulus present, but there is an annular line or flange on the stipe composed of slender, anastomosed, interwoven, occasionally clamped, septate, hyaline to yellow hyphae, marking the early position of the pileal margin against the stipe. Filaments of the annular zone same as those forming the scales of the pileus and base of the stipe, and often containing similar amorphous contents in some of the cells. Colored appressed scales like those at the pileal apex often present on the stipe below the annular line or flange. Spores usually less than 12 μm long and occasionally distinctly ornamented. Species of medium to large size, growing near trees and on disturbed soils, never coprophilous

TYPE SPECIES: Coprinus atramentarius (Bull. per Fr.) Fr. Epicrisis, p. 243, 1838.

Observations: The universal veil of the species of section Atramentarii seems to be unique. It is composed of mostly very slender, thin walled hyphae that usually contain a yellow to yellow-brown amorphous substance. With age or exposure, the walls of most of these hyphae seem to lyse, leaving this amorphous content behind as the only visual evidence of the veil. Sometimes the individual

strands seem to merge into broad filaments and patches which form the colored scales of the stipe and pileus. The microscopical features seem to be uniform for these species, and most of the major differences are the pileal shape and the presence or absence of an umbo.

KEY TO TAXA OF SECTION ATRAMENTARII

A. Pileus with prominent brownish striations, but no plicate striations .... 1. Coprinus striatus

A. Pileus with no prominent brownish striations, but sometimes with small plicate striations ... B

B. Spores broadly ovate-ellipsoidal to subglobose .... 2. Coprinus pinguisporus

B. Spores mostly ellipsoidal or narrowly ovate-ellipsoidal but never subglobose ... C

C. Spores broadest in lateral view (laterally compressed); apex of pileus depressed ..... 3. Coprinus depressiceps

C. Spores round in cross-section or broadest in dorsal view (dorsoventrally compressed); apex of pileus plane or umbonate ..... D

D. Apex of pileus rounded, flattened, or truncate but never umbonate, veil always rather scanty and never present as thick areolate patches ..... 4. Coprinus atramentarius var. atramentarius

D. Apex of pileus either umbonate or the veil rather abundant and often forming areolate patches ..... E

E. Apex of pileus umbonate, veil not abundant ..... 5. Coprinus atramentarius var. acuminatus

E. Apex of pileus not umbonate, veil thick, often forming areolate patches .... 6. Coprinus atramentarius var. crassivelatus

1. Coprinus striatus VAN DE BOGART sp. nov. (Fig.1)

Pileus primo ovatus dein conicus, postea campanulatus, postremo revolutus, semper ad apicem umbonatus, primo 2.0-2.8 cm longus, post expansionem 3.0-4.0 cm latus, cremeialutaceus, ex apice ad marginem striis prominentibus brunneis radiantibus, apex brunneus, color pilei immutatus praeter locos per autolysem denigratos; pagina pilei glabra, non vere plicato-striata. Velum universale haud manifestum. Caro tenuis, fere membranacea, ad apicem usque ad 2.0 mm crassa. Stipes cavus, basem versus angustatus, tum diametro maximo circa 1/3 longitudinis suis attingens, inde apicem versus satis angustatus, 8.0-10.0 cm longus, 2.4-5.5 mm crassus, albus praeter squamellas parvas brunneas in parte tertia baseos, opacus. Pagina stipitis laevis et glabra, etiam sericea supra basim leviter squamatam. Caro aliquantum fibrosa et usque ad 2.0 mm crassa. Lamellae angustae ellipsoideae, aliquot lamellulae adsunt, 1.0-2.6 cm longae, 0.8-1.0 cm latae, librae, primo confertae sic remanentes, per cystidia longa separatae quae inter paginas lamellarum contiguarum ponticulos facunt, primo pallidae dein pallide fuscae, postea satis atrobrunneae, autolysis completa.

Sporae ovatae, per transectionem rotundae, 6.5-8.8 x 4.4-5.0 µm, poro germininali apicali 1.8-2.1 µm lato, in cumulo atrobrunneiatrae, per microscopium brunneae, in 3% KOH mox pallidigriseae, guttulatae, rasilitunicatae. Basidia trimorphica, tetraspora; basidia breviter clavata 13.0-14.5 µm longa, 7.5 µm crassa, basidia longe clavata 16.2-20.0 µm longa, 8.8 µm crassa, basidia clavata longe pedicellata 22.5-28.8 µm longa, 6.2-8.8 µm crassa. Cheilocystidia ellipsoidea, 105.0-125.0 µm longa, 20.0-35.0 µm crassa, hyalina, rasilitunicata. Pleurocystidia anguste ellipsoidea, 105-144.5 µm longa, 19.0-36.5 µm crassa, hyalina, rasilitunicata, in lamella admodum contigua saepe per apicam inclusa. Pagina pilei e hyphis gracilibus cylindriceis radiantibus constans. Velum universale in pagina pilei et basi stipitis e fibrillis vel reliquiis fibrillarum constans. Elementa veli in pagina pilei pro parte maxima e contenta amorpha luteibrunnea cellularum tabidarum constantia, solum aliquot cellulae intactae remanentes. Cellulae veli stipitis nunc ad fragmenta amorpha luteibrunnea deminutae, nunc pro hyphis propriis videtur, quibus cylindricis, 1.2-2.5 µm diam, tenuitunicatis, et saepe contentis simillimis luteibrunneis quibus

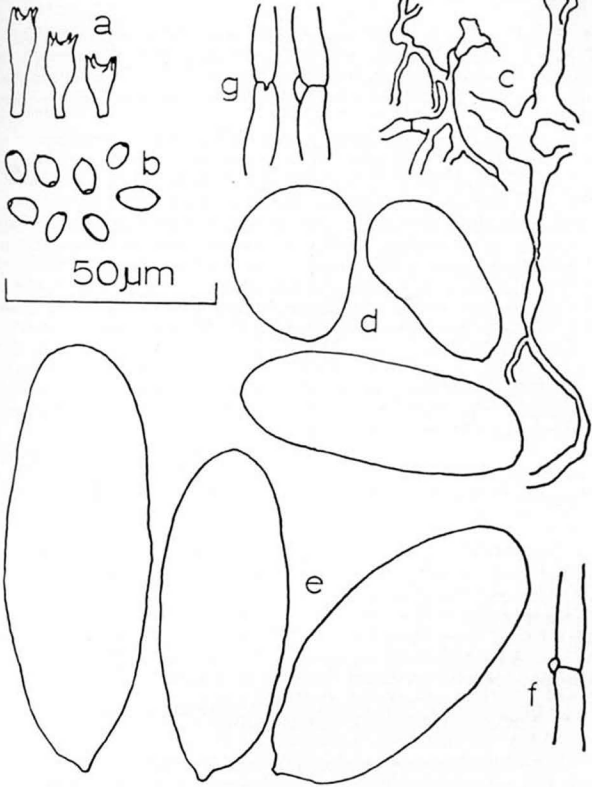

Fig. 1. Coprinus striatus FVDB 2168, a. basidia, b. spores, c. universal veil, d. cheilocystidia, e. pleurocystidia, f. stipe clamp connection, g. pileal trama clamp connections.

fragmentis amorphis sensim commiscunt.

Fibulae in stipite, pagina pilei, et in trama lamellarum adsunt.

Holotypus FVDB 2168, terrestris, solitarius vel in turmis parvis, in sylva Lee dicta in comitato Snohomish pagi Washingtonis 4 Novembris 1968 lectus, in herbario Universitatis Washingtonensis (WTU) conservatus.

PILEUS at first ovate, then conic, then campanulate, and finally revolute, always with an umbonate apex, prior to expansion 2.0-2.8 cm in length and after expansion 3.0-4.0 cm in breadth. Creamy pale tan with prominent, radially oriented brown striations from apex to margins, apex brown. Color remaining the same except where blackened by the products of autodigestion. No plicate striation develops. Surface glabrous to the unaided eye, no superficial evidence of a universal veil. Flesh thin, almost membranous, except at the apex where it is up to 2.0 mm thick.

STIPE hollow, narrow at base, then enlarging to a maximum diameter about one-third of the way up and then tapering to a fairly narrow apex 8.0-10.0 cm x 2.4-5.5 mm. White except for small brown scales on the lower one-third, opaque. Surface smooth and glabrous or even silky above the slightly scaly stipe base. Flesh somewhat fibrous and up to 2.0 mm thick.

LAMELLAE narrow ellipsoidal, some short lamellae present, 1.0-2.6 x 0.8-1.0 cm, free, crowded at first and remaining so, kept separate by long bridging pleurocystidia that prevent opposing lamellar faces from touching. Pale, then light brown and eventually deep brownish black. Autodigestion complete, the entire complement of lamellae as well as most of the pileal flesh being lysed.

ODOR AND TASTE not observed.

SPORES ovate, round in cross-section, 6.5-8.8 x 4.4-5.0 μm, apiculus of moderate size and visible, germ pore apical, 1.8-2.1 μm in diameter. Color en masse deep brownish black, microscopically medium brown in 3% KOH, guttulate, tending slowly to turn pale grey in 3% KOH after 10-12 minutes. Wall smooth.

BASIDIA trimorphic, short clavate and 13.0-14.5 x 7.5 μm, long clavate 16.2-20.0 x 8.8 μm, long pedicellate-clavate and 22.5-28.8 x 6.2-8.8 μm, all four-spored.

CYSTIDIA: Cheilocystidia ellipsoidal, 105.0-125.0 x 20.0-35.0 μm, hyaline, smooth. Pleurocystidia narrowly ellipsoidal, 105.0-144.5 x 19.0-36.5 μm, with a short pedicel, 2.0-3.0 μm long, hyaline, smooth. No other cystidia present.

PILEAL SURFACE of radially oriented slender cylindrical hyphae.

UNIVERSAL VEIL of fibrils or the remains of fibrils on pileal surface and stipe base, the veil elements on the pileal surface consisting almost entirely of the amorphous yellowish brown contents of broken-down cells, only a few intact cells remaining. Stipe veil elements sometimes reduced to patches of amorphous yellow-brown material and sometimes appearing as distinct slender cylindric hyphae 1.2-2.5 μm in diameter, thin walled and often with the same yellow-brown amorphous content, that often imperceptibly merge with the amorphous patches.

CLAMP CONNECTIONS present in stipe, on pileal surface, and in lamellar trama.

HABITAT terrestrial, on duff in coniferous woods, solitary or in small groups.

Observations: The pileal striations are very marked and are an easily recognizable feature of this species.

Material Examined. Washington: FVDB 147; HOLOTYPE, FVDB 2168*, 4 November, 1968.

2. Coprinus pinguisporus VAN DE BOGART sp. nov. (Fig. 2)

Pileus primo late conico-ovatus dein conico-expansus, demum per autolysem destructus, nunquam revolutus, primo 3.5-4.0 cm longus, post expansionem 3.0-4.0 cm latus ante diametro apicis stipitis per autolysem deminutus est, modice griseibrunneus, ad apicem brunneus demum in omni pileo sordide brunneus, haud plicato-striatus; pagina pilei ut videtur laevissima et

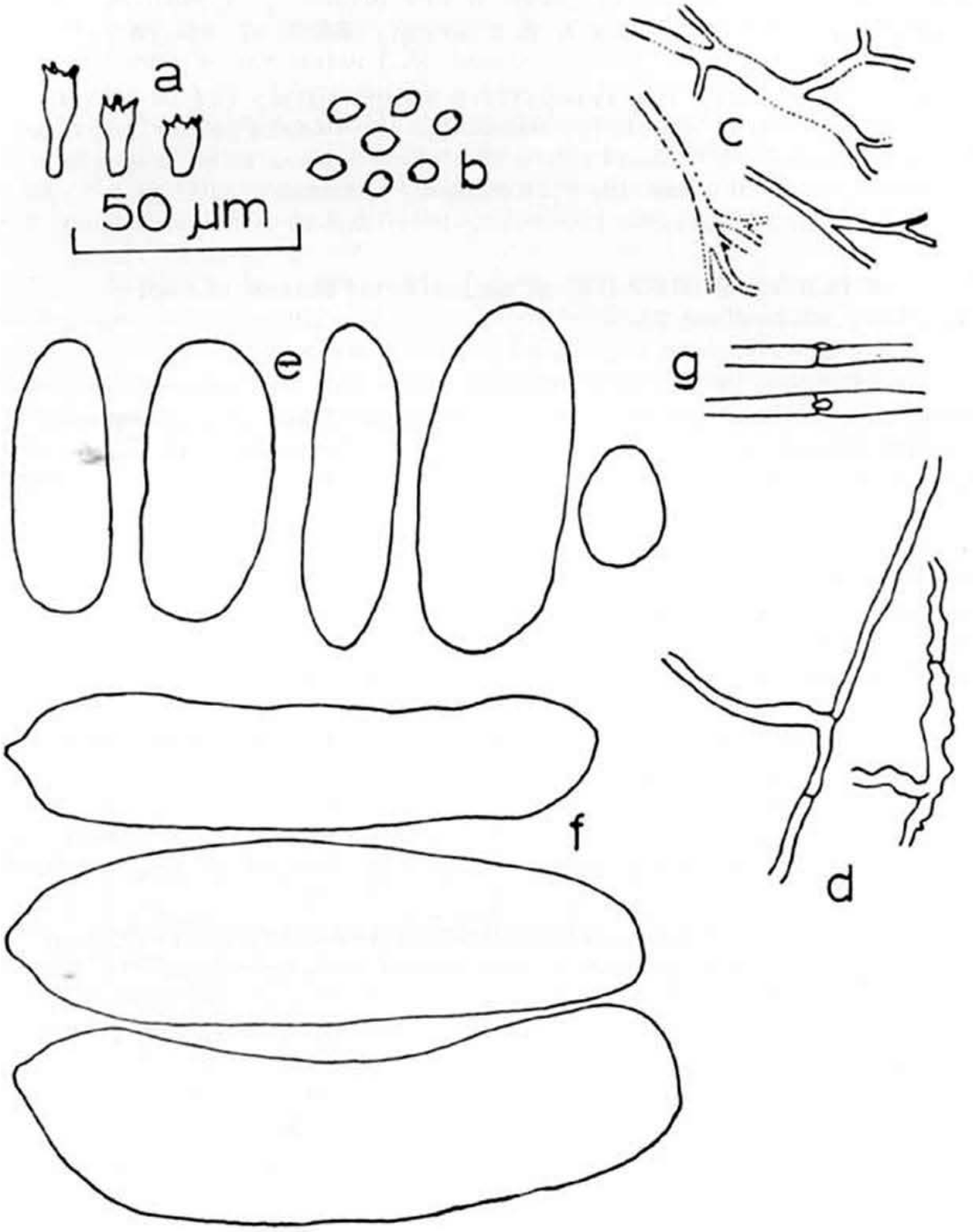

Fig. 2. Coprinus pinguisporus FV DB 17, a. basidia, b. spores, c. pileal universal veil, d. stipe universal veil, e. cheilocystidia, f. pleurocystidia, g. pileal trama clamp connections.

tantum squamas brunneas parvas adhaerentes et late dispersas praebens quas sericeas videntur. Caro ad marginem tenuis, apicem versus crassior usque ad 2.5 mm. Stipes cavus, gracilis sed diametro circa 1/3 longitudinis suis leviter amplificato, ad basim angustior et ad apicem etiam angustior, 7.0-11.0 cm longus, 4.0-8.0 mm crassus, albus, opacus; pagina pro parte maxima laevis praeter squamas paucas brunneas adpressas subter prominentia annuliformi in parte infera dilatata stipitis; pars superna stipitis laevis, subsericea. Prominentia annuliformis locus est, ubi margo pilei in paginam stipitis conjungitur. Caro fibrosa, 0.8-2.0 mm crassa. Lamellae anguste ellipsoideae, aliquot lamellulae adsunt sed haud manifestae, 2.0-3.8 cm longae, 0.7-1.0 cm crassae, liberae, ab initio confertissimae, ita usque ad autolysem remanentes, sordide albae dein pallidibrunneae et postremo atrobrunneae. Autolysis completa.

Sporae late ellipsoideae vel subglobosae, per transectionem rotundae, 5.6-8.4 x 4.2-5.0 µm, poro germinationis apicali 1.9-2.5 µm lato, tenuitunicatae, in cumulo atrobrunneae, per microscopium pallidibrunneae, contento guttulato. Basidia trimorphica, tetraspora; basidia breviter clavata 15.0-17.5 µm longa, 7.5-8.8 µm crassa, basidia longe clavata 20.0-22.5 µm longa, 7.5-8.8 µm crassa, basidia perlonge clavata 29.0-31.0 µm longa, 7.5-8.8 µm crassa. Cheilocystidia globosa 12.0-15.0 µm lata, cheilocystidia clavato-ellipsoidea 80.5-92.5 µm longa, 25.0-29.0 µm crassa, hyalina, tenuitunicata. Pleurocystidia ellipsoidea, 82.5-99.0 µm longa, 26.4-33.0 µm crassa, hyalina, tenuitunicata, pedicello brevi 1.0-3.0 µm longo, in lamella admodum contigua saepe per apicam inclusa. Pagina pilei ex hyphis cylindriceis radiantibus constans. Velum universale in pagina pilei e squamis parvis 1.0-2.0 mm longis, 0.5-1.0 mm crassis constans, quibus per microscopium hyphis gracilibus vel reliquiis hypharum constantur. Elementa veli in pagina pilei pro parte maxima e contentis amorphis luteibrunneis cellularum tabidarum constantia. Velum universale in basi stipitis et in zona annuliformi vel volviformi ex hyphis gracilis tenuitunicatis 1.0-3.0 µm diam, aliquantum anastomosantibus intertextissimis constans, hyphae veli stipitis saepe contentia pallidiluteibrunnea praebens.

Fibulae in pagina pilei, trama lamellarum, et in trama pilei adsunt. Sporocarpium odore et sapore nullo.

Holotypus FVDB 17, terrestris, cespitosus, in solo argillaceo ad basim alni, in sylva Castrae Sini Sulphuris dicta in comitato Snohomish pagi Washingtonis 16 Octobris 1965 lectus, in herbario Universitatis Washingtonis (WTU) conservatus.

PILEUS at first broadly conic-ovate, then spreading conic and eventually lysing, never revolute, prior to expansion 3.5-4.0 cm in length and after expansion 3.0-4.0 cm in breadth before being reduced to size of stipe apex by lysis. Medium grey-brown to brown at the apex and eventually becoming dark sordid brown over the entire pileus. No plicate striation, entire surface seeming very smooth and having only a few small brown, adherent, somewhat fibrillose-appearing scales that are widely scattered. Flesh thin at the margins and thicker towards the apex, up to 2.5 mm thick.

STIPE hollow, slender but slightly enlarged about one-third of the way up and narrower at the base and even narrower at the apex, 7.0-11.0 cm x 4.0-8.0 mm. White except for a few brownish adherent scales below a small ringlike flange on the enlarged portion of the lower stipe, opaque. Upper part of stipe smooth, somewhat silky. Ringlike flange present where immature cap margin rested on stipe surface. Flesh fibrous, 0.8-2.0 mm thick

LAMELLAE narrowly ellipsoidal, some short lamellae present but not obvious, 2.0-3.8 x 0.7-1.0 cm, free, extremely crowded from the earliest stages and remaining so until lysis, sordid white, then pale brown and finally dark brown. Autodigestion consuming the entire pileus.

ODOR AND TASTE not observed.

SPORES broadly ovate-ellipsoidal to subglobose, round in cross-section, 5.6-8.4 x 4.2-5.0 μm, apiculus tiny and often not visible, germ pore apical, 1.9-2.5 μm in diameter. Color en masse dark brown, microscopically light brown in 3% KOH. Contents guttulate. Walls smooth.

BASIDIA trimorphic, short clavate and 15.0-17.5 x 7.5 8.8 μm, long clavate and 20.0-22.5 x 7.5-8.8 μm, very long clavate and 29.0-31.0 x 7.5-8.8 μm, all four-spored.

CYSTIDIA: Cheilocystidia globose, 12.0-15.0 μm in diameter or clavate-ellipsoidal, 80.5-92.5 x 25.0-29.0 μm, hyaline, smooth. Pleurocystidia ellipsoidal, 82.5-99.0 x 26.4-33.0 μm, hyaline, smooth, apices embedded in opposing lamella and bridging the interlamellar gap, with a short pedicel, 1.0-3.0 μm long. No other cystidia present.

PILEAL SURFACE of radially oriented cylindrical hyphae.

UNIVERSAL VEIL on pileus appearing as small scales 1.0-2.0 x 0.5-1.0 mm, microscopically made up of poorly defined remains of slender hyphae with amorphous yellow-brown contents left as a deposit when the cell walls of the hyphae lysed, the ringlike flange and small scales on the lower part of the stipe composed of thin walled, slender, somewhat anastomosed and very interwoven hyphae 1.0-3.0 μm in diameter that often have pale yellow-brown amorphous contents.

CLAMP CONNECTIONS present in lamellar trama, in pileal trama, and on pileal surface.

HABITAT sublignicolous, on clay soil at base of alder tree in campground, in large caespitose clumps.

Observations: This species is readily separable from others in the section by its very broad to subglobose spores.

Material Examined. Washington: HOLOTYPE, FVDB 17*, 16 October, 1965.

3. Coprinus depressiceps VAN DE BOGART sp. nov. (Fig. 3)

Pileus primo subglobosus dein globoso-conicus, ad apicem depressus, primo 2.5-3.5 cm longus, post expansionem 3.0-4.5 cm latus, postremo per autolysem destructus, griseibrunneus, ad apicem atrogriseibrunneus et sic remanens usque ad nigrescionem admodum ante autolysem; pagina pilei haud plicato-striata, pro parte maxima laevis et glabra, aliquot fibrillis parvis brunneis dispersis et adpressis. Caro ad marginem tenuis et apicem versus incrassata, usque ad 2.0 mm crassa.

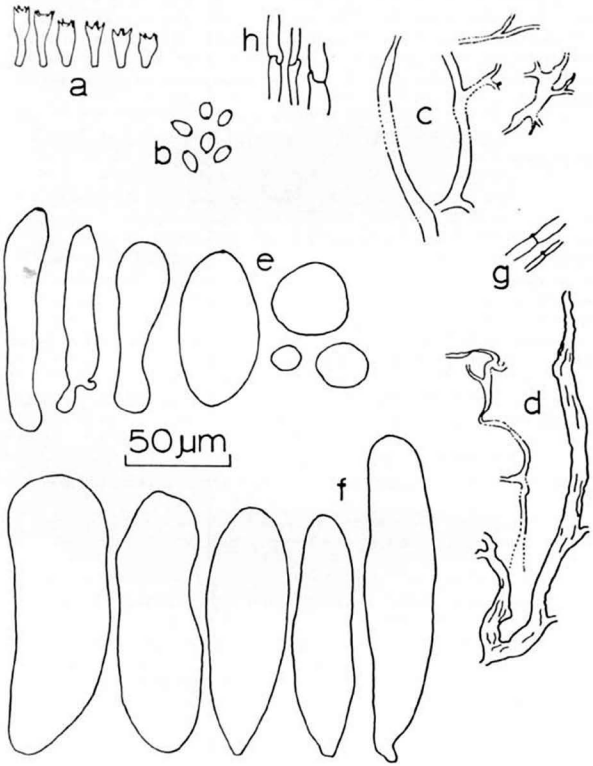

Fig. 3. Coprinus depressiceps FVDB 1745,
a. basidia, b. spores, c. pileal universal veil,
d. stipe universal veil, e. cheilocystidia, f.
pleurocystidia, g. stipe clamp connections,
h. pileal trama clamp connections.

Stipes cavus, longus et gracilis, in medio amplificatus, basim et apicem versus leviter contractus, basis in substrato peniter radicata, supra medium albus, infra medium laevis, sericeus, opacus vel notis coloratis exhibens. Zona parva annuliformi vel volviformi prope medium stipitis est locus ubi margo pilei immaturi in paginam stipitis conjungitur. Caro aliquantum crassa, fibrosa etsi friabilis, 1.0-3.0 mm crassa. Lamellae lanceolatae 1.0-3.3 cm longae, 0.8-1.1 cm crassae, ab initio confertissimae et sic remanens dum per autolysem destructae, sordide albae dein alutaceae, postea brunneipurpureae, postremo atrobrunneae; autolysis completa.

Sporae ellipsoideae, leviter complanatae, aspectu laterali latissimae, 7.5-9.0 x 4.5-5.4 µm, poro germinationis apicali 1.0-2.0 µm lato, in cumulo brunneiatrae, per microsporium fumosibrunneae, guttulatae, rasilitunicatae. Basidia trimorphica, tetraspora, basidia breviter clavata 13.5-17.5 µm longa, 8.0-8.5 µm crassa, basidia longe clavata 19.0-21.0 µm longa, 7.5-8.0 µm crassa, basidia longissima et clavata vel subululiformia 26.0-27.5 µm longa, 6.5-8.0 µm crassa. Cheilocystidia variabilissima, interdum globosa 14.0-36.0 µm lata, aliter ellipsoidea vel subcylindracea vel etiam subtibiiformia, 77.0-110.0 x 14.0-38.0 x 10.0-14.0 x 12.0-18.0 µm, hyalina, tenuitunicata, apicibus nunc obtusis nunc subcapitatis et aliquando irregulariter ramosis. Pleurocystidia ellipsoidea vel subcylindracea, 122.5-165.0 x 34.0-46.0 µm, longa, hyalina, tenuitunicata, interdum pedicello 2.0-8.0 µm. Pagina pilei ex hyphis cylindriceis radiatim dispositis. Velum universale ad basem stipitis et in pagina pilei ex frustillis squamiformibus quibus e multitudinibus coadunitis contentorum amorphorum luteibrunneorum hypharum gracilium cylindricarum facuntur; frustilla stipitis cum tomento laxo intexto hypharum gracilium tenuitunicatarum 1.0-2.5 µm diam commiscuntur; hyphae illae prominentiam annuliformem facunt. Hyphae tomenti illius contenta amorpha luteibrunnea aliquando habent.

Fibulae in trama lamellorum adsunt.

Holotypus FVDB 1745, terrestris vel sublignicola, in solo prope Salicem, solitarius vel in turmis parvis, in sylva Watermain dicta prope oppidum Redmond dictum, comitato King pagi Washingtonis 1 Novembris 1972 lectus, in herbario Universitatis Washingtonis (WTU) conservatus.

PILEUS at first subglobose then rounded conic, center of pileus depressed at apex. Prior to expansion 2.5-3.5 cm in length and after expansion 3.0-4.5 cm in breadth until reduced by autodigestion. Grey-brown to dark grey-brown at apex and remaining so until blackening just prior to autodigestion. No plicate striation. Surface mostly smooth, largely glabrous with only a few scattered small bits of brown fibrils appressed to it. Flesh thin at margin but thicker towards the apex, up to 2.0 mm thick.

STIPE hollow, long and slender, 8.0-10.0 cm x 4.0-9.0 mm, tapered slightly towards both base and apex from an enlarged portion in the middle. Base rooted deeply into the substratum. White above the enlarged portion and white with small brown appressed scales below the enlarged portion, opaque. Surface smooth or silky above and finely covered with small appressed scales or scale-like marks below. A small ringlike flange present on the swollen middle portion where the immature pileal margin was attached. Flesh somewhat thick, fibrous, although brittle, 1.0-3.0 mm thick.

LAMELLAE lanceolate, 1.0-3.3 x 0.8-1.1 cm, free, extremely crowded from the first and remaining so until destroyed by autodigestion, sordid white, then tan, then brownish purple, and finally deep blackish brown. Autodigestion destroying all of the lamellae and all of the pileal flesh except the apical disk.

SPORES ellipsoidal, slightly flattened, broadest in lateral view, 7.5-9.0 x 4.5-5.4 x 5.8-6.4 μm apiculus of moderate size, usually evident, germ pore apical, 1.0-2.0 μm in diameter. Color en masse dark brownish black, microscopically medium smoky brown. Contents guttulate. Wall smooth.

BASIDIA trimorphic, short clavate and 13.5-17.5 x 8.0-8.5 μm, long clavate and 19.0-21.0 x 7.5-8.0 μm, very long clavate to subululiform and 26.0-27.5 x 6.5-8.0 μm, all four-spored.

CYSTIDIA: Cheilocystidia very variable, some globose and 14.0-36.0 μm in diameter, others ellipsoidal to subcylindrical to subtibiiform, 77.0-110.0 x 14.0-38.0 x 10.0-14.0 x 12.0-18.0 μm, apices sometimes obtuse, sometimes subcapitate and occasionally irregularly

branched, hyaline, smooth. Pleurocystidia ellipsoidal to subcylindrical, 122.5-165.0 x 34.0-46.0 μm sometimes with a pedicel 2.0-8.0 μm long, smooth, hyaline. No other cystidia present.

PILEAL SURFACE of radially oriented cylindrical hyphae.

UNIVERSAL VEIL of scalelike patches on stipe base and pileus composed of coalesced masses of the amorphous yellow-brown cellular contents of slender cylindric hyphae, those on the stipe merging imperceptibly with a loose, interwoven tomentum of slender, thin walled, cylindric hyphae 1.0-2.5 μm in diameter that makes up the ringlike flange. The slender hyphae of this tomentum also occasionally having the amorphous yellow-brown cell contents.

CLAMP CONNECTIONS present in the lamellar trama.

HABITAT terrestrial or sublignicolous, on soil around a willow tree in a mixed forest, solitary or in small clusters.

Observations: This species is recognizable by its depressed pileal apex and by the laterally flattened spores. It resembles C. soboliferus Fr., Epicrisis, p. 243, 1838, with its depressed disk.

Material Examined. Washington: HOLOTYPE, FVDB 1745*, 1 November, 1972.

4. Coprinus atramentarius (Bull. per Fr.) Fr. var. atramentarius (Fig. 4)

PILEUS shape variable at first, globose, subglobose, short-glandiform, ovate, subconic and then broadly rounded conic, and often finally revolute or laciniate. Prior to expansion 2.0-6.5 cm in length and after expansion 3.0-8.0 cm in breadth. Light greyish tan and medium brown at apex at first, becoming darker prior to blackening when it lyses. Small, poorly developed plicate striations present on some and not on others. Surface ranging from smooth and glabrous to the unaided eye to partially covered with small, brown, closely adherent scales.

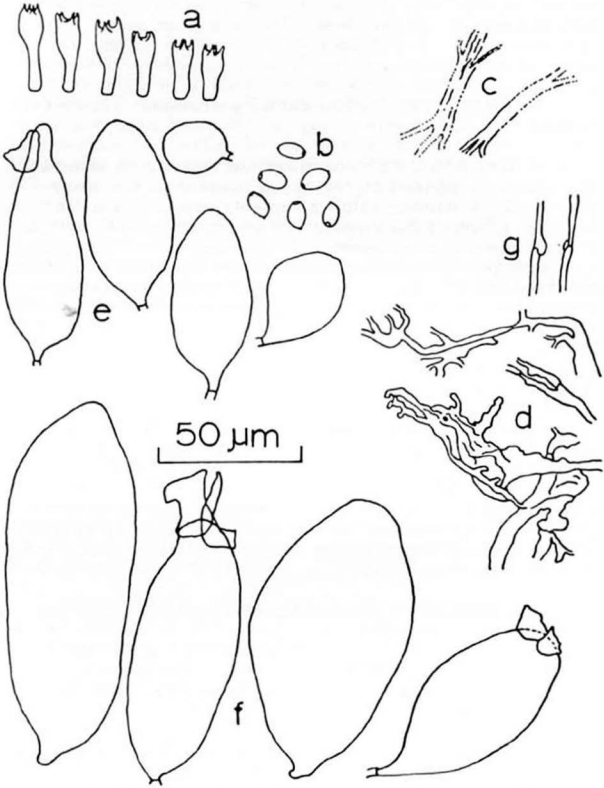

Fig. 4. Coprinus atramentarius var. atramentarius FVDB 1807, a. basidia, b. spores, c. pileal universal veil, d. stipe universal veil, e. cheilocystidia, f. pleurocystidia, g. stipe clamp connections.

Flesh ranging from thin and membranous at the margins to 3.0 mm thick at the apex in large specimens.

STIPE hollow, slender, tapering to both base and apex from a slightly enlarged area about one-third of the distance up from the base, 3.0-17.5 cm x 2.5-10.0 mm. White above the annular ring or flangelike zone, white with small appressed brown scales below this zone. Surface smooth and often silky in appearance above the annular zone and slightly roughened by the small appressed scales below it. Flesh thick and fibrous, sometimes brittle and sometimes rather tough, 1.0-3.5 mm thick.

LAMELLAE narrowly ellipsoidal, 4.5-6.2 x 1.4 cm, often shorter lamellae present, free and remote to broadly adnate, extremely crowded at first and remaining so until destroyed by autodigestion during spore liberation. Dingy white, then brown and finally deep brownish black.

ODOR AND TASTE; odor none, taste mild.

SPORES broadly ovate, narrowly ovate or ellipsoidal, round in cross-section or nearly so, (6.2-)8.1-10.0(-11.4) x (3.7-)4.4-6.5 µm, apiculus medium to small size, usually visible microscopically, germ pore apical 0.6-2.2 µm in diameter. Color en masse deep brownish black to almost black, microscopically light to medium brown or smoky brown, sometimes also with a purple tint in 3% KOH. Contents almost all guttulate. Wall smooth.

BASIDIA dimorphic, with only the first two basidial types present, or trimorphic, rarely tetramorphic, short clavate and 12.0-17.0 x 7.5 µm, long clavate and 17.5-22.5 x 7.5-8.8 µm, sphaeropedicellate to ululiform and 25.0-28.8 x 7.5-10.0 µm, very long ululiform and 35.6-37.4 x 8.8 µm all four-spored.

CYSTIDIA: Cheilocystidia globose, 13.8-50.0 µm in diameter or ovate to long ellipsoidal, 74.8-100.0 x 25.0-56.3 µm, smooth, hyaline. Pleurocystidia subcylindrical to ellipsoidal, 59.0-214.0 x 16.5-75.0 µm, smooth, hyaline, occasionally pedicellate, the pedicel 1.0-7.0 µm in length. No other cystidia present.

PILEAL SURFACE of radially oriented, slender, cylindrical hyphae, hyaline to pale yellow in 3% KOH.

UNIVERSAL VEIL of pileus mostly of agglutinated, slender, thin walled hyphae 1.0-5.0(-25.0) μm in diameter, often seeming to be devoid of any walls, with only a mass of amorphous yellow-brown cellular contents remaining, some of the individual hyphae with the same amorphous contents sometimes visible. These hyphae often oriented more or less parallel to each other but not necessarily parallel to the radially oriented surface hyphae, producing the small brown colored surface scales on both the pileus and stipe base, and also making up the annular ringlike zone on the enlarged area of the stipe. This zone is composed of a tomentum of slender, thin walled, branched and anastomosed cylindrical hyphae, some of which contain the amorphous yellow-brown cellular contents of the other universal veil cells. The tomentum merges gradually into the scales of the lower stipe.

CLAMP CONNECTIONS present on the stipe, usually on the pileal surface, occasionally in the lamellar trama.

HABITAT seemingly terrestrial or sublignicolous, or even lignicolous, usually on soil and frequently near rotting wood and especially partially buried rotting wood. Rarely found directly on rotting wood of Populus tricho-carpa. Solitary or in loose groups of several to many or in dense caespitose clusters.

Observations: This species is very uniform in its pigmentation, its overall form, and its universal veil characteristics. There is, however, some variation in the number of basidial sizes and shapes, the spore size and shape, and the pileal shape in young expanding specimens. At the present time no correlations between the several variable features seem to be detectable, hence only two varietal names are given. However, future work may necessitate the use of other varietal names, or even the splitting of C. atramentarius into more than one species.

Material Examined. Washington: FVDB 9, 11, 12, 31, 35, 36, 79, 84, 190, 197, 235, 1739, 1742, 1752, 1755, 1918, 2146, 2148, 2198. Utah: 1807*. British Columbia, Canada: 2200.

5. Coprinus atramentarius var. acuminatus Romagn. Rev. de Myc., 16:127, 1951.

As described in variety atramentarius except that there is a prominent umbo present at the apex of the pileus.

Observations: Typical C. atramentarius in the Friesian sense has no umbo present according to Fries' description (Epicrisis, p. 243) and as shown in the illustrations cited by him. Romagnesi, in his description of var. acuminatus, states that the general stature of the sporocarp is smaller than in variety atramentarius yet the measurements given are essentially the same. The same is true of the sizes he reports for pileal scales and spores. The only real difference is the presence of the umbo. Romagnesi restricts the varietal name acuminatus to sporocarps with acutely conical-shaped pilei, while I include those with ovate and more or less globose pilei as well, all of which possess an umbo. Since the full range of slight variations in spores, basidia, and universal veil occurs in both var. acuminatus and in var. atramentarius, it would be preferable to include all variants of pileal shape that possess an umbo in var. acuminatus.

Material Examined. Washington: FVDB 1, 18, 24, 99, 168, 179, 192, 230, 231, 253, 255, 263, 1713, 1727, 1731, 1734, 1735, 1737, 1741, 1748, 1750, 1753, 2162, 2164, 2175, 2190. Arizona: 1813.

6. Coprinus atramentarius var. crassivelatus VAN DE BOGART var. nov. (Fig. 5)

A typo differt velo universali multo magis abundanti quam in typo, quo in fragmento areolato in pagina pilei fatiscitur.

Holotypus FVDB 2147 in solo, in turmis parvis, prope Christ Church in oppido Pateros dicto, comitato Okanogan pagi Washingtonis 12 Maius 1941 lectus, in herbario Universitatis Washingtonis (WTU) conservatus.

As described in var. atramentarius except that the universal veil is much more abundant and breaks up into areolate patches on the pileal surface.

Material Examined. Washington: FVDB 2147*.

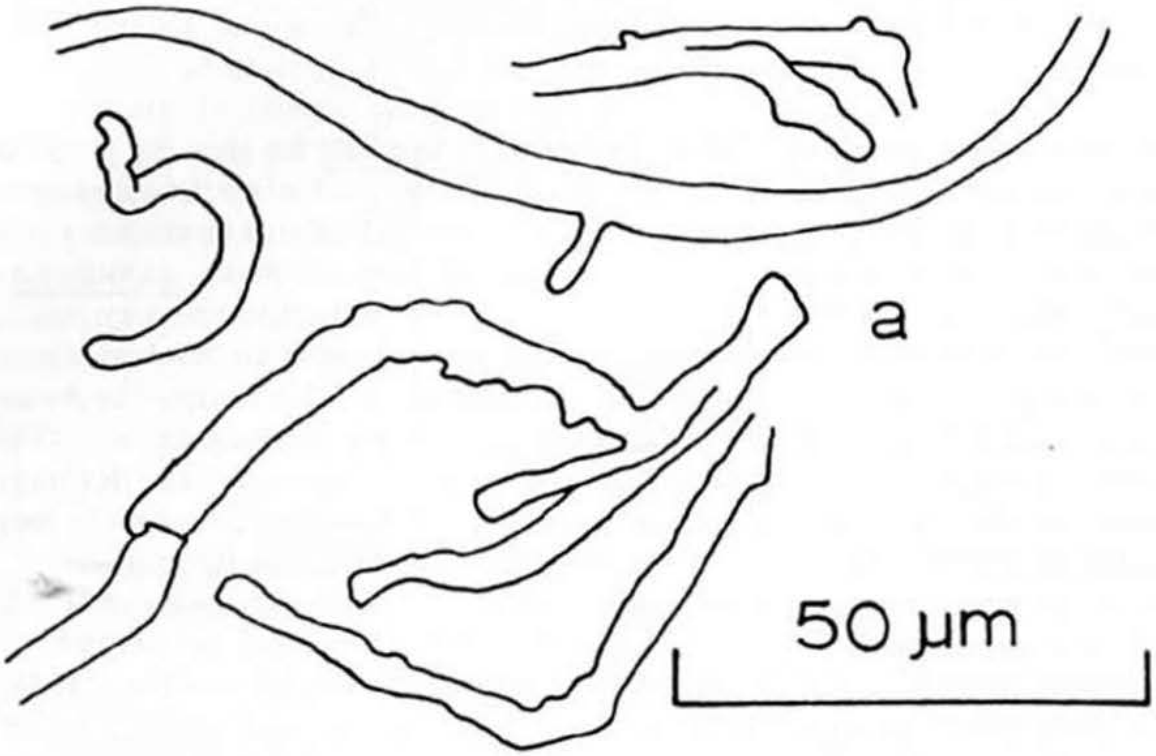

Fig. 5. Coprinus atramentarius var. crassivelatus FVDB 2147, a. universal veil.

ACKNOWLEDGMENTS

The author wishes to thank Dr. D. E. Stuntz for his comments and criticism while preparing the manuscript and especially for his assistance in the preparation of the Latin descriptions.

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MYCOTAXON

Vol. X, No. 1, pp. 175-200 October-December 1979

A STUDY OF *AMANITA* TYPES III. TAXA DESCRIBED BY W. A. MURRILL

DAVID T. JENKINS

Department of Biology, University of Alabama in Birmingham Birmingham, AL 35294

"One of the most distinctive figures in North American mycology was W. A. Murrill. He worked furiously, loved his vocation, did not hesitate to deviate from the middle of the road taxonomy, and in the field had an extremely discriminating eye" (Hesler, 1975).

Although he was recognized as being "an unusually perceptive field man" (Weber, 1961), Murrill did receive considerable criticism concerning his taxonomic and nomenclatural individualism. He irritated certain mycologists with his many name changes. To the present, however, many of his taxonomic concepts have been upheld by the most scrutinous examination.

Concerning the use of generic names Murrill deviated from the general practice by publishing many new species as *Venenarius* and *Vaginata*. He would, however, frequently list nomenclatural synonyms at the end of the publication, "for those using Saccardo" (Murrill, 1912), in which he would include the appropriate *Venenarius* = *Amanita* and *Vaginata* = *Amanitopsis* comparisons. There is a question, however, as to whether this listing of comparisons constitutes valid publication of the new *Amanita* or *Amanitopsis* combinations.

In the International Code of Botanical Nomenclature (Lanjouw, 1966) Article 34.1 states that a name is not validly published when it is not accepted by the author in the original publication; and article 34.4 states that alternative names are not validly published when proposed on or after Jan. 1, 1953. The question to be considered is whether or not Murrill accepted the names *Amanita* and *Amanitopsis* as alternative names.

In the discussion following the description of a new species Murrill would frequently use *Amanita* or *Amanitopsis* interchangeably or in substitution for *Venenarius* and *Vaginata* (Murrill, 1941). Also, all but one of his new species published after 1949 appeared as *Amanita* or *Amanitopsis* (Murrill, 1949; 1951; 1953; 1955).

Since Murrill apparently felt quite at ease in using these generic names interchangeably I feel that these should be recognized as alternative names. Therefore, the *Amanita* and *Amanitopsis* combinations frequently included by Murrill in his publications should be considered as validly published.

In this paper 44 type specimens named by Murrill are described for taxa in the genus *Amanita*. All descriptions are from direct examination of the type specimens with the exception of color (*in italics*), taken from the original description.

TYPES STUDIED

1. *Venenarius abruptiformis* Murrill. 1938. Mycologia 30(4): 360. ≡ *Amanita abruptiformis* (Murr.) Murrill. 1938. Mycologia 30(4): 371.

Holotype: Gainesville, Florida, 9-23. viii. 1937, W. A. Murrill 16048 (FLAS).

PILEUS: approximately 60 mm broad, convex to plano-convex, margin non-striate, *white, avellaneous-isabelline on disk*; volval remnants as thick patches on disc. LAMELLAE: free, crowded, *white, changing to dark-isabelline on drying*. STIPE: up to 65 x 7-9 mm, tapering slightly upward, apex slightly expanded, solid, slightly fibrillose, *white*, basal bulb abruptly marginate with rim about 3 mm high, ovoid, up to 35 x 30 mm; annulus superior, membranous, persistent, very thick and sturdy, *white*; volval remnants as a few patches in groove at bulb apex, *white, rarely purplish below*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-7 µm diam, only slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to inflated ramose, no clamps. BASIDIA: up to 46 x 4.7-12.5 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus very conspicuous, moderately branched, up to 9 µm diam; inflated cells mostly terminal or short, terminal chains, broadly elliptic, up to 72 x 57 µm, and small clavate, up to 94 x 15 µm; volval material at base of stipe very similar to that above, but with more hyphae and cells more elongate. STIPE TRAMA: filamentous hyphae sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 281 x 31 µm. PARTIAL VEIL: almost completely filamentous hyphae, up to 7 µm diam, moderately branched, no clamps; inflated cells clavate, terminal, up to 60 x 10 µm.

SPORES: 7.0-7.8 x 11.7-14.1 µm ($\underline{E}$ = 1.67-1.81; $\underline{E}^{m}$ = 1.77), elongate, often adaxially flattened, hyaline, yellowish brown to weakly amyloid, thin walled; contents guttulate, apiculus sublateral, cylindric.

Bas (1969) has placed this taxon in synonymy with *Amanita mutabilis* Beardslee.

2. *Venenarius alliaceus* Murrill. 1941. Mycologia 33(4): 434. ≡ *Amanita alliacea* (Murr.) Murrill. 1941. Mycologia 33(4): 448.

Holotype: Tung-oil Mill, west of Gainesville, Florida, 18. vi. 1938, 16418(FLAS).

PILEUS: approximately 52 mm broad, plano-convex, margin non-striate, *white*; volval remnants as thin, floccose patches covering pileus. LAMELLAE: free, crowded, *white*. STIPE: up to 55 x 7-10 mm, tapering upward, apex slightly expanded, solid, *white*, basal bulb fusiform, rooting; annulus delicate, adhering to gills, *white*; only a few floccose pieces of volva remaining at bulb apex.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-6 µm diam, strongly gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to inflated ramose, no clamps. BASIDIA:

up to 54.5 x 4-11.7 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus very conspicuous, moderately branched, up to 8 µm diam; inflated cells few, terminal, mostly elliptical, up to 75 x 32 µm, but with a few, smaller, ovoid, cells: volval material at base of stipe similar to that on pileus, but more densely compact, cells more abundant but smaller. STIPE TRAMA: filamentous hyphae sparsely branched, up to 9 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 312 x 34 µm. PARTIAL VEIL: mostly filamentous hyphae, moderately branched, up to 6 µm diam, no clamps; inflated cells ovoid to elliptic, terminal, up to 30 x 10 µm.

SPORES: (3.1)3.9-4.7 x 10.2-13.3 µm ($\underline{E}$ = 2.62-3.41; $\underline{E}^m$ = 2.97), cylindrical, often adaxially flattened, hyaline, amyloid, thin walled: contents guttulate, apiculus sublateral, cylindrical.

3. *Venenarius anisatus* Murrill. 1944. Lloydia 7(4): 314.
≡ *Amanita anisata* (Murr.) Murrill. 1944. Lloydia 7(4): 327.

Holotype: Gainesville, Florida, 25. vi. 1938, W. A. Murrill 16364 (FLAS).

PILEUS: 50 mm broad, plano-convex, margin non-striate, slightly incurved, *white*; volval remnants as slight pulverulence on pileus margin. LAMELLAE: widely free, very crowded, *white*. STIPE: 40 x 7 mm, subcylindric, solid, *white*, basal bulb ovoid, submarginate, 28 x 22 mm; annulus superior, fragments adhering to stipe, *white*; volval remnants as a few pieces of a shallow rim on bulb margin.

PILEIPELLIS: filamentous hyphae interwoven, densely packed, 3-8 µm diam, only slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, no clamps. BASIDIA: up to 70 x 4-12 µm, 4-sterigmate, no clamps. VOLVA: on pileus almost completely filamentous hyphae, moderately branched, up to 9 µm diam, no clamps; inflated cells very rare, then being elongate, small: volval material at base of stipe with filamentous hyphae dominant, similar to that on pileus; inflated cells more conspicuous, broadly elliptic to short clavate, terminal or short, terminal chains, up to 62.6 x 46 µm. STIPE TRAMA: filamentous hyphae sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 290 x 31 µm. PARTIAL VEIL: almost completely filamentous hyphae, up to 6 µm diam, moderately branched, no clamps; inflated cells rare, short clavate.

SPORES: 6.2-7.0(7.8) x 10.9-11.7(12.1) µm ($\underline{E}$ = 1.50-1.84; $\underline{E}^m$ = 1.74), elliptic to elongate, often adaxially flattened, hyaline, yellowish to weakly amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

Bas (1969) has placed this taxon in synonymy with *Amanita mutabilis* Beardslee.

4. *Venenarius cylindrisporiformis* Murrill. 1944. Proc. Fla. Acad. Sci. vii: 114.
≡ *Amanita cylindrisporiformis* (Murr.) Murrill. 1944. Proc. Fla. Acad. Sci. vii: 127.

Holotype: Green Cove Springs, Clay Co., Florida, 27. vii. 1939, W. A. Murrill 16301(FLAS).

PILEUS: 35 mm broad, plano-convex, margin non-striate, *white*; no volval remnants remaining. LAMELLAE: free, moderately close, *white, brownish after drying*. STIPE: 35 x 2-4 mm, tapering slightly upward, solid, *white*, basal bulb elliptic; annulus superior, delicate, membranous, pendant, *white*; volva membranous, saccate, thick, approximately 10 mm deep, *white*.

PILEIPELLIS: filamentous hyphae radial to interwoven, 2-8 µm diam, thin layer of gelatinized hyphae at surface. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, no clamps. BASIDIA: up to 47 x 3.5-11.8 µm, 4-sterigmate, no clamps. VOLVA: no remnants on pileus: volval material at base of stipe with two layers; outer layer almost completely filamentous hyphae, moderately branched, up to 8 µm diam, no clamps, with only occasional inflated cells, broadly elliptic, up to 93.9 x 62.6 µm, and elongate, up to 94 x 25 µm; inner layer quite similar, but with many more smaller, inflated cells. STIPE TRAMA: filamentous sparsely branched, moderately conspicuous, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 250 x 22 µm. PARTIAL VEIL: almost completely filamentous hyphae, interwoven, moderately branched, up to 7 µm diam, no clamps; inflated cells only occasional, clavate, terminal, up to 40 x 8 µm.

SPORES: 3.9-4.7 x 10.9-13.3 µm ($\underline{E}$ = 2.49-3.21; $\underline{E}^m$ = 2.87), cylindrical to bacilliform, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, truncate-conic.

5. *Venenarius flavescens* Murrill. 1951. Bull. Flor. Agric. Exp. Stn. 478: 24.
≡ *Amanita rhoadsii* var. *flavotingens* Bas. Persoonia 5(4): 285-579.

Holotype: Gainesville, Florida, 10. vi. 1950, W. A. Murrill 21676 (FLAS).

PILEUS: 50 mm broad, plano-convex, margin slightly striate, inrolled, *white, turning yellow when bruised*; volval remnants as pulverulent material covering entire pileus, denser on disc. LAMELLAE: free, moderately crowded, *white, yellow where bruised*. STIPE: 35 x 4-6 mm, slightly expanded at apex, solid, bulb subradicate, marginate, 32 x 17 mm, *white, yellow where bruised*; exannulate; volva as slight pulverulence at apex of basal bulb.

PILEIPELLIS: filamentous hyphae interwoven, 3-6 µm diam, strongly gelatinized. PILEUS TRAMA; elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae inflated ramose, no clamps. BASIDIA: up to 51 x 4-11 µm, 4-sterigmate, clamps rare. VOLVA: filamentous hyphae on pileus relatively sparse, up to 8 µm diam, moderately branched; inflated cells variform, predominantly clavate to elliptic, with few globose to subglobose, up to 70 x 65 µm: volval material at base of stipe similar, cells slightly larger and less abundant. STIPE TRAMA: filamentous hyphae sparsely branched, relatively inconspicuous, up to 6 µm diam, no clamps; inflated cells terminal, clavate to fusiform, longitudinally oriented, up to 60 x 8 µm.

SPORES: 3.9 x 10.2-11.7 µm ($\underline{E}$ = 2.62-3.00; $\underline{E}^m$ = 2.92), cylindrical, often adaxially flattened, hyaline, amyloid, thin walled;

contents guttulate, apiculus sublateral, cylindric.

6. *Amanita flavivolva* Murrill. 1953. Mycologia 45(5): 794.

Holotype: Gainesville, Florida, 16. vii. 1950, W. A. Murrill 19598 (FLAS).

PILEUS: approximately 50 mm broad, plano-convex, margin non-striate, *pale yellow with graying disc, whitish on margin*; no volval remnants remaining. LAMELLAE: narrowly adnexed to just free, crowded, *white*. STIPE: up to 66 x 4-7 mm, tapering upward, apex slightly expanded, solid, *white*, basal bulb ovoid, up to 18 x 14 mm; annulus superior, membranous, pendant, *white with flavous edge*; volva as very slight pulverulence at apex of bulb, *flavous*.

PILEIPELLIS: filamentous hyphae interwoven, 3-8 µm diam, only slightly gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to inflated ramose, no clamps. BASIDIA: up to 40 x 3-9.5 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae moderately branched, conspicuous, up to 8 µm diam, no clamps; inflated cells terminal or short, terminal chains, subglobose to broadly elliptic, very few oblong elliptic, up to 63 x 47 µm: volval material at base of stipe similar, very sparse. STIPE TRAMA: filamentous hyphae abundant, sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 300 x 16 µm. PARTIAL VEIL: mostly filamentous hyphae, moderately branched, up to 8 µm diam, no clamps; inflated cells broadly elliptic to oblong elliptic, terminal, up to 46 x 15 µm.

SPORES: 5.1-5.9 x 7.8-8.6 µm ($\underline{E}$ = 1.40-1.69; $\underline{E}^m$ = 1.49), elliptic to elongate, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short, cylindric.

7. *Amanitopsis floridana* Murrill. 1949. Mycologia 41(4): 490.

Holotype: Gainesville, Florida, 5. viii. 1948, W. A. Murrill 21484 (FLAS).

PILEUS: 32 mm broad, plane, margin distinctly striate, *avellaneous with blackish disc*; no volval remnants remaining. LAMELLAE: free, crowded, *milk-white*. STIPE: 31 x 2-6 mm, tapering upward, apex slightly expanded, hollow, *white*, no basal bulb; exannulate; volva membranous, saccate, lobed, very sturdy, *dirty-white*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 2-8 µm diam, many hyphae gelatinized. PILEUS TRAMA: elongate, inflated cells, and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, clamped. BASIDIA: up to 54.5 x 4-20 µm, 4-sterigmate, clamped. VOLVA: no remnants remaining on pileus: volval material at base of stipe layered; outer layer exclusively filamentous hyphae, moderately branched, up to 9.5 µm diam, no clamps; inner layer also filamentous hyphae with considerable gelatinized hyphae. STIPE TRAMA: filamentous hyphae sparsely branched, conspicuous, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 170 x 22 µm.

SPORES: 7.0-7.8(8.2) x (12.5)13.3-13.7(14.1) µm ($\underline{E}$ = 1.67-2.00; $\underline{E}^m$ = 1.76), elongate, often adaxially flattened, hyaline, non-amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

8. *Venenarius fraternus* Murrill. 1941. Mycologia 33(4): 436-437.
≡ *Amanita fraterna* (Murr.) Murrill. 1941. Mycologia 33(4): 448.

Holotype: Gainesville, Florida, 7. vi. 1938, W. A. Murrill 16376(FLAS).

PILEUS: up to 30 mm broad, plano-convex, margin non-striate, *dull melleous with subfuliginous disc*; volval remnants as a few, randomly distributed, floccose patches. LAMELLAE: narrowly adnexed to just free, crowded, *white*. STIPE: up to 55 x 2-3 mm, tapering upward, apex slightly expanded, *rosy-isabelline*; annulus superior, membranous, delicate, missing in some specimens, *white*; volval remnants as floccose patches on apex of bulb and lower stipe.

PILEIPELLIS: filamentous hyphae interwoven to subradial, slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: unable to reinflate tissues. BASIDIA: up to 47 x 4-11 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae inconspicuous, moderately branched, up to 7 µm diam; inflated cells dominant, terminal and short, terminal chains, globose, subglobose, broadly elliptic, ovoid, up to 63 x 53 µm, with some oblong elliptic to clavate, up to 65 x 18 µm: volval material at base of stipe similar to that on pileus but with more filamentous hyphae. STIPE TRAMA: filamentous hyphae inconspicuous, sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 310 x 31 µm. PARTIAL VEIL: almost exclusively filamentous hyphae, moderately branched, up to 7 µm diam, no clamps; inflated cells few, small, clavate,

SPORES: 5.5-5.9 x 7.8-8.6 µm ($\underline{E}$ = 1.32-1.56; $\underline{E}^{m}$ = 1.46), elliptic, often adaxially flattened, hyaline, weakly amyloid, thin walled; contents guttulate, apiculus sublateral, short, truncate-conic.

9. *Venenarius gemmatus* var. *volvatus* Murrill. 1941. Mycologia 33(4): 437.
≡ *Amanita murrilliana* Singer. 1949. Lilloa 22: 385.

Holotype: Gainesville, Florida, 28. v. 1938, W. A. Murrill 16224 (FLAS).

PILEUS: 50 mm broad, plano-convex, margin distinctly striate, *cremeous, dark isabelline on the disc, margin almost white*; no volval remnants remaining. LAMELLAE: free, but connected to stipe by line, crowded, *white*. STIPE: 130 x 4-7 mm, tapering upward, stuffed to hollow, *white*, no basal bulb; only slight annular remains approximately 35 mm from apex of stipe, *white*; volva membranous, saccate, lobed, 30 mm high.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-7 µm diam, gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: unable to reinflate. BASIDIA: up to 54 x 6.5-15.5 µm, 4-sterigmate, no clamps. VOLVA: no volval remnants on pileus: volval material on base of stipe layered; outer layer completely filamentous hyphae, interwoven, moderately branched, no clamps, up to 9 µm diam; inner layer mostly filamentous hyphae as in outer layer, but with few, terminal, inflated cells. STIPE TRAMA: filamentous hyphae sparsely branched, very inconspicuous, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 130 x 31 µm. PARTIAL VEIL: almost completely filamentous hyphae, moderately branched, up to 7 µm diam,

no clamps; inflated cells few, elongate, terminal, up to 60 x 15 µm.

SPORES: (7.0)7.8-8.6(9.4) x (10.9)11.7-13.3(14.1) µm (E = 1.33-1.67; E^m = 1.52), elliptic to elongate, often adaxially flattened, hyaline, non-amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

10. *Venenarius maculans* Murrill. 1944. Lloydia 7(4): 314-315.
≡ *Amanita maculans* (Murr.) Murrill. 1944. Lloydia 7(4): 327.

Holotype: northwest of High Springs, Columbia Co., Florida, 14. xii. 1941, W. A. Murrill 20157(FLAS).

PILEUS: up to 33 mm broad, convex to plano-convex to plane, margin slightly incurved, non-striate, *white or lemon-tinted, sometimes isabelline on the disk or in spots*; volva sparse as thin, floccose-membranous crust. LAMELLAE: free, crowded, *white*. STIPE: up to 70 x 4-7 mm, tapering upward, apex slightly expanded, solid, *white, becoming reddish where bruised*, basal bulb globose to subglobose; annulus evanescent, superior, submembranous, *white*; volval remnants floccose-membranous, occasional lobe at apex of bulb.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-7 µm diam, slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, no clamps. BASIDIA: up to 43 x 4-11.5 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus moderately inconspicuous, sparsely branched, up to 7 µm diam, no clamps; inflated cells dominant, subglobose to broadly elliptic, up to 66 x 62.6 µm and rarely elliptic, up to 93 x 31 µm, terminal chains: volval material at base of stipe with more filamentous hyphae, similar to that on pileus, and with more elongate, inflated cells. STIPE TRAMA: filamentous hyphae sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 188 x 31.3 µm. PARTIAL VEIL: filamentous hyphae inconspicuous, sparsely branched, up to 7 µm diam, no clamps; inflated cells dominant, subglobose to broadly elliptic, up to 35 x 30 µm.

SPORES: 7.8-8.6 x (7.8)8.6 µm (E = 1.0-1.1; E^m = 1.04), globose to subglobose, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

11. *Venenarius malodorus* Murrill. 1945. Jour. Flor. Acad. Sci. 8(2): 183.
≡ *Amanita malodora* (Murr.) Murrill. 1945. Jour. Flor. Acad. Sci. 8(2): 198.

Holotype: Gainesville, Florida, 11. viii. 1944, W. A. Murrill 32707 (FLAS).

PILEUS: 50 mm broad, plano-convex, margin non-striate, *rosy-isabelline*; volval remnants as randomly scattered patches. LAMELLAE: adnexed, very crowded, *white with slight pinkish tint*. STIPE: up to 105 x 3-7 mm, tapering upward, slightly expanded at apex, solid, *white*, basal bulb subglobose, only slightly broader than stipe base; annulus superior, delicately membranous; volval remnants as a very few floccose-membranous patches remaining at apex of basal bulb.

PILEIPELLIS: filamentous hyphae interwoven to subradial 3-8 µm

diam, only very slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae inflated ramose to subcellular no clamps. BASIDIA: up to 40 x 3-11 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus conspicuous, moderately branched, up to 8 µm diam; inflated cells mostly elongate, fusiform to clavate with occasional broadly elliptic, up to 115 x 35 µm, terminal or short, terminal chains: volval material at base of stipe very similar to that on pileus. STIPE TRAMA: filamentous hyphae conspicuous, sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 250 x 18.8 µm. PARTIAL VEIL: filamentous hyphae dominant, moderately branched, up to 8 µm diam, no clamps; inflated cells numerous, clavate to fusiform, terminal, up to 125 x 15 µm.

SPORES: 6.2-7.0 x 7.0-7.8 µm ($\underline{E}$ = 1.13-1.26; $\underline{E}^m$ = 1.14), subglobose to broadly elliptic, often adaxially flattened, hyaline, weakly amyloid, thin walled; contents guttulate, apiculus sublateral, truncate-conic.

Bas (1969) has placed this taxon in synonymy with *Amanita praegraveolens*.

12. *Venenarius mappa* var. *tenuipes* (Fr.) Murrill. 1948. Lloydia 2(2): 104.
≡ *Amanita mappa* var. *tenuipes* (Fr.) Murrill. 1948. Lloydia 2(2): 105.

Holotype: Fairbanks, Alachua Co., Florida, 29. xii. 1945, G. F. Weber 15454(FLAS).

PILEUS: 55 mm broad, plane, margin non-striate, *pale-citrinous*; volva as very thin, floccose crusts, randomly distributed. LAMELLAE: just free, crowded. STIPE: 90 x 3 mm, cylindric, slightly expanded at apex, solid, *white with cream scales below*, basal bulb globose, 26 x 26 mm; no annulus remaining; volva as shallow, membranous patches on bulb apex.

PILEIPELLIS: filamentous hyphae interwoven, up to 8 µm diam, gelatinized. PILEUS TRAMA: considerable filamentous hyphae and elongate, inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae inflated ramose to subcellular, no clamps. BASIDIA: up to 50 x 4-11 µm, 4-sterigmate, very distinctive, like horns, no clamps. VOLVA: filamentous hyphae on pileus sparse, moderately branched, up to 7 µm diam, no clamps; inflated cells dominant, terminal chains, subglobose, broadly elliptic to ovoid, up to 94 x 78.5 µm, with a few fusiform and clavate, up to 71 x 15 µm: volval material at base of stipe mostly filamentous hyphae, interwoven, with a few inflated cells. STIPE TRAMA: filamentous hyphae sparsely branched, moderately conspicuous, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 345 x 35 µm.

SPORES: 7.0-8.6 x 7.8-8.6 µm ($\underline{E}$ = 1.00-1.11; $\underline{E}^m$ = 1.03), globose to subglobose, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short cylindrical.

13. *Venenarius margarita* Murrill. 1945. Mycologia 37(2): 270.
≡ *Amanita margarita* (Murr.) Murrill. Mycologia 37(2): 271.

Holotype: Gainesville, Florida, 28. vi. 1944, W. A. Murrill 38906(FLAS).

PILEUS: up to 50 mm broad, convex to plano-convex, shiny, margin non-striate, *dull white with an avellaneous tint*; volva as a membranous patch, usually on disc. LAMELLAE: free, crowded, *white*. STIPE: up to 40 x 7 mm, cylindric, slightly expanded at apex, solid, *white*, basal bulb subradicate; annulus thin, membranous, apical, pendant, *white*; volva membranous, saccate, slightly lobed, about 15 mm deep, very sturdy, *white*.

PILEIPELLIS: filamentous hyphae interwoven, 2-7 µm diam, only slightly gelatinized. PILEUS TRAMA: inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae slightly inflated ramose, no clamps. BASIDIA: up to 43 x 4-9.5 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus dominant, moderately branched, up to 8 µm diam, no clamps; inflated cells conspicuous, subglobose, broadly elliptic, elliptic and clavate, up to 63 x 31 µm: volval material at base of stipe slightly layered; outer layer mostly filamentous hyphae, moderately branched, up to 11.8 µm, no clamps; inflated cells few, mostly clavate, terminal, up to 156 x 21 µm, with very few broadly elliptic, up to 31 x 21 µm; inner layer with greater number of inflated cells, terminal, up to 93 x 61 µm; filamentous hyphae up to 9 µm diam, many gelatinized. STIPE TRAMA: filamentous hyphae moderately conspicuous, sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 218 x 61 µm. PARTIAL VEIL: completely filamentous hyphae, moderately branched, interwoven, up to 6 µm diam, no clamps.

SPORES: 5.0-5.5 x 12.5-14.8 µm ($\underline{E}$ = 2.42-2.82; $\underline{E}^{m}$ = 2.59), cylindrical, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, truncate-conic.

14. *Amanita neglecta* Murrill. 1955. Mycologia 47(3): 427.

Holotype: Gainesville, Florida, 16. ix. 1950, W. A. Murrill 32887 (FLAS).

PILEUS: 32 mm broad, plano-convex, margin slightly incurved, appendiculate, non-striate, *white*; volval remnants as slight flocculence covering most of pileus. LAMELLAE: narrowly adnexed, crowded, *white*. STIPE: 60 x 8 mm, tapering slightly upward, apex expanded, solid, *white*; annulus superior, only a few remnants remaining, *white*; volval remnants absent.

PILEIPELLIS: filamentous hyphae interwoven, 3-7 µm diam, very slightly gelatinized. PILEUS TRAMA: filamentous hyphae dominant, inflated cells elongate, large number of gloeoplerous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: unable to reinflate. BASIDIA: up to 47 x 3.5-11 µm, 4-sterigmate. VOLVA: filamentous hyphae on pileus inconspicuous, moderately branched, up to 8 µm diam, no clamps; inflated cells dominant, terminal or short, terminal chains, mostly elliptic to clavate with very few broadly elliptic, up to 94 x 31 µm: volval material at base of stipe absent. STIPE TRAMA: filamentous hyphae inconspicuous, sparsely branched, up to 7 µm diam, no clamps. PARTIAL VEIL: difficult to reinflate; mostly filamentous hyphae with a few inflated cells.

SPORES: 3.9-5.5 x 8.6-10.2 µm ($\underline{E}$ = 1.85-2.21; $\underline{E}^{m}$ = 2.00), elongate to cylindric, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

15. *Venenarius odoriferus* Murrill. 1943. Mycologia 35(4): 427-428.
≡ *Amanita odorifera* (Murr.) Murrill. 1943. Mycologia 35(4): 433.

Holotype: Sugarfoot, near Gainesville, Florida, 11. vii. 1938, West, Arnold, and Murrill 17684(FLAS).

PILEUS: up to 105 mm broad, plano-convex, margin non-striate, appendiculate, slightly incurved, glabrous, *white*; volval remnants as floccose-mealy material covering most of pileus in younger specimens. LAMELLAE: free, moderately close, *white*. STIPE: up to 80 x 11 mm, subcylindric, solid, *white*, basal bulb globose to subglobose, up to 35 x 35 mm; annulus evanescent, floccose, adhering to lamellae, *white*; volval remnants as floccose-mealy material on bulb.

PILEIPELLIS: filamentous hyphae mostly decomposed into gelatinous matrix. PILEUS TRAMA: elongate, inflated cells, and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae inflated ramose, no clamps. BASIDIA: up to 46 x 3-9 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae very inconspicuous, sparsely branched, up to 7 µm diam, no clamps; inflated cells dominant, subglobose, ovoid, broadly elliptic, elliptic, clavate, pyriform, up to 68 x 49 µm, terminal and short, terminal chains: volval material at base of stipe very similar to that on pileus. STIPE TRAMA: filamentous hyphae very conspicuous, moderately branched, up to 9 µm diam, no clamps; inflated cells terminal with few very short, terminal chains, clavate, longitudinally oriented, up to 157 x 22 µm. PARTIAL VEIL: almost completely inflated cells, subglobose, broadly elliptic, pyriform, oblong-elliptic, clavate, up to 31 x 29 µm; filamentous hyphae very inconspicuous, up to 7 µm diam.

SPORES: 6.3-7.8 x 10.2-11.7 µm ($\underline{E}$ = 1.40-1.86; $\underline{E}^{m}$ = 1.63), elliptic to elongate, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short, cylindric.

Bas (1969) has placed this taxon in synonymy with *Amanita polypyramis* (Berk. & Curt.) Sacc.

16. *Venenarius pantherinoides* Murrill. 1912. Mycologia 4(5): 242-243.
≡ *Amanita pantherinoides* (Murr.) Murrill. 1912. Mycologia 4(5): 262.

Holotype: Seattle, Washington, 20. x. - 1. xi. 1911, W. A. Murrill 399(NY).

PILEUS: up to 45 mm broad, convex to plane, margin not striate, *melleous or dirty-cremeous with brown or chestnut center*; volval remnants as thin, floccose patches, *white*. LAMELLAE: free, crowded, *white*. STIPE: up to 70 x 7 mm, tapering slightly upward, apex expanded, stuffed, *white*; volval remnants as small, free margin and occasional floccose material at apex of basal bulb, *white*.

PILEIPELLIS: filamentous hyphae densely interwoven, 3-8 µm diam, gelatinized. PILEUS TRAMA: filamentous hyphae undifferentiated, up to 7 µm diam; inflated cells clavate to irregularly elongate, up to 160 x 32 µm. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, rarely clamped. BASIDIA: up to 47 x 4.5-11 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus conspicuous, moderately branched, up to 8 µm diam, no clamps; inflated

cells terminal or short, terminal chains, subglobose, ovoid, broadly elliptic, elliptic, oblong-elliptic, clavate, up to 83 x 58 µm: filamentous hyphae at base of stipe up to 7 µm diam, moderately branched, no clamps; inflated cells terminal or short, terminal chains, primarily clavate to oblong-elliptic, with fewer broadly elliptic to ovoid, up to 105 x 38 µm. STIPE TRAMA: filamentous hyphae inconspicuous, sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 286 x 32 µm. PARTIAL VEIL: filamentous hyphae moderately branched, up to 6 µm diam, rarely clamped; inflated cells terminal, clavate to elliptic, up to 130 x 25 µm.

SPORES: 6.3-7.9 x 7.0-9.4 µm ($\underline{E}$ = 1.11-1.38; E^m = 1.20), subglobose to elliptic, often adaxially flattened, hyaline, non-amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

Jenkins (1977) has reduced this to a variety of *Amanita pantherina*, i.e., *Amanita pantherina* var. *pantherinoides*.

17. *Venenarius parviformis* Murrill. 1944. Lloydia 7(4): 315.
≡ *Amanit parviformis* (Murr.) Murrill. 1944. Lloydia 7(4): 327.

Holotype: Gainesville, Florida, 4. x. 1943, W. A. Murrill 19266(FLAS).

PILEUS: up to 25 mm broad, plano-convex, margin slightly incurved, very slightly striate, *white*; volval remnants as thin, floccose-membranous patches on disc. LAMELLAE: free, moderately crowded, *white*. STIPE: 25 x 3 mm, cylindric, solid, *white*, basal bulb subglobose, *white*; annulus superior, membranous, pendant, *white*; volval remnants membranous, saccate, slightly lobed, sturdy.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 2-8 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae probably ramose (poor reinflation). BASIDIA: up to 46 x 4-13 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae dominant, moderately branched, up to 8 µm diam, no clamps; inflated cells few, terminal, broadly elliptic to elliptic, up to 93 x 63 µm: volval material at base of stipe very similar to that on pileus. STIPE TRAMA: filamentous hyphae moderately conspicuous, sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 187 x 28 µm. PARTIAL VEIL: exclusively filamentous hyphae, moderately branched, up to 7 µm diam, no clamps.

SPORES: 5.5-6.3 x 7.8-9.4 µm ($\underline{E}$ = 1.24-1.54; E^m = 1.40), broadly elliptic to elliptic, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short cylindrical.

18. *Venenarius parvus* Murrill. 1945. Proc. Fla. Acad. Sci. 7: 114.
≡ *Amanita parva* (Murr.) Murrill. 1945. Proc. Fla. Acad. Sci. 7: 127.

Holotype: Gainesville, Florida, 21. vi. 1938, W. A. Murrill 17404 (FLAS).

PILEUS: 20 mm broad, plane, margin non-striate, *white*; volval remnants as a few randomly distributed, floccose patches. LAMELLAE: narrowly adnexed, moderately crowded, *pallid*. STIPE: 30 x 2 mm, cylindric, apex slightly expanded, solid, *white*, basal bulb abruptly marginate, napiform, *white*; annulus apical, submembranous; volval

remnants as a very shallow, submembranous cup at apex of basal bulb.

PILEIPELLIS: filamentous hyphae interwoven, 2-7 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, clamped. BASIDIA: up to 40 x 5.5-10 µm, 4-sterigmate, clamped. VOLVA: filamentous hyphae on pileus conspicuous, moderately branched, up to 7 µm diam, clamps occasional; inflated cells terminal or short, terminal chains, globose, subglobose, broadly elliptic, clavate to fusiform, up to 65 x 65 µm: volval material at base of stipe very similar to that on pileus. STIPE TRAMA: filamentous sparsely branched, moderately conspicuous, up to 8 µm diam, clamps occasional; inflated cells terminal, clavate, longitudinally oriented. PARTIAL VEIL: filamentous hyphae moderately branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, up to 31 x 16 µm.

SPORES: 4.7-5.5 x 10.2-10.9 µm ($\underline{E}$ = 1.85-2.32; $\underline{E}^{m}$ = 2.03), elongate to cylindric, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, truncate-conic to short cylindrical.

19. *Venenarius praegemmatus* Murrill. 1912. Mycologia 4(5): 243. ≡ *Amanita praegemmata* (Murr.) Murrill. 1912. Mycologia 4(5): 262.

Holotype: Seattle, Washington, 20. x. - 1. xi. 1911, W. A. Murrill 247(NY).

PILEUS: approximately 40 mm broad, convex to plano-convex, margin non-striate, *melleous-avellaneous in the center, dark-melleous on the margin*; volval remnants as *white*, floccose-fibrillose patches or occasionally angular warts covering most of pileus. LAMELLAE: free, crowded, *white*. STIPE: 40 x 3-5 mm, tapering slightly upward, stuffed, *white*, basal bulb ovoid, annulus superior, slightly, *white*; volval remnants appressed, as slight free margin on basal bulb.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-8 µm diam, gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, occasionally clamped. BASIDIA: up to 47 x 4.5-12.5 µm, 4-sterigmate, occasionally clamped. VOLVA: filamentous hyphae moderately branched, 3-8 µm diam; inflated cells terminal or short, terminal chains, irregularly disposed to apico-basal, globose, subglobose, ovoid, broadly elliptic, up to 64 x 45 µm, and clavate, elliptic, to oblong-elliptic, up to 115 x 38 µm: filamentous hyphae of volva at base of stipe very similar to that on pileus; inflated cells primarily elongate to clavate, up to 127 x 31 µm, with a few small, broadly elliptic to ovoid. STIPE TRAMA: filamentous hyphae moderately conspicuous, sparsely branched, up to 7 µm diam; inflated cells terminal, clavate, longitudinally oriented, up to 221 x 35 µm. PARTIAL VEIL: filamentous hyphae dominant, moderately branched, 3-7 µm diam, rarely clamped; inflated cells sparse, clavate, up to 125 x 20 µm.

SPORES: 6.3-7.0 x 8.7-9.4 µm ($\underline{E}$ = 1.34-1.49; $\underline{E}^{m}$ = 1.43), elliptic, often adaxially flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical to truncate-conic.

Jenkins (1977) has reduced this to synonymy with *Amanita pantherina* var. *pantherinoides*.

20. *Lepiota praegraveolens* Murrill. 1939. Bull. Torr. Bot. Club 66: 153.

≡ *Amanita praegraveolens* (Murr.) Singer. 1949. Lilloa 22: 388.

Holotype: Gainesville, Florida, 25. x. 1938, W. A. Murrill 18298 (FLAS).

PILEUS: 70 mm broad, plano-convex, margin slightly incurved, non-striate, *white*; no volval remnants remaining. LAMELLAE: free, very crowded, *white*. STIPE: up to 80 x 8 mm, subcylindric, solid, apex slightly expanded, *white*; annulus superior, evanescent, floccose, *white*; no volval remnants remaining.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-7 µm diam. PILEUS TRAMA: filamentous hyphae and inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae subcellular to cellular, no clamps. BASIDIA: up to 40 x 4-10 µm, 4-sterigmate, no clamps. VOLVA: no remnants remaining on pileus or stipe base. STIPE TRAMA: filamentous hyphae moderately abundant, sparsely branched, up to 11 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 301 x 40 µm.

SPORES: (6.2)7.0-7.8 x (6.2) 7.8-8.6 µm ($\underline{E}$ = 1.0-1.11; $\underline{E}^{m}$ = 1.04), globose to subglobose, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

21. *Venenarius praelongisporus* Murrill. 1941. Mycologia 33(4): 434-435.

≡ *Amanita praelongispora* (Murr.) Murrill. 1941. Mycologia 33(4): 448.

Holotype: Gainesville, Florida, 16. v. 1938, W. A. Murrill 16108 (FLAS).

PILEUS: up to 60 mm broad, plano-convex, glabrous-shiny, margin slightly incurved, slightly appendiculate, non-striate, *white or with faint cream tint*. LAMELLAE: free, crowded, *white*. STIPE: up to 55 x 8 mm, subcylindric, solid, *white with a yellowish tint*, basal bulb subglobose to ovoid; annulus evanescent, delicate membranous, adhering to lamellae, *white*; volval remnants as a few floccose patches, *white*.

PILEIPELLIS: filamentous hyphae interwoven, 2-7 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, no clamps. BASIDIA: up to 50 x 4-10 µm, 4-sterigmate, clamped. VOLVA: filamentous hyphae of volva at stipe base moderately branched, up to 7 µm diam, no clamps; inflated cells dominant, terminal or short, terminal chains, ovoid, broadly elliptic, up to 63 x 47 µm and fusiform up to 110 x 47 µm. STIPE TRAMA: filamentous hyphae sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 358 x 38 µm. PARTIAL VEIL: filamentous hyphae moderately branched, up to 5 µm diam, no clamps; inflated cells abundant, broadly elliptic, ovoid, subglobose, up to 40 x 40 µm, with fusiform to clavate, up to 218 x 37 µm.

SPORES: 4.7-5.5 x (10.2)10.9-11.7(14.1) µm ($\underline{E}$ = 1.98-2.56; $\underline{E}^{m}$ = 2.34), elongate to cylindric, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

22. *Venenarius pseudovernus* Murrill. 1944. Proc. Fla. Acad. Sci. 7: 114-115.
≡ *Amanita pseudoverna* (Murr.) Murrill. 1944. Proc. Fla. Acad. Sci. 7: 127.

Holotype: Gainesville, Florida, 29. v. 1938, W. A. Murrill 16431 (FLAS).

PILEUS: up to 40 mm broad, plano-convex, margin slightly incurved, non-striate, *pure white throughout or with cream disc*. LAMELLAE: free, crowded. STIPE: up to 65 x 8 mm, subcylindric, solid, *white*, basal bulb ovoid; annulus submembranous, easily torn, superior, *white*; volval remnants as membranous, saccate, lobed, relatively thick, *white*.

PILEIPELLIS: filamentous hyphae interwoven, 2-6 µm diam, gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to inflated ramose, no clamps. VOLVA: remnants at base of stipe layered; outer layer composed exclusively of densely interwoven, filamentous hyphae, moderately branched, up to 12 µm diam, no clamps; inner layer very similar, but not as densely interwoven. STIPE TRAMA: filamentous hyphae abundant, sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 140 x 16 µm. PARTIAL VEIL: filamentous hyphae abundant, interwoven, moderately branched, no clamps; inflated cells small, irregularly shaped, terminal.

SPORES: 7.0-7.8 x 7.8-8.6(10.2) µm ($\underline{E}$ = 1.11-1.31; $\underline{E}^m$ = 1.22), subglobose to elliptic, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, truncate-conic.

23. *Venenarius rhoadsii* Murrill. 1939. Bull. Torr. Bot. Club 66: 30.
≡ *Amanita rhoadsii* (Murr.) Murrill. 1939. Bull. Torr. Bot. Club 66: 37.

Holotype: Lake Rosa, Putnam Co., Florida, 8. ix. 1938, A. S. Rhoads 18125(FLAS).

PILEUS: up to 65 mm broad, plano-convex, margin non-striate, inrolled, *white, cremeous on drying*; pileus densely covered with loose, floccose, volval material. LAMELLAE: free, distant, *white, becoming brown when dried*. STIPE: up to 145 x 18 mm, subcylindric, solid, *white, cremeous when dried*, basal bulb slenderly fusiform to napiform; annulus evanescent, strongly floccose, *white*; volva as a few floccose patches.

PILEIPELLIS: filamentous hyphae interwoven, 3-6 µm diam, slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to inflated ramose, clamps rare. BASIDIA: up to 50 x 4-11.7 µm, 4-sterigmate, clamped. VOLVA: filamentous hyphae on pileus conspicuous, moderately branched, up to 7 µm diam; inflated cells terminal or short, terminal chains, globose, elliptic, oblong-elliptic, pyriform, clavate, fusiform, up to 120 x 60 µm, primarily apico-basal; volval material at base of stipe similar to that on pileus. STIPE TRAMA: filamentous hyphae sparsely branched, up to 7 µm diam, few clamps; inflated cells terminal, clavate, longitudinally oriented, up to 258 x 27 µm.

SPORES: 3.1-3.9 x 10.9-12.5 µm ($\underline{E}$ = 2.70-3.77; $\underline{E}^m$ = 3.24),

cylindrical to bacilliform, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

24. *Venenarius roanokensis* f. *inodora* (Coker) Murrill. 1946. Lloydia 9(4): 324.
≡ *Amanita roanokensis* f. *inodora* (Coker) Murrill. 1946. Lloydia 9(4): 330.
≡ *Amanita inodora* (Murr.) Bas. 1969. Persoonia 5(4): 547-548.

Holotype: Gainesville, Florida, 29. viii. 44, W. A. Murrill 20091 (FLAS).

PILEUS: up to 45 mm broad, plano-convex, margin slightly raised, non-striate; no volval remnants. LAMELLAE: free or connected by floccose line, moderately close, STIPE: up to 30 x 5 mm, cylindric, solid, slightly expanded at apex, glabrous or with slightly floccose, material, basal bulb marginate, ovoid to subradicate, up to 20 x 15 mm; annulus floccose-membranous, evanescent; only slight, floccose volval material remaining.

PILEIPELLIS: filamentous hyphae interwoven, up to 7 µm diam, gelatinized. PILEUS TRAMA: filamentous hyphae undifferentiated with broadly clavate to fusiform inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: ramose to slightly inflated ramose, no clamps. BASIDIA: up to 45 x 4-8 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus very sparse, sparsely branched, up to 6 µm diam, no clamps; inflated cells dominant, mostly terminal chains, broadly elliptic to ovoid, up to 50 x 28 µm, with fewer oblong-elliptic to clavate, up to 63 x 25 µm: volval material at base of stipe very similar, but with inflated cells slightly smaller. STIPE TRAMA: filamentous hyphae sparsely branched, inconspicuous, up to 6 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented; considerable gloeoplerous hyphae present. PARTIAL VEIL: filamentous hyphae dominant, moderately branched, up to 6 µm diam, no clamps; inflated cells terminal, clavate, up to 38 x 12 µm.

SPORES: 3.9-4.7 x 12.5-13.3(14.1) µm ($\underline{E}$ = 2.66-3.41; $\underline{E}^{m}$ = 2.94), cylindrical to bacilliform, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short, truncate-conic.

25. *Venenarius roseitinctus* Murrill. 1914. North American Flora 10(1): 75.
≡ *Amanita roseitincta* (Murr.) Murrill. 1914. Mycologia 6: 269.

Holotype: Biloxi, Mississippi, 13. ix. 1904, Mrs. F. S. Earle 182(NY).

PILEUS: 35 mm broad, convex, margin non-striate, slightly incurved, *salmon colored*; volval remnants as pulverulent meal over most of surface. LAMELLAE: free, crowded, *white*. STIPE: 60 x 5-8 mm, tapering upward, apex slightly expanded, stuffed, *white tinged with salmon*, basal bulb elliptic, 20 x 12 mm; annulus membranous, delicate, remaining attached to gills and pileus margin, *white tinged with salmon*; volval remnants as a slightly, mealy material on apex of bulb, *salmon colored*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-6 µm diam, slightly gelatinized. PILEUS TRAMA: undifferentiated, filamentous hyphae and inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae inflated ramose to subcellular, no clamps. BASIDIA: up

to 54 x 4-12 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus conspicuous, moderately branched, up to 6 µm diam, no clamps; inflated cells terminal or short, terminal chains, mostly globose to broadly elliptic, up to 46 x 46 µm: volval material at base of stipe predominantly filamentous hyphae, moderately branched, up to 8 µm diam, no clamps; inflated cells short, terminal chains, globose, subglobose, broadly elliptic, up to 35 x 35 µm, with subtending cells elliptic to fusiform, up to 45 x 15 µm. STIPE TRAMA: filamentous hyphae sparsely branched, up to 5 µm diam, no clamps; inflated cells terminal, clavate. PARTIAL VEIL: almost completely filamentous hyphae, moderately branched, up to 7 µm diam, no clamps; inflated cells few, terminal, short clavate.

SPORES: none found.

26. *Venenarius solitariiformis* Murrill. 1941. Mycologia 33(4): 435.
≡ *Amanita solitariiformis* (Murr.) Murrill. 1941. Mycologia 33 (4): 448.

Holotype: Gainesville, Florida, 9. viii. 1937, W. A. Murrill 16415 (FLAS).

PILEUS: 42 mm broad, plano-convex, margin non-striate, slightly incurved, *white stained with cream*; volval remnants as pyramidal to irregularly shaped warts, easily removed. LAMELLAE: free, moderately close, *white to isabelline with white edges*. STIPE: 25 x 6-8 mm, tapering slightly upward, solid, *white*, basal bulb nearly subradicate; volval remnants as pulverulence covering most of stipe surface and basal bulb.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-8 µm diam, slightly gelatinized. PILEUS TRAMA: filamentous hyphae moderately branched, up to 8 µm diam; inflated cells mostly clavate, up to 218 x 40 µm. LAMELLA TRAMA: bilateral. SUBHYMENIUM: ramose to inflated ramose, no clamps. BASIDIA: up to 60 x 4-11.7 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae quite inconspicuous, moderately branched, up to 8 µm diam, no clamps; inflated cells dominant, terminal and short, terminal chains, globose, subglobose, broadly elliptic, ovoid, elliptic, and clavate, up to 40 x 35 µm: volval material at base of stipe very similar, but with fewer hyphae than on pileus. STIPE TRAMA: filamentous hyphae sparsely branched, moderately abundant, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 188 x 31 µm.

SPORES: 4.7-5.5 x (12.5)13.3-14.1(15.6) µm ($\underline{E}$ = 2.42-3.00; $\underline{E}^{m}$ = 2.69), cylindrical, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus, short, cylindrical.

27. *Venenarius spretellus* Murrill. 1948. Lloydia 2(2): 105.
≡ *Amanita spretella* (Murr.) Murrill. 1948. Lloydia 2(2): 105.

Holotype: Gainesville, Florida, 19. viii. 1948, W. A. Murrill 40841 (FLAS).

PILEUS: 33 mm broad, plane, margin distinctly striate, *gray, darker on disc*; no volval remnants remaining. LAMELLAE: just free, crowded, *white*. STIPE: 70 x 4-6 mm, tapering slightly upward, stuffed to hollow, *white above, lower half delicate rosy-cream*, no basal bulb; no annulus; volva saccate, membranous, *white*, lobed.

PILEIPELLIS: filamentous interwoven, 3-7 µm diam, gelatinized.

PILEUS TRAMA: filamentous hyphae and elongate, inflated cells, terminal or short, terminal chains. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, no clamps. BASIDIA: up to 45.8 x 3.9-12.5 µm, 4-sterigmate, no clamps. VOLVA: no remnants on pileus: volval material at base of stipe predominantly filamentous hyphae, moderately branched, up to 7 µm diam, no clamps; inflated cells few, elongate, terminal, up to 34 x 8 µm. STIPE TRAMA: filamentous hyphae moderately branched, moderately conspicuous, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 244 x 40 µm.

SPORES: (6.7)7.0-7.8 x 11.7-13.3 µm ($\underline{E}$ = 1.50-1.88; $\underline{E}^m$ = 1.66), elliptic to elongate, often adaxially flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

28. *Venenarius subalbiaceus* Murrill. 1941. Mycologia 33(4): 437-438.

≡ *Amanita subalbiacea* (Murr.) Murrill. 1941. Mycologia 33(4): 448.

Holotype: Gainesville, Florida, 22. vi. 1938, W. A. Murrill 16495 (FLAS).

PILEUS: approximately 20 mm broad, plano-convex, margin nonstriate, *white*; no volval remnants. LAMELLAE: free, crowded, *white*. STIPE: up to 75 x 2-4 mm, slightly expanded at apex, solid, *white*, basal bulb ovoid; annulus superior, membranous, fairly delicate, *white*; volval remnants as one membranous patch at apex of bulb.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-8 µm diam, slightly gelatinized. PILEUS TRAMA: filamentous hyphae and inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: ramose to slightly inflated ramose, no clamps. BASIDIA: up to 58.5 x 4-10.5 µm, 4-sterigmate, no clamps. VOLVA: remnants at base of stipe completely filamentous hyphae, moderately branched, up to 6.5 µm diam, no clamps. STIPE TRAMA: filamentous hyphae sparsely branched, relatively inconspicuous, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 274 x 37 µm. PARTIAL VEIL: mostly filamentous hyphae, moderately branched, up to 6 µm diam, no clamps; inflated cells numerous, terminal, subglobose to ovoid, up to 16 x 16 µm.

SPORES: 5.9-7.0 x 11.7-14.1 µm ($\underline{E}$ = 1.66-2.27; $\underline{E}^m$ = 1.98), elongate to cylindric, often adaxially flattened, hyaline, weakly amyloid, thin walled; contents guttulate, apiculus sublateral, short cylindric.

29. *Venenarius subcitriniceps* Murrill. 1945. Jour, Fla. Acad. Sci. 8(2): 183-184.

≡ *Amanita subcitriniceps* (Murr.) Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 198.

Holotype: Gainesville, Florida, 30. vi. 1944, W. A. Murrill 38901 (FLAS).

PILEUS: approximately 29 mm broad, plano-convex, margin nonstriate, *pale citrinous*; no volval remnants remaining. LAMELLAE: narrowly adnate, crowded, *white*. STIPE: 60 x 2-5 mm, tapering upward, apex slightly expanded, solid, *white*, basal bulb elliptic, *white*; exannulate; volva as a few floccose patches on lower part of stipe.

PILEIPELLIS: filamentous hyphae interwoven, 3-8 µm diam,

gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to inflated ramose, no clamps. BASIDIA: up to 40 x 4-8.5 µm, 4-sterigmate, no clamps. VOLVA: poor reinflation. STIPE TRAMA: filamentous hyphae sparsely branched, moderately abundant, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 212 x 34 µm.

SPORES: 5.5-6.2 x 7.8-8.6(9.4) µm ($\underline{E}$ = 1.39-1.52; $\underline{E}^m$ = 1.43), elliptic, often adaxially flattened, hyaline, extremely weakly amyloid, thin walled; contents guttulate, apiculus sublateral, short cylindric.

30. *Venenarius submutabilis* Murrill. 1943. Mycologia 35(4): 428.
≡ *Amanita submutabilis* (Murr.) Murrill. 1943. Mycologia 35(4): 433.

Holotype: Burnett's Lake, Alachua Co., Florida, 24. ix. 1941, W. A. Murrill 20004(FLAS).

PILEUS: up to 70 mm broad, plano-convex, margin non-striate, slightly incruved, *white*; volval remnants as a thin layer of pulverulence, easily removed. LAMELLAE: free, moderately crowded, *white*. STIPE: up to 60 x 8 mm, apex slightly expanded, solid, *white*, basal bulb subglobose to ovoid; annulus superior, floccose-membranous, *white*; volval remnants membranous, thick, forming shallow cup at top of bulb, *white*.

PILEIPELLIS: filamentous hyphae interwoven, 3-7 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, no clamps. BASIDIA: up to 63 x 6.5-10.5 µm, 4-sterigmate, clamps rare. VOLVA: filamentous hyphae on pileus dominant, moderately branched, up to 8 µm diam, no clamps; inflated cells conspicuous, mostly elliptic to clavate, terminal, up to 132 x 47 µm, few ovoid: volval material at base of stipe very similar to that on pileus, but with larger number of broadly elliptic to ovoid cells. STIPE TRAMA: filamentous hyphae moderately conspicuous, sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 306 x 47 µm. PARTIAL VEIL: filamentous hyphae dominant, moderately branched, up to 8 µm diam, no clamps; inflated cells few, slenderly clavate, terminal.

SPORES: 6.2-7.8 x 13.3-14.1(14.8) µm ($\underline{E}$ = 1.81-2.15; $\underline{E}^m$ = 1.98), elongate to cylindric, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

Bas (1969) has placed this taxon into synonymy with *Amanita mutabilis* Beardslee.

31. *Venenarius subphalloides* Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 184.
≡ *Amanita subphalloides* (Murr.) Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 198.

Holotype: Gainesville, Florida, 11. vii. 1938, Lillian Arnold 17832 (FLAS).

PILEUS: 25 mm broad, plano-convex, margin non-striate, *umbrinous with fuliginous disk*; volval remnants as randomly distributed floccose patches. LAMELLAE: free, crowded, *white with a rosy tint*.

Stipe: 35 x 2 mm, solid, *white*, *blushing where bruised*, basal bulb subglobose, *white*; annulus superior, delicate, membranous, *white*; volval remnants as a few floccose-membranous patches on apex of basal bulb.

PILEIPELLIS: filamentous hyphae interwoven, 3-8 µm diam, gelatinized. PILEUS: elongate, inflated cells and undifferentiated, filamentous hyphae, no clamps. LAMELLA TRAMA: bilateral. SUBHYMENIUM: inflated ramose to subcellular, no clamps. BASIDIA: up to 32 x 4-8.5 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus moderately abundant, moderately branched, up to 8 µm diam, clamps; inflated cells terminal or short, terminal chains, globose, subglobose, broadly elliptic, ovoid, up to 40 x 40 µm, with few fusiform and clavate: volval material at base of stipe very similar, but with slightly larger cells, up to 55 x 55 µm. STIPE TRAMA: filamentous hyphae sparsely branched, relatively inconspicuous, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 212 x 34.5 µm.

SPORES: 5.5-6.2(7.4) x 5.5-7.0(7.8) µm ($\underline{E}$ = 1.0-1.13; $\underline{E}^m$ = 1.07) globose to subglobose, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

32. *Venenarius subrecutitus* Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 184.
≡ *Amanits subrecutita* (Murr.) Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 198.

Holotype: Gainesville, Florida, 26. iii. 1944, W. A. Murrill 17996 (FLAS).

PILEUS: approximately 40 mm broad, plane with margins upturned, shiny, margin striate, *avellaneous*; no volval remnants. LAMELLAE: narrowly adnate, crowded, *white*. STIPE: up to 60 x 4-6 mm, stuffed to hollow, *white*, basal bulb elliptical; no annular remnants; volval remnants as a membranous, shallow cup, *white*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-6 µm diam, gelatinized. PILEUS TRAMA: inflated cells and undifferentiated filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: unable to reinflate. BASIDIA: up to 40 x 4-7.8 µm, 4-sterigmate, no clamps. VOLVA: unable to reinflate. STIPE TRAMA: filamentous hyphae sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, elliptic to fusiform, longitudinally oriented, up to 190 x 47 µm.

SPORES: 7.0-8.6 x 12.5-13.3 µm ($\underline{E}$ = 1.54-1.90; $\underline{E}^m$ = 1.75), elliptic to elongate, often adaxially flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

33. *Venenarius subsolitarius* Murrill. 1941. Mycologia 33(4): 435.
≡ *Amanita subsolitaria* (Murr.) Murrill. 1941. Mycologia 33(4): 448.

Holotype: Gainesville, Florida, 1. vi. 1938, W. A. Murrill 16449 (FLAS).

PILEUS: up to 55 mm broad, convex, margin non-striate, slightly incurved, *white or rosy-isabelline*; volval remnants as a few floccose warts, randomly distributed, densest near center. LAMELLAE: narrowly adnate, crowded, *white*. STIPE: up to 75 x 6-9 mm, slightly expanded

at apex, solid, *white*, basal bulb elliptical; annulus fugacious, only a few floccose remnants remaining; volval remnants as a very slight flocculence, easily removed.

PILEIPELLIS: filamentous hyphae interwoven, 3-7 µm diam, slightly gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: ramose to inflated ramose, no clamps. BASIDIA: up to 50 x 4-13.5 µm, 4-sterigmate, rarely clamped. VOLVA: filamentous hyphae on pileus moderately branched, up to 8 µm diam, no clamps; inflated cells as terminal chains, globose, subglobose, broadly elliptic, pyriform, up to 55 x 40 µm: volval remnants at base of stipe very similar to that on pileus. STIPE TRAMA: filamentous hyphae conspicuous, sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 290 x 31 µm. PARTIAL VEIL: filamentous hyphae dominant, moderately branched, up to 7 µm diam, no clamps; inflated cells terminal, oblong elliptic to clavate, up to 47 x 10 µm.

SPORES: (4.7)5.0-5.5 x (10.9)11.7-12.8(13.3) µm ($\underline{E}$ = 2.20-2.66; $\underline{E}^m$ = 2.36), cylindrical, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short cylindrical.

34. *Venenarius subvirginianus* Murrill. 1941. Mycologia 33(3): 286. ≡ *Amanita subvirginiana* (Murr.) Murrill. 1941. Mycologia 33(3): 287.

Holotype: Gainesville, Florida, 27. iii. 1938, W. A. Murrill 16134 (FLAS).

PILEUS: 10 mm broad, plane, margin distinctly striate, *avellaneous*; volval remnant as one floccose-membranous patch on disc. LAMELLAE: free, subdistant, *white*. STIPE: 27 x 1-2 mm, stuffed, *milk-white*, basal bulb very slight; annulus superior, nearly median, delicately membranous, *white*; volval remnants membranous, saccate, thin, *white*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-8 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: inflated ramose to subcellular, clamps rare. VOLVA: filamentous hyphae dominant, up to 8 µm diam, moderately branched, clamps; inflated cells mostly terminal, broadly elliptic, elliptic, cylindric, up to 93 x 46 µm: volval material at base of stipe very similar, but with more filamentous hyphae and fewer inflated cells. STIPE TRAMA: filamentous hyphae sparsely branched, up to 6 µm diam, no clamps; inflated cells terminal or short, terminal chains, oblong elliptic, longitudinally oriented, up to 291 x 47 µm. PARTIAL VEIL: completely filamentous hyphae, moderately branched, up to 7 µm diam, no clamps.

SPORES: 7.8-9.4 x 10.2-11.7(12.5) µm ($\underline{E}$ = 1.24-1.43; $\underline{E}^m$ = 1.35), broadly elliptic to elliptic, often adaxially flattened, hyaline, non-amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

Singer (1949) has placed this in synonymy with *Amanita spreta* var. *minor* Beardslee.

35. *Venenarius tenuifolius* Murrill. 1945. Mycologia 37(2): 270. ≡ *Amanita tenuifolia* (Murr.) Murrill. 1945. Mycologia 37(2): 271.

Holotype: Gainesville, Florida, 22. vi. 1944, W. A. Murrill 38002 (FLAS).

PILEUS: up to 35 mm broad, plano-convex, margin non-striate, *white, becoming yellowish on the disk with age or on drying*; no volval remnants. LAMELLAE: just free or narrowly adnexed, crowded, *white*. STIPE: up to 55 x 4-6 mm, tapering slightly upward, apex expanded, solid, *white*, basal bulb ovoid; annulus superior, thin, membranous, *white*; volval remnants as thin, membranous cup at apex of bulb, lobed, *white*.

PILEIPELLIS: filamentous hyphae interwoven, 3-7 µm diam, gelatinized. PILEUS TRAMA: filamentous hyphae and inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: ramose to slightly inflated ramose, no clamps. BASIDIA: up to 51 x 4-10.5 µm, 4-sterigmate, no clamps. VOLVA: no volval remnants on pileus: volval material at base of stipe mostly filamentous hyphae, moderately branched, up to 8 µm diam, no clamps; inflated cells broadly elliptic, elliptic, clavate, cylindric, terminal, up to 94 x 40 µm. STIPE TRAMA: filamentous hyphae sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, cylindric, longitudinally oriented, up to 321 x 21 µm. PARTIAL VEIL: almost exclusively filamentous hyphae, moderately branched, up to 7 µm diam, no clamps; inflated cells few, clavate, terminal, up to 50 x 10 µm.

SPORES: 4.3-4.7 x 11.7-12.5(13.6) µm ($\underline{E}$ = 2.49-2.89; $\underline{E}^{m}$ = 2.63); cylindric, often adaxailly flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short cylindrical.

36. *Venenarius umbrinidiscus* Murrill. 1912. Mycologia 4(5): 242.
≡ *Amanita umbrinidisca* (Murr.) Murrill. 1912. Mycologia 4(5): 262.

Holotype: Seattle, Washington, 20. x. - 1. xi. 1911, W. A. Murrill 414(NY).

PILEUS: up to 50 mm broad, plano-convex to plane, margin striate, *melleous, fading to stramineous on the conspicuously long-striate margin, the umbo yellow in young plants, becoming umbrinous*; volval remnants as large membranous patch, frequently on disc. LAMELLAE: narrowly adnexed to just free, crowded, *white*. STIPE: up to 70 x 4-7 mm, tapering upward, apex slightly expanded, hollow, *white or slightly yellowish*, basal bulb only slightly swollen; annulus superior, only a few fragments remaining, *white*; volval remnants membranous, as a very shallow cup, *white*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-8 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. BASIDIA: up to 54 x 4-12 µm, 4-sterigmate, no clamps. SUBHYMENIUM: inflated ramose to subcellular, no clamps. VOLVA: filamentous hyphae at base of stipe dominant, moderately branched, up to 7 µm diam, no clamps; inflated cells conspicuous, terminal or short, terminal chains, broadly elliptic, up to 47 x 38 µm, with elongate to clavate, up to 78 x 15.5 µm: volval material on pileus with a much larger number of inflated cells, globose to broadly elliptic, up to 62 x 62 µm, with elongate, up to 70 x 15 µm; filamentous hyphae similar to that at base of stipe. STIPE TRAMA: filamentous hyphae sparsely branched, very inconspicuous, up to 6 µm diam, no clamps; inflated cells terminal, clavate, longitudinally

oriented, up to 327 x 46 µm. PARTIAL VEIL: primarily filamentous hyphae, moderately branched, densely interwoven, up to 7 µm diam, no clamps; inflated cells conspicuous, terminal, clavate, up to 94 x 22 µm.

SPORES: 7.0-7.8(8.6) x 10.2-11.7 µm ($\underline{E}$ = 1.31-1.56; $\underline{E}^m$ = 1.46), elliptic, often adaxially flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

37. *Venenarius vernellus* Murrill. 1944. Lloydia 7(4): 315-316.
≡ *Amanita vernella* (Murr.) Murrill. 1944. Lloydia 7(4): 327.

Holotype: Gainesville, Florida, 4. x. 1943, W. A. Murrill 20002(FLAS).

PILEUS: approximately 25 mm broad, plane, margin non-striate and incurved, *white, slightly stramineous at the center*; no volval remnants. LAMELLAE: free, crowded, *white*. STIPE: 55 x 2-3 mm, tapering upward, apex slightly expanded, solid, *white*, basal bulb subglobose; annulus superior, thin, membranous, few fragments remaining, *white*; volval remnants membranous, thin, lobed.

PILEIPELLIS: filamentous hyphae interwoven, 3-8 µm diam, gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: inflated ramose to subcellular, no clamps. BASIDIA: up to 35 x 4-8 µm, 1, but mostly 2-sterigmate, no clamps. VOLVA: no volval remnants on pileus: filamentous hyphae at base of stipe dominant, moderately branched, up to 7 µm diam, no clamps; inflated cells few, terminal, broadly elliptic, up to 125 x 94 µm. STIPE TRAMA: filamentous hyphae sparsely branched, very conspicuous, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 218 x 21 µm. PARTIAL VEIL: almost exclusively filamentous hyphae, moderately branched, up to 7 µm diam, no clamps; inflated cells very few, terminal, small.

SPORES: 7.0-7.8(9.4) x 7.0-7.8(9.7) µm ($\underline{E}$ = 1.0-1.03; $\underline{E}^m$ = 1.001), globose, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

38. *Venenarius verniformis* Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 184-185.
≡ *Amanita verniformis* (Murr.) Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 198.

Holotype: Newnan's Lake, Alachua Co., Florida, 9. vii. 1944, W. A. Murrill 32931(FLAS).

PILEUS: approximately 57 mm broad, plano-convex, margin non-striate, slightly inrolled, *milk-white*; no volval remnants remaining. LAMELLAE: free, crowded, *white*. STIPE: 70 x 6-8 mm, tapering upward, apex slightly expanded, solid, *white*, basal bulb ovoid, *white*; annulus superior, membranous, fairly delicate, *white*; volval remnants membranous, lobed, relatively thick, 25 x 20 mm, *white*.

PILEIPELLIS: filamentous hyphae interwoven, 3-7 µm diam, gelatinized. PILEUS TRAMA: undifferentiated, filamentous hyphae and inflated cells, elongate, with large number of subglobose to ovoid. LAMELLA TRAMA: bilateral. SUBHYMENIUM: unable to reinflate. BASIDIA: up to 51 x 4-14 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae at base of stipe moderately branched, dominant, up to 10 µm diam, no clamps; inflated cells few, terminal, clavate, up to

94 x 31 µm. STIPE TRAMA: filamentous hyphae abundant, sparsely branched, up to 8 µm diam, clamps occasional; inflated cells terminal, clavate, longitudinally oriented, up to 281 x 22 µm. PARTIAL VEIL: mostly filamentous hyphae, moderately branched, up to 10 µm diam, no clamps; inflated cells terminal, elliptic to fusiform, up to 45 x 20 µm.

SPORES: 7.0-7.8(8.6) x (9.4)10.2-10.9(11.7) µm ($\underline{E}$ = 1.12-1.56; $\underline{E}^m$ = 1.37), subglobose to elliptic, often adaxailly flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short, truncate-conic.

39. *Venenarius virginianus* Murrill. 1914. North American Flora 10(1): 71.
≡ *Amanita virginiana* (Murr.) Murrill. 1914. Mycologia 6(5): 269.

Holotype: Mountain Lake, Virginia, 8-14. vii. 1909, W. A. Murrill 28(NY).

PILEUS: up to 15 mm broad, plane, margin strongly striate, *fuliginous, margin white*; no volval remnants remaining. LAMELLAE: free, crowded, *white*. STIPE: up to 38 x 1-2 mm, tapering upward, apex slightly expanded, stuffed to hollow, *white*, no basal bulb; no annular material remaining; volval remnants membranous, saccate, fairly sturdy, *white*.

PILEIPELLIS: filamentous hyphae interwoven, to subradial, 2-7 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, no clamps. BASIDIA: up to 35 x 3-9 µm, mostly 1-2 sterigmate, rarely 4-sterigmate, no clamps. VOLVA: exclusively filamentous hyphae at base of stipe, interwoven, moderately branched, up to 8 µm diam, no clamps. STIPE TRAMA: filamentous hyphae dominant, up to 7 µm diam, sparsely branched, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 198 x 31 µm.

SPORES: 9.4-11.7(13.3) x 12.5-13.3(14.1) µm ($\underline{E}$ = 1.11-1.45; $\underline{E}^m$ = 1.28), subglobose to elliptic, often adaxailly flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

40. *Venenarius virosiformis* Murrill. 1941. Mycologia 33(4): 436.
≡ *Amanita virosiformis* (Murr.) Murrill. 1941. Mycologia 33(4): 448.

Holotype: Gainesville, Florida, 26. v. 1938, W. A. Murrill 16229 (FLAS).

PILEUS: approximately 50 mm broad, plano-convex, margin nonstriate, *white*; no volval remnants remaining. LAMELLAE: free, crowded *white*. STIPE: 55 x 6 mm, tapering upward, apex slightly expanded, solid, *white*, basal bulb subglobose, 18 x 16 mm, *white*; volval remnants membranous, delicate, irregularly lobed, shallow, cup on apex of basal bulb.

PILEIPELLIS: filamentous hyphae interwoven, 3-8 µm diam, gelatinized. PILEUS TRAMA: filamentous hyphae and elongate, inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to

slightly inflated ramose, no clamps. BASIDIA: up to 50 x 3.5-11.5 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae at base of stipe abundant, moderately branched, up to 7 µm diam, no clamps; inflated cells abundant, globose, subglobose, broadly elliptic, up to 63 x 63 µm, with fewer oblong elliptic to clavate, up to 63 x 21 µm, terminal or short, terminal chains. STIPE TRAMA: filamentous hyphae moderately abundant, sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 118 x 21 µm. PARTIAL VEIL: almost exclusively filamentous hyphae, moderately branched, up to 8 µm diam, no clamps; inflated cells few, terminal, clavate to oblong elliptic, up to 31 x 11.5 µm.

SPORES: 3.9-4.7 x 11.7-13.3 µm ($\underline{E}$ = 2.49-3.41; $\underline{E}^{m}$ = 2.71), cylindrical to bacilliform, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, very short cylindrical.

41. *Venenarius watsonianus* Murrill. 1944. Lloydia 7(4): 316.
≡ *Amanita watsoniana* (Murr.) Murrill. 1944. Lloydia 7(4): 327.

Holotype: Camp O'leno, Columbia Co., Florida, 19. x. 1941, W. A. Murrill 21875(FLAS).

PILEUS: approximately 85 mm broad, plano-convex, margin non-striate, incurved, glabrous, *white*; volval remnants as a few thin patches. LAMELLAE: widely free, crowded, *white*. STIPE: 95 x 12 mm, cylindrical, solid, *white*; volval remnants as a shallow cup, membranous, *white*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-7 µm diam, gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, no clamps. BASIDIA: up to 43 x 4-11 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae dominant, sparsely to moderately branched, up to 6 µm diam, no clamps; inflated cells moderately conspicuous, broadly elliptic to elliptic, up to 47 x 31.5 µm, terminal or short, terminal chains: volval material at base of stipe similar to that on pileus. STIPE TRAMA: filamentous hyphae sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 343 x 25 µm.

SPORES: 3.9-4.7 x 11.3-14.1(15.6) µm ($\underline{E}$ = 2.90-4.00; $\underline{E}^{m}$ = 3.38), cylindrical to bacilliform, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, very short truncate.

Bas (1969) has placed this in synonymy with *Amanita roanokensis* Coker.

42. *Venenarius wellsii* Murrill. 1920. Mycologia 12(5): 291.
≡ *Amanita wellsii* (Murr.) Murrill. 1920. Mycologia 12(5): 292.

Holotype: Springfield, New Hampshire, 1. ix. 1917, W. A. Murrill s.n. (NY).

PILEUS: approximately 55 mm broad, convex to plano-convex, margin not striate, *salmon-colored, fading, especially after a rain, usually remaining more deeply colored on the disk*; volval remnants scarce, minimal amount of pulverulent material remaining, *yellowish-buff*. LAMELLAE: free, crowded, *pale dull yellow*. STIPE:

100 x 4-9 mm, tapering slightly upward, stuffed, *pale dull yellow*, basal bulb subglobose; annulus not present; volval remnants as sparsely scattered, pulverulent material, *distinctly yellow*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-8 µm diam, slightly gelatinized. PILEUS TRAMA: filamentous hyphae and elongate, inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, no clamps. BASIDIA: up to 47 x 4.5-9.5 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus moderately branched, up to 8 µm diam, rarely clamped; inflated cells in terminal chains, elliptic, clavate, fusiform, irregularly elongate, up to 110 x 25 µm, with fewer broadly elliptic to ovoid, up to 80 x 62 µm: volval remnants at base of stipe similar to that on pileus. STIPE TRAMA: filamentous hyphae moderately branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 470 x 38 µm.

SPORES: 6.3-7.9 x 11.0-12.6 µm ($\underline{E}$ = 1.48-2.00; $\underline{E}^{m}$ = 1.63), elliptic to cylindrical, adaxially flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

43. *Venenarius westii* Murrill. 1944. Proc. Fla. Acad. Sci. 7: 115.
≡ *Amanita westii* (Murr.) Murrill. 1944. Proc. Fla. Acad. Sci. 7: 127.

Holotype: Newnan's Lake, near Gainesville, Florida, 7. vii. 1938, Erdman West 17466(FLAS).

PILEUS: 70 mm broad, plano-convex, margin non-striate, slightly incurved, *pale reddish-brown*; volval remnants as irregularly shaped warts, mostly near center, few on margin. LAMELLAE: widely free, moderately crowded, *pale grayish-white, reddish-brown when dry*. STIPE: 45 x 8-11 mm, slightly expanded at apex, solid, basal bulb ovoid; annulus superior, very delicate, *pale reddish-brown*; volval remnants as a few warts on basal bulb.

PILEIPELLIS: filamentous hyphae interwoven, 3-7 µm diam, slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: inflated ramose, no clamps. BASIDIA: up to 63 x 4-15 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus sparsely to moderately branched, up to 8 µm diam, no clamps; inflated cells subglobose, broadly elliptic to elliptic, up to 78.5 x 62.6 µm, terminal or short, terminal chains; volval remnants at base of stipe similar to that on pileus; filamentous hyphae same; inflated cells more numerous, usually larger, up to 109.5 x 94 µm, more elliptic and clavate, terminal or short, terminal chains. STIPE TRAMA: filamentous hyphae sparse, sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 174 x 41 µm. PARTIAL VEIL: filamentous hyphae moderately branched, up to 8 µm diam, no clamps; inflated cells numerous, terminal, elliptic, up to 69 x 31.5 µm.

SPORES: 7.0-8.6 x 12.5-13.3(14.1) µm ($\underline{E}$ = 1.45-2.00; $\underline{E}^{m}$ = 1.76), elongate, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

44. *Leucomyces mexicanus* Murrill. 1911. Mycologia 3(1): 80.

Holotype: Motzorongo, Mexico, 15. i. 1910, W. A. Murrill 1067(NY).

PILEUS: up to 25 mm broad, plano-convex to plane, margin non-striate, inrolled, *milk-white*; volval material as a few membranous patches, randomly distributed. LAMELLAE: free to narrowly adnexed, crowded, *white*. STIPE: up to 45 x 1-3 mm, hollow, *white*, basal bulb ovoid, no annulus, volval remnants as floccose material at apex of basal bulb, *white*.

This specimen is not a member of the genus *Amanita*. This is evidenced by the lack of a bilateral gill trama and *Amanita*-type stipe trama, both of which are characteristic of *Amanita* (Hoffman, 1861: 11; Boudier, 1886: pl. 1, fig. 8; Bas, 1969: 328).

Singer (1944) has placed this specimen in the genus *Smithiomyces*.

ACKNOWLEDGEMENTS

I would like to thank Dr. Clark T. Rogerson, Senior Curator, New York Botanical Garden, and Dr. James W. Kimbrough, University of Florida, for providing type specimens.

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MYCOTAXON

Vol. X, No. 1, pp. 201-209 October-December 1979

NOTES ON CORTICIACEAE (BASIDIOMYCETES) V.

KURT HJORTSTAM

Målaregatan 12
S- 441 00 Alingsås, Sweden

and

LEIF RYVARDEN

Botanical Laboratory
University of Oslo
P.O.Box 1045, Blindern
Oslo 3, Norway

S U M M A R Y

Amyloathelia typified by Corticium amylaceum Bourd. & Galz. and A. crassiuscula nov. sp. are described. The genus is characterized by pellicular fruitbodies and thickwalled amyloid spores. Corticium laceratum Litsch. is transferred to Amylocorticium and the typification of Athelopsis lembospora is discussed. A preliminary key to the amyloid species in Corticiaceae of N. Europe is presented.

AMYLOATHELIA Hjortst. & Ryv. nov. gen.

Fructificatio resupinata, effusa, laxe adnata, pellicularis, paulatim membranacea, plus minusve rimosa; hymenio albido vel ochraceo; margine fibrilloso vel indeterminato. Systemate hyphali monomitico. Hyphis basalibus rectis, tenuitunicatis vel crassiusculis, interdum incrustatis; hyphis subhymenialibus irregularibus, sinuosis, omnisibus fibulatis. Cystidiis nullis. In hymenio hyphis paraphysoideis praesentes. Basidiis clavatis, generatim terminalibus, basaliter plus minusve elongatis, interdum lateralibus. Sporis crassitunicatis, levibus, amyloideis.

Generitype. Corticium amylaceum Bourd. & Galz.

Fruitbody resupinate, effuse, loosely adnate, at first bys-

soid to pellicular, in time thickened and distinctly membranaceous, usually cracking, in colour whitish to light ochraceous. Margin indeterminable or slightly fibrillose. Hyphal system monomitic. Basal hyphae thin to becoming thickwalled, straight and uniform, sometimes encrusted; subhymenial hyphae irregular, sinuous, all hyphae with clamps. Cystidia lacking but mostly with hyphal ends (paraphysoids) between the basidia. Basidia varying in shape, clavate, in some cases suburniform, terminal with more or less tapering base or sometimes lateral. Spores thickwalled, smooth, amyloid, in known species ellipsoid to subglobose.

Remarks. Among genera with amyloid spores Amyloathelia is easily recognized by its smooth and thickwalled spores and in lacking sterile elements such as gloeocystidia, dendrohyphidia, and acanthophyses. In outer appearance it is much like species of Athelia or other fungi in Corticiaceae with pellicular to membranaceous fruitbodies.

Amyloathelia amylacea is somewhat related to species of Melzericium in having similar basidia but is well separated by its thickwalled spores. As the thickness of the spore-wall is a distinct characteristic and used for generic delimitiation e.g. in Hyphochicium, we consider this is a good reason to establish a new genus.

AMYLOATHELIA AMYLACEA (Bourd. & Galz.) Hjortst. & Ryv. nov. comb.

Basionym. Corticium amylaceum Bourd. & Galz. Bull. Soc. Myc. France, 27:259,1911.

Lectotype. France. Aveyron, Layrolle, sur genevrier. 1910-06-12. Galzin 6264, Bourdot 7408. GB.

Fruitbody resupinate, effuse, loosely adnate, at first more or less byssoid, later pellicular to soft membranaceous and often rimose, in colour generally white to creamish. Margin indeterminable. Hyphal system monomitic; basal hyphae thinwalled, somewhat encrusted straight and uniform, about 2-3 um in diam., subhymenial hyphae more irregular, all hyphae with clamps. Cystidia lacking but in most specimens paraphysoid hyphae between the basidia. Basidia polymorphous, sometimes distinctly clavate, in some cases suburniform, mostly terminal but some lateral basidia present, usually 20-35 x 6-7 um, with four sterigmata. Spores ellipsoid to subglobose, thickwalled, smooth, varying in size, generally 9-11 x 5-7 um, strongly amyloid.

Habitat. According to Lemke the species is growing on Thuja in North America. In Central Europe known as living on Juniperus.

Distribution in Europe. As far as we know only from Central Europe.

Remarks. Microscopically A. amylacea is readily recognized by its amyloid spores, and also in most cases, also by presence of paraphysoid hyphae in the basidial layer. Macros-

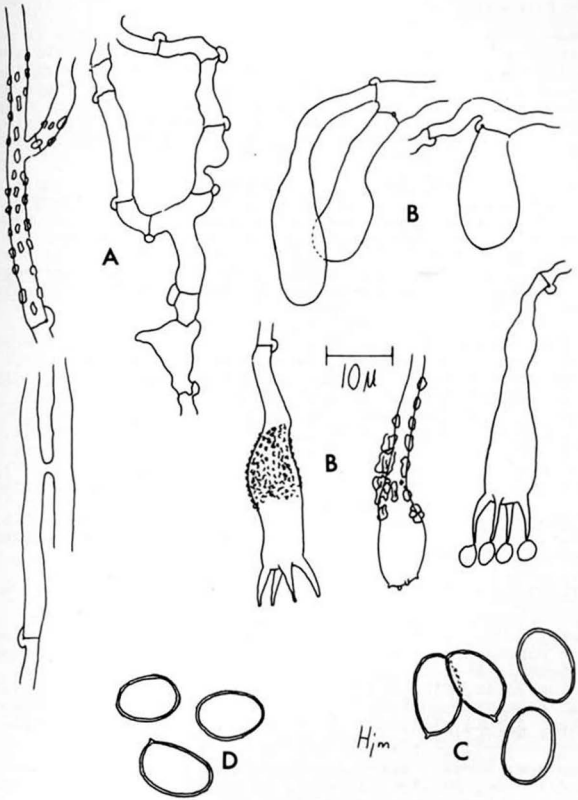

Fig. 1. Amyloathelia amylacea a) hyphae b) basidia c) spores - Coll. Hubert 1919-09-30 (U.S.A.) d) spores - Coll. Bourdot 7408.

copically it is probably overlooked in bearing a close resemblance to species of Athelia or other pellicular taxa in Corticiaceae.

Lemke (1964) excluded C. amylaceum from Aleurodiscus as this genus is characterized by having sterile elements such as acanthophyses, dendrohyphidia or moniliform gloeocystidia between the basidia. Further, in many species there are ordinary gloeocystidia with a positive sulfovanilline reaction. Such sterile organs are absent from A. amylacea except for some partly projecting, simple hyphal ends, which here are called paraphysoid hyphae.

The spores of Amyloathelia are somewhat similar to those of Dendrothele. In the latter they are thickwalled and non-amyloid or with a weak and variable amyloid reaction. However, species of Dendrothele are confined to the bark of living trees and there are numerous dendrohyphidia in the hymenium. We are of the opinion that neither Aleurodiscus nor Dendrothele are appropriate genera for Corticium amylaceum.

Specimens studied.
West-Germany. Ober-Bayern, Kalvarienberg. 1912-08-31. H. Sydow (GB). France. Aveyron, Layrolle, sur genevrier. 1910-06-12. Galzin 6264 (Bourdot 7408) (GB). Canada. Ontario, Brant Co., Oakland Swamp, on Thuja occidentalis. 1939-10-09. leg. R. F. Cain. det. H. S. Jackson (GB): do. Etonia, on Thuja occidentalis. 1937-08-11. R. F. Cain (GB): York Co., E of Maple, on Thuja. 1935-11-02. H. S. Jackson (GB): S of Aurora, on Thuja occidentalis. 1942-09-27 H. S. Jackson (GB). Br. Columbia, Cowichan Lake For. Exp. St., on Thuja plicata. No date J. E. Bier. det. H. S. Jackson (GB). U.S.A. Idaho, Priest River, Barney Fox area, host unknown. 1919-07-30 Hubert det. John Eriksson (S).

AMYLOATHELIA CRASSIUSCULA Hjorst. & Ryv. nov. spec.

Fructificatio resupinata, effusa, adnata, pellicularis, crassiuscula, leviter rimosa; hymenio albido, posterior modice ochraceo; margine plus minusve indeterminato. Systemate hyphali monomitico; hyphis sparsim ramosis, hyalinis, 3-4 um latis, fibulatis. Cystidiis nullis. Basidiis clavatis, basaliter contractis, 20-30(-40) x 5-7 um, 4-sterigmatibus. Sporis ellipsoideis vel subglobosis, crassitunicatis, 5-7 x 4-4,5 um, amyloideis.

Holotype. Norway. Akershus, Nannestad, Horna river near Hurdal lake, 200-300 m.a.s.l., on deciduous wood. 1978-09-25. Hjortstam & Larsson Hjm 9941 (O).

Paratype. Norway. Akershus, Eidsvoll, Mistberget, northern slope near Tisjøen, 400 m.a.s.l., on Picea abies. 1978-09-26. Hjortstam & Larsson Hjm 10062 (O).

Fruitbody resupinate, effuse, loosely adnate, thin, pellicular and slightly cracking with age, whitish to light ochraceous, margin indistinct. Macroscopically similar to Athelia species. Hyphal system monomitic, hyphae with sparse

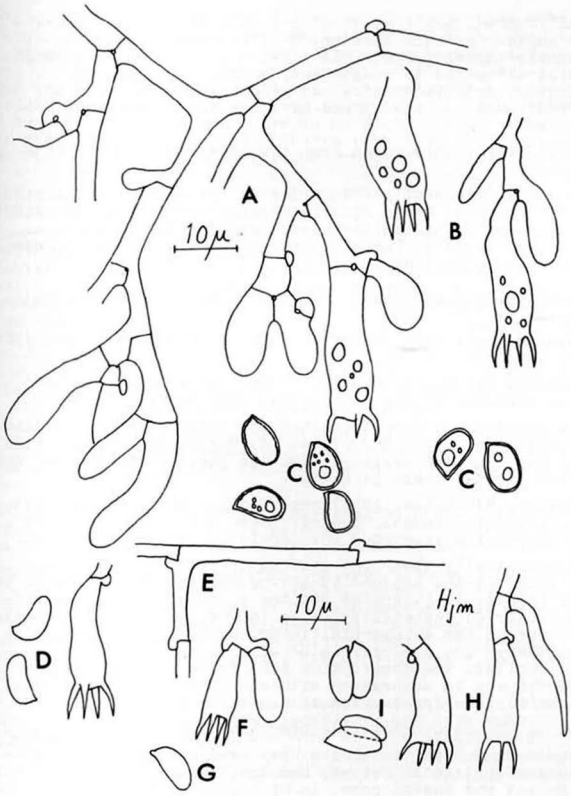

Fig. 2. Amyloathelia crassiuscula a) hyphae b) basidia c) spores - Coll. Hjortstam & Larsson 9941, type. Amylocorticium laceratum d) spores and basidium - Coll. Romell 3990, type. Athelopsis lembospora e) hyphae f) basidia g) spore - Coll. Hjortstam 7508 h) basidia i) spores - Coll. Eriksson 21791.

ramification, hyaline, about 3-4 um wide, with clamps at all septa. Cystidia lacking. Basidia clavate, basally slightly tapering 20-30(40) x 5-7 um, with four sterigmata. Spores ellipsoid to subglobose, smooth, thickwalled, slightly variable in size but generally 5-7 x 4-4,5 um, amyloid. Most of the spores have oil-droplets in the protoplasm.

Distribution. Only known from the type and paratype localities.

The species is easily recognized by its thickwalled and amyloid spores. It is closely related to A. amylacea but well separated by smaller spores and shorter and less elongated basidia. Paraphysoid hyphae have not been observed as in A. amylacea.

AMYLOCORTICIUM LACERATUM (Litsch.) Hjortst. & Ryv. comb. nov.

Basionym. Corticium laceratum Litsch., Ann. Mycol. 39: 118-119, 1941.

Holotype. Sweden. Stockholm, Bromma, on decayed conifer wood. 1918-04-21 Lars Romell 3990 (S). Isotype in GB.

This species has been described and illustrated by Eriksson and Ryvarden (1973) and placed in Athelopsis. At that time only the type was available and the amyloid reaction of the spores escaped their attention.

Recently, Hjortstam (1978) reported A. laceratum from Västergötland in Sweden. However, these collections are not Amylocorticium laceratum but Corticium lembosporum Bourd.

Microscopically these two species are very similar but well separated in the amyloidity of the spores. The sporewall is very thin in A. laceratum but the amyloidity is rather easily observed, especially in collapsed spores, which usually occur in the subhymenial layer. Besides, the hyphae are more narrow and the basidia as well as the spores are usually smaller. The description and figure in Eriksson and Ryvarden are in accordance with the material studied by us, except for the information of non-amyloid spores.

Habitat. On dead coniferous branches, preferably on Pinus.

Distribution. Specimens have been examined from Västergötland and Uppland in Sweden, Hedmark, Nordland and Troms in Norway and Huesca prov. in Spain.

ATHELOPSIS LEMBOSPORA (Bourd.) Oberw., Persoonia 7 (1):3, 1972.

CORTICIUM LEMBOSPORUM Bourd., Rev. sci. Bourd. 23:10, 1910.

Specimens examined (all from PC).
Lectotype. France. Aveyron, St. Sernin. 1909-05-11 Galzin 4292, Bourdot 6517. France. Aveyron, Vergnas. 1910-10-09 Galzin 7116, Bourdot 7625.

Liberta (1961) selected the Bourdot collection 6517 as lec-

totype. However, today this collection is completely destroyed and no information can be obtained from it. Thus, we propose to reject this typification and instead select Bourdot 7055. On the label of this collection there are good annotations and fine figures of hyphae with clamps, basidia and spores made by Bourdot himself. The collection is in good condition and there is no doubt that it covers his concept of the species. Liberta (1961) selected Bourdot 7625 as the type of Corticium confusum Bourd. & Galz. This collection is the same as Bourdot 7055, and thus, Corticium confusum Bourd. & Galz becomes a synonym of Corticium lembosporum Bourd.

Description of A. lembospora.
Fruitbody resupinate, effuse, loosely adnate, smooth, pellicular, whitish, margin not especially differentiated. Hyphal system monomitic, basal hyphae straight and uniform, thinwalled, 2-2,5 um wide, subhymenial hyphae more ramified and slightly broader, all hyphae with clamps. Cystidia lacking but in some collections with paraphysoid hyphae between the basidia. Basidia clavate, tapering towards the base, 15-25 x 5-7 um, with four sterigmata. Spores short-allantoid, broadened towards the base, thinwalled, generally 7-8 x 3 um, often glued together in pairs.

Habitat. Collected on Athyrium filix-femina and Dryopteris, in favourable localities as well as on Equisetum pratense. Also some collections on deciduous wood. Not known on conifer.

Distribution. Probably a rare species and previously not reported from North Europe. In Norway only known from Oslo and in Sweden from Bohuslän, Halland, and Västergötland.

Remarks. Athelopsis lembospora has been discussed by Liberta (1961) and by Oberwinkler (1965). Jülich (1975) transferred the species to Luellia but the type of this genus is brown because of coloured hyphae, and also because of other characteristica we are of the opinion that C. lembospora is unacceptable in this genus. See also Eriksson and Ryvarden (1967).

In basidial morphology this species is closely related to other species of Athelopsis, especially the type species A. glaucina. The basidia have more or less stalked bases, the hyphae are thinwalled, and the spores are neither amyloid nor cyanophilous. Moreover, the fruitbody is distinctly athelioid (pellicular).

PRELIMINARY KEY TO THE CORTICIACEAE OF NORTH EUROPE

Part 1. Species with amyloid spores

1. Spores echinulate - verruculose 2
1. Spores smooth 9

2. Dimitic or trimitic species 3
2. Monomitic species 4

3. Trimitic, fruitbody often more or less pileate, with numerous metuloids, gloeocystidia absent ..... Laurilia
3. Dimitic, fruitbody resupinate, encrusted cystidia present or lacking, gloeocystidia present. If skeletal hyphae dextrinoid, see Scytinostroma ..... Scytinostromella

4. Hyphae without clamps 5
4. Hyphae with clamps 6

5. Spores large 10-25 um long ..... Aleurodiscus
5. Spores smaller, usually 5-8 um long . Gloeocystidiellum

6. Basidia lateral ..... Pseudoxenasma
6. Basidia terminal, some lateral may occur 7

7. Spores large 10-20 um long ..... Aleurodiscus
7. Spores smaller 8

8. Gloeocystidia with sulfovanilline reaction ..... Gloeocystidiellum
8. Gloeocystidia without such reaction ..... Laxitextum

9. Fruitbody pileate, hymenium hydnoid or sublamellate ..... Irpicodon
9. Fruitbody in most cases resupinate, hymenium smooth 10

10. Hyphal system dimitic, fruitbody steroid or/and strongly cracked 11
10. Hyphal system monomitic, in most cases corticioid 13

11. Metuloid cystidia present ..... Amylostereum
11. Metuloid cystidia absent 12

12. Acanthophyses numerous ..... Xylobolus
12. Acanthophyses absent or rarely seen ..... Stereum

13. Clamps absent 14
13. Clamps present 17

14. Sterile elements in the basidial layer present 15
14. Sterile elements absent 16

15. Vesicular gloeocystidia present, dendrohyphidia absent ..... Vesiculomyces
15. Dendrohyphidia present together with gloeocystidia ..... Dendrothele

16. Fruitbody violaceous, spores ellipsoid - subfusiform, basal hyphae 7-12 um wide .... Hypochnella
16. Fruitbody whitish - reddish, spores allantoid, basal hyphae 3-5 um wide .... Amylocorticium

17. Metuloids present ..... Amylostereum
17. Metuloids absent, but other cystidial organ sometimes present 18

18. Spores thickwalled 19
18. Spores thinwalled 21

19. Cystidia present ..... "Leucogyrophana" mollis
19. Cystidia absent 20

20. Spores relatively large, 5-12 um long and distinctly amyloid ..... Amyloathelia
20. Spores smaller, 3-5 um long, indistinctly amyloid, mostly greyish in Melzer ....."Leucogyrophana" subillaqueta

21. Cystidia present ..... Amylocorticium
21. Cystidia absent 22

22. Fruitbody closely adnate, hyphae gelatinized, indistinct .....Xenasmatella
22. Fruitbody pellicular - membranaceous 23

23. Basidia in some cases lateral, spores ellipsoid - reniform ..... Melzericium
23. Basidia strictly terminal, spores allantoid ..... Amylocorticium

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MYCOTAXON

Vol. X, No. 1, pp. 210-212 October-December 1979

STUDIES IN THE LICHEN FAMILY PHYSCIACEAE. V. TWO SPECIES OF *PHYSCIA* NEW TO NORTH AMERICA

THEODORE L. ESSLINGER

Department of Botany
North Dakota State University
Fargo, North Dakota 58105

SUMMARY

Physcia dimidiata *(Arn.) Nyl. and* Ph. magnussonii *Frey are reported as new to the North American lichen flora.* Physcia dimidiata, *a sorediate species known previously from Europe, has been found in North Dakota. The fertile species* Ph. magnussonii, *also previously known only from Europe, is now known from Washington and Idaho.*

General collecting of lichens has turned up two previously unreported species of *Physcia* for North America. The following descriptions are based only on the North American specimens examined.

PHYSCIA DIMIDIATA (Arn.) Nyl.

Thallus up to 4 cm in diameter, the upper surface white to gray or blue-gray, sometimes with a slight brownish tinge in part, pruinose more or less throughout and often heavily so. Lobes more or less flat, 1-3 mm broad, the tips crenate. Sorediate, the soralia mostly marginal and elongate, occasionally very weakly labriform, laminal soralia also sometimes developing in older portions; soredia granular, pale gray or darkening. Lower surface white to tan or slightly brownish, the rhizines mostly concolorous with the lower surface. Upper cortex paraplectenchymatous, lower cortex prosoplectenchymatous.

Apothecia sessile, infrequent, up to 1 mm in diameter, the disk black but lightly pruinose, the margin weakly

crenate and becoming eroded and sorediate; ascospores 18-20 x 6-7 µm, of the *Physcia*-type.

Chemistry: Atranorin only (by TLC); cortex K+ yellow, medulla PD-, K-, C-, KC-.

The previously known distribution of this species was mapped by Moberg (1971) who reported it from Norway and central Europe. Although I have it only from western North Dakota, it seems probable that *Ph. dimidiata* will be found more broadly distributed as the western North American lichen flora becomes better known.

The linear marginal soralia and the pruinose upper surface which reacts K+ yellow are diagnostic for this species and there are few others likely to be confused with it. Moberg (1971) compared it with *Ph. dubia* (Hoffm.) Lynge and *Ph. tribacia* (Ach.) Nyl., both of which have primarily labriform or laminal soralia and little or no pruina. In North America, the southern species *Ph. crispa* Nyl. (=*Ph. albicans* (Pers.) Thoms.) has similar marginal soralia but is usually pruinose only on the young lobe margins and has a K+ yellow medulla. At first glance, because of the pruinosity, *Ph. dimidiata* bears a superficial similarity to a *Physconia* species, but the upper cortex in members of that genus is K-. It seems probable that the report by Wetmore (1967) of a K+ yellow form of *Physconia grisea* (Lam.) Poelt (as *Physcia grisea*) from the Black Hills, an area with strong floristic similarities to western North Dakota, is actually based on *Physcia dimidiata*.

Specimens examined: North Dakota. Billings Co.: in the South Unit of the Theodore Roosevelt National Memorial Park, vicinity of the Ridgeline Nature Trail, on bark at the base of Juniper, *Esslinger 6858* (NDA), on bark of dead Juniper, *Esslinger 6867* (NDA). Slope Co.: about 7 miles N and 9 miles W of Amidon, near Logging Camp Ranch in the Ponderosa Pine area, over mosses on a large boulder, *Esslinger 6746* (NDA).

PHYSCIA MAGNUSSONII Frey

Thallus up to 6 cm in diameter, the upper surface gray, often with a brownish tinge, especially on the lobe-ends, pruinose more or less throughout but more strongly so near the lobe-ends. Lobes more or less flat, 0.8-3 mm broad, the tips crenate. Without soredia or isidia. Lower surface tan to yellowish or pale brownish, with similarly colored rhizines, the rhizines simple but often tufted at

the end. Upper cortex paraplectenchymatous, lower cortex prosoplectenchymatous.

Apothecia short stipitate, up to 3 mm in diameter, the disk black but lightly pruinose, the margin entire or becoming grossly crenate; ascospores 14-21 x 6.5-9 µm, of the pachysporaria-type but rather irregular, faintly but definitely ornamented when mature.

Chemistry: Atranorin only (by TLC); cortex K+ yellow, medulla PD-, K+ yellow (in white areas) or K+ dingy-rose (in discolored areas), C-.

Physcia magnussonii was known previously only from Scandinavia (Moberg, 1977) and central Europe (Frey, 1963; Poelt, 1969). In North America, it apparently has a western or northwestern distribution. In addition to the below cited collections from Washington and Idaho, this species has been reported from Oregon by Dr. Amy Y. Rossman (in litt.).

The pruinose thallus, K+ yellow to dingy rose medulla, and the saxicolous habit will distinguish this *Physcia* from other North American species. The faintly ornamented spores, although somewhat difficult to distinguish, are also diagnostic.

Specimens examined: Idaho. Bonner Co.: Priest River Experimental Forest, on large exposed boulder, *Esslinger 585* (Herb. Esslinger). Washington. Spokane Co.: Turnbull National Wildlife Refuge, on soil over rock, *Esslinger 2476* (Herb. Esslinger); near N end of Fish Lake, on rock, *Esslinger 189* (Herb. Esslinger).

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MYCOTAXON

Vol. X, No. 1, pp. 213-216 October-December 1979

ADDITIONS TO THE DIAPORTHALES

MARGARET E. BARR

Department of Botany, University of Massachusetts, Amherst, Massachusetts 01003

1. Orthography

Dr. R. A. Shoemaker has pointed out that genera such as *Plagiostoma*, although originally and in Barr (1978) treated as feminine are neuter (Stearn, 1966) and that species epithets should be corrected to read: *Plagiostoma acerophilum* (Dearn. & House) Barr, *P. alneum* (Fries) von Arx and *P. alneum* var. *betulinum* Barr, *P. bavaricum* (Rehm) Barr, *P. campylostylum* (Auersw.) Barr and *P. campylostylum* var. *mirabile* (Peck) Barr, *P. devexum* (Desm.) Fckl., *P. euphorbiis* (Fckl.) Fckl., *P. inclinatum* (Desm.) Barr, *P. magnoliis* (Ell.) Barr, *P. micromegalum* (Ell. & Ev.) Barr; also *Apioplagiostoma aceriferum* (Cke.) Barr, *A. carpinicolum* (von Höhnel) Barr, *Pleuroceras groenlandicum* (Rostr.) Barr, *P. helveticum* (Rehm) Barr, *P. pleurostylum* (Auersw.) Barr, *P. tenellum* (Ell. & Ev.) Barr.

2. Hapalocystis

A recent collection from Georgia provided a specimen of *Melanconis corni* Wehm., a species that Wehmeyer (1941) arranged in section Thelebolae of *Melanconis*, and that Barr (1978) suggested might belong in *Melanconis* ss. str. This specimen (on *Cornus florida* L., University of Georgia Botanical Garden, Athens, Clarke Co., Georgia, 25 Aug 1978, Barr 6476, MASS) agrees with Wehmeyer's description of the species from Georgia. The oblique, circinately grouped perithecia are surrounded by a thin pseudoparenchymatous stromatic layer; the lateral beaks are fused together as an enlarged structure containing a single canal. The combination of characters makes it necessary to refer the species to subfamily Massariovalsoideae, tribe Massariovalseae in the Melanconidaceae. In this tribe, I had separated

Massariovalsa from *Hapalocystis* (Barr, 1978) on the bases of ascospore septation and presence or absence of a gel coating and appendages, but the conidial states are also quite different for species of the two genera. The genera of tribe Massariovalseae may be separated more precisely:

1. Ascospores dark brown, one septate, not appendaged, surrounded by wide gel coating; conidial state *Melanconiopsis*, conidia dark brown, one celled, obovoid or subgloboid, surrounded by gel coating..... *Massariovalsa*
1. Ascospores hyaline or light brown or dark brown in age, one or several septate, terminal appendages broad, pulvinate or straplike, usually surrounded by narrow inconspicuous gel coating; conidial state *Stilbospora*-like, conidia hyaline or brown, ellipsoid or cylindroid, several septate, without gel coating..... *Hapalocystis*

Melanconis corni does present some problems: the ascospores are one septate as in *Massariovalsa* but are light vinaceous brown, surrounded by a narrow indistinct gel coating and bear short pulvinate appendages. The conidial state (Wehmeyer, 1940) is similar to those known for species of *Hapalocystis*, e.g., *H. ulmi* (Wehm.) Barr, where conidia and ascospores remain hyaline until shortly before germination. On balance, *M. corni* is more allied to species of *Hapalocystis*, as Wehmeyer noted in his discussion (1940, as *Prosthecium* subgenus *Pseudoprosthecium*), than elsewhere. The transfer of this species is proposed as

Hapalocystis corni (Wehm.) Barr, comb. nov.

Basionym: *Melanconis corni* Wehm. Mycologia 32: 324. 1940
Synonym: *Melanconiella corni* (Wehm.) Petrak, Sydowia 6: 15. 1952.

Hapalocystis corni is a small species of the genus; the ascospores measure 16-25 x 7-9 µm and the terminal appendages are pulvinate, 3-5 µm wide and 2-3 µm long. The configuration of perithecia and adherent stromatic tissues, covered by a film of brown hyphae, is in accord with other species of *Hapalocystis*.

3. Dicarpella

An inquiry about relationships of *Cryptosporella* with *Physalospora*, based on similarities in presumptive conidial states between species of *Cryptosporella* and *Physalospora quercifolia* Ell. & Ev., prompted re-examination of the latter. Earlier (Barr, 1964) I had excluded that species from *Pseudomassaria*, where von Arx (1952) had placed it, and

left it in *Physalospora*. The intimately associated and presumed conidial state, *Mastigosporella hyalina* (Ell. & Ev.) von Höhnel, appears to be related to species of *Harknessia* Cooke, whose presumed perfect states are species of *Cryptosporella*. On the other hand, this sort of conidial state is not of the type known to occur in the Physosporellaceae where Barr (1976) now arranges *Physalospora*.

The short-beaked perithecia of *P. quercifolia* (on *Quercus coccinea* Muenchh., Newfield, New Jersey, 6 Jun 1885, Ellis & Everhart N.A.F. 1666, MASS) are surrounded by a narrow pseudoparenchymatous stromatic layer. In 3% KOH the stromatic layers of cells become light vinaceous while the compressed cell layers forming the peridium darken to a dull brown, especially in the upper region. The ellipsoid asci have a shallow refractive apical annulus that is non-amyloid and, in the aged herbarium material available, showed no definite chitinoid reaction. No paraphyses were seen, a negative feature because they are often compressed or deliquescent in mature specimens of species of the Physosporellaceae. The entire aspect of this fungus is similar to that of *Dicarpella georgiana* (Miller & Thompson) Barr, on leaves of species of *Nyssa* and *Liquidambar*. A conidial fungus is connected with *D. georgiana* by association and by similarities in pigmentation in KOH and ascospore-conidium shapes -- tentatively termed a foliicolous variant of *Harknessia americana* (Mont.) Sutton by Barr (1978) but better considered a species of *Mastigosporella* because of the hyaline to yellowish conidia that bear an apical appendage. The following combination is proposed:

Dicarpella quercifolia (Ell. & Ev.) Barr, comb. nov.

Basionym: *Physalospora quercifolia* Ell. & Ev. J. Mycol. 1: 92. 1885.

Synonyms: *Laestadia quercifolia* (Ell. & Ev.) Cooke, Grevillea 18: 65. 1890.

Pseudomassaria quercifolia (Ell. & Ev.) von Arx Ber. Schweiz. Bot. Ges. 62: 353. 1952.

The ascospores and conidia of *D. quercifolia* are narrower and longer, thus more fusoid (ascospores 15.5-25 x 4.5-7.5 µm, conidia 22.5-24 x 4.5-5 µm) compared to those of *D. georgiana* (ascospores 13-18(-23) x 6-8(-9) µm, conidia 13-22(-26) x 6-8 µm). The ascospores of *D. bina* (Harkn.) Sydow & Sydow, the type species, are broader, 7.5-12 µm, and the asci are two spored. This species develops in spotted areas of living leaves of *Quercus agrifolia* Neé, and no conidial association has been observed.

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MYCOTAXON

Vol. X, No. 1, pp. 217-218 October-December 1979

KUTILAKESA PIRONII SP. NOV., A STEM GALL- AND CANKER-INCITING FUNGUS, NEW TO THE UNITED STATES

S. A. ALFIERI, JR.

Assistant Director and Plant Pathologist
Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, FL 32602

Nectriella pironii Alfieri and Samuels (2) causes stem galls and cankers on *Aphelandra squarrosa* Nees, *Clerodendrum bungei* Steud., and *Codiaeum variegatum* Blume (1). In addition to the perfect state, this fungus has an anamorph referred to the genus *Kutilakesa*. It appears to be an undescribed species differing from the previously reported species, *Kutilakesa madreeya* (4,5) and *Kutilakesa circinosetifera* (3). *Kutilakesa* is the predominant stage found in nature and is demonstrated to cause stem galls and cankers on the various hosts (1). Although the perfect state has been formerly described (2), I feel that it is practical and appropriate to establish a binomial for this imperfect state.

Kutilakesa pironii sp. nov.

Sporodochia alba, erumpentia, sessilia, 250-750 µm maxima dimensione. Phialides 7-12 x 1.5-2.5 µm. Conidia pallide aurantiaca, unicellularia, ellipsoidea, 6-8 (-9) x 2.0-2.5 µm. Pili e sporodochiis nascentes, septati, undulati, spinulosi, 50-150 x 4-5 µm, primo albi, deinde flavidi.

Holotypus: USA: Gainesville, in artificialibus inoculationibus truncorum *Aphelandra squarrosa* Nees, S. A. Alfieri, Jr. Mar 1978 (G.J. Samuels 78-24), NY.

Sporodochia white, erumpent, 250-750 µm maximum dimension. Phialides 7-12 x 1.5-2.5 µm. Conidia pale orange, unicellular, ellipsoidal, 6-8 (-9) x 2.0-2.5 µm. Hairs arising from sporodochium are septate, undulate, spinulose, 50-150 x 4-5 µm, at first white, then pale yellow.

Holotype: USA: Gainesville, on artificially inoculated stem of *Aphelandra squarrosa* Nees, S. A. Alfieri, Jr. March 1978 (G. J. Samuels 78-24), NY.

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MYCOTAXON

Vol. X, No. 1, pp. 219-232 October-December 1979

ZOOPHTHORA ERINACEA SP.N. (ZYGOMYCETES : ENTOMOPHTHORACEAE), A FUNGAL PARASITE OF APHIDS

ISRAEL BEN-ZE'EV and ROBERT G. KENNETH

Department of Plant Pathology and Microbiology
Faculty of Agriculture, Hebrew University of Jerusalem
P.O.Box 12, Rehovot 76-100, Israel

SUMMARY

Zoophthora erinacea sp.nov. attacked *Aphis craccivora* throughout the year and *A. umbrella*, *A. fabae* and *Myzus persicae* in winter in a number of localities in the Coastal Plain of Israel and in the Jordan Valley. The fungus proved infective to *Aphis spiraecola*. It possessed mononucleate, turbinate conidia with an outer wall which sometimes separated, digitate conidiophores and many unusually long and thick cystidia, giving the dead hosts a hedgehog appearance. Cystidia were occasionally bifurcate. The primary conidia produced, on short conidiophores, secondary conidia resembling primary ones, but smaller. Resting spores were regularly echinulate, subhyaline zygospores, produced by conjugating hyphal bodies. True rhizoids were absent and diseased aphids clung to the plants by their rostra. The taxonomic position of this fungus, in relation to Batko's classification of entomophthoraceous fungi is discussed, as are some of the genera and subgenera employed by Batko.

INTRODUCTION

In May 1977, a number of dead specimens were noticed in small populations of the cowpea aphid, *Aphis craccivora* Koch (Homoptera : Aphididae), in an alfalfa field near Rehovot, in the Coastal Plain of Israel. Microscopic examination revealed an entomophthorosis, with the conidial stage present. The fungus resembled *Zoophthora montana* (Thaxter) Batko (=*Entomophthora montana* (Thaxter)Gustafsson)

(Thaxter, 1888; Gustafsson, 1965; Batko, 1964 d), known only from Dipteran hosts and never encountered in Israel. The same field was inspected again in August 1978 and the same disease was again found on many individuals of this host; others showed the conidial stage of *Triplosporium fresenii* (Nowakowski) Batko (=*Entomophthora fresenii* (Nowak.) Gustafsson) (Batko, 1964 b; Gustafsson, 1965).

During December 1977, January and February 1978, the new disease caused different degrees of mortality in both homogeneous and heterogeneous populations of the mallow aphid, *Aphis umbrella* Börner, and the green peach aphid, *Myzus persicae* Sulzer on *Malva* sp. in and near citrus groves at Be'er-Ya'akov and Mikveh-Israel in the Coastal Plain. Heavy mortality occurred also in a dense, homogeneous population of *A. umbrella* on *Malva* sp. at Sdeh-Eliyahu in the Beith-Shean Valley (which is part of the Jordan Valley). Some of these populations were stricken also by *Zoophthora aphidis*, *Triplosporium fresenii* and *Entomophthora planchoniana* Cornu.

During January 1979 the aforementioned alfalfa field was inspected, together with the different weeds growing on its borders and between the alfalfa plants. At the beginning of the month only the new disease was found on *A. craccivora* on alfalfa and on *A. umbrella* on *Malva* sp.. Some of the dead aphids of both species were filled with resting spores which were later identified as belonging to the fungus causing the new disease. Later in the month, both conidial and resting spore stages of that fungus were formed also in different individuals of *Aphis fabae* Scopoli on *Ammi majus* (in the same field), together with *T. fresenii*. *Z. aphidis* was present then on all the three species of aphids.

DESCRIPTION OF DISEASE AND PATHOGEN

In spite of the color differences in the four aforementioned aphid species, all the dead aphids from which conidia were discharged took on a rusty-brown color.

The development of the fungus was followed in artificially inoculated *Aphis spiraecola* Patch (Bitton, 1978), as well as in naturally infected aphid species.

Measurements of spores and other structures were made from slide preparations in lactophenol-aniline-blue which had been gently heated.

Living infected aphids and recently dead ones were filled with different amounts of branched mycelium and mycelial segments (hyphal bodies) of different lengths and shapes (Fig. 6). Shorter and wider, often ramified, hyphal

bodies were present in individuals in which resting spore formation was observed (Fig. 7).

The first structures which protruded from recently dead hosts were the very thick cystidia: (15.8) 22.1-28.0 (39.5) µm, (24.3± 5.4 µm, $\bar{x}$±s, 36 measurements), occasionally branched in the form of the letter Y (Fig. 3). The emergence of before conidiophores had been observed also in *Zoophthora aphidis* (=*E. aphidis*) (Brobyn and Wilding, 1977). They usually extended outside the host's integument 150-225 µm, but some were approximately twice as long and these seemed to be adhesive over their entire length, as they stuck to the glass slide on which the dead aphid had been placed. Rhizoid-like endings were not formed on cystidia, however, and a thorough search for rhizoids (with specialized endings) never revealed any.

Keeping in mind Brobyn and Wilding's (1977) findings, fine rhizoids were looked for around the mouth parts of dead aphids, but were never found.

Clusters of branched, septate conidiophores surrounded each long cystidium. These clusters, when viewed from the side, were almost spherical in shape, with a central projecting cystidium. After a few hours, with more conidiophores elongating, the whole mass coalesced over the entire integument at one level, with only the cystidia protruding (Fig. 1). That part of the cystidium which was outside the host was coenocytic and partially or completely filled with cytoplasm, while the intra-host part was septate in short, empty compartments (Fig. 6). In moist chambers, primary conidia were ejected to a distance of up to 5 mm. They were hyaline, usually with one or two large vacuoles, sometimes with several smaller ones. The single nucleus present in each conidium was located at one side of the vacuole, or among them when several small vacuoles were present, its shape varying according to its position, which was seemingly dictated by the form and number of vacuoles. In germ-tubes formed by germinating conidia the nucleus always assumed a sausage-like shape.

The conidia were of the *Turbinata*-type (according to Lakon, 1919), long, turbinate (obconical). They tapered evenly to a narrow papillate base, the papilla being short, rounded and surrounded by a barely visible collar. They were symmetrical or slightly curved toward the base; (12.6) 15.0-18.2 (20.5) x (7.1) 7.9-11.0 (13.4)µm, (16.5±1.3 x 9.3 ±1.1 µm, length $\bar{x}$±s x width $\bar{x}$±s, 100 measurements), with length/width ratio of 1.4-2.2 (1.8±0.1, $\bar{x}$±s, 100 measurements).

The primary conidia were measured at random from a

microscopic preparation made from conidia ejected onto a glass slide for only a short period in order not to allow them time to produce secondary conidia; thus there were very few resporulating conidia in this preparation. The measured dimensions formed a very symmetrical bell-shaped distribution curve with 72% of the lengths and 70% of the widths in the $\bar{x}\pm 1s$ range; 95% of the lengths and 98% of the widths were in the $\bar{x}\pm 2s$ range, only 1% of the lengths were greater than $\bar{x}+2s$ and 4% smaller than $\bar{x}-2s$. This very last fact strongly suggests that part of those conidia which were 13.9 µm long, or shorter, were secondary conidia.

The diameter of the internal hyphal (bodies) segments, in aphids showing the conidial stage, was like that of the conidiophores : 4.7-7.2 µm (5.6±0.5 µm, $\bar{x}\pm s$, 50 measure - ments).

The primary conidia germinated on wetted glass slides and on rich agar media by means of germ-tubes growing from the apex or through the papilla and sometimes from both, or by means of a short, usually laterally-borne conidiophore, on which a secondary conidium, smaller than the primary but similarly shaped, was formed and then forcibly ejected (Figs. 2 and 5). Germination of primary conidia through the papilla had been observed in *Entomophthora turbinata*

FIGURES 1-6 *Zoophthora erinacea* sp.n. conidial stage

1. Dead aphid covered by conidiophores, the protruding cystidia giving it a "hedgehog appearance". X 40.

2. Primary and secondary conidia; secondary conidium formation at lower right corner. X 800.

3. Cystidia, one of them bifurcated; the preparation was made before massive sporulation began. X 200.

4. Digitate conidiophores, their width being about ¼ that of the cystidia shown in Fig. 3. at the same magnification. X 200.

5. Primary and secondary conidia germinating in hyphal manner or resporulating. X 200.

6. Hyphal bodies of the conidial stage and a relatively small cystidium showing septum and the intra-host part emptied of cytoplasm and collapsed (lower, left part of the figure). X 200.

(on the facing page →)


1


2


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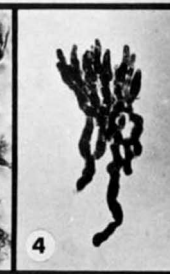
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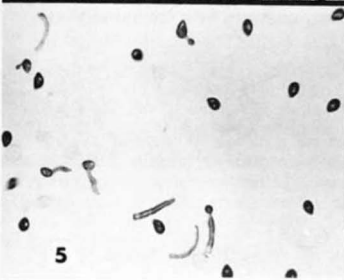
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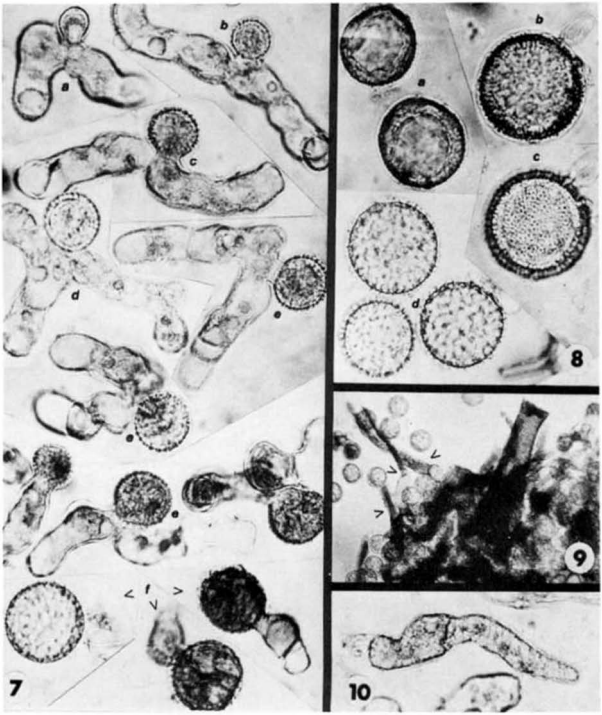

FIGURES 7-10 *Zoophthora erinacea* sp.n. zygospore stage

7 a-b-c. Consecutive early stages of conjugation of hyphal bodies and prespore growth; d-e. later stage, beginning of septation in the hyphal bodies, the distal compartments devoid of cytoplasm; f. more advanced stage, only short segments remain attached to the prespore. X 400.

8. Mature zygospores photographed at different focal distances to show: a. wall width; b. echinulation at the circumference; c. echinulation at the surface; d. echinulation on both. X 400.

9. Cystidia (arrows) on aphid with zygospores. X 100.

10. Vestigial (very short) cystidia. X 200.

(Kenneth, 1977). The germination of the secondary conidia of our fungus was similar to that of the primary ones.

As a preparation containing a homogeneous population of secondary conidia could not be obtained, 50 measurements were made from a preparation which contained many empty primary conidia (which produced secondary ones and then became emptied "ghosts") and many smaller conidia which were obviously secondary ones (Fig. 2). However, this was a heterogeneous population containing ungerminated primary conidia as well, and from it only the minimum dimensions of the secondary conidia, which are 10.3 x 6.3 µm, can be given, their maximum dimensions overlapping to an unknown extent over the lower dimensions of the primary conidia. The length/width ratio of the secondary conidia was in the same range as that of the primaries so that this index can not help to discriminate between them in a heterogeneous population.

Some of the dead aphids found on alfalfa and associated weeds during January 1979 showed the characteristic cystidia but failed to produce conidia when placed in moist chambers. They were filled with conjugating hyphal bodies and different stages of resting spore formation. The hyphal bodies conjugated terminally or laterally and the prespore was formed by budding, often very close to the point of juncture of the hyphal bodies; sometimes, however, the prespore appeared at the distal end of one of the hyphal bodies. Generally, one spore was formed by a pair of conjugating hyphal bodies. The prespore was regularly echinulate (sharp, cone-like protrusions) from the very beginning and remained so until and after maturation. After budding, the prespore grew and the nuclei of the hyphal bodies gradually passed into it. Septa were formed sequentially in the hyphal bodies from the distal ends toward the prespore, as their contents gradually passed into the growing prespore. The end of the growing process was characterised by the thickening of the prespore wall. Of the empty hyphal bodies, only small remnants remained attached to the spore. Mature spores did not stain with cotton-blue and a collar marked the point of budding (Fig. 8b-c).

Although the characteristic cystidia were not found in some aphids producing resting spores, vestigial cystidia were revealed upon dissection of these insects (Fig. 10).

Attempts to isolate and cultivate the fungus on egg-yolk medium and several rich agar media failed; it started to grow very slowly on egg-yolk, however, and this sustains the hope of future isolation.

The resemblance of the host during sporulation to a hedgehog, due to the bristling cystidia of the fungus (Fig. 1), inspired its name: *Zoophthora erinacea* (*erinaceus* = Latin for hedgehog).

IDENTIFICATION OF THE PATHOGEN

Our fungus fits in almost all respects into the genus *Zoophthora* Batko (Batko, 1964 b), by having elongate, mononucleate conidia with an outer wall which may partially separate from an inner one and by possessing digitate conidiophores (Fig. 4); the lack of rhizoids in this species would seem to be the only obstacle in placing it in *Zoophthora*. Its long and wide, sometimes bifurcate cystidia further place it in the *Zoophthora* subgenus *Erynia* (Batko, 1966), all species of which have such cystidia. In this subgenus the rhizoids are "...as thick as pseudocystides or thinner, generally without distinct foot" (Batko, 1966). According to this, some cystidia of *Z. erinacea* could be regarded as rhizoids of this subgenus although their function as rhizoids was not completely clarified by us and is still doubtful.

The entomophthoraceous species resembling most closely the one described here is *Zoophthora montana* (Thaxter) Batko, placed by Batko (1966) in the subgenus *Erynia*. The points of resemblance are its similarly shaped, mononucleate conidia, its digitate conidiophores and its very wide cystidia (Gustafsson, 1965, Figs. 104-105). However, the conidia of *Z. montana* are larger: 15-25 x 11-18 µm according to Thaxter (1888) and 17-26 x 10-19 µm according to Gustafsson (1965); it possesses true rhizoids with expanded ends (Thaxter, 1888) and was reported by both authors from Dipteran hosts only. The only other entomophthoraceous species with conidia resembling in shape those of *Z. erinacea* is *Entomophthora turbinata* Kenneth. The later species has larger conidia with 5-7 round nuclei, a greater conidial length/width ratio, and has conidia which neither germinate from both ends nor produce secondary conidia, does not form cystidia, forms simple conidiophores, and forms black, ellipsoid resting spores (Kenneth, 1977).

The identification of the resting spores as belonging to *Z. erinacea* was made only after considering the following:

1. The resting spores were present in the same species of aphids, at the same location and time, when no other entomophthoraceous fungi were present except the conidial stage of *Z. erinacea*.

2. Resting spores similar with those found by us were found in Israel in *A. fabae* and *M. persicae* by Wallis (1972), and were described as *Entomophthora aphidis* according to the resting spores of *E. aphidis* described by Gustafsson (1965). Indeed, Gustafsson's photographs (Figs. 78-82) resemble the resting spores described by us and by Wallis (1972). However, a thorough checking of Wallis' work, including his microscopic preparations, revealed that significant parts of his *E. aphidis* are *Z. erinacea* resting spores, conidia and characteristic cystidia. This explains also his claim that *E. aphidis* sometimes produces rhizoids and sometimes does not.

3. Later in January 1979 when conidia of the shape and size universally attributed to *Z. aphidis* appeared in aphid populations already infected with *Z. erinacea* (conidial and resting spore stages), smooth-walled resting spores were found in a number of individuals in which *Z. aphidis* conidia and rhizoids were also present. This further reduces the possibility of the echinulate zygospores being connected with *Z. aphidis* as claimed by Gustafsson (1965) and Wallis (1972).

4. In almost all instances, the echinulate zygospores were produced in aphids bearing the characteristic cystidia or vestigial cystidia of *Z. erinacea*.

Although absolute proof of the connection between resting spores and conidia depends upon the obtention of both in pure culture, or upon obtention of resting spores in insects artificially inoculated with conidia, the evidence appears overwhelming that the echinulate zygospores belong to *Z. erinacea*.

Of more than 15 entomophthoraceous species described from aphids, usually under the generic heading *Entomophthora* (Thoizon, 1970; Hall, 1973; and others), this is, so far, the one with the smallest conidia and the only one with occasionally bifurcate cystidia.

Z. erinacea seems to be the first species in the subgenus *Erynia* Batko (1966) known to parasitize aphids, although aphids are among the hosts of some species of two other subgenera of *Zoophthora:* - *Zoophthora* Batko and *Pandora* Batko (Batko, 1966).

ZOOPHTHORA ERINACEA BEN-ZE'EV & KENNETH SP. NOV.

Conidia symmetrica vel basem versus paulo curvata, turbinata vel obovoidea apice lato rotundato, sursum attenuata ad angustam basem papilla perparva et collo paulo prominen-

te praeditam, hyalina, mononucleata, externo pariete aliquando disjungente (basi excepta); 12.6-20.5 x 7.1-13.4 µm; per papillas vel per apicem vel per utrumque germinantia. Conidia secundaria conidiis primariis similia, minime 10.3 x 6.3 µm, conidiophoris brevibus ex conidiis primariis lateraliter ex orientibus portata. Conidia vehementer ejectilia. Conidiophora digitata, septata; 4.7-7.2 µm lata. Cystidia numerosa, longa et crassa; 150-225 (-500) x 15.8-39.5 µm, aliquando bifurcata, pre conidiophoris protrudentia. Rhizoidea verae desunt. Sporae perdurantes: plerumque zygosporae, sphaericae; 27.7-37.1 µm diametro; zygosporarum paries 4.0-7.1 µm crassus, cum episporio regulatim echinulato, subtiliter flavido. Hospites conidiophorum palisadis continuis ferrugineo-brunneis ad latera et ad partem superiorem thoracis et abdominis tecti; hospites ad substrato probosce affixi.

Conidia symmetrical or slightly curved toward the base, turbinate to obovoid, with a broadly rounded apex, tapering uniformly toward a narrow base with a small papilla and slightly prominent collar, hyaline, mononucleate, outer wall occasionally separating except at base; 12.6-20.5 x 7.1-13.4 µm; germinating through the papilla or through the apex or both. Secondary conidia resemble primary conidia; minimum 10.3 x 6.3 µm, borne on short conidiophores arising laterally from primary conidia. Conidia forcibly ejected. Conidiophores digitate, septate: 4.7-7.2 µm in width. Cystidia many, long and thick: 150-225 (-500) x 15.8 x 39.5 µm; occasionally bifurcated, protruding before conidiophores. True rhizoids absent. Resting spores: mostly zygospores, sphaerical, 27.7-37.1 µm in diameter with wall width: 4.0-7.1 µm, with a regularly echinulate, somewhat yellowish epispore. Hosts covered with a continuous rusty-brown palisade of conidiophores over the sides and upper part of the thorax and abdomen, attached to substratum by probosces.

Hosts: Rhynchota fam. Aphididae:*Aphis craccivora* Koch; *Aphis umbrella* Börner; *Aphis fabae* Scopoli; *Myzus persicae* Sulzer. Experimental host: *Aphis spiraecola* Patch. Rehovot, Israel. May 1977.

Holotype and paratype materials (microscopic preparations) are deposited at the Department of Plant Pathology and Microbiology, Faculty of Agriculture, Hebrew University, Rehovot, Israel.

DISCUSSION

In using the generic name *Zoophthora* (Batko, 1964 b) for this species and placing it within the subgenus *Erynia* (Batko, 1966) we have adopted part of Batko's taxonomical classification of Entomophthoraceae. Batko was by no means the first to attempt to divide the genus *Entomophthora* Fresenius into various groupings, and Roland Thaxter (1888) already had proposed subgenus status for some groups of species, e.g. *Triplosporium*.

The many continuing efforts to find natural groupings for the ever more unwieldy genus *Entomophthora* Fresenius, burdened with new members and displaying great differences among some species, is in itself evidence for the need to do so.

Admittedly, some of these attempts have resulted in more taxonomic and nomenclatural confusion than before, but greater insights into group relationships have eventually developed because of these attempts and in spite of any confusion.

Batko's treatment (1964 a, b, c, d; 1966; Batko and Weiser, 1965), in which *Entomophthora* Fresenius (*sensu lato*) was broken into five genera, seems to be the most logical system yet worked out, although we believe it needs considerable changes regarding some genera and subgenera in the scheme. Of his five genera (*Entomophaga*, *Entomophthora*, *Culicicola*, *Triplosporium* and *Zoophthora*), some appear to be heterogeneous and therefore faulty, since certain species attributed by him to *Entomophaga* could be accomodated in *Conidiobolus* Brefeld whereas all species attributed to *Culicicola* seem to belong either to *Conidiobolus* or to *Entomophthora* (*sensu stricto* or *sensu* Batko) (R. Humber, personal communication); we leave this problem for specialists in *Conidiobolus* taxonomy.

The genera *Zoophthora* and *Triplosporium* (Batko, 1964 b), however, are so distinct from other groups and so well defined that we believe that there is no sense in hesitating any longer in using them. One problem that must eventually be solved is where to place entomophthoraceous species such as *Entomophthora turbinata* (Kenneth, 1977), which fit into none of the above-mentioned genera nor into the widely accepted genera *Massospora* Peck (*emend.* Soper) (Soper, 1974) or *Strongwellsea* Batko & Weiser (*emend.* Humber) (Humber, 1976). Apparently, new genera will have to be erected to accommodate them.

It is more problematic to find a refuge (hopefully only

temporarily) for those species in which not all characters are known well enough to allow them to be sorted into one of the above genera. They could be kept, meanwhile, in *Entomophthora* Fresenius *sensu lato*. Batko (1964 a) had retained *Entomophthora* among his five genera as "*Entomophthora* Fresenius *non* Nowakowski", for only a limited number of species resembling *E. muscae*. Its acceptance in that meaning would result in confusion, unless it is emphasized for each fungus in this group whether one is referring to the genus in its wide sense (as a temporary refuge) or narrow one (*s.s.* or *sensu* Batko).

Minor emendations might have to be made in the diagnoses of *Zoophthora* and *Triplosporium* in order to accomodate a few slightly divergent species. As an example, *Entomophthora parvispora* MacLeod & Carl (MacLeod *et al.*,1976) appears to be an excellent *Triplosporium*, except for its hyaline, rather than fuliginous conidia. If smoky conidia were to be deleted as a necessary character for this genus, *E. parvispora* would fit well into that genus and still allow *Triplosporium* to remain quite distinct from all other genera, to judge from Batko and Weiser's (1965) Table 1 "Comparative characteristics of zoophilic genera of Entomophthoraceae". Similarly, *Z. erinacea* is missing one of the hallmarks of a typical *Zoophthora*, - rhizoids. As explained earlier, one of Batko's (1966) four subgenera within that genus, *Erynia*, could accomodate our species, as the rhizoids, according to him, may be as thick as the very thick cystidia, and are generally without a distinct foot. This could correspond to some of the long, wide cystidia of *Z. erinacea*. Unlike in species of Batko's subgenus *Pandora*, in which the rhizoids and cystidia are highly differentiated (Brobyn and Wilding, 1977) and therefore easily distinguished, it is a matter of interpretation here over what constitutes a rhizoid; we take the view that it is not a true one, but that in this species some cystidia might be making the transition to rhizoids.

We can not vouch for the validity of Batko's other subgenera within the genus *Zoophthora*, although they all appear distinct from each other and from *Erynia*. The subgenus *Zoophthora* includes species which form capillispores (anadhesive conidia) at the apex of thin capillary conidiophores on primary conidia, as well as species which have never been shown to form these structures. We doubt that these two kinds of species belong together in one subgenus. Batko (1966) refers to:"rhizoids thin, threadlike, unbranched, not widened at ends, aggregated in pseudorhizomorphs". Thaxter (1888) showed clearly (Plate 17, Fig.179) a monohy-

phal "rhizoid with irregularly expanded extremity" for *Z. occidentalis*, a species which belongs to this subgenus according to Batko (1964 b); we found, in the "sphaerosperma group" of which *Z.(E.) occidentalis* is one species, thin, monohyphal rhizoids along with multihyphal pseudorhizomorphs occurring on the same individual host, with either of them having a definitely broad, disc-shaped or irregularly expanded foot. Batko's diagnosis for *Zoophthora* subgen. *Zoophthora* will have to be emended, as we intend doing.

AKNOWLEDGMENTS

This research was supported in part by grant No. 744 from the United States - Israel Binational Science Foundation and 'The Fund for the Encouragement of Research' — Histadrut—The General Federation of Labour in Israel. We are grateful to Dr. Irene Gruenberg-Fertig, Hebrew University, and to Prof. E.D. Kollman, Tel-Aviv University, for the Latin diagnosis. We also thank Agron. S. Bitton, Hebrew University, for permission to cite his findings on infection of *A. spiraecola* by *Z. erinacea*. We are particularly grateful to Dr. Richard Humber for his very valuable criticisms and insights.

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MYCOTAXON

Vol. X, No. 1, pp. 233-240 October-December 1979

BLISTUM MUSAE: A NEW SPECIES OF SYNNEMATAL HYPHOMYCETE[1]

KEITH A. SEIFERT[2]

Prairie Regional Laboratory
National Research Council of Canada
Saskatoon, Saskatchewan
S7N OW9

During a damp chamber experiment a cluster of about ten synnemata grew on the outer surface of a banana peel which had been incubated at room temperature for sixteen days. Microscopic examination suggested that the fungus was a member of the genus Blistum Sutton (1973), but was not one of the species previously described. Attempts to culture the fungus on 2% malt agar, potato dextrose agar, and sterilized banana peel were unsuccessful.

The status of the generic names Stilbella, Stilbum and Blistum was clarified by Sutton (1973). Stilbum is the valid name applied to a Basidiomycete genus and Stilbella is used for a hyphomycete genus characterized by smooth, white to cream, unbranched, erect synnemata, with distinct monophialidic apertures and globose, hyaline, aseptate conidia. Blistum is distinguished from Stilbella by the lateral or terminal projections ornamenting the stipe of the synnemata.

The new species Blistum musae is described, and Blistum orbiculare (Berk. & Br.) Ing, transferred to the genus by Ing (1976), is redescribed and illustrated. Because the ornamentations of B. musae and B. orbiculare

[1]Issued as NRCC No. 17570

[2]Present address: Department of Biology, University of Waterloo, Waterloo, Ontario N2L 3G5

and the arrangement of the phialides of B. musae differ from those in the generic description of Sutton (1973), the description of Blistum is emended.

Blistum emend. nov.

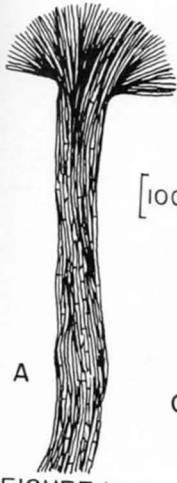
Mycelium immersed or superficial, hyaline, branched, septate. Conidiophores macronematous, synnematous. Synnemata erect, unbranched, creamy white with a capitate head, ornamented along the side by hyaline projections, which may or may not be delimited by a septum. Conidiogenous cells monophialidic, integrated or discrete, lateral, terminal, or verticilliate, determinate, hyaline. Conidia slimy, acrogenous, simple, hyaline, aseptate.

Blistum musae sp. nov.

Mycelium immersum, ex hyphis hyalinis, ramosis, septatis, compositum. Conidiophora synnematosa, recta, non ramosa, alba, apice capitato, 1100µm longa et 60-160µm crassa, cum irregularis, hyalinis, ornata minor 2µm. Cellulae conidiogenae monophialidicae, in conidiophoris incorporatae laterales, vel terminales, discretae, determinatae, hyalinae, attenuatae, 20-35µm longae, 2-3µm in diametro in basis, 1-2µm in apice. Conidia mucosa, acrogena, hyalina, aseptata, ellipsoidea vel cylindrica, 6-7x1.5-2µm.

Mycelium immersed in substrate, composed of branched septate, hyaline hyphae. Synnematal conidiomata gregarious, white, unbranched, erect, straight, brittle when dry, up to 1100µm long x 60-160µm thick, of uniform thickness, when mounted the apex may splay out to form capitate head 220µm wide x 95µm long, individual hyphae hyaline, branched, septate, smooth-walled, interwoven, 1-2µm in diameter, ornamented in the upper half of the stipe by hyaline, lateral or terminal, irregular or three- or four-lobed projections, usually less than 2µm x 2µm. Conidiogenous cells monophialidic, lateral or terminal, occurring only at the apex of the synnema, discrete, determinate, subulate, hyaline, with narrow apical aper-

Figure 1: A-F) B. musae IMI 235790 A) Synnema B) lateral phialide with developing conidium C) conidia D) terminal ornamentations E) lateral ornamentation.
Figure 2: A-D) B. orbiculare from type collection A) synnema B) phialide with developing conidium C) conidia D) ornamenting cells.



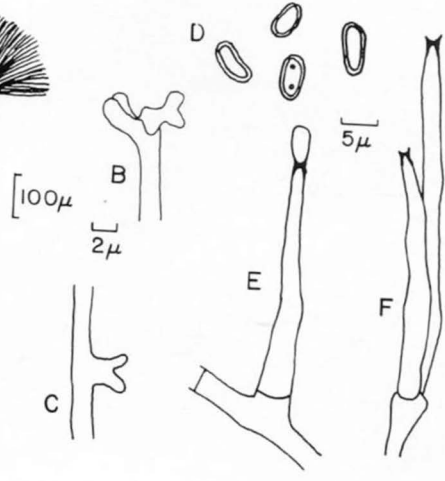


FIGURE 1:

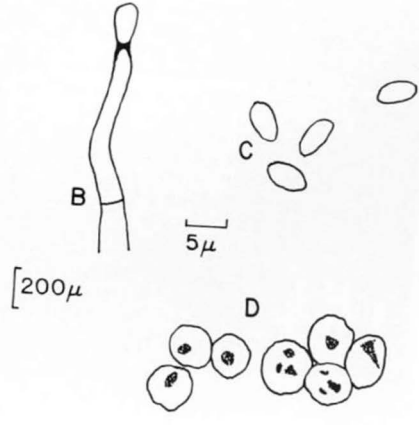


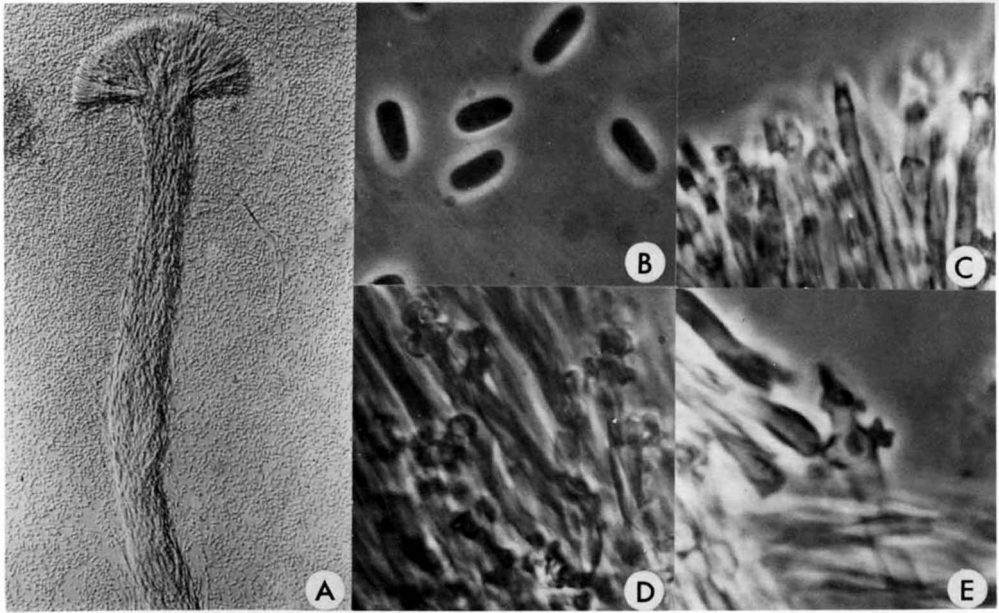
FIGURE 2:

ture, with distinct collarettes, 20-35µm long, 2-3µm in diameter at base, 1-2µm at apex. Conidia aggregated in globose, pale orange to red, mucoid heads, individual conidia ellipsoid to cylindrical, sometimes slightly reniform, aseptate, hyaline, walls slightly thickened, two to four guttulate, light walled with darker cytoplasm under phase contrast, sometimes losing cytoplasm, 6-7µmx1.5-2µm. Habitat: skin of Musa fruit consocio Verticillium, Acremonium.
Holotype: IMI 235790, isolated January 29, 1979 at University of Waterloo, Waterloo, Canada
Material examined: IMI 235790 isotype material in DAOM

Several features distinguish Blistum musae from B. tomentosum (Scrad. ex Fr.) Sutton, the type species, and from B. ovalisporum (A.L. Smith) Sutton and B. orbiculare. Instead of covering the entire synnema as in other Blistum species, the ornamentations of B. musae are present only on the upper half, concentrated on the captitate head, and visible only at high magnification. The ornamentations are much smaller, morphologically quite irregular, and apparently not delimited by a septum. The ornamentations appear to be restricted to the surface of the synnema. Other members of the genus are typically parasitic on myxomycetes, but B. musae was detected on the skin of Musa fruit. The phialides of B. musae are lateral or terminal, and discrete, whereas those of other members of the genus are either integrated and terminal, or discrete and verticilliate.

Blistum orbiculare (Berk. & Br.) Ing, Bull. Br. mycol. Soc. 10(1):30 (1976)
Stilbum orbiculare Berk. & Br., Ann. Mag. Nat. Hist. Ser. 5, 1:28 (1878)
Stilbella orbicularis (Berk. & Br.) W.Gams, Cephalosporium-artige Schimmelpilze (Hyphomycetes). p. 230 (1971)

Plate 1: A-F) B. musae IMI 235790 A) synnema 90X B) conidia 2000X C) phialide at apex of synnema 2000X D) terminal and lateral ornamentations of hypha 1750X E) portion of synnematal head showing texture due to ornamentations 2000X.


A
B
C
D
E

Mycelium immersed in substrate, composed of branched, septate, hyaline hyphae. Synnematal conidiomata gregarious, stained brown by host, unbranched, erect, sometimes drooping, flattened, brittle when dry, 1500-2300µm long, 500-800µm thick, often thicker in centre of stipe than at base, tapering then expanding to the apex, individual hyphae hyaline, branched, septate, smooth-walled, interwoven, 1-2µm in diameter, entire stipe ornamented with globose to subglobose hyaline, guttulate, projecting cells, easily dislodged when dry, 4-5µmx 4-6(10)µm. Conidiogenous cells monophialidic, terminal or verticilliate, occurring only at apex, discrete, cylindrical, hyaline, 20µm long, 1-2µm in diameter. Conidia ellipsoid, aseptate, hyaline, thin-walled, 2x4-5µm.

Material examined: Type collection of Stilbum orbiculare of Rev. J. Keith on Lindbladia effusa, in Herb. Berkeley, Kew.

Blistum orbiculare was transferred to Blistum from Stilbella by Ing (1976), but he neglected to give details of the characteristic ornamentations which, though previously undescribed, were mentioned by Berkeley and Broome (1878). The synnemata of B. orbiculare are originally white (Berkeley & Broome 1878, Cejp 1964, Karsten 1887) and are stained brown by the host (Berkeley & Broome 1878). The conidia are held in globose or ovoid, white to yellow, translucent mucoid heads, 120µm in diameter (Cejp 1964, Karsten 1887). The synnemata of the type collection vary considerably in size, which accounts for the range of measurements found in previous descriptions. Phialides are difficult to distinguish even under phase contrast, and conidia are few on the type collection. The ornamenting cells are extremely numerous and easily dislodged during mounting, which explains the felt-like consistency of the stipe noted by previous authors (Berkeley & Broome 1878, Cejp 1964). The ornamentations might easily be mistaken for conidia or spores of the host. Gams (1971) observed that in pure culture B. orbiculare rapidly loses its ability to form synnemata.

The fungus has been reported in the literature as parasitizing the following myxomycete genera: Lindbladia, Fuligo, Trichia (Gams 1971), Fulgine (Karsten 1887), Arcyria, Hemiarcyria, Didymium, Dictydium,

Table I: A comparison of *Blistum* species

Species	Synnema		Ornamentation		Conidia	
	length (µm)	width(µm)	nature	size(µm)	shape	size (µm)
B. musae	1100	60-160	irregular	1-2	ellipsoidal	1.5-2x6-7
B. orbiculare	1500-2300	500-800	globose guttulate	4-5	ellipsoidal	2x4-5
B. ovalisporium	200	15-20	globose verrucose	3-4	ellipsoidal	1-1.5x2.5-4
B. tomentosum	1000	60-70	globose verrucose	3-4	globose	1-1.5

Cribraria, Lachnobolus and Stemonitis (Cejp 1964). On the bases of some of the synnemata of the type collection, I found a hyperparasite, most likely a species of Nematogonium.

Table I is included as an aid to the quick identification of the four species accepted in Blistum.

ACKNOWLEDGEMENTS: I am indebted to Dr. Bryce Kendrick, S. Berch, F. DiCosmo, J. Michaelides, Dr. Ian Reid, Dr. Reg Haskins, and Dr. B.C. Sutton for suggestions and encouragement. L.R. Nesbitt and E. Knapp are thanked for assistance preparing illustrations.

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MYCOTAXON

Vol. X, No. 1, pp. 241-245 October-December 1979

Phacidiales Exsiccati
Decades I-III

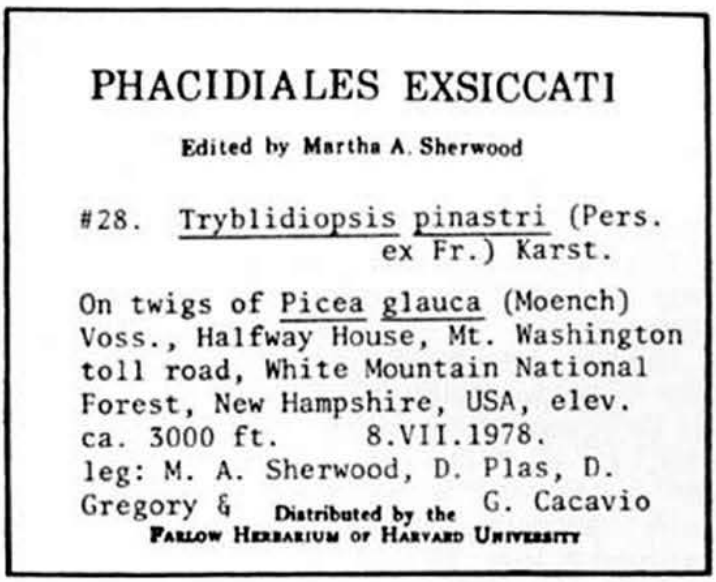
Martha A. Sherwood
Farlow Herbarium, Harvard University, Cambridge, MA 02138*

In order to further knowledge of the morphology, taxonomy, and geographical distribution of immersed discomycetes, the author has undertaken the preparation of an exsiccata, Phacidiales Exsiccati, the first thirty numbers of which were offered for distribution in July, 1979.

The principal aim of the exsiccata is to make available type and authentic specimens documenting the author's researches in this group of fungi (Sherwood, 1974a; 1974b; 1977a; 1977b; 1977c; 1979), examples of infrequently collected species, specimens representing significant range extensions, and examples of species which are commonly misidentified or represented by mixed collections in herbaria.

The term Phacidiales has been used in a very broad sense for a taxonomically heterogeneous group of fungi distinguished by their immersed growth habit and ecology. The first thirty numbers include members of the Stictidaceae, Rhytismataceae (including Hypodermataceae), Hemiphacidiaceae, Acrospermataceae, Leotiaceae, and a number of species whose family affinities are uncertain.

The printed labels attached to the packets have the format shown in figure 1. Annotation labels have been included in some of the packets.


PHACIDIALES EXSICCATI

Edited by Martha A. Sherwood

#28. Tryblidiopsis pinastri (Pers. ex Fr.) Karst.

On twigs of Picea glauca (Moench) Voss., Halfway House, Mt. Washington toll road, White Mountain National Forest, New Hampshire, USA, elev. ca. 3000 ft. 8.VII.1978. leg: M. A. Sherwood, D. Plas, D. Gregory & G. Cacavio

Distributed by the Farlow Herbarium of Harvard University

Figure 1. Facsimile label from Phacidiales Exsiccati.

* Present Address: Botany Department, University of Liverpool, Liverpool L69 38X, Great Britain.

The species and localities of the collections are as follows (label data is quoted verbatim):

(1). *Robergea nigra* Sherwood, on living and dead twigs of *Lonicera involucrata* (Rich.) Banks ex Spreng., Devil's punch-bowl State Park, Lincoln Co., Oregon, USA, 9.VIII.1978, leg. & det. M. A. Sherwood (Authentic, from type locality).
(2). *Coccomyces leptideus* (Fr.) B. Erikss., on living and dead twigs of *Gaultheria shallon* Pursh, wet forest 2 mi. N. of Yachats, Lincoln Co., Oregon, elev. ca. 50 ft., 10-12. VIII.1978, leg. & det. M. A. Sherwood (=*Coccomyces quadratus* (Schm. & Kunze) Sacc. Parasitic, causing dieback. Fairly common on this host in the Pacific Northwest. Collection date erroneously given as 10-12.VIII.1979 on label).
(3). *Myriophacidium aphyophyllicum* Sherwood, on fallen leaves of *Castanopsis chrysophylla* (Doug. ex Hook.) A. DC, junction roads 1500 and 1500-134, H. J. Andrews Experimental Forest, ca. 15 mi. NE of Blue River, Lane Co., Oregon, USA, 8.VIII.1978, leg. & det. M. A. Sherwood. (Authentic. Collected about 4 miles from the type locality, which has since been clearcut).
(4). *Coccomyces tumidus* (Fr.) de Not., on last year's fallen leaves of *Quercus rubra* L., Estabrook woods, Concord, Massachusetts, USA, 17.IX.1978, leg. D. H. Pfister, det. M. A. Sherwood. (Not a synonym of *Lophodermium tumidum* (Fr.) Rehm sensu Rehm, or of *Coccomyces coronatus* (Fr.) de Not. This is the type species of *Coccomyces*).
(5). *Robergea albicedrae* (Heald & Wolf) Sacc. & Trav., on twigs of *Juniperus ashei* Buchholz, junct. State Hwy 71 and Ranch Road 620, Edwards Plateau, Travis Co., Texas, USA, 26. IX.1978, leg. John J. Biesele, det. M. A. Sherwood.
(6). *Fabrella tsugae* (Farl.) Kirschst., on dead needles of *Tsuga canadensis* (L) Carr. still attached to twigs, Ringwood Preserve, Tompkins Co., New York, USA, 15.VI.1978, leg. & det. M. A. Sherwood (Parasitic, often found on dead needles mixed with living needles on the same twig. Very common, particularly on suppressed understory trees).
(7). *Stictis radiata* Pers., on dead canes of *Rubus parviflorus* Nutt., Hendrick's Park, Eugene, Oregon, USA, 5.VIII.1978, leg. & det. M. A. Sherwood.
(8). *Eupropolella vaccinii* (Rehm) Höhnel, on dead leaves of *Arctostaphylos uva-ursi*, Reference Stand 14, Wildcat Mountain, Willamette National Forest, Linn Co., Oregon, elev. 5200 ft., 18.VIII.1978, leg. M. A. Sherwood, L. H. Pike, & G. Chrones, det. M. A. Sherwood.
(9). *Lophodermium decorum* Darker, on living *Abies procera* Rehder, Reference Stand 14, Wildcat Mountain, Willamette National Forest, Linn Co., Oregon, USA, elev. 5200 ft., 18. VIII.1978, leg. M. Sherwood, L. H. Pike, & G. Chrones, det. Sherwood.
(10). *Therrya fuckelii* (Rehm) Kujala, on dead branches of *Pinus resinosa* Ait., Kancamangus Hwy 10 mi. W. of Conway, White Mountain National Forest, New Hampshire, elev. ca 1000 ft., 23.VII.1978, leg. M. A. Sherwood & E. J. Kneiper, det. M. A. Sherwood.
(11). *Bifusella linearis* (Peck) Höhnel, on *Pinus strobus* L, Weirs, New Hampshire, 4.VII.1934, leg. & det. G. D. Darker

nr. 5024.
(12). *Rhabdocline weirii* Parker & Reid subsp. *obovata* Parker & Reid, on *Pseudotsuga menziesii* (Mirb.) Franco, Floral Hill Drive, Eugene, Oregon, USA, VI.1978, leg. & det. G. C. Carrol.
(13). *Tryblidium alpinum* (Hazsl.) Rehm, on *Vaccinium ovatum* Pursh, associated with dieback, stabilized sand dune area between hwy 101 and Clear Lake, 4 mi. N. of Florence, Lane Co., Oregon, elev. ca. 50', 14.III.1979, leg. M. A. Sherwood & L. H. Pike, det. M. A. Sherwood. (The identification is tentative. Does not correspond to the description of any fungus known to occur on this host in North America, or to any species found on Ericaceae by B. Eriksson (1970) in Fennoscandia).
(14). *Lasiostictis fimbriata* (Schw.) Bäuml., on cone scales of *Pinus resinosa* Ait., North Truro, Cape Cod, Massachusetts, USA, 25.VI.1978, leg. M. A. Sherwood nr. 2431, det. M. A.S.
(15). *Lophodermium arundinaceum* (Schrad. ex Fr.) Chev., on *Ammophila arenaria* (L) Link, 2 mi. N. of Yachats, Lincoln Co., Oregon, USA, elev. 20 ft. August 10-12, 1978, leg. & det. M. A. Sherwood.
(16). *Coccomyces delta* (Schm. & Kunze) Sacc., on leaves of Lauraceae, São Miguel, Hickling Park, Furnas, Azores, 5.IV. 1978, leg. R. P. Korf, L. M. Kohn, N. Korf & A. Y. Rossman, det. M. A. Sherwood (= CUP, Mycoflora Macaronesia 1845).
(17). *Agyrium rufum* (Pers.) Fr., on decorticated conifer wood, Pacific Crest trail crossing at Santiam Summit, Linn County, Oregon, USA, elev. 4800 ft. 15.VIII.1978, leg. M. A. Sherwood & L. H. Pike, det. M. A. Sherwood.
(18). *Rhytisma acerinum* Pers. ex Fr., tar spot, on fallen leaves of *Acer rubrum* L. Ottawa National Forest, Upper Michigan, October 5, 1978, leg. & det. R. W. Stack. (Leaves were artificially overwintered for 160 days at 4°c).
(19). *Coccomyces strobi* Reid & Cain, very common on recently dead twigs of *Pinus strobus* L., Estabrook Woods, Concord, Massachusetts, 31.V.1978, leg. & det. M. A. Sherwood.
(20). *Coccomyces dentatus* (Schm. & Kunze) Sacc., common on fallen leaves of *Berberis nervosa* Pursh, Watershed 20, H. J. Andrews Experimental Forest, Willamette National Forest, Lane Co., Oregon, USA, 9.VIII.1978, leg. & det. M. A. Sherwood.
(21). *Acrospermum gaminum* Libert, on culms and leaves of *Dactylis glomerata* L., Corvallis, Oregon, 9.III.1979, leg. M. A. Sherwood & W. C. Denison, det. M.A.S.
(22). *Discocainia treleasei* (Sacc.) J. Reid & Funk, on recently dead bark of *Picea sitchensis* (Boug.) Carr., Cascade Head, Tillamook Co., Oregon, 20.III.1979, leg. M. A. Sherwood & W. C. Denison, det. M.A.S. (This material is slightly immature but shows developmental stages well. Label incorrectly gives collection date as 30.III.1979).
(23). *Pseudographis* cfr. *elatina* (Ach.) Nyl., on bark of *Pseudotsuga menziesii* (Mirb.) Franco, Reference Stand 20, H. J. Andrews Experimental Forest, Willamette National Forest, Lane Co., Oregon, USA, 8.VIII.1978, leg. & det. M. A. Sherwood.

(24). *Stictis radiata* Pers. var. *aggregata* Sherwood, on *Pyrus*-like tree, Corral, Chile, December, 1905, leg. R. Thaxter, det. M. A. Sherwood, ISOTYPE of the variety (see Occ. Pap. Farlow Herbarium 14: (1979).
(25). *Stictis ostropoides* Sherwood, on *Lonicera* sp., Devil's Punchbowl State Park, Lincoln Co., Oregon, USA, 9.VIII.1978, leg. & det. M. A. Sherwood (authentic).
(26). *Durella atrocyanea* (Fr.) Höhnel, Horse Rock Ridge, ca. 15 mi. N.E. of Marcola, Linn Co., Oregon, USA, elev. 450 m. 21.III.1979, leg. M. A. Sherwood, L. H. Pike & D. Wagner, det. M.A.S. (On *Arbutus menziesii* Pursh).
(27). *Lophodermium uncinatum* Darker, on dead needles of *Abies procera* Rehder, RS-14, Wildcat Mountain, Willamette National Forest, Linn Co., Oregon, USA, elev. 5200', 18.VIII. 1978, leg. M. A. Sherwood, L. H. Pike & G. Chrones, det. MAS.
(28). *Tryblidiopsis pinastri* (Pers. ex Fr.) Karst., on twigs of *Picea glauca* (Moench) Voss, Halfway House, Mount Washington toll road, White Mountain National Forest, New Hampshire, USA, elev. ca. 3000 ft., 8.VII.1978, leg. M. A. Sherwood, D. Plas, D. Gregory & G. Cacavio, det. M.A.S. (Spores of the Eastern North American specimens are smaller than spores of European examples of this species. The affinities of *Tryblidiopsis* appear to lie with the wood-inhabiting species of *Coccomyces*).
(29). *Coccomyces irretitus* Sherwood, on bark of *Picea* sp., Seal Cove Road, Acadia National Park, Mt. Desert Island, Maine, 16.VI.1979, leg. & det. M. A. Sherwood. (ISOTYPE of species to be published in Occ. Pap. Farlow Herbarium 15. A nomen nudum here).
(30). *Lophodermium pinastri* (Pers. ex Fr.) Chev., on fallen needles of *Pinus resinosa* Ait., North Truro, Cape Cod, Massachusetts, USA, 25.VI.1978, leg. & det. M. A. Sherwood.

The first thirty numbers of Phacidiales Exsiccati were distributed through the exchange program of the Farlow Herbarium. Future decades will probably be distributed through other channels.

Decades I-III of Phacidiales Exsiccati have been distributed to the following herbaria (Abbreviations are taken from Holmgren & Keuken, 1974): FH, DAOM, UPS, UC, NY, IMI, O, PRM, and ZT.

Acknowledgements

The author would like to thank several collectors, whose names appear in the list of specimens above, for generously contributing material for distribution or providing collecting assistance. Several herbaria loaned specimens on which determinations are based; for further details see Sherwood (1979). Donald Pfister (FH), the author's supervisor, offered help and encouragement throughout the course of the project. The costs of processing, labelling, and distributing the specimens were met by the Farlow Herbarium and by NSF grant DEB 72-02503-A04 to Harvard University Herbaria.

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MYCOTAXON

Vol. X, No. 1, pp. 246-250 October-December 1979

PITHOMYCES FUNICULOSA SP. NOV. FROM FUNGAL COMB OF MACROTERMES UKUZII IN SWAZILAND

MARY E. PALM, ELWIN L. STEWART

Department of Plant Pathology
University of Minnesota
St. Paul, MN 55108 USA

and

AMY Y. ROSSMAN

Plant Pathology Herbarium
Cornell University
Ithaca, NY 14853 USA

During a study of fungi occurring in fungal comb in mounds of *Macrotermes ukuzii* Fuller (Termitidae, Isoptera) in Luyengo, Swaziland, a fungus was isolated which was determined to belong to the genus *Pithomyces* Berk. & Br. (Hyphomycetes, Deuteromycotina) (Ellis, 1960,1976). It differs from previously described species and is herein described as new.

Spore size ranges and means are based on measurements of 50 spores taken from colonies grown on 3% malt agar (pH 5.5) at 27°C. Colonies were irradiated 12 hours/day with Sylvania F15T8-BLB "Blacklight Blue" bulbs which emit near-ultraviolet wavelengths. Anatomical features were described from sections of colonies mounted in glycerin and water (40/60,v/v). Collections are deposited in MPPD and CUP.

Pithomyces funiculosa Palm, Stewart, & Rossman sp. nov.
Figs. 1-3

COLONIAE in agaro hordeano juniores albidae vel

fumosae; vetustiores brunneae vel anthracinae. CONIDIOPHORA et HYPHAE plerumque funiculosa, denticulata. CELLULAE CONIDIOGENAE holoblasticae. CONIDIA levia vel verruculosa, luteo-brunnea vel atrobrunnea, septis transversis (0-) 1-3 (-4), plerumque 2-septata, raro 1-2 septis obliquis vel longitudinalibus praesentibus; conidia 1-septata 10-17 ($\bar{x}$ = 13.9) x 6-12 ($\bar{x}$ = 8.5) µm, 2-septata 14-23 ($\bar{x}$ = 18.6) x 7-12 ($\bar{x}$ = 9) µm, 3-septata 17-25 ($\bar{x}$ = 21.2) x 7-12 ($\bar{x}$ = 9) µm. Holotypus Rossman #1429 (MPPD), isotypus Rossman #1429 (CUP).

COLONIES on malt agar white to grey becoming brown to black, floccose to appressed, dark ropy strands of conidiophores frequently present. HYPHAE septate, branched, of two types: hyaline to subhyaline, smooth, 1.5-5 ($\bar{x}$ = 2.8) µm diam, and subhyaline to pale brown, sometimes finely roughened, 2.5-6 ($\bar{x}$ = 3.4) µm diam. CONIDIOPHORES micronematous to semi-macronematous, mononematous, frequently

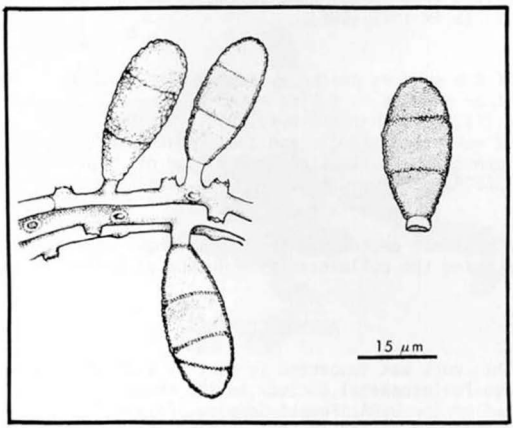


FIG. 1. *Pithomyces funiculosa*. Funiculose conidiophores, conidiogenous cells, and transversely septate conidia with infrequent oblique septa.

funiculose, infrequently branched, septate, subhyaline to pale brown. CONIDIOGENOUS CELLS holoblastic, monoblastic or polyblastic, integrated, intercalary, determinate, cylindric to doliform, denticulate following secession of conidia, denticles short cylindric to doliform, 1-4 ($\bar{x}$ = 2.4) x 1.5-3 ($\bar{x}$ = 2.2) µm. CONIDIA solitary, pleurogenous, mostly verrucose, pale to dark brown, clavate to obovate to obpyriform to broadly or fusiform ellipsoid to reniform, transversely (0-) 1-3 (-4)-septate, mostly 2-septate, may be slightly constricted at the septa, rarely with 1-2 oblique or longitudinal septa, 10-17 ($\bar{x}$ = 13.9) x 6-12 ($\bar{x}$ = 8.5) µm (1-septate), 14-23 ($\bar{x}$ = 18.6) x 7-12 ($\bar{x}$ = 9) µm (2-septate), 17-25 ($\bar{x}$ = 21.2) x 7-12 ($\bar{x}$ = 9) µm (3-septate), bases 2-4 ($\bar{x}$ = 2.6) µm diam, with a portion of the conidiogenous cell usually remaining as a basal frill.

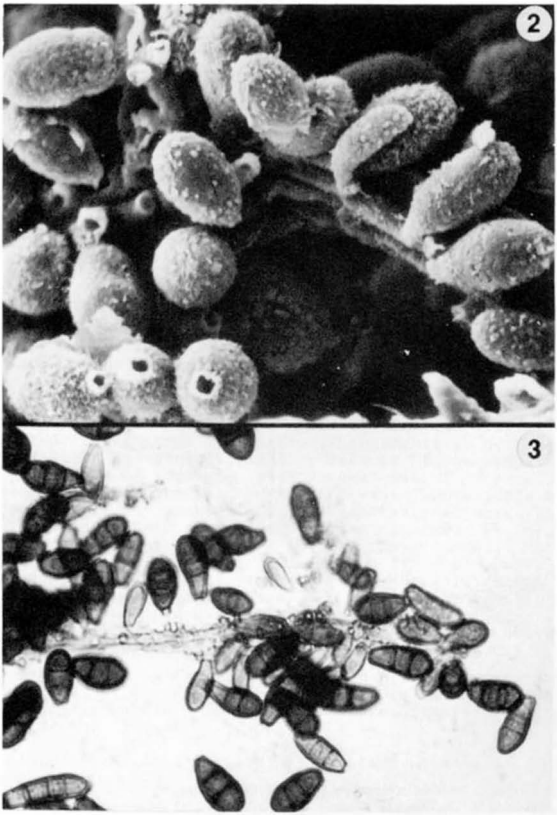
Collections examined: Holotype: Swaziland, Luyengo, Rossman #1429. Dried culture of isolate, from fungal comb in mounds of *Macrotermes ukuzii*. 15 ix 1977 (MPPD). Isotype: Swaziland, Luyengo, Rossman #1429. Dried culture of isolate, from fungal comb in mounds of *Macrotermes ukuzii*. 15 ix 1977 (CUP).

Of the species presently assigned to *Pithomyces*, *P. funiculosa* appears most like *Pithomyces graminicola* Roy & Rai (Ellis, 1976, Roy and Rai, 1968). It differs in its larger, verrucose conidia and the frequently funiculose conidiophores. Examination of the type of *P. graminicola* (IMI 126508) confirmed that *P. funiculosa* is a distinct taxon.

A. Rossman determined that this fungus degrades cellulose using the cellulose-azure method of Smith (1977).

ACKNOWLEDGMENTS

This work was supported in part by a grant from the American Philosophical Society to the third author. Funds provided by the USDA, Forest Service, Forest Products Division (Nos. 12-39 and 12-144) enabled the first two authors to undertake this study. We extend sincere thanks to Drs. J. Leland Crane and G. Morgan-Jones for comments and suggestions regarding the manuscript. Minnesota Agricultural Experiment Station, Scientific Journal Series, Paper No. 10,942.



FIGS. 2-3. *Pithomyces funiculosa*. 2. Scanning electron micrograph illustrating roughened conidia and conidiogenous cells which remain as a basal frill on conidia and as denticles on the often funiculose conidiophores. X1000. 3. Conidia, conidiogenous cells, and funiculose conidiophores from culture on malt agar. X550.

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MYCOTAXON

Vol. X, No. 1, pp. 251-254 October-December 1979

A NEW SPECIES OF FENNELLOMYCES (MUCORALES)

P. C. MISRA, N. N. GUPTA AND KANCHAN LATA

Department of Botany, University of Gorakhpur
Gorakhpur 273001, U. P., India

SUMMARY

Fennellomyces heterothallicus Misra, Gupta & Lata sp. nov. isolated from dung of rodents and bat is described and illustrated. The species is heterothallic and the zygospores are described in the genus for the first time.

The genus *Fennellomyces* was erected by Benny and Benjamin (1975) to accommodate a single species which was originally described in the genus *Circinella* (Mucoraceae) as *C. linderi* by Hesseltine and Fennell (1955). Because of the simultaneous production of terminal, deliquescent-walled, *Mucor*-like sporangia and circinately borne, apophysate sporangiola having persistent but separable wall, Benny and Benjamin *(loc. cit.)* assigned their genus to the Thamnidiaceae. The type species, *Fennellomyces linderi* (Hesseltine & Fennell) Benny & Benjamin, can be readily distinguished from the other Thamnidiaceae on account of the conspicuous enlargement of the sporophore immediately below the terminal sporangium and also by the tough and membranous sporangiolar wall, the sporangiolar wall of other Thamnidiaceae being fragile but persistent. The zygospores are not known in the type species.

A new species of *Fennellomyces* is described in this communication. It is named *F. heterothallicus* on account of its heterothallic nature. The zygospores are described in the genus for the first time.

Fennellomyces heterothallicus Misra, Gupta & Lata *sp. nov.* FIG. 1

Coloniae in agaro composito ad mucores colendos idoneo crescentes die undecima sub calore 25-27 C ad diametrum 8 cm attingentes, albae, 1.5 cm altae. Sporangiophora ex mycelio per substratum penetrante orta biformia: procera usque ad 1.5 cm alta, 6-21 µ diametro, quaeque gerentia sporangium unum magnum terminale atque circulum unum (vel circula dua) ramorum plerumque verticillatorum lateralium sporangia terminalia singula producentium, ramis eisdem raro ramos secundarios sporangia terminalia producentes gerentibus, ramis omnibus 70-500 µ longis, 5.7-16.0 µ diametro; sub ramis sporangiiferis rami breves circinati per sporangiophororum longitudinem inaequaliter orti sporangiolum unum gignentes vel dua; brevia simplicia vel semel, bis, vel ter modo sympodii ramosa, sporangia nulla, sporangiola tantum in pedicellis circinatis gignentia. Sporangia globosa, 28-58 µ diametro; tunica hyalina, subtiliter echinulata, deliquescens et collare re-

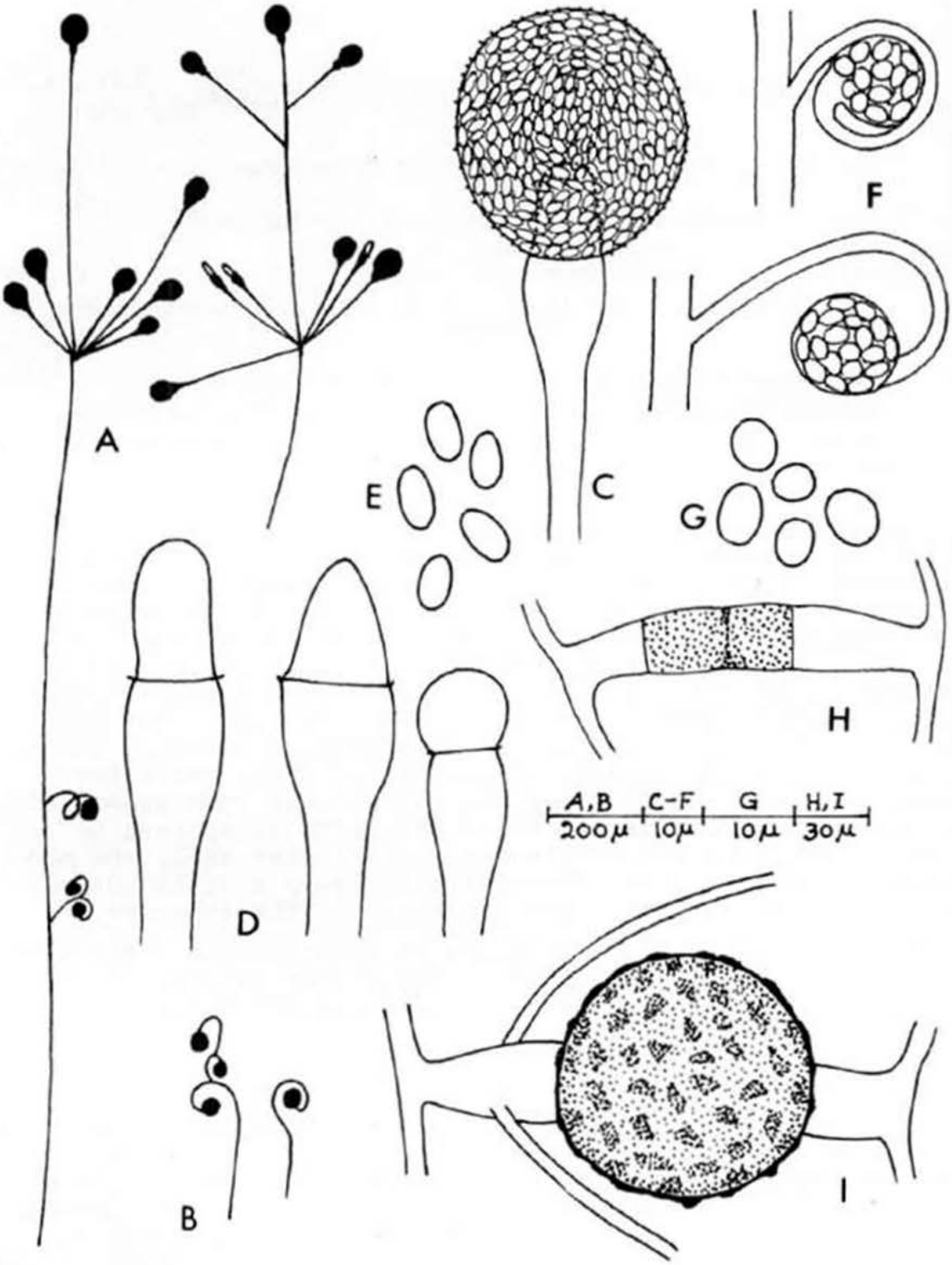

FIG. 1. *Fennellomyces heterothallicus*. A, tall sporangiophores; B, short sporangiophores; C, sporangium; D, columellae and subsporangial vesicles; E, sporangiospores from sporangia; F, sporangiola; G, sporangiospores from sporangiola; H, fusion of gametangia; I, zygospore.

linquens; columellae conicae, elongatae, vel hemisphaericae, leves, nonnumquam palo constrictae, subhyalinae, vel in colorem pallide griseum fuscescentes, 9-44 μ altae, 7-35 μ diametro; dilatatio subsporangialis clavata vel ovoidea, 11-37 μ diametro, pallide grisea vel grisea, infra pallescens. Sporangiola plerumque multispora, globosa vel subglobosa, 15-35 μ diametro, apophyse praedita, dilatatione subsporangiali nulla; tunica incoloris, persistens, pressione fracta; columellae subglobosae vel hemisphaericae, 7-18 μ diametro, leves, incolores. Sporangiosporae e sporangiis ortae ellipsoidales vel oblongae, subhyalinae, leves, tenuiter tunicatae, 5.0-8.2 × 2.3-4.6 μ; e sporangiolis multisporis ample ellipsoidales, ovoideae, vel subglobosae, paulo crassius tunicatae quam eae e sporangiis ortae, 4.6-9.7 × 3.4-5.7 μ. Zygosporae in agara cum extracto malti composito genitae eis in hyphis aereis a conjunctione gametangiorum oppositorum comparium efformatae, globosae vel subglobosae, 38-66 μ diametro, griseobrunneae, tunica crassa verrucosa; suspensores haud pares, 14-40 μ longi, 12-25 μ lati, interdum appendice una (vel plures) longa, 3.4-4.6 μ lata, haud ramosa, continua, e suspensore alio orta praediti. Species heterothallica. Holotypus: PCM *582*.

Colonies on synthetic *Mucor* agar (SMA) 8 cm in diam in 10 days at 25-27 C, dull white, 1.5 cm high; reverse pale straw colored. Sporophores arising directly from the substrate mycelium, erect or ascending, branched, of two types: (1) tall sporangiophores bearing primary sporangia towards the apex and circinately borne sporangiola laterally, (2) short sporangiophores bearing only sporangiola on circinate pedicels. Tall sporangiophores up to 1.5 cm high, 6-21 μ in diam, colorless to very light greyish, smooth or minutely verruculose, each bearing a large, terminal, primary sporangium and one or two groups of usually verticillate, lateral branches also bearing single, terminal, primary sporangia, and these branches, in turn, rarely forming secondary branches bearing terminal sporangia; branches 70-500 μ long, 5.7-16.0 μ in diam; below the sporangia-bearing branches are produced few, short, lateral branches arranged irregularly along the sporangiophore and bearing one or two sporangiola on circinate pedicels. Short sporangiophores colorless to very light greyish, smooth, produced in small numbers, simple or 1-3 times sympodially branched, lacking sporangia and bearing only pedicellate sporangiola; sporangiolar pedicels 2.3-8.0 μ in diam near the middle, circinate or forming a complete circle, rigid, smooth or minutely verruculose, usually slightly darker in color below the sporangiolum. Primary sporangia globose, 28-58 μ in diam, in reflected light white to pale yellow when young, becoming dark grey at maturity; wall hyaline, finely echinulate, deliquescent, leaving a collar; columellae conical, elongate or hemisphaerical, smooth, sometimes slightly constricted near the middle or towards the base, subhyaline to light grey, 9-44 μ high, 7-35 μ in diam; subsporangial swelling clavate to ovoid, 11-37 μ in diam, light grey to grey, the color fading below. Sporangiola mostly multispored, globose to subglobose, white to grey in reflected light, 15-35 μ in diam, apophysate, without subsporangial swelling, wall colorless, persistent, breaking under pressure, leaving a large portion as a collar; columellae small, subglobose to hemisphaerical, 7-18 μ in diam, smooth, colorless. Unispored sporangiola rarely produced, up to 11.5 μ in diam. Sporangiospores from sporangia and sporangiola differing in size and shape; sporangiophores from sporangia ellipsoidal or oblong, rarely slightly curved, sub-

hyaline, smooth, thin-walled, 5.0-8.2 × 2.3-4.6 μ; sporangiospores from multispored sporangiola broadly ellipsoidal, ovoid or subglobose, smooth, slightly thicker-walled than those from sporangia, 4.6-9.7 × 3.4-5.7 μ.

Zygospores formed on mating compatible strains on malt extract agar at 25-30 C, formed on aerial hyphae by fusion of equal gametangia, globose to subglobose, 38-66 μ in diam, greyish-brown, with thick, warted wall; suspensors unequal, smooth, colorless to very light greyish brown, 14-40 μ long, 12-25 μ wide at the point of attachment with zygospores, usually with one or more long, 3.4-4.6 μ wide, unbranched, colorless to very light colored, aseptate appendages arising from one of the suspensors. Heterothallic.

Holotype: PCM *582*, isolated from mouse dung, Jatepur, Gorakhpur, U. P., India, N. N. Gupta, 4 Oct. 1975. A living culture of the type strain has been deposited with Rancho Santa Ana Botanic Garden, Claremont, California.

Other specimens examined: PCM *640*, bat dung, Fatehpur, U. P., India, P. C. Misra, 20 June 1978. PCM *641*, mouse dung, Jatepur, Gorakhpur, U. P., India, N. N. Gupta, 23 June 1978. PCM *642*, shrew dung, Dewan Bazar, Gorakhpur, U. P., India, Kanchan Lata, 28 June 1978.

Zygospores were first observed when the type strain (PCM *582*) was mated with PCM *642* on malt extract agar. Subsequent mating experiments have shown that zygospores are also produced when the type strain is mated with PCM *640* or *641*. Zygospores are not produced on synthetic *Mucor* agar.

Fennellomyces heterothallicus can be easily distinguished from *F. linderi* on the basis of the terminal branching of the tall sporangiophores and the shape of the sporangiophores.

ACKNOWLEDGMENTS

The authors thank Dr. D. P. Rogers for the Latin diagnosis, Dr. R. K. Benjamin for examining a culture of the new species and Dr. M. A. A. Schipper for reviewing the manuscript. The work was supported by grant no. F.23-613/77(SR.II) from the U. G. C., India.

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MYCOTAXON

Vol. X, No. 1, pp. 255-264 October-December 1979

THREE NEW SPECIES OF CLAUSSENOMYCES FROM MACARONESIA

G. B. OUELLETTE

Laurentian Forest Research Centre, Canadian Forest Service, Department of Fisheries and the Environment, 1080 Route de Vallon, Sainte-Foy, Québec, Canada G1V 4C7

AND

RICHARD P. KORF

Plant Pathology Herbarium, Cornell University Ithaca, New York 14853, U. S. A.

RÉSUMÉ

Nous présentons la description de trois nouvelles espèces de *Claussenomyces: C. canariensis* de Gran Canarie, et *C. clavatus* et *C. dacrymycetoideus* de Madère. Une autre espèce assignée antérieurement à *Claussenomyces* est transférée à *Chlorociboria (C. salviicolor)*. Une clé pour les neuf espèces de *Claussenomyces* connues accompagne ces descriptions.

The genus *Corynella* Boud. was erected for a group of small, highly gelatinous, greenish to blackish inoperculate discomycetes with septate ascospores that produce many asconidia both within the ascus and after discharge. The generic name is a later homonym (Korf and Abawi, 1971), and *Claussenomyces* Kirschst. provides an available name for this group of species (Korf, 1973; Dennis, 1978). The type species of Kirschstein's genus, *C. jahnianus* Kirschst., and another transferred from *Holwaya* by Korf and Abawi, release a dark pigment in aqueous KOH mounts (the ionomidotic reaction) while two other species they transferred from *Corynella* do not. This reaction with KOH is an important criterion in the separation of species.

Claussenomyces is clearly allied to *Tympanis* Tode *ex* Fr., recently monographed by Ouellette and Pirozynski (1974). In both genera the excipular and medullary hyphae of the apothecia are embedded in a copious gel, and ascoconidia are produced from the primary ascospores. In *Claussenomyces* the ascoconidia form directly from phialidic cells of the ascospore; in *Tympanis* they arise from one or more intermediate cells budded from the ascospores (Ouellette and Pirozynski, 1974). Primary ascospores in *Tympanis* are rarely more than 2-celled (several-celled in *T. confusa* Nyl.); they are pluriseptate and often muriform in *Claussenomyces*.

Ouellette and Pirozynski (1974) transferred *Tympanis pseudotsugae* Groves, an ionomidotic species with ascoconidia arising directly from primary ascospores, to *Claussenomyces*, and described a new species, *C. luteoviridis* Ouellette & Korf (non-ionomidotic) from Puerto Rico.

One additional species has since been transferred to *Claussenomyces*, a viridous to black, non-ionomidotic species, *Chlorosplenium salviicolor* Ell. & Everh. [as *Claussenomyces salviicolor* (Ell. & Everh.) Korf & Dixon *in* Dixon (1974)]. The junior author has restudied not only the type and isotype specimens of this species, but also the two other collections reported and tentatively so identified by Dixon (1974), one from Dominica (Welden *1876*) on wood, the other from New York (Korf *3231*) on wood of *Carpinus caroliniana*. All three collections show similar apothecial structure: a dark-viridous ectal layer of densely intertwined hyphae in a gel, with some isodiametric cells, some loose hyphal "hairs" on the outside, and a medulla of textura intricata immersed in gel. The New York collection has larger asci and ascospores, and may well represent an undescribed species. Dixon (1974) felt compelled to exclude this species (or these species) from *Chlorociboria* Seaver emend. Dixon because of this medullary gel, which is absent in all the species he classified in that genus (Dixon, 1975). The only genus with similar pigments and gel present in both the ectal and medullary layers appeared to be *Claussenomyces*, which accounts for its transfer.

Chlorosplenium salviicolor differs from any known species of *Claussenomyces* in what we consider to be fundamental features: (i) no ascoconidia are formed, (ii) the ascospores remain unicellular, (iii) the gel is not as copious as in species of *Claussenomyces*, (iv) the structure recalls *Chlorociboria*, not *Claussenomyces*, in transverse sections of apothecia, and (v) there is a distinct green pigmentation of the substrate, just as in typical species of *Chlorociboria*. This (these ?) species can not remain in *Claussenomyces* as we de-

limit the genus. The medullary gel is a character not previously noted in *Chlorociboria*, but the other characters are so close to those of that genus that a formal transfer is made here; another alternative would be the erection of a new genus or of a new subgenus within *Chlorociboria* to accommodate such fungi, which seems premature. The species becomes Chlorociboria salviicolor (Ell. & Everh.) Korf, *comb. nov.* (basionym: *Chlorosplenium salviicolor* Ell. & Everh., Proc. Acad. Sci. Philadelphia 45: 146. 1893).

During preparation of a Discomycete Flora of Macaronesia undertaken by the junior author, three apparently undescribed species of *Claussenomyces* were collected and are described here. Two belong in the ionomidotic series *(C. canariensis, C. clavatus)*, and one *(C. dacrymycetoideus)* has non-iodomidotic apothecia.

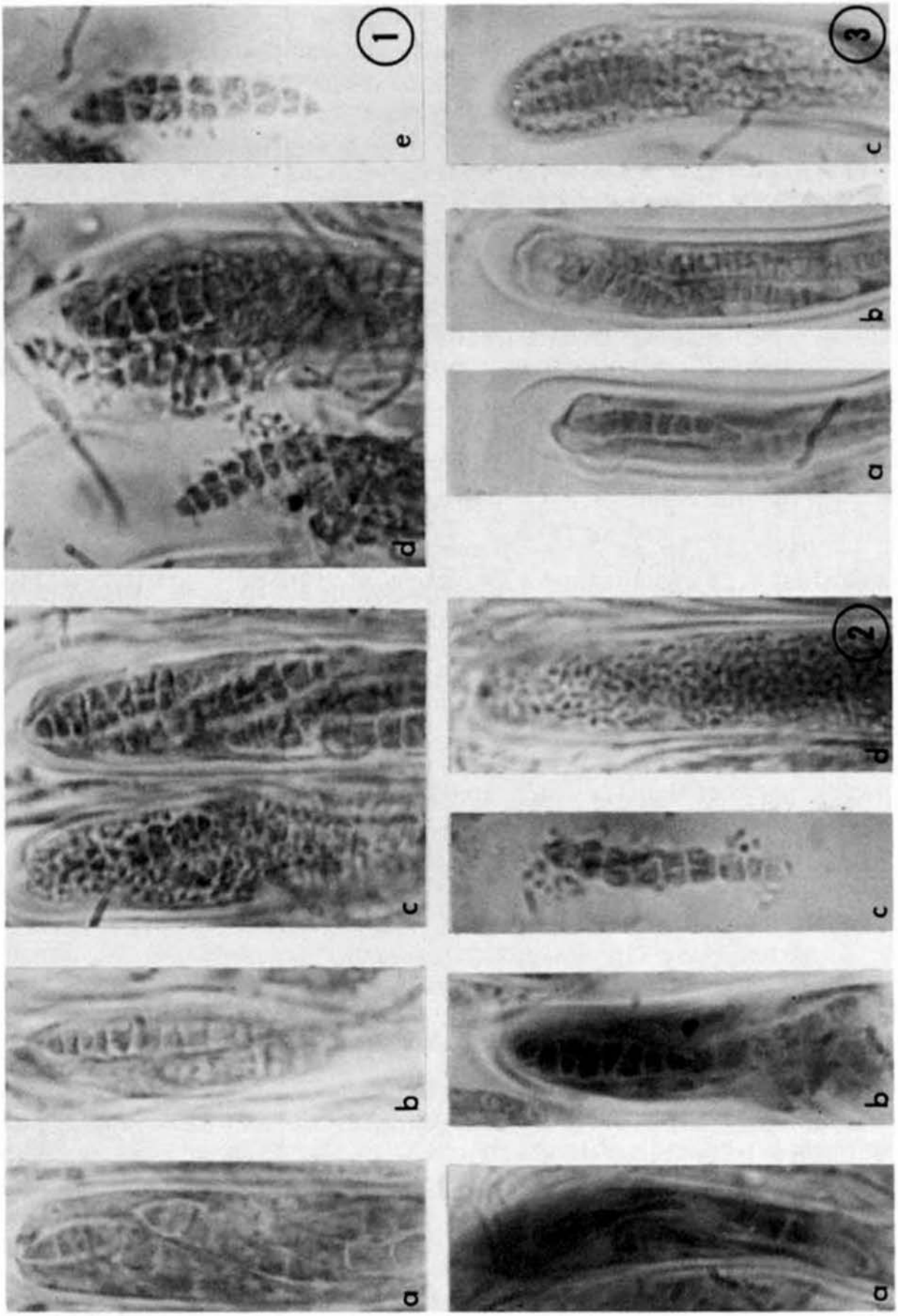
1. Claussenomyces canariensis Ouellette & Korf, *sp. nov.*

FIGS. 1, 4

Apotheciis in ligno putrescente superficialibus, fuscis, rugulosis, singularibus, breviter stipitatis, orbicularibus vel ellipticis, (0.25-) 0.3-0.5 (-0.6) mm latis, marginibus fimbriatis; receptaculo nigro, ad maturitatem fere plano; ascis cylindrico-clavatis, 8-ascosporis dein multimicrosporis, (66-) 75-95 (-105) × (7.5-) 9-11 (-14.5) µm; ascosporis hyalinis, denique biseriatis, plerumque fusoideis, pluriseptatis (septis 6-13, cellulis medianis septa verticalia praeterea parientibus), (10-) 16-26 × 3.1-4.6 (-5.0) µm, ascoconidiis ex phialide ipsa difficiliter visibili enascentibus, hyalinis, tenellis, ovoideis, aliquando leniter curvatis; paraphysibus filiformibus, septatis, ramosis, apicibus fuscis, inflatis.

Holotypus: CUP-MM *1025*, on wood, Casas Tamadaba, Pinar de Tamadaba, elev. 1450 m, Gran Canaria, Canary Islands, 21. I.1976, leg. R. P. Korf, W. C. Denison, L. M. Kohn and M. A. Sherwood. (Isotypus: TFC)

Notes: Morphologically, this species is close to *C. luteoviridis*, differing in its ionomidotic reaction and apparent lack of yellowish-green color. The ascoconidia in *C. canariensis* are mostly ovoid, approximately 2.0 × 1.5 µm; they are bacilliform and less than 1 µm broad in *C. luteoviridis*. Phialides and conidia similar to those described for *C. luteoviridis* were observed in one of a few pycnidium-like structures occurring close to the apothecia.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2. Claussenomyces clavatus Ouellette & Korf, *sp. nov.*

FIGS. 2, 5

Apotheciis in ligno putrescente superficialibus, rubellis, singularibus vel gregariis, 0.3-0.6 mm latis, marginibus irregularibus; ascis cylindrico-clavatis, 8-ascosporis (ascosporis cum aliquando paucioribus, tum majoribus), denique multimicrosporis, 89-96 × 9.0-12.0 µm; ascosporis hyalinis, denique biseriatis, clavatis, pluriseptatis (septis 5-10, cellulis apicalibus medianisque septa verticalia praeterea parientibus), 18.0-25.1 × 3.3-4.6 µm, ascoconidiis ex phialide ipsa difficiliter visibili enascentibus, hyalinis, ovoideis; paraphysibus filiformibus, septatis, ramosis.

Holotypus: CUP-MM *2258*, on decorticated branch, Ribeiro Frio, Madeira, 21.IV.1978, leg. R. P. Korf, L. M. Kohn, N. Korf and A. Y. Rossman.

Notes: In this species the ascospores are distinctly clavate, with the wide or distal part often vertically septate, and the ascoconidia are larger than those of *C. canariensis*. The hymenium has a rugulose appearance with reddish-brown tints. The apothecia give a particularly strong ionomidotic reaction.

3. Claussenomyces dacrymycetoideus Ouellete & Korf, *sp. nov.*

FIGS. 3, 6

Apotheciis in ligno putrescente superficialibus, gelatinosis, olivaceis, singularibus, ca. 0.5 mm latis; ascis cylindricis, 8-ascosporis, dein multimicrosporis, 43-72 × 8.3-

FIGS. 1-3. New species of *Claussenomyces*, × 1250, photomicrographs by the senior author. 1. *C. canariensis*. a, young, fusoid ascospores with a few transverse septa; b, older, more elongate ascospores, with transverse and vertical septa; c, ascus at left filled with ascoconidia nearly obscuring the primary ascospores, ascus at right with muriform ascospores; d, ascospores both within asci and free, producing ascoconidia; e, single, free ascospore producing ascoconidia. 2. *C. clavatus*. a, young, clavate ascospores with one to a few septa and elongated base; b, older, muriform ascospores; c, single, free ascospore producing ascoconidia; d, ascus filled with ascoconidia completely obscuring the primary ascospores. 3. *C. dacrymycetoideus*. a, young, transversely septate ascospores; b, older, very closely septate ascospores; c, ascus with ascoconidia and primary ascospores still visible.

9.9 µm; ascosporis hyalinis, denique biseriatis, cylindricis, pluriseptatis (septis 7-21), 16.0-21.4 × 2.1-2.9 µm, ascoconidiis ex phialide ipsa difficiliter visibili enascentibus, hyalinis, ellipsoideis vel subglobosis; paraphysibus tenellis, filiformibus, anastomosantibus, aliquando scabris.

Holotypus: CUP-MM *2310*, on decorticated branch of *Pinus* sp., at stream just south of Santo da Serra, km mark 18, Madeira, 21.IV.1978, leg. R. P. Korf, L. M. Kohn, N. Korf and A. Y. Rossman.

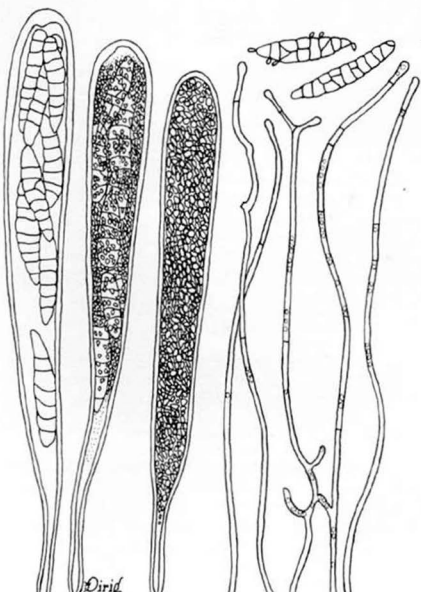

FIG. 4. *Claussenomyces canariensis*, × 1000. Three asci, from left: with mature primary ascospores, primary ascospores partially obscured by ascoconidia, and filled with ascoconidia; paraphyses; primary ascospores, the upper producing ascoconidia. Drawn with the aid of a drawing tube.

Notes: This olive-colored species has at first sight the appearance of a minute *Dacrymyces*. The apothecia are greenish-yellow in 10% KOH. Ascospores are cylindrical and very closely multiseptate (with rare vertical septa) at the time ascoconidia are produced. The ascoconidia are cylindrical to ovoid. The species may be related to *C. atrovirens*, which differs in having larger apothecia and ascospores. The senior author has noted that ascospores of *C. atrovirens* occasionally have one or two swollen, larger cells with vertical septa.

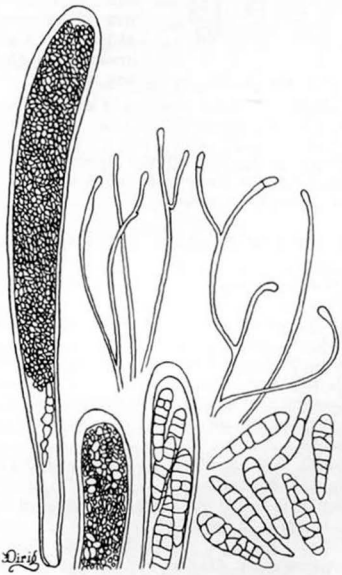

FIG. 5. *Claussenomyces clavatus*, × 1000. Ascus filled with ascoconidia; paraphysis apices; two ascus apices, one with ascoconidia, the other with primary ascospores; 7 primary ascospores. Drawn with the aid of a drawing tube.

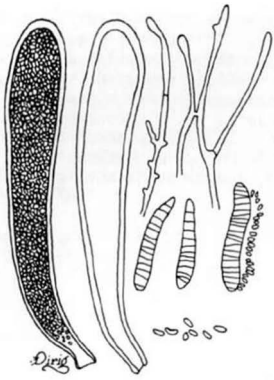

FIG. 6. *Claussenomyces dacrymycetoideus*, × 1000. Two asci, one filled with ascoconidia; paraphysis apices; three primary ascospores, one with a row of ascoconidia along one side; seven ascoconidia. Drawn with the aid of a drawing tube.

Since there is no key to the species of *Claussenomyces* other than that to the four species treated in Korf and Abawi (1971), we present one here:

KEY TO THE SPECIES OF CLAUSSENOMYCES

1. Apothecia nearly black, some with reddish tints, ionomidotic 2
1'. Apothecia light to dark green or yellowish, often finally black, not ionomidotic 6
2(1). Ascospores cylindrical, transversely 7- to 15-septate 3
2'(1). Ascospores fusoid or clavate, multiseptate, with apical or medial cells forming vertical septa 4
3(2). Apothecia 2-4 mm diam, ascospores 90-120 (-150) µm long, 7-septate . . . . . *C. jahnianus* Kirschst.
3'(2). Apothecia 0.2-0.3 mm diam, ascospores 38-78 µm long, mostly 15-septate.
C. pusillus (Rehm) Korf & Abawi
4(2'). Ascospores distinctly clavate, with apical cells becoming vertically septate; ascoconidia ellipsoidal to subglobose.
C. clavatus Ouell. & Korf
4'(2'). Ascospores predominantly fusoid 5
5(4'). Apothecia 1-4 mm diam, asci (175-) 190-240 (-260) µm long, ascoconidia bacilliform.
C. pseudotsugae (Groves) Ouell. & Piroz.

5'(4'). Apothecia (0.25-) 0.3-0.5 (-0.6) mm diam, asci (66-) 75-95 (-105) µm long; ascoconidia larger, ovoid . . . . . *C. canariensis* Ouell. & Korf

6(1'). Ascospores predominantly fusoid, medial part vertically septate; ascoconidia bacilliform.
C. luteoviridis Ouell. & Korf *in* Ouell. & Piroz.

6'(1'). Ascospores predominantly cylindrical, transversely pluriseptate; ascoconidia mostly ellipsoidal to subglobose 7

7(6'). Ascospores 3-septate, (8.8-) 10-13 µm long.
C. prasinulus (Karst.) Korf & Abawi

7'(6'). Ascospores 5-16 (-21)-septate, longer than 15 µm. . 8

8(7'). Apothecia 0.5-1.5 mm diam, brittle, dark green; ascospores 15-30 µm long, 5-11-septate.
C. atrovirens (Pers. *ex* Pers.) Korf & Abawi

8'(7'). Apothecia mostly less than 0.5 mm diam, gelatinous even at maturity, olivaceous; ascospores 16.0-21.4 µm long, 7-16 (-21)-septate. . . . *C. dacrymycetoideus* Ouell. & Korf

ACKNOWLEDGEMENTS

The authors jointly acknowledge the suggestions of Dr. K. A. Pirozynski in reviewing this paper prior to publication. The senior author expresses his thanks to Mr. J. Bard for technical assistance in making measurements. The junior author owes a major debt of gratitude to the National Science Foundation for financial support through NSF grant DEB75-23557 which supported three Discomycete Explorations to the islands of Macaronesia and also provided the funds to support his able technician and illustrator, Mr. Robert Dirig, who has drawn some of the illustrations and inked all of them for this paper, and who prepared many of the microscopic mounts used in these studies. The cooperation of the scientists who accompanied the junior author on the field trips is also deeply appreciated, as is the amiable reception provided to the Expeditions by the staff at TFC, notably that of Prof. Wildpret de la Torre and Prof. Esperanza Beltrán Tejera, and of Dr. David Bramwell, on Gran Canaria, and Dr. G. E. Maul, on Madeira. Their knowledge of the terrain and of the flora made it possible to obtain these collections with much more facility than would otherwise have been possible. Dr. William J. Dress (BH) revised the Latin diagnoses.

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