

# MYCOTAXON

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

Vol. III

April-June 1976

No. 3

## CONTENTS

<i>Hypoxyton grandineum</i> : a loculoascomycete.....	MARGARET E. BARR	325
Notice: Second International Mycological Congress, 1977.....		330
A new species of <i>Lactarius</i> section <i>Plinthogali</i> from northeastern North America.....	RICHARD L. HOMOLA	331
<i>Trichodroma</i> in Colorado.....	F. BRENT REEVES AND CORINNE HORN	337
Synopsis of a new lichen genus, <i>Everniastrium</i> Hale (Parmeliaceae).	MASON E. HALE, JR.	345
Book Reviews.....	G. L. HENNEBERT	354
A new species of <i>Polyohidium</i> (Lichenes: Peltigeraceae) from New Guinea.....	ANTONIN VEZDA AND WILLIAM A. WEBER	355
Cultural characteristics of <i>Auriscalpium</i> and <i>Gloiodon</i> .	RONALD H. PETERSEN	358
A new species of <i>Omphalotus</i> .	HOWARD E. BIGELOW, ORSON K. MILLER, JR., AND HARRY D. THIERS	363
<i>Pseudococcolus javanicus</i> in Connecticut and its distribution in the United States.....	WILLIAM R. BURK	373
<i>Angiopoma</i> Lév., 1841, an earlier name for <i>Draechalera</i> Ito, 1930.	B. C. SUTTON	377
<i>Lepiota</i> sensu lato in California. II. Type studies of <i>Lepiota</i> <i>oppressa</i> and <i>Lepiota marginata</i> .....	WALTER J. SUNDBERG	381
A new species of <i>Eotestalzia</i> from Mexico and Venezuela.	R. S. JENG AND R. F. CAIN	387
A new species of <i>Ascodesmia</i> from Venezuela....	R. S. JENG AND R. F. CAIN	391
A nomenclatural note concerning <i>Sarcinomyces</i> Lindner and <i>Sarcinomyces</i> Ohio.....	S. C. JONG AND D. S. KING	397
<i>Acauloconidium</i> : a new hyphomycetous genus to accommodate <i>Trichosporon aculeatum</i> .....	D. S. KING AND S. C. JONG	401
Contribution to the knowledge of <i>Staehybotrys</i> and <i>Memnoniella</i> in culture.....	S. C. JONG AND E. E. DAVIS	409
Fungi that decay mesquite in southern Arizona.	R. L. GILBERTSON, H. H. BURDSALL, JR., AND E. R. CANFIELD	487
<i>Puciola spinosa</i> , a new dematiaceous hyphomycete from soil.	M. DE BERTOLDI	553
Notes on Hyphomycetes. IX. A new species of <i>Curvularia</i> .	G. MORGAN-JONES AND G. W. KARR, JR.	559
<i>Acaulospora trappii</i> sp. nov.....	ROBERT N. AMES AND ROBERT G. LINDERMAN	565
INDEX to Fungous and Lichen Taxa.....		570
Reviewers.....		579
Errata.....		580

[MYCOTAXON for January-March 1976 (3: 193-324)  
was issued February 6, 1976]

ISSN 0093-4666

MYXNAE 3(3) 325-580 (1976)

Library of Congress Catalogue Card Number 74-7903

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

# MYCOTAXON

VOLUME III, 1975-1976

*COMPLETE IN THREE QUARTERLY ISSUES  
CONSISTING OF v + 580 PAGES  
INCLUDING FIGURES*



CO - EDITORS

G. L. HENNEBERT

*French Language Editor & Book Review Editor*

RICHARD P. KORF

*English Language Editor & Managing Editor*

*Published by*

*MYCOTAXON, LTD., P.O. BOX 264, ITHACA, NY 14850, USA*

*Printed in the United States of America*

## TABLE OF CONTENTS, VOLUME THREE

AMES, ROBERT N. AND ROBERT G. LINDERMAN <i>Acaulospora trappei</i> sp. nov. ....	565
AMIRATI, JOSEPH F. <i>Cortinarius</i> , section <i>Dermocybe</i> — <i>Cortinarius clelandii</i> .....	95
BARR, MARGARET E. The genus <i>Ostreichnion</i> .....	81
<i>Hypoxyton grandineum</i> : a loculoascomycete .....	325
BERTOLDI, M. DE <i>Puciola spinosa</i> , a new dematiaceous hyphomycete from soil .....	553
see MOORHOUSE & DE BERTOLDI	
BIGELOW, HOWARD E., ORSON K. MILLER, JR., & HARRY D. THIERS A new species of <i>Omphalotus</i> .....	363
BRAUN, KARL LEO & HAROLD W. KELLER Myxomycetes of Mexico I .....	297
BURDSALL, H. H., JR., see GILBERTSON <i>et al.</i>	
BURK, WILLIAM R. <i>Pseudocolus javanicus</i> in Connecticut and its distribution in the United States .....	373
CAIN, R. F., see JENG & CAIN	
CANFIELD, E. R., see GILBERTSON <i>et al.</i>	
CARPENTER, STEVEN E. Taxonomy, morphology and ontogeny of <i>Gelatinodiscus flavidus</i> ..	209
CONSTANTINESCU, O. Revision of <i>Cercospora</i> species (Hyphomycetes) parasitic on <i>Psoralea</i> .....	119
DEMOULIN, V. Species of <i>Lycoperdon</i> with a setose exoperidium .....	275
GILBERTSON, R. L., H. H. BURDSALL, JR., & E. R. CANFIELD Fungi that decay mesquite in southern Arizona .....	487
HALE, MASON E., JR. Studies on the lichen family Thelotremaaceae. 3. ....	173
Synopsis of a new lichen genus, <i>Everniastrum</i> Hale (Parmeliaceae) .....	345
HENNEBERT, G. L. Book Reviews .....	182, 318, 354
HOMOLA, RICHARD L. A new species of <i>Lactarius</i> section <i>Plinthogali</i> from northeastern North America .....	331
HORN, CORINNE, see REEVES & HORN	
HUANG, L. H. & J. A. SCHMITT Soil microfungi of central and southern Ohio .....	55



JENG, R. S. & R. F. CAIN	
A new species of <i>Eotetraspora</i> from Mexico and Venezuela .....	387
A new species of <i>Ascodesmia</i> from Venezuela .....	391
JONG, S. C., <i>see</i> KING & JONG, <i>see</i> ROXON & JONG	
JONG, S. C. & E. E. DAVIS	
<i>Phialocephala gabalongii</i> as a synonym of <i>Phialocephala humicola</i>	126
Contribution to the knowledge of <i>Stachybotrys</i> and <i>Memnoniella</i> in culture .....	409
JONG, S. C. & D. S. KING	
A nomenclatural note concerning <i>Sarcinomyces</i> Lindner and <i>Sarcinomyces</i> Oho .....	397
KARR, G. W., JR., <i>see</i> MORGAN-JONES AND KARR	
KELLER, HAROLD W., <i>see</i> BRAUN & KELLER	
KING, D. S., <i>see</i> JONG & KING	
KING, D. S. & S. C. JONG	
<i>Sarcinosporon</i> : a new genus to accommodate <i>Trichosporon</i> <i>inkin</i> and <i>Prototheca filamenta</i> .....	89
<i>Aciculoconidium</i> : a new hyphomycetous genus to accommodate <i>Trichosporon aculeatum</i> .....	401
KOHN, LINDA M. & RICHARD P. KORF	
Variation in Ascomycete iodine reactions: KOH pretreatment explored .....	165
KORF, RICHARD P., <i>see</i> KOHN & KORF, <i>see</i> SHERWOOD & KORF	
KRAMER, CHARLES L., <i>see</i> REDDY & KRAMER	
LAUNDON, G. F.	
Taxonomy and nomenclature notes on Uredinales .....	133
LINDERMAN, ROBERT G., <i>see</i> AMES & LINDERMAN	
MAJEWSKI, TOMASZ, <i>see</i> TAVARES & MAJEWSKI	
MILLER, ORSON K., JR., <i>see</i> BIGELOW <i>et al.</i>	
MISRA, P. C.	
A new species of <i>Syncephalastrum</i> .....	51
MOORHOUSE, J. & M. DE BERTOLDI	
Electrophoretic characteristics of enzymes as a taxonomic criterion in the genus <i>Humicola</i> .....	109
MORGAN-JONES, G.	
Notes on Hyphomycetes. VIII. <i>Lylea</i> , a new genus .....	129
MORGAN-JONES, G. AND G. W. KARR, JR.	
Notes on Hyphomycetes. IX. A new species of <i>Curvularia</i> .....	559
PETERSEN, RONALD H.	
Specific and infraspecific names for fungi used in 1821. Part III. D-G. ....	239
Cultural characteristics of <i>Auriscalpium</i> and <i>Gloiodon</i> .....	358

PFISTER, DONALD H.	
Scanning electron micrographs of ascospores of <i>Pachyella</i> (Discomycetes) .....	105
Comments on the Scleromyceti Sueciae in the Farlow Herbarium ..	185
REDDY, M. SUGUNAKAR & CHARLES L. KRAMER	
A taxonomic revision of the Protomycetales .....	1
REEVES, F. BRENT & CORINNE HORN	
<i>Trichoderma</i> in Colorado .....	337
ROXON, J. E. & S. C. JONG	
<i>Arthrobotrys entomopaga</i> in pure culture .....	162
SCHMITT, J. A., see HUANG & SCHMITT	
SHERWOOD, MARTHA A.	
The genus <i>Platystieta</i> .....	233
SHERWOOD, MARTHA A. & RICHARD P. KORF	
A revision of <i>Helotiopsis</i> .....	319
SUNDBERG, WALTER J.	
<i>Lepiota</i> sensu lato in California. II. Type studies of <i>Lepiota cupresssea</i> and <i>Lepiota marginata</i> .....	381
SUTTON, B. C.	
<i>Angiopoma</i> Lév., 1841, an earlier name for <i>Drechslera</i> Ito, 1930	377
TAVARES, ISABELLE I. & TOMASZ MAJEWSKI	
<i>Siemaszkoa</i> and <i>Botryandromyces</i> , two segregates of <i>Misgomyces</i> (Laboulbeniales) .....	193
THIERS, HARRY D.	
Boletes of the southwestern United States .....	261
see BIGELOW <i>et al.</i>	
THOMSON, JOHN W., see WEBER & THOMSON	
VEZDA, ANTONIN & WILLIAM A. WEBER	
A new species of <i>Polyehidium</i> (Lichenes: Peltigeraceae) from New Guinea .....	355
WEBER, WILLIAM A., see VEZDA & WEBER	
WEBER, WILLIAM A. & JOHN W. THOMSON	
<i>Physcia duplicorticata</i> Weber & Thomson sp. nov. from California	102
Errata .....	580
Index to Fungus and Lichen Taxa .....	570
Notices	
MYCOTAXON policy on arguments supporting proposals on nomina generica conservanda .....	274
Second International Mycological Congress 1977 .....	330
Reviewers .....	579



# MYCOTAXON

Vol. III, No. 3, pp. 325-329

April-June 1976

## HYPOXYLON GRANDINEUM: A LOCULOASCOMYCETE

MARGARET E. BARR

Department of Botany, University of Massachusetts, Amherst,  
MA 01002

A fungus which has been accepted as a small aberrant species of *Hypoxylon*, *H. grandineum* (Berk. & Rav.) Miller (Miller, 1928, 1941, 1961), upon examination proves to be a species belonging to the Loculoascomycetes. This organism produces widely effused reddish brown to blackened areas on fallen trunks of oak (Miller 1961, fig. 118). The aspect is of a thin stroma dotted with protruding apices of small ascocarps. Ascospores (Miller 1961, fig. 146) are similar to those of many species of *Hypoxylon*: one-celled, brown, often apiculate at both ends and with an apparent longitudinal germ slit. The locule differs, however, in the presence of cellular pseudoparaphyses and bitunicate asci.

Very few Loculoascomycetes and members of the Pleosporales especially have one-celled brown ascospores. Some, such as *Auerswaldiella* Theiss. & Syd. have ascospores which become light brown in age. *Auerswaldiella* differs from *Hypoxylon grandineum* in parasitic habit and in the formation of multiloculate ascocarps erumpent from leaf tissue. When the classification of von Arx and Müller (1975) was utilized, *H. grandineum* was sought in the Botryosphaeriaceae. In this family the choices were limited to *Botryosphaeria* and *Guignardia*. Neither genus could be considered acceptable for *H. grandineum* (cf. Barr, 1972). If one emphasizes the presence of germ pores and slit in the ascospores, the family Sporormiaceae is indicated. In this mostly coprophilous family the only genus with one-celled ascospores is *Semidelitschia* Cain & Luck. The sole species, *S. agasmatica* Cain & Luck is coprophilous, has large ascocarps, large ascospores with prominent germ slit, surrounded by a gel sheath. According to Cain and Luck-Allen (1969) "This is the first Loculoascomycete with

1-celled ascospores thus far reported from the temperate region." Certainly this fungus differs markedly from *H. grandineum*. To express the characteristics and relationships of *H. grandineum* a new genus is required.

*Loculohypoxyton* Barr, gen. nov.

Ascocarpia immersa vel erumpentia, numerosa, effusae vinaceo-brunneae vel atrae formantes. Asci bitunicati, oblongi vel clavati, quadri- vel octospori, pseudo-paraphyses angustae, cellulosae. Ascospores unicellularis, brunneae, ellipticae vel subglobosae.

Typus generis: *Loculohypoxyton grandineum* (Berk. & Rav.) Barr, comb. nov.

Ascocarps numerous, immersed in inner periderm of host and forming widely effused, reddish brown to blackened patches; ascocarps perithecioid, immersed or widely erumpent, small, frequently darkened and thicker-walled over upper sides as a shallow clypeus, peridium thin and light brown below. Asci bitunicate, oblong or clavate, short stipitate, 4- or 8-spored, arising from base and lower sides of locule, in narrow cellular pseudoparaphyses. Ascospores one-celled, light to dark brown, broadly elliptic or subglobose, symmetric, often apiculate at both ends, apparent germ slit throughout length, wall smooth, overlapping uniseriate or partially biseriate in upper part of ascus.

*Loculohypoxyton grandineum* (Berk. & Rav.) Barr, comb. nov.  
Figs. 1-3.

*Diatrype grandinea* Berk. & Rav. in Berkeley, Grevillea 4: 95. 1876.

*Anthostoma grandineum* (Berk. & Rav.) Sacc. Syll. Fung. 1: 299. 1882.

*Fuckelia grandinea* (Berk. & Rav.) Cooke, Grevillea 12: 53. 1883.

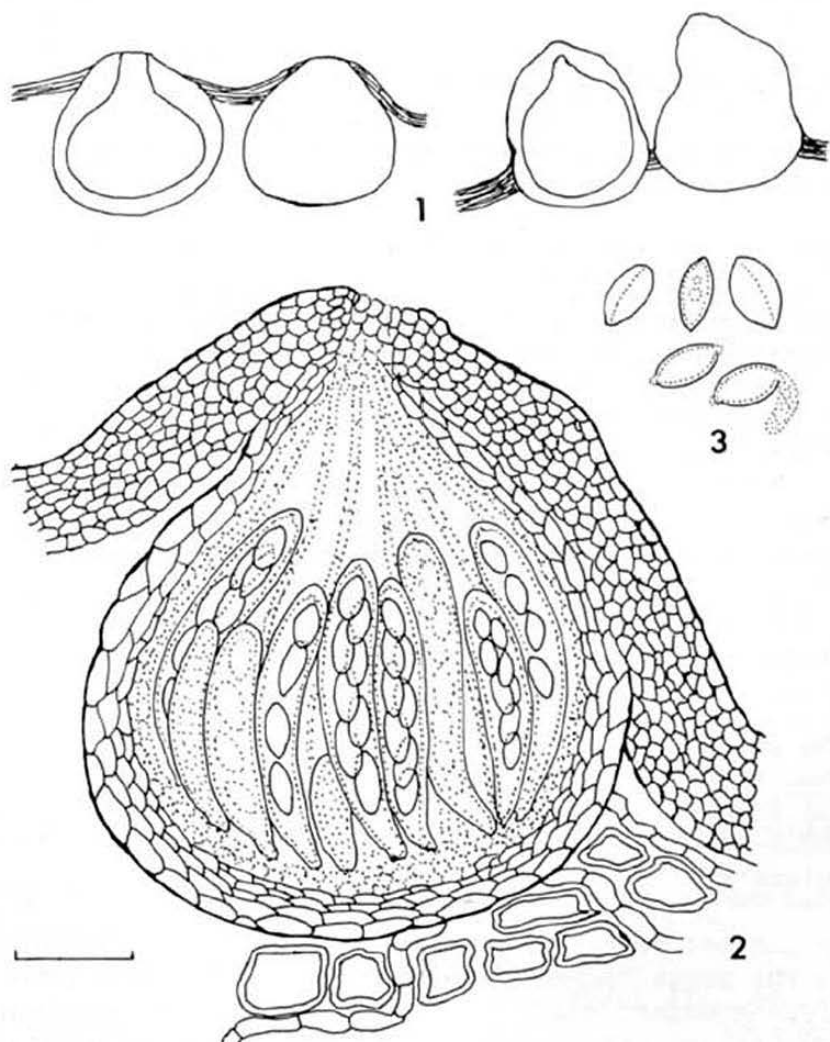
*Camarops grandinea* (Berk. & Rav.) Cooke, Grevillea 13: 108. 1885.

*Hypoxyton grandineum* (Berk. & Rav.) Miller, Mycologia 33: 74. 1941.

Infected areas widely effused, extending for 15 cm or more, smooth and even or finally rimose, developed beneath



outer layers of host periderm and producing light brown, reddish brown, chocolate brown, and finally blackened color to periderm, exposed with sloughing of outer periderm; ascocarps numerous, in a  $\pm$  even layer in and erumpent from periderm, globose-depressed with papillate apex when mostly immersed, globose-conic when widely erumpent, (90-)120-160  $\mu$ m diam; peridium soft, pseudoparenchymatous, slightly



Figs. 1-3. *Loculohypoxylon grandineum*. 1. Immersed and erumpent ascocarps in outline. 2. Clypeate ascocarp in section. 3. Ascospores, the lower two germinating on host periderm. Standard line = 100  $\mu$ m for fig. 1, 20  $\mu$ m for figs. 2 and 3.

compressed in side view, reddish brown, 20-25  $\mu\text{m}$  wide in upper part, often extended out from sides as shallow clypeus, light brown, ca. 10  $\mu\text{m}$  wide in lower part; apical pore filled by pallid pseudoparenchymatic mass of cells which gradually gelatinizes, hyphae intercellular in host periderm, light brown near ascocarp base, darkened near surface. Asci 44-70 X 9-11  $\mu\text{m}$ , oblong or clavate, stipe short or elongate, bitunicate, apex nonamyloid, 4- or 8-spored; pseudoparaphyses cellular, narrow. Ascospores 7.5-10(-11) X (4-)5-6.5  $\mu\text{m}$ , light to dark brown, nearly opaque in age, elliptic or subglobose, slightly compressed at times, symmetric, usually with a short hyaline apiculus at both ends, with apparent elongate germ slit, contents 1-2-globulate, wall smooth, uniseriate or partially biseriata in the ascus.

On dead, usually fallen, trunks of *Quercus*.

Material examined: New Jersey: on *Quercus coccinea*, Newfield, Sept 1878, as *Diatrype grandinea*; Ellis N.A.F. 494, (MASS, NY); Newfield, Oct 1881, as *Diatrype grandinea* (NY); Newfield, 29 Nov 1893 as *Anthostoma* (NY); Ellis & Everhart Fungi Col. 324, Newfield, Nov 1893, as *Anthostoma* (NY). South Carolina: Ravenel, Fungi Carol. exs. Fasc. IV: 40, as *Diatrype grandinea* n.sp. (MASS). Georgia: (all as *Hypoxyton grandineum*): *Quercus* sp., Talassie Shoals, 27 Oct 1926, J.H. Miller (GA 2724); Mt. City, 18 Aug 1932, J.H. Miller (GA 2725); Barron Playhouse, Rabun Co., 18 Aug 1932, J.H. Miller (GA unnum.); Athens, J.H. Miller 4467 (GA).

The germ slit visible in the ascospores apparently is nonfunctional. Numerous discharged ascospores are present on the surface of most of the specimens examined, and all of those which had germinated did so by germ tubes from the apiculate tips.

The closest relative of *Loculohypoxyton grandineum* seems to be the genus *Didymosphaeria* Fckl. Both genera have immersed-erumpent small ascocarps, a  $\pm$  well-developed clypeus around the papillate apex, narrowly cellular pseudoparaphyses, and bitunicate asci with short stipes, containing eight or less ascospores. Species of *Didymosphaeria* have one-septate ascospores, dark brown, with smooth or roughened wall and at times a minute (germ) pore in the tips. The ascospores of *Loculohypoxyton* are similar except that no septum is formed, the wall is smooth,



and an apparent germ slit is present. *Loculohypoxyton* and *Didymosphaeria* should be grouped together in the family Didymosphaeriaceae Munk ("ss. restr.", 1957). While Munk also included *Valsaria* Ces. & de Not. in the family, his interpretation of that genus is unacceptable. *Valsaria insitiva* Ces. & de Not. is a member of the Euascomycetes, in the Amphisphaeriaceae of the Xylariales. Other genera of similar ascocarp and locule configuration, whose ascospores are symmetric and brown could be considered also. The sequence of ascospore septations in this small family would be completed by species with several-septate ascospores (e.g. *Passariniella* Berl.) and muriformly-septate ascospores (the Loculoascomycete species presently in *Thyridium* Nits., i.e. *Mycothyridium* Petrak non Müller).

#### ACKNOWLEDGMENTS

I deeply appreciate the courtesy of the curators of the J. H. Miller Mycological Herbarium (GA) and the New York Botanical Garden (NY), for permission to study collections in their keeping.

#### LITERATURE CITED

- ARX, J.A. VON, and E. MÜLLER. 1975. A re-evaluation of the bitunicate Ascomycetes with keys to families and genera. *Studies in Mycology* No. 9: 1-159.
- BARR, M.E. 1972. Preliminary studies on the Dothideales in temperate North America. *Contr. Univ. Michigan Herb.* 9: 523-638.
- CAIN, R.F., and E.R. LUCK-ALLEN. 1969. *Semidelitschia*, a new genus of the Sporormiaceae. *Mycologia* 61: 580-585.
- MILLER, J.H. 1928. Biologic studies in the Sphaeriales. *Mycologia* 20: 305-339.
- \_\_\_\_\_. 1941. Georgia Pyrenomycetes. II. *Mycologia* 33: 74-81.
- \_\_\_\_\_. 1961. A monograph of the world species of *Hypoxyton*. Univ. Georgia Press. 158 p.
- MUNK, A. 1957. Danish Pyrenomycetes. *Dansk Bot. Ark.* 17(1): 1-491.

## NOTICE

### SECOND INTERNATIONAL MYCOLOGICAL CONGRESS 1977

The first circular describing the Second International Mycological Congress has been mailed to interested persons throughout the world. For the purpose of preliminary planning this circular had a December 15, 1975 return date. However, the second circular will not be mailed until the summer of 1976 and there is ample opportunity for all to contribute to the program.

If you have not registered for the second mailing, please contact the Secretary:

Dr. Melvin S. Fuller  
Secretary IMC<sup>2</sup>  
Department of Botany  
University of Georgia  
Athens, Georgia 30602, USA



*AUGUST 27 to SEPTEMBER 3, 1977*

*UNIVERSITY OF SOUTH FLORIDA  
TAMPA, FLORIDA*

A NEW SPECIES OF LACTARIUS SECTION PLINTHOGLI  
FROM NORTHEASTERN NORTH AMERICA<sup>1</sup>

RICHARD L. HOMOLA

Department of Botany and Plant Pathology  
University of Maine  
Orono, Maine 04473

## SUMMARY

*Lactarius louisii* is a species of Section *Plinthogali* found in Carbon County, Pennsylvania on very decayed wood, and on *Sphagnum* in wet areas of a woods predominantly of oak and maple. SEM micrographs of the spores and line drawings of details of pilear cuticle, cystidia and spores are presented. The species appears to be most closely related to *L. xanthodorheus* in stature, watery latex, yellowish distant lamellae, a basal cellular layer in the pilear cuticle, and a yellowish narrow stipe. It differs from *L. xanthodorheus* in having a white spore deposit, disagreeable taste, and latex not staining or changing to yellow.

*Lactarius louisii* Homola, sp. nov.

Figs. 1-6

*Pileus* 1.7-2.3 cm latus, atrobrunneus vel olivaceus, saepe luteus in medio; contextus cremo colore, fragilis; latex exiguus aquosus, constans; lamellae subdistantes vel distantes, subdecurrentes vel decurrentes, cremo colore; stipes 1.5-3.1 cm longus, 0.3-0.7 cm crassus, concolor cum pileo, fragilis; spores in cumulo albae,

This work was supported by a grant-in-aid given to the author through a Faculty Research Grant (5-4-26140) administered through Research Funds Committee, University of Maine, Orono, Maine.

6.6-7.7 x 5.1-6.8 $\mu$  (ornamentatione exclusa) verrucis et cristis usque ad 0.5-0.75 $\mu$  altis et cinnectivis, ornamentatione reticulum formanti; pileocystidia 16.4-22.4 x 5.1-5.6 $\mu$ ; caulocystidia 22.1-37.5 x 3.0-85 $\mu$ . Specimen typicum in Herbario University of Michigan, legit R. L. Homola 6276, prope Bowmanstown, Pennsylvania, 30 Aug. 1975.

Pileus (1.6)1.7-2.3(3.5) cm broad, convex with a distinct umbo, expanding to plane or shallowly depressed in center, usually with a conspicuous umbo, dark brown ("Mummy brown") becoming olive brown to olive yellow at maturity ("Isabella color"), often slightly mottled and yellow ("Honey yellow") in center, moist, showing a pruinose effect under a hand lens, distinctly rugose-venose especially in the center, plicate striate, margin crenate and wavy. Context very brittle, thin 0.5-1.5 cm, cream to light yellow ("Cream-buff"), unchanging in contact with air or KOH; odor none; taste unpleasant (bitter, metallic), not acrid. Latex very scanty, watery, unchanging not staining flesh.

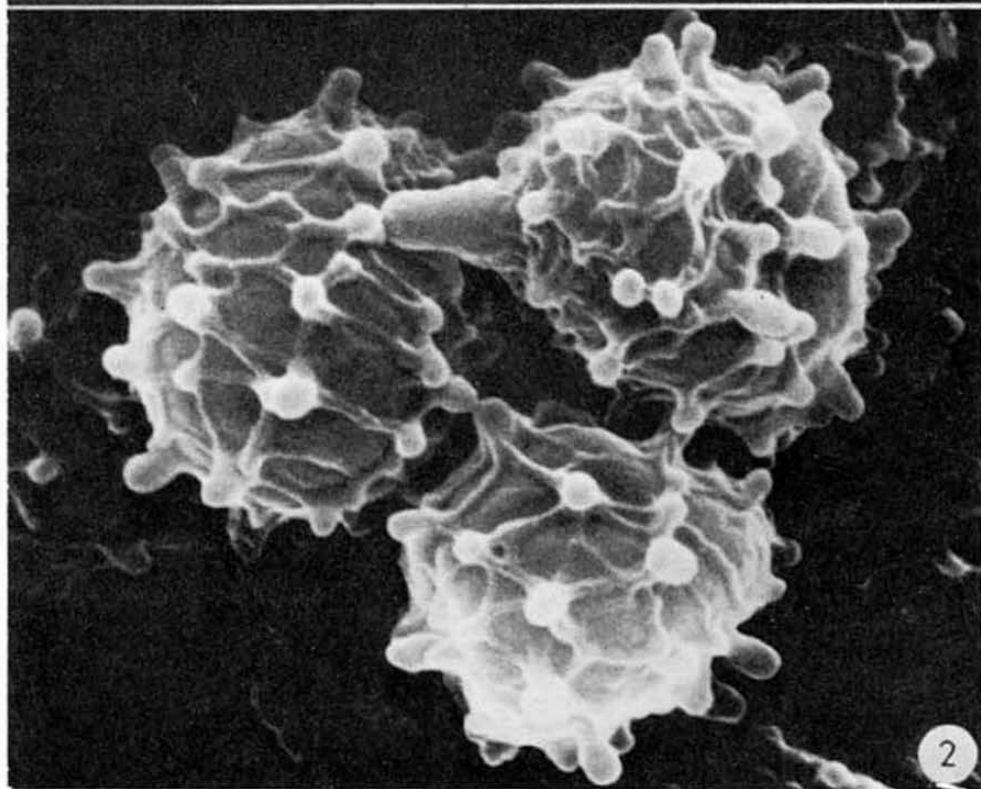
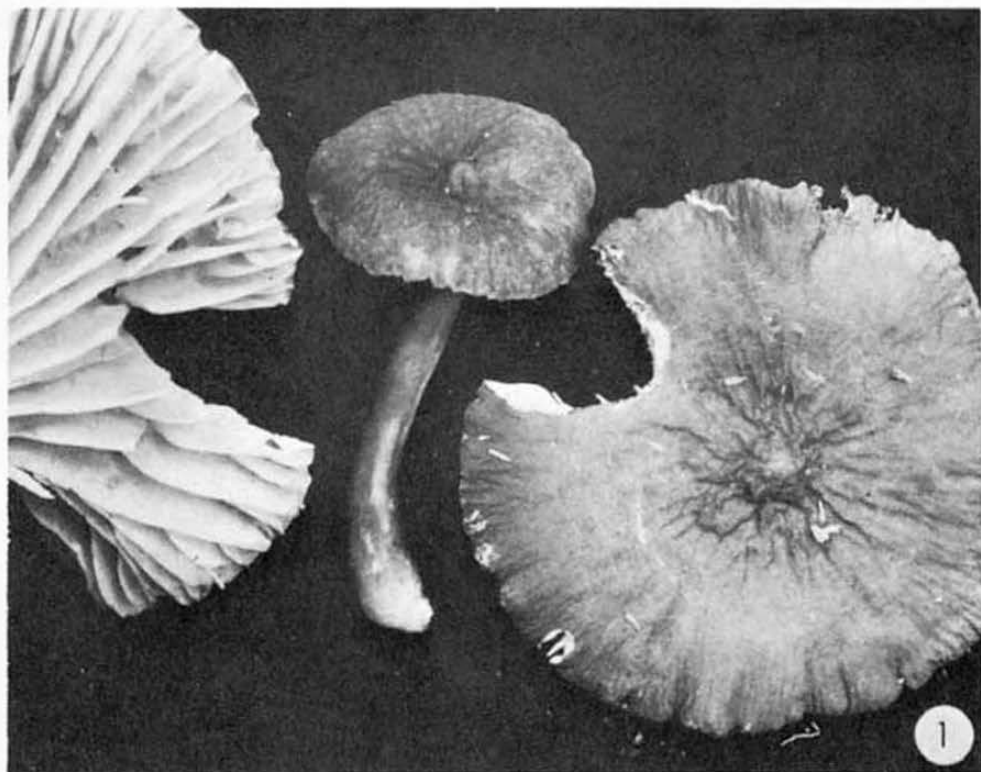
Lamellae adnate to clearly decurrent, cream to yellow ("Cream buff"), subdistant to distant, thick moderately broad 0.15-0.4 cm; lamellulae numerous.

Stipe 1.5-3.1 cm long, 0.3-0.7 cm thick, equal but usually tapered to a pointed base, stuffed becoming hollow, often curved and somewhat twisted, dry, pruinose like pileus under a hand lens, apex yellow ("Cream buff", "Honey yellow") becoming dull olive ("Isabella color") to blackish brown ("Mummy brown") toward base, often with white mycelium at base.

Spore deposit white; spores 6.6-7.7 x 5.1-6.8 $\mu$  with an occasional giant spore 9.7 x 7.2 $\mu$ , broadly ovate to subglobose; ornamentation of cylindrical to conic warts up to 0.5-0.75 $\mu$  high, with numerous fine to coarse ridges and connectives, forming a partial to complete reticulum; suprahilar area with low, uneven diffuse ornamentation, amyloid.

Basidia 41.1-46.3 x 7.7-8.7 $\mu$ , 4-spored, clavate, broadest at or near apex, hyalina to yellowish in KOH with the

Figures 1-2. *Lactarius louisii*. 1. Basidiocarps (*Homola* 6276), x2½. 2. Scanning electron micrograph of spores. (*Homola* 5973), x6516.





content oily-granular. Pleurocystidia: macrocystidia  $42.0-55.1 \times 6.1-11.8\mu$ , narrowly cylindrical clavate, or fusiform, apex rounded or acute, arising in the subhymenium, projecting, hyaline to pale yellow in KOH with content oily-granular, thin walled, scattered but numerous; pseudocystidia  $62.3-73.6 \times 6.1-11.8\mu$ , filamentous, flexuous, arising in the trama, embedded or slightly projecting, pale yellowish in KOH with the content oily-granular, thin walled, rare. Cheilocystidia  $12.0-25.7 \times 5.1-7.2\mu$ , clavate, finger-like to fusoid-ventricose, hyaline, thin-walled, common. Subhymenium prosenchymatous or almost so.

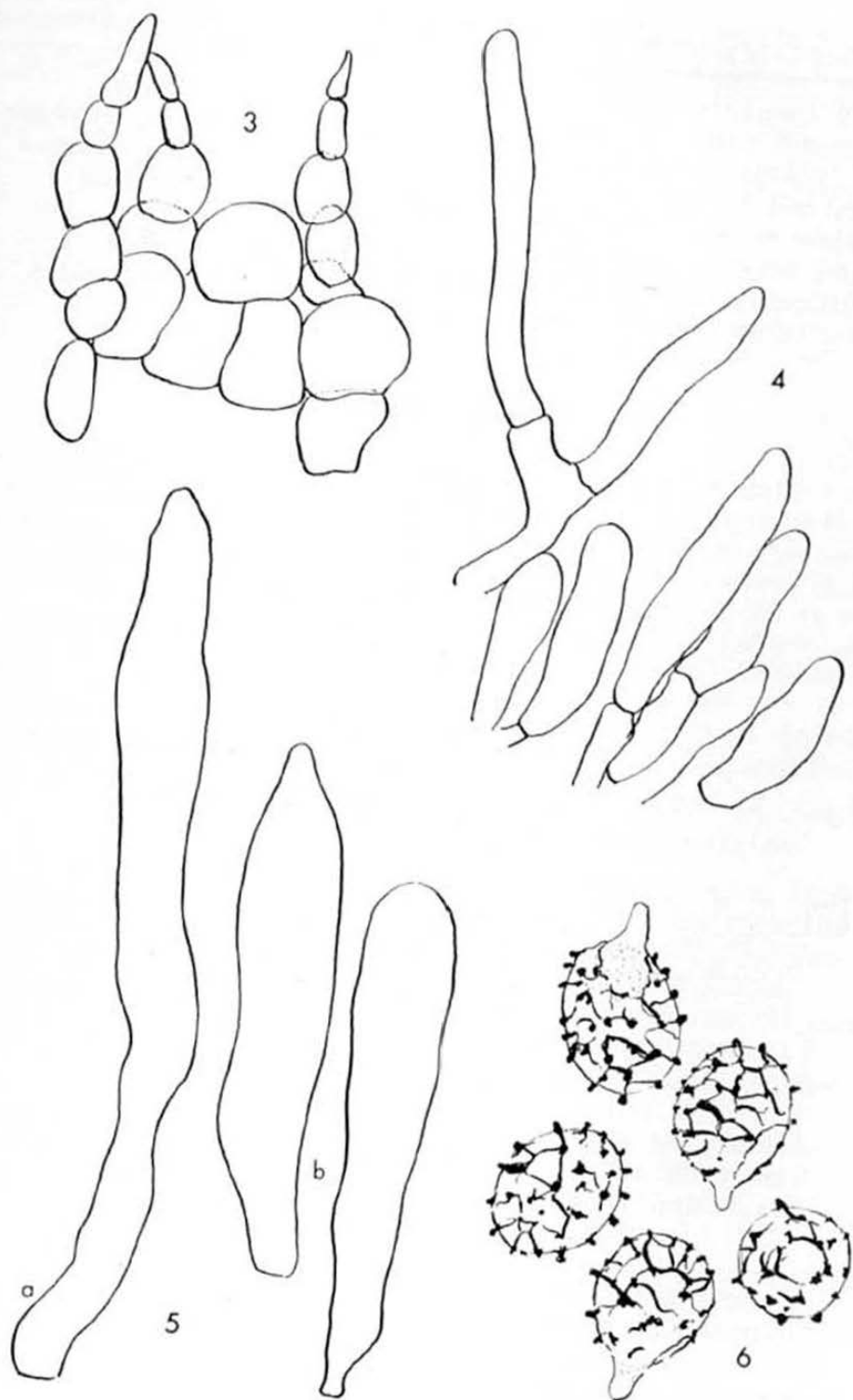
Pileus cuticle  $77.2-85.4\mu$  thick, of 3-5 layers of vesiculose to clavate  $24.7-37.0 \times 16.4-31-9\mu$  cells, often bearing end-cells differentiated as pileocystidia  $16.4-22.4 \times 5.1-5.6\mu$ , cylindrical to clavate to finger-like, occasionally septate, containing brown vacuolar pigment. Lactiferous hyphae  $9.2-14.4\mu$  broad, hyaline to pale yellow in KOH, with oily content, often with pores which appear operculate, rather common. Pileus trama heteromerous. Caulocystidia  $22.1-37.5 \times 3.0-8.5\mu$ , clavate to cylindrical to filamentous, clustered and forming a turf of cells containing a brown vacuolar pigment, of 1-3 layers. basal cells rectangular to broadly clavate which are attached to prostrate hyphae.

Scattered to gregarious on buried wood or among *Sphagnum* in wet areas of a deciduous woods which are predominately oak and maple.

Collections: Pennsylvania: Carbon Co., near Bowmans-town, Aug. 27, 1974, *Homola* 5973 (parts of collection MICH & MAINE) *Homola* 6003 (MAINE), Aug. 30, 1975, *Homola* 6276 (holotype of *Lactarius louisii*, MICH).

Among the species of section *Plinthogali*, *Lactarius louisii* is distinguished by the following set of characters: a small, fragile brown to yellow basidiocarp; scanty watery latex; bitter tasting flesh, thick cream colored, sub-distant decurrent lamellae; a fragile partially yellow

Figures 3-6. *Lactarius louisii*, (*Homola* 6276). 3. Pileus cutis, x460. 4. Hyphal ends from stipe surface, x1140. 5. Hymenial cystidia; a. pseudocystidium; b. macrocystida, x1140. 6. Spores, x1481.



stipe; white spores with moderate high wart-like prominences as part of the ornamentation but under the SEM showing a fairly complete reticulum; and the epithelial type of pileus cuticle. The species differs from *L. xanthodorheus* Sing. (1945) in having a white spore deposit, disagreeable taste, and in not having the latex change to yellow on exposure to air. In section *Plinthogali*, *L. louisii* differs from *L. gerardi* Pk. in having a much smaller basidiocarp, smaller differently ornamented spores, and a watery latex (Smith and Hesler, 1962).

#### ACKNOWLEDGMENT

I wish to thank A. H. Smith for reading the manuscript and checking out the species in the unpublished manuscript of Hesler and Smith on North American Species of *Lactarius*. I also wish to thank Professor David Tatem of the Department of Foreign Languages and Classics, University of Maine, Orono, for his help in writing the Latin description.

#### LITERATURE CITED

- Singer, R. 1945. New and Interesting Species of Basidiomycetes. *Mycologia* 37: 425-439.
- Smith, A. H. and L. R. Hesler. 1962. Studies on *Lactarius*-III. The North American Species of Section *Plinthogali*. *Brittonia* 14: 369-440.

## TRICHODERMA IN COLORADO

F. BRENT REEVES AND CORINNE HORN

*Botany and Plant Pathology Department  
Colorado State University  
Fort Collins, Colorado 80523*

## SUMMARY

Seven of the ten species aggregates of *Trichoderma* are found in Colorado. The most common species are *T. harzianum*, *T. aureoviride*, *T. viride*, and *T. koningii*. There is no obvious correlation of altitude and species distributions in this genus. In addition to the *Trichoderma* species, a list of fungi reportedly isolated from Colorado soils is included. This list, including the *Trichoderma* species, contains 97 taxa.

A compilation of the reports of fungi isolated from Colorado soils indicates that 97 taxa have been reported (1,7,8,9,10,12,14,15). In each of these reports *Trichoderma* is an important and frequently occurring genus. However, most of the identifications in these reports were made prior to Rifai's (11) monograph. Because of the confusion of disposition of species (species aggregates) (4,11) in this genus we began a study of the common *Trichodermas* found in Colorado soils with a special effort directed towards determining if there were any correlation between elevation and distribution of the species aggregates.

In this report we list the fungi isolated from Colorado soils and treat the *Trichoderma* isolates according to Rifai (11). Of the ten common species of this genus reported from the soil (5,11), seven occur in Colorado.

## MATERIALS AND METHODS

Soil samples were collected in June, July, and August of 1974 at the sites given in Table I. The top three cm of soil were removed with a sterile vial; surface debris was not included unless it had been incorporated into the mineral portion of the soil. The samples were transported to the lab at air temperature and immediately processed for isolation studies.

The dilution plate technique was used for isolation. One ml of a 1:50 dilution was pipetted onto the surface of potato dextrose agar (PDA) containing antibiotics (Penicillin G and Streptomycin) in 100 mm Petri plates and incubated at room temperature (23°C). From each soil sample five plates were made. From *Trichoderma*-like colonies subcultures were established on 2% malt agar plates for identification (11).

All nomenclature is given as it first appears in the original literature cited with equivalents in parentheses according to recent treatments cited in Domsch and Gams (4), Kendrick and Carmichael (6), or Sutton (13).

## RESULTS AND DISCUSSION

Two species of *Trichoderma* previously reported from Colorado (see list of soil fungi reportedly isolated from Colorado) are now disposed in several species aggregates, viz. *T. lignorum* in *T. harzianum* and *T. viride*, and *T. glaucum* in *T. aureoviride* and *T. viride*, and the other two species are questionably disposed (11).

The concept of the species of *Trichoderma* has been so confused by different authors that it has been impossible to assign the species previously reported from Colorado to any of those proposed by Rifai (11). Our investigation reveals the following taxa, as defined by Rifai (11): *Trichoderma aureoviride* Rifai aggr., *T. hamatum* (Bon.) Bain., *T. harzianum* Rifai aggr., *T. koningii* Oud., *T. polysporum* (Link ex Pers.) Rifai aggr., *T. pseudokoningii* Rifai aggr., and *T. viride* Pers. ex S. F. Gray.

The sites, elevations and species of *Trichoderma* collected are given in Table I. Figure 1 shows the



TABLE I

Locality, elevation, and *Trichoderma* species present

<u>COLLECTION SITE</u>	<u>ELEVATION (M)</u>	<u>TRICHODERMA SPECIES</u>
16 Sterling Reservoir	1212	harzianum, hamatum
15 Sterling	1250	---
14 Fort Morgan	1280	harzianum, aureoviride
13 Greeley	1402	pseudokoningii, hamatum
4 Horsetooth Res.	1585	harzianum, aureoviride
10 Lyons	1951	harzianum, koningii
5 Colorado Springs	2195	harzianum, koningii, viride
2 Black Canyon	2621	aureoviride, koningii, viride
17 Idaho Springs	2804	harzianum, viride
12 White River Nat'l. Forest	2865	viride, pseudokoningii, koningii
9 Frazier	2896	harzianum, viride, pseudokoningii
7 Cripple Creek	2972	harzianum, aureoviride, viride
6 Gold Camp Road	2987	viride, koningii, pseudokoningii
3 Leadville	3109	harzianum, aureoviride, polysporum, viride
18 Loveland Pass	3109	harzianum
11 White River Nat'l. Forest	3200	viride, aureoviride
8 Berthoud Pass	3444	harzianum, viride
1 Monarch Pass	3448	harzianum, aureoviride

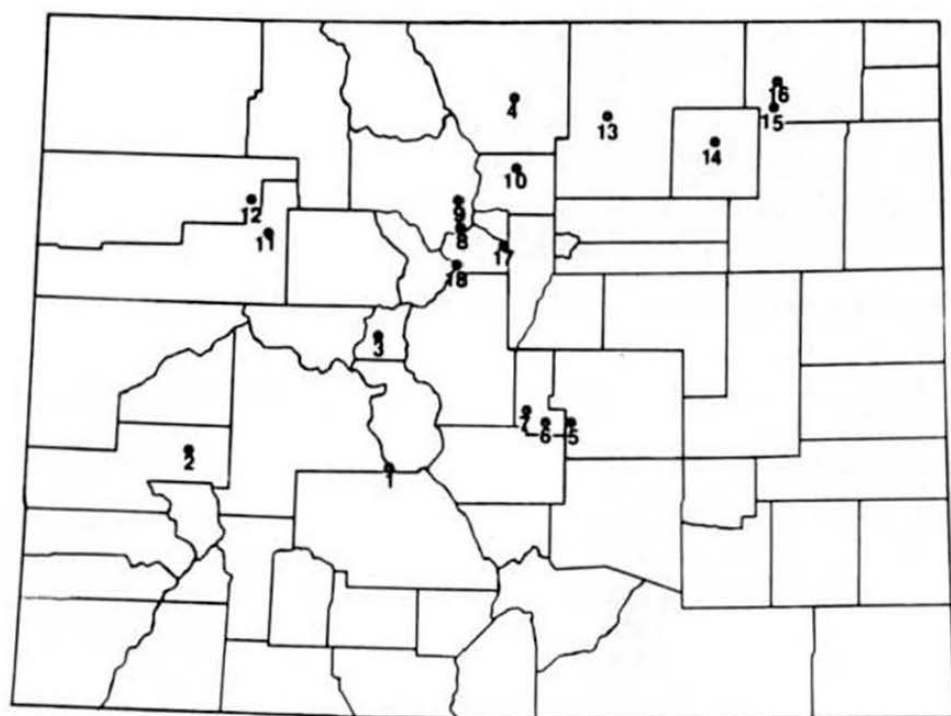


Figure 1. Collection sites in Colorado.

Site	Elev.	harz.	aureov.	koningii	viride	polys.	hamatum	pseudok.
1	3448	+	+	-	-	-	-	-
8	3444	+	-	-	+	-	-	-
11	3200	-	+	-	+	-	-	-
18	3109	+	-	-	-	-	-	-
3	3109	+	+	-	+	+	-	-
6	2987	-	-	+	+	-	-	+
7	2972	+	+	-	+	-	-	-
9	2896	+	-	-	+	-	-	+
12	2865	-	-	+	+	-	-	+
17	2804	+	-	-	+	-	-	-
2	2621	-	+	+	+	-	-	-
5	2195	+	-	+	+	-	-	-
10	1951	+	-	+	-	-	-	-
4	1585	+	+	-	-	-	-	-
13	1402	-	-	-	-	-	+	+
14	1280	+	+	-	-	-	-	-
15	1250	-	-	-	-	-	-	-
16	1212	+	-	-	-	-	+	-

harz. aureov. koningii viride polys. hamatum pseudok.

Figure 2. Elevation vs. *Trichoderma* species present.

location of the collection sites in Colorado; note that both sides of the Continental Divide were sampled. Figure 2 illustrates the *Trichoderma* species isolated at each elevation; note that only Site 15 had no demonstrative *Trichoderma* isolates. When this site was sampled the air temperature was 32°C (90°F) and the soil temperature was very hot. Perhaps the heat killed the *Trichoderma* species at this site.

In a series of papers Dennis and Webster (2,3) have shown that *Trichoderma* species produce both non-volatile and volatile antibiotics against various test fungi; however, antibiotic production is variable within each species group. Based on very limited data we have found that *T. harzianum* and *T. koningii* grow most rapidly and *T. pseudokoningii* and *T. polysporum* grow most slowly. No doubt both variable antibiotic-production and variable growth-rate among the species are very important in the recovery of *Trichoderma* species from the soil plates. However, other factors must also be important because *T. aureoviride*, recovered at most elevations (Table I), is neither among the most rapid growers nor most efficient antibiotic producers. Only further ecological studies can determine the relationships among the soils and these fungi.

We initially expected to find a definite distribution of *Trichoderma* species based on altitude. No such distribution is obvious. In fact we suspect that if enough soil samples are screened one can probably find most of the species of *Trichoderma* at each elevation. At those elevations for which we have the greatest number of samples, viz. 2865-3109 M, Sites 12,9,7,6,3,18, six of the seven species are found. The apparent absence of *T. piluliferum* Webster & Rifai, *T. longibrachiatum* Rifai, and *T. saturni-sporum* Hammill may be explained by their inability to compete in the soil plates or their actual absence. The latter is probably the best explanation since Dennis and Webster (2,3) report that both *T. piluliferum* and *T. longibrachiatum* produce non-volatile antibiotics and Rifai (11) notes that *T. longibrachiatum* grows very rapidly.

Previous studies have reported the following Colorado soil fungi: *Absidia spinosa* Lendner (9); *Acrothecium robustum* Gilman & Abbott (9); *Actinomucor repens* Schost. (= *A. elegans* (Eidam) Benj. & Hesselt.) (7); *Alternaria* spp.

(9,15); *Alternaria tenuis* Nees (= *A. alternata* (Fr.) Keissl.) (1,12); *Arthrinium arundinis* (Corda) Fr. (1,12); *Aspergillus* spp. (1,12); *Aspergillus candidus* group (8); *Aspergillus clavatus* Desm. (9); *A. flavus* Link ex Fr. (8, 9); *A. fumigatus* Fres. (1,9,12); *A. glaucus* Link (= *A. glaucus* group) (9,10); *A. minutus* Abbott (= *A. ustus* (Bainier) Thom & Church) (8,9); *A. niger* V. Tieg. (9,10); *A. ochraceus* Wilhelm (8); *A. quadrilineatus* Thom & Raper (14); *A. terreus* Thom (1,8,9,12); *A. wentii* Wehmer (8,9); *Beauveria bassiana* (Bals.) Vuill. (1,12); *Cephalosporium* spp. (= ? *Acremonium* spp.) (1,7,10,12); *Cephalosporium curtipes* Sacc. (15); *Cladosporium cladosporioides* (Fres.) de Vries (1,12); *Coniothryrium* sp. (1,12); *Cunninghamella verticillata* Paine (8,9); *Dicoccum asperum* (Corda) Lindau (= *Trichocladium asperum* Harx.) (15); *Diplodia* sp. (1,12); *Discosia* sp. (1,12); *Fusarium* spp. (9,10); *Fusarium caudatum* Wollenw. (= *F. equiseti* (Corda) Sacc.) (11); *F. moniliforme* Sheld. (1,7,12); *F. nivale* (Fr.) Ces. (1,12); *F. oxysporum* Schlecht. emend Snyder & Hansen (7,15); *F. roseum* (Lk.) Sacc. (= *Fusarium* sp. aggr.) (1,7,12); *F. solani* (Mart.) Sacc. (1,7,12,15); *F. tricinctum* (Corda) Sacc. (7); *Gliobotrys alboviridis* Hohnel (= *Stachybotrys subsimplex* Cooke) (9); *Helminthosporium* spp. (15); *H. anomalum* Gilman & Abbott (1,12); *H. sativum* Pammel, King & Bakke (= *Drechslera* state of *Cochliobolus sativus* (Ito & Kuribayashi) Drechsler ex Dastur) (7); *Hormiscium* spp. (= *Torula* spp.) (1,12); *Hormodendrum cladosporioides* (Fres.) Sacc. (= *Cladosporium cladosporioides* (Fres.) de Vries) (8,9); *H. pallidum* Oud. (= *Cladosporium*) (10); ?*Idriella lunata* Nelson & Wilhelm (1,12); *Macrosporium* sp. (10); *Mucor circinelloides* van Tieg. (15); *M. glomerula* Lender (8,9); *M. lausannensis* Lender (8,9); *M. racemosus* Fres. (15); *Mortierrella* spp. (7); *Papulospora* spp. (1, 12); *Penicillium* spp. (10); *P. adametzi* Zaleski (1,12); *P. chrysogenum* Thom (8,9,10,15); *P. citrinum* Thom (8,9); *P. commune* Thom (8); *P. decumbens* Thom (15); *P. digitatum* Sacc. (8,9); *P. duclauxi* Delacroix (10); *P. echinatum* Dale (= *P. nigricans* (Bain.) Thom) (9); *P. expansum* Link (8,9, 10); *P. funiculosum* Thom (1,10,12); *P. humicola* Oud. (= species of uncertain position) (8,9); *P. intricatum* Thom (= *P. godlewskii* Zaleski) (10); *P. janthinellum* series (1,12); *P. janthinellum* Biourge (1,12); *P. lilacinum* Thom (1,10,12); *P. piceum* Raper & Fennell (1,12); *P. purpurogenum* Stoll (8,9); *P. restrictum* Gilman & Abbott (1,12); *P. roseum* Link (= *Gliocladium roseum* Bainier) (10); *P. stoloniferum* Thom (8,9); *P. viridicatum* Westling (8,9); *Peyronellaea* sp. (1,12); *Phoma* spp. (9); *Phoma betae* Frank

(7); *Phytophthora* spp. (7); *Pullularia pullulans* (deBary) Berkhout (= *Aureobasidium pullulans* (deBary) Arn.) (1,12); *Pyrenochaeta* sp. (1,12); *P. terrestre* (Hansen) Gorenz, Walker & Larson (7); *Pythium* spp. (7); *Rhizoctonia solani* Kuhn (7); *Rhizopus arrhizus* Fischer (8); *R. elegans* Eidam (= *Actinomucor repens* Schost.) (8,9); *R. nigricans* (= *R. stolonifer* (Fr.) Linder) (8,9,10); *Sepedonium chryso-spermum* (Pers.) Fr. (9); *Sphaeropsis* sp. (1,12); *Spicaria simplicissima* Oud. (= *Penicillium simplicissimum* (Oud.) Thom) (10); *Sporotrichum pruinatum* Gilman & Abbott (= *Chrysosporium pruinatum* (Gil. & Abb.) Carmichael) (8); *Stachybotrys cylindrospora* Jensen (10); *Stemphylium* sp. (1,12); *Syncephalastrum racemosum* (Cohn) Schroet. (1,12); *Trichoderma album* Preuss. (?= *Trichoderma polysporum* (Link ex Pers.) Rifai (1,12); *T. glaucum* Abb. (?= *T. viride* Pers. ex Fr.) (10); *T. lignorum* (Tode) Harz. (= *T. viride* Pers. ex Fr.) (8,9,10); *T. viride* Pers. ex Fr. (1,7,12); *Trichothecium roseum* Link (8); and *Verticillium terrestre* (Link) Lindau (= *Costantinella terrestris* (Link) Hughes) (10).

As indicated in almost all of the reports of soil fungi from Colorado (1,7,8,9,10,12,15) *Trichoderma* is one of the most important genera found. This report confirms previous reports and demonstrates that the genus is well represented with most of the known species occurring in the state.

#### LITERATURE CITED

1. CHRISTENSEN, MARTHA, and ARLA M. SCARBOROUGH. 1969. Soil microfungi investigations, Pawnee site. Technical Report 23. Grasslands Biome. U.S. International Biological Program. Natural Resource Ecology Laboratory. Colorado State University. Fort Collins, Colorado.
2. DENNIS, C., and J. WEBSTER. 1971. Antagonistic properties of species-groups of *Trichoderma*. I. Production of non-volatile antibiotics. *Trans. Brit. Mycol. Soc.* 57: 25-39.
3. DENNIS, C., and J. WEBSTER. 1971. Antagonistic properties of species-groups of *Trichoderma*. II. Production of volatile antibiotics. *Trans. Brit. Mycol. Soc.* 57: 41-48.



4. DOMSCH, K. H., and W. GAMS. 1972. Fungi in Agricultural Soils. Halsted Press Div. John Wiley & Sons, Inc., New York. 290 p.
5. HAMMILL, T. M. 1970. *Paecilomyces clavisporis* sp. nov., and other noteworthy soil fungi from Georgia. Mycologia 62: 107-122.
6. KENDRICK, W. B., and J. W. CARMICHAEL. 1973. Hyphomycetes, pp. 323-509. In G. C. AINSWORTH, F. K. SPARROW, and A. S. SUSSMAN (eds.), The Fungi, An Advanced Treatise. IV A. Academic Press, New York.
7. KREUTZER, W. A. 1972. *Fusarium* spp. as colonists and potential pathogens in root zones of grassland plants. Phytopathology 62: 1066-1070.
8. LECLERG, E. L. 1930. Cultural studies of some soil fungi. Mycologia 22: 186-210.
9. \_\_\_\_\_. 1931. Distribution of certain fungi in Colorado soils. Phytopathology 21: 1073-1081.
10. \_\_\_\_\_, and F. B. SMITH. 1928. Fungi in some Colorado soils. Soil Sci. 25: 433-441.
11. RIFAI, M. 1969. A Revision of the Genus *Trichoderma*. Mycological Papers 116. 56 p. Commonwealth Mycological Institute, Kew, Surrey, England.
12. SCARBOROUGH, ARLA M. 1970. The soil microfungi of a Colorado grassland. M.S. Thesis, University of Wyoming, Laramie. 68 p.
13. SUTTON, B. C. 1973. Coelomycetes, pp. 513-582. In G. C. AINSWORTH, F. K. SPARROW, and A. S. SUSSMAN (eds.), The Fungi, An Advance Treatise, IV A. Academic Press, New York.
14. THOM, C., and K. B. RAPER. 1939. The *Aspergillus nidulans* group. Mycologia 31: 653-669.
15. WAKSMAN, S. A. 1917. Is there any fungus flora in the soil? Soil Sci. 3: 565-589.

SYNOPSIS OF A NEW LICHEN GENUS, *EVERNIASTRUM* Hale  
(Parmeliaceae)

Mason E. Hale, Jr.

Department of Botany, Smithsonian Institution  
Washington, D.C. 20560

## SUMMARY

The presently recognized species of *Parmelia* subgenus *Everniiformes* (Hue) Hale & M. Wirth are transferred to the new genus *Everniastrum* Hale and three additional species are described, *E. africanum* Hale, *E. peruvianum* Hale, and *E. subnepalense* Hale.

*EVERNIASTRUM* Hale, nom. et genus nov.

*Parmelia* section *Everniiformes* Hue, Jour. de Bot. 12:180. 1898.  
*Parmelia* subgenus *Everniiformes* (Hue) Hale & M. Wirth, Phytologia 22:36. 1971.

Lectotype species: *Parmelia cirrhata* E. Fries, Syst. Orb. Veg. 1:283. 1825 (= *Everniastrum cirrhatum* (E. Fries) Hale).

The genus *Everniastrum* includes those species formerly classified in *Parmelia* subgenus *Everniiformis*. It is characterized by long, linear, subcanaliculate to involute lobes with or without long marginal cilia and rhizines (see Figures 1-4). It has a pored epicortex and a generally palisade-like upper cortex (Hale, 1973). The chemistry is not varied, all species having atranorin in the cortex and nearly half salazinic acid in the medulla, often accompanied by protolichesterinic acid, a fatty acid. Alectoronic acid, constictic acid, fumarprotocetraric acid, gyrophoric acid, norstictic acid, and protocetraric acid have also been reported (Hale & Wirth, 1971).

*Everniastrum* occurs primarily in the high mountains of tropical America from Mexico and the West Indies to Chile and southern Brazil and Argentina. Only four of the 21 species in the genus, *E. cirrhatum*, *E. nepalense*, *E. sorochailum*, and *E. vexans*, occur in Asia. No species are known at the present time from Europe or North Africa, and the genus is only sparsely represented in south-central Africa. The center of speciation is the pine-covered highlands of Mexico, where 12 species have been collected, and the Andean region in Peru.

*Everniastrum* bears considerable superficial resemblance to *Pseudevernia* Zopf (Hale, 1968), which also has divaricate, canaliculate lobes but lacks rhizines completely and, more significantly, lacks an epicortex (Hale, 1973). *Evernia*, too, is similar, but this usneoid genus contains usnic acid in the cortex and lacks an epicortex. Some species of *Hypotrachyna* (Vainio) Hale have long linear lobes but these are not canaliculate and dichotomously branched rhizines are always present (Hale, 1975).

The following 21 species are recognized in the genus. Certain complex South American and African populations have not yet been worked out, but relatively few undescribed species remain.

*Everniastrum africanum* Hale, sp. nov.

Thallus (Figure 1) adnatus, corticola, albo-cinereus, 6-8 cm latus, lobis lineari-elongatis, subcanaliculatis, 1.5-2.5 mm latis, margine rhizinatis, rhizinis dichotome ramosis, usque ad 2 mm longis, superne continuus, nitidus, emaculatus, sorediis isidiisque destitutus, subtus niger, nudus vel pro parte rhizinosus, rhizinis dichotome ramosis. Apothecia sparsa, sessilia, 2 mm diametro, sporis octonis, 6 X 9-12  $\mu$ m.

Chemistry: Cortex K+ yellow, medulla K-, C-, KC+ reddish, P+ deep yellow, atranorin, alectoronic acid and echinocarpic acid.

Holotype: Subalpine elfin forest, Lukwangule Plateau, Uluguru Mountain, Morogoro District, Tanzania, elev. 2400 m, T. Pócs and P. & K. Csontos 6082/H, 8 Dec. 1969 (BM; isotype in US).

This species is not closely related to any other in the genus. The lobes are quite flat and broad. The most unusual feature, however, is the chemistry, a previously unreported combination of two acids, alectoronic acid and echinocarpic acid, neither of which was known before in *Everniastrum*.

*Everniastrum americanum* (Meyen & Flot.) Hale, comb. nov.  
 Basionym: *Evernia americana* Meyen & Flot. Nov. Acta  
 Caes. Leop. Carol. Suppl. 1, 19:211. 1843.

The identity of the often misapplied epithet has been established with an isotype at Geneva from Tinguirica River, Chile. It is densely marginally tufted-ciliate, nonisidiate, and more or less bare below (Figure 2), containing proto-lichesterinic acid and restricted to Chile. Nylander (Ann. Sci. Nat. ser. 4, 11:215. 1859) seems to be the first lichenologist to have taken up the name in the wrong sense, as a variety of "*Parmelia camtschadalis*", which is actually *Xanthoparmelia camtschadalis* (Ach.) Hale, an unrelated species. Vainio (Hedw. 38:(123). 1899) considered "*Parmelia americana*" to have isidia, and in general isidiate specimens from tropical America have been rather consistently identified as such. Most of them, however, must be redetermined as *E. vexans* (Zahlbr.) Hale.

*Everniastrum arsenei* (Hale & M. Wirth) Hale, comb. nov.  
 Basionym: *Parmelia arsenei* Hale & M. Wirth, Phytologia  
 22:40. 1971.

*Everniastrum catawbiense* (Degelius) Hale, comb. nov. Basionym: *Parmelia sorocheila* var. *catawbiensis* Degelius, Ark. f. Bot. 30A(3):65. 1941.

*Everniastrum cirrhatum* (E. Fries) Hale, comb. nov. Basionym: *Parmelia cirrhata* E. Fries, Syst. Orb. Veg. 1:283. 1825.

*Everniastrum columbiense* (Zahlbr.) Hale, comb. nov. Basionym: *Parmelia columbiensis* Zahlbr. Cat. Lich. Univ. 6:61. 1929.

*Everniastrum ecuadoriense* (R. Sant.) Hale, comb. nov. Basionym: *Parmelia ecuadoriensis* R. Sant. Bot. Not. 1942: 328. 1942.

*Everniastrum fistulatum* (Taylor) Hale, comb. nov. Basionym: *Parmelia fistulata* Taylor, Lond. Jour. Bot. 6:168. 1847.

- Everniastrum imitatum (Hale & M. Wirth) Hale, comb. nov.  
 Basionym: *Parmelia imitata* Hale & Wirth, Phytologia  
 22:38. 1971.
- Everniastrum limaeforme (Taylor) Hale, comb. nov. Basionym:  
*Parmelia limaeformis* Taylor, Lond. Jour. Bot. 6:170.  
 1847.
- Everniastrum lipidiferum (Hale & M. Wirth) Hale, comb. nov.  
 Basionym: *Parmelia lipidifera* Hale & M. Wirth, Phyto-  
 logia 22:37. 1971.
- Everniastrum moreliense (Bouly de Lesd.) Hale, comb. nov.  
 Basionym: *Parmelia moreliensis* Bouly de Lesd. Lich.  
 Mex. 5. 1914.
- Everniastrum neocirrhatum (Hale & M. Wirth) Hale, comb. nov.  
 Basionym: *Parmelia neocirrhata* Hale & M. Wirth,  
 Phytologia 22:37. 1971.
- Everniastrum nepalense (Taylor) Hale, comb. nov. Basionym:  
*Parmelia nepalensis* Taylor, Lond. Jour. Bot. 6:172.  
 1847.
- Everniastrum nigrociliatum (Bouly de Lesd.) Hale, comb. nov.  
 Basionym: *Parmelia nigrociliata* Bouly de Lesd. Ann.  
 Crypt. Exot. 6:117. 1933.
- Everniastrum pachydermum (Hue) Hale, comb. nov. Basionym:  
*Parmelia pachyderma* Hue, Nouv. Arch. Mus. Paris, ser.  
 4, 1:137. 1899.
- Everniastrum peruvianum Hale, sp. nov.
- Thallus (Figure 3) laxe adnatus, suberectus, ramulicola,  
 cinereo-albus, 8-12 cm latus, lobis lineari-elongatis, di-  
 varicatis, canaliculatis vel involutis, 1.5-2 mm latis, mar-  
 gine sparse vel modice ciliato-rhizinosi, ciliis usque ad  
 3 mm longis, simplicibus vel furcatis, superne nitidus, le-  
 viter albo-maculatus, isidiis sorediisque destitutus, subtus  
 niger vel apicem versus pallide castaneus, nudus. Apothecia  
 numerosa, subterminalia, 5-8 mm diametro, amphithecio rugoso,  
 sporis octonis, 6-8 X 14-18  $\mu$ m.
- Chemistry: Cortex K+ yellow, medulla K+ yellow, C-, KC-,  
 P+ orange, atranorin and constictic acid.



Holotype: Cloud forest remnants, base of Huayna Picchu, Prov. Urubamba, Dept. Cuzco, Peru, elev. 2500 m, H. H. & C. M. Iltis 3020, 3 January 1973 (US; isotypes in UPS, WIS).

Additional specimens examined: Same locality as the holotype, H. H. & C. M. Iltis 3148, 3170 (US, WIS).

This species would probably be identified as *E. cirrhatum* if no chemical test were made. *Everniastrum cirrhatum* contains salazinic acid and in general has a more fragile thallus without conspicuous white maculation. Constrictic acid usually occurs with stictic acid. Outside of this report, it has been found alone only in *Usnea* (Asahina, 1968).

*Everniastrum pseudonepalense* (Hale & M. Wirth) Hale, comb. nov. Basionym: *Parmelia pseudonepalensis* Hale & M. Wirth, *Phytologia* 22:40. 1971.

*Everniastrum sorocheilum* (Vainio) Hale, comb. nov. Basionym: *Parmelia sorocheila* Vainio, *Hedw.* 38:(123). 1899.

*Everniastrum subnepalense* Hale, sp. nov.

Thallus (Figure 4) laxe adnatus, corticola, cinereo-albus, 8-10 cm latus, lobis lineari-elongatis, divaricatis, modice involutis, 1-2 mm latis, margine sparse ciliato-rhizinosus, ciliis ca. 1 mm longis, superne nitidus, valde albo-maculatus, isidiis sorediisque destitutus, subtus niger, apicem versus castaneus, dense rhizinosus, rhizinis sparse dichotome furcatis, ca. 0.5 mm longis. Apothecia desunt.

Chemistry: Cortex K+ yellow, medulla K-, C-, KC-, P+ red, atranorin and fumarprotocetraric acid.

Holotype: 5½ Km below San Pablo on road to Chilete, Dept. Cajamarca, Peru, elev. 2080 m, P. C. Hutchinson and J. K. Wright 5088 (US; isotypes in UC and UPS).

Additional specimens examined: Prov. Cajatamba, Peru, elev. 2700 m, Sandeman 5307 (BM, US).

This species resembles *E. nepalense* superficially in having rhizines below, but the lobes are not as flattened and the thallus is smaller and more fragile. The chemistry is unique, this being the first report of fumarprotocetraric acid in the everniiform group.

*Everniastrum vexans* (Zahlbr.) Hale, comb. nov. Basionym:  
*Parmelia vexans* Zahlbr. Fedde Repert. Sp. Nov. 33:55.  
 1934.

KEY TO THE SPECIES

1. Thallus isidiate.
  2. Medulla K+ red (salazinic acid). . . . . *E. vexans*
  2. Medulla K- (protolichesterninic acid). *E. limaeforme*
1. Thallus lacking isidia.
  3. Thallus sorediate.
    4. Soralia diffuse over the upper surface.  
*E. columbiense*
    4. Soralia in discrete subterminal groups.
      5. Medulla K+ red (salazinic acid).  
*E. sorocheilum*
      5. Medulla K-, C+ rose (gyrophoric acid).  
*E. catawbiense*
  3. Thallus lacking soredia.
    6. Lower surface densely and more or less uniformly short-rhizinate.
      7. Medulla K+ red (salazinic acid group).
        8. Salazinic acid present. . . *E. nepalense*
        8. Salazinic and norstictic acids present.  
*E. pseudonepalense*
      7. Medulla K-.
        9. Medulla P- (no acids present).  
*E. ecuadoriense*
        9. Medulla P+ red.
          10. Protocetraric acid present.  
*E. arsenei*
          10. Fumarprotocetraric acid present.  
*E. subnepalense*
    6. Lower surface bare or with sparse, irregularly scattered long rhizines.
      11. Medulla K+ yellow turning red.
        12. Constictic acid alone present.  
*E. peruvianum*
        12. Salazinic acid present.
          13. Salazinic and norstictic acids present. . . . . *E. neocirrhatum*
          13. Salazinic acid alone present.
            14. Thallus stiff and leathery, collected on soil and rocks in Uruguay and Argentina.  
*E. fistulatum*

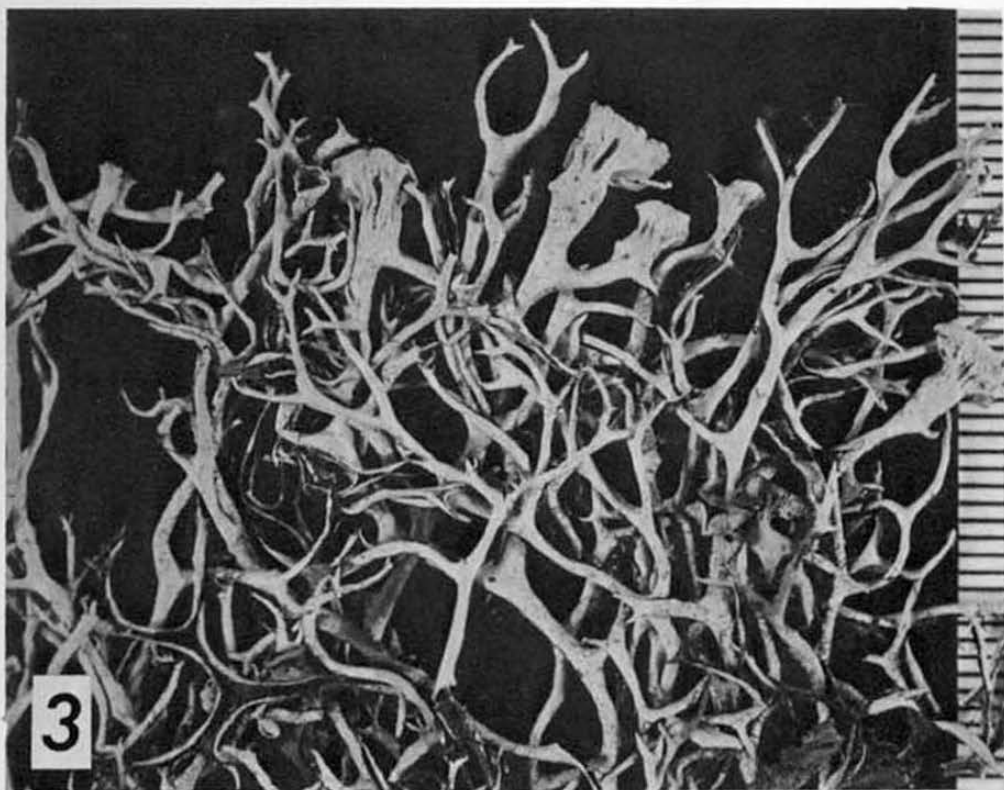
14. Thallus not leathery; collected on trees or over humus in the mountains of tropical America (*E. cirrhatum* also in Asia).
15. Lobes 1-2 mm wide, usually strongly involute; pantropical. . . . . *E. cirrhatum*
15. Lobes 2-5 mm wide, flattened; collected in Mexico. . . . . *E. moreliense*
11. Medulla K-.
16. Medulla C+ rose (gyrophoric acid).
17. Cilia conspicuous, to 5 mm long. *E. nigrociliatum*
17. Cilia sparse, short (1 mm long). *E. imitatum*
16. Medulla C-.
18. Medulla P+ orange or red.
19. Collected in Africa; echinocarpic acid present. . . . . *E. africanum*
19. Collected in Uruguay-Argentina; protocetraric acid present. . . . . *E. pachydermum*
18. Medulla P- (protolichesterinic acid).
20. Cilia dense in tufts along the margin; collected in Chile. . . . . *E. americanum*
20. Cilia scattered, not in tufts; collected in tropical America. . . . . *E. lipidiferum*

## LITERATURE CITED

- Asahina, Y. 1968. Lichenologische Notizen. *Jour. Jap. Bot.* 43:97-101.
- Hale, M. E., Jr. 1968. A Synopsis of the Lichen Genus *Pseudevernia*. *Bryologist*, 71:1-11.
- Hale, M. E., Jr. 1973. Fine Structure of the Cortex in the Lichen Family Parmeliaceae Viewed with the Scanning-electron Microscope. *Smithsonian Contr. Bot.* 10:1-92.
- Hale, M. E., Jr. 1975. A Revision of the Lichen Genus *Hypotrachyna* (Parmeliaceae) in Tropical America. *Smithsonian Contr. Bot.* 25:1-73.
- Hale, M. E., Jr., and M. Wirth. 1971. Notes on *Parmelia* subgenus *Everniiformes* with Descriptions of Six New Species. *Phytologia*, 22:36-40.

LEGENDS FOR FIGURES: Figure 1, *Everniastrum africanum* (holotype in BM); Figure 2, *E. americanum* (Mahu 2968 in US); Figure 3, *E. peruvianum* (holotype in US); Figure 4, *E. subnepalense* (holotype in US). Scale in mm.







## BOOK REVIEWS

by

G. L. HENNEBERT

*Book Review Editor, Huttelaan 36, B-3030 Heverlee, Belgium*

THE AGARICALES IN MODERN TAXONOMY, par Rolf SINGER, 3e édition complètement revue et augmentée, 1975, vi + 912 p., 84 pl. fotogr. (3 coul.), ed. J. Cramer, FL-9490 Vaduz, Liechtenstein. DM 250.-

Devant cet imposant ouvrage, on ne peut s'empêcher de féliciter l'auteur pour la somme d'observations nouvelles qu'il y a réunies. Le livre n'est pas une simple réédition; l'auteur n'a pas modifié fondamentalement sa classification des Agaricales, mais l'a ajustée et enrichie.

Des Agaricales, il retire la sous-famille des Schizophylloideae, avec *Schizophyllum* de même que *Lentinellus* (Leucopaxilleae) pour les placer dans les Aphyllophorales. De même il rejette le genre *Amparoina* (Myceninae) qu'il considère comme Gastéromycète. Par contre il y inclut les Bon-darzewiaceae.

Depuis la 2e édition de l'ouvrage, on trouve dans les Agaricales quelques réarrangements et des ajoutés.

Dans les Hygrophoraceae, *Aeruginospora* et *Bertrandia* sont réduits en synonymie.

Dans les Tricholomataceae, les Clitocybeae s'enrichissent d'*Arthrosporella*, *Lulesia*, *Macrocyttidia*, *Termitomyces* (auparavant dans les Amaniteae) et *Cyphellostereum* tandis que *Pleurocybella* est reclassé dans les Collybieae, comme synonyme de *Nothopanus*, *Riparites* dans les Paxillaceae, *Squamanita* dans les Cystodermateae. Les Collybieae s'enrichissent de *Cheimonophyllum*, *Skepperiella* et *Phaeodepas* et les Resupinateae de *Stromatoscyphella* et *Aphyllotus*, tandis qu'*Asterotus* devient synonyme de *Resupinatus*.

La tribu des Marasmieae s'enrichit de trois genres, *Physo-cystidium*, *Strobilurus* et *Amyloflagellula*, mais est beaucoup amendée. Le genre *Cyphellopsis* passe aux Crepidotaceae. Des Flammulinae, les genres *Pseudohiatula* et *Cryptotrama*, avec *Xerulina* en synonymie, sont retirés pour former la tribu des Pseudohiatuleae. De même les Myceninae, sans *Amparoina*, deviennent la tribu des Myceneae. A ces tribus nouvelles s'ajoute encore la tribu des Rhodoteae, précédemment classée dans les Amanitaceae.

(continued on page 396)



# MYCOTAXON

Vol. III, No. 3, pp. 355-357

April-June 1976

## A NEW SPECIES OF POLYCHIDIUM (LICHENES: PELTIGERACEAE) FROM NEW GUINEA

ANTONIN VEZDA

Czechoslovakian Academy of Science, Brno, CSR.

and

WILLIAM A. WEBER

University of Colorado Museum, Boulder, Colorado 80309.

### SUMMARY

Polychidium stipitatum, characterized by a well-developed excipular stipe subtending the apothecium, is described from Northeastern New Guinea.

POLYCHIDIUM STIPITATUM Vezda and W. A. Weber, sp. nov.

Thallus fruticulosus, crebre dichotome ramosus, corticatus, cellulae corticales flexuose connatae, 12-18 x 6-10 $\mu$ , membranibus crassis, ramis ambitu substrato adpressis, centro + erectis, usque ad 5 mm altis, fuscis; ramis cylindricis, primariis ca. 0.3 mm, incrassatis, ramusculos crebros, ca. 0.1 mm crassos proferentibus. Alga ad Scytonema pertinens. Apothecia 0.5-0.8 mm lata, stipitata; stipites 3-5 mm longi, 0.2-0.3 mm crassi, luteofusci, simplices, rarius dichotome ramosi, ramusculis thallinis parce instructi; discus primum planus, mox tamen convexus, rufofuscus, opacus, nudus; margo integer, tenuis, luteofuscus, mox exclusus; excipulum hyalinum, ad latera hymenii 50-60 $\mu$  crassum, in parte subhymeniali stipitem formans, pseudoparenchymaticum, cellulis usque ad 25 $\mu$  crassis, strato corticali algisque destitutus; subhymenium pseudoparenchymaticum, hyalinum, ca. 40 $\mu$  altum; hymenium ca. 80 $\mu$  altum, hyalinum, IKI+ caerulescens; paraphyses simplices, rectae, septatae, 2-3 $\mu$  crassae; asci numerosi, cylindrico-clavati, 8-spori; spores late ellipsoideae, hyalinae, simplices, 8-12 x 5-7 $\mu$ , membranibus tenuibus. Species nova apotheciis stipitatis ab alia bene distincta.

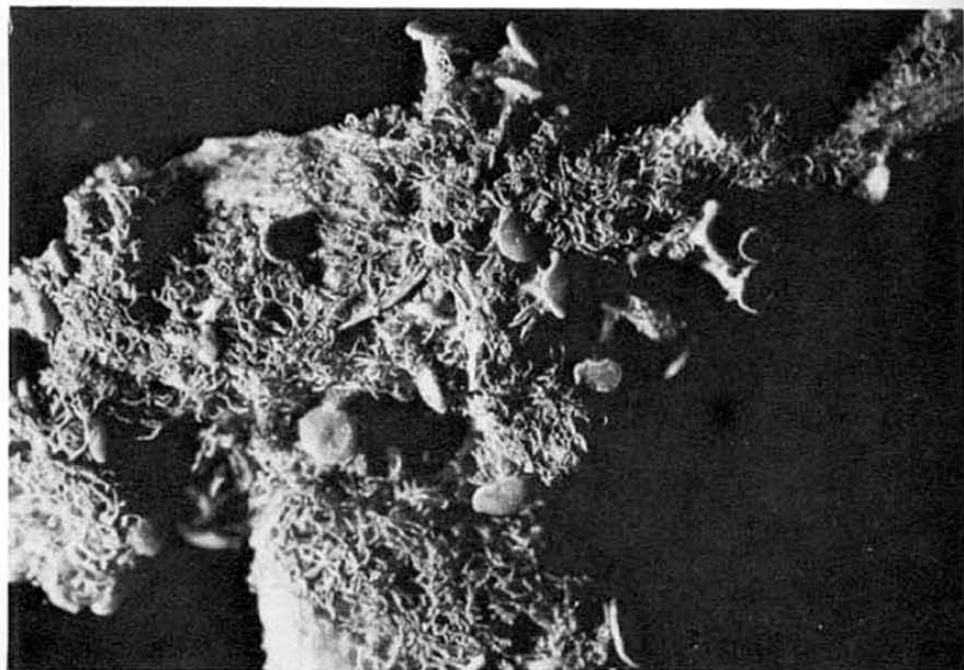


Fig. 1. Polychidium stipitatum, holotype (E. Licht photo)

Thallus fruticulose, richly dichotomously branched, forming polsters 10-20 mm diam and 5 mm high, prostrate-spreading along the edges and erect or ascending toward the center, fuscous, matte or somewhat glossy; branches cylindrical, the principal axes ca. 0.3 mm thick, the lateral branchlets narrow, ca. 0.1 mm thick, intricately dichotomous; neither trichomes nor rhizines present. Thallus corticate, the cortex unistratose, its cells in surface view 12-18 x 6-10 $\mu$  diam, interlocking and strongly incrassate. Phycobiont Scytonema sp., the cells 6-8 $\mu$  diam, the filaments running parallel to the thallus axis, appearing in cross-section as a subcortical ring, in longitudinal section showing two layers. Apothecia 0.5-0.8 mm diam, stipitate; stipe 3-5 mm long, 0.2-0.3 mm wide, yellowish-brown, simply or rarely dichotomously forked, sparingly studded with thalline branchlets; disk at first plane, soon convex, reddish-brown, matte, not pruinose; margin entire, thin, yellowish-brown, soon excluded; exciple hyaline, 50-60 $\mu$  wide alongside the hymenium, decurrent to the stipe, pseudoparenchymatous, the cells up to 25 $\mu$  diam, their walls 2-4 $\mu$  thick; subhymenium pseudoparenchymatous, hyaline, ca. 40 $\mu$  high; hymenium ca. 80 $\mu$  high, hyaline, IKI+ blue; paraphyses simple, straight,

septate, 2-3 $\mu$  wide; asci abundant, cylindrical-clavate, 8-spored; spores broad-ellipsoidal, hyaline, simple, thin-walled, 8-12 x 5-7 $\mu$ .

TYPE COLLECTION. Northeastern New Guinea. Morobe District, vicinity of Samanzing, 1800-2100 m, 19 December 1938, M. S. Clemens s.n. (Holotype COLO L-62430; Isotype in herb. A. Vezda). On very slender twigs and small evergreen leaves of a shrub. Fig. 1.

Diagnostic for P. stipitatum is the elongate stipe bearing the apothecium. This feature has not been observed in any other species of the genus. The stipe is formed by the decurrent basal part of the excipulum. It shows no cortical development and lacks algal cells.

CULTURAL CHARACTERISTICS OF AURISCALPIUM AND GLOIODON.<sup>1</sup>

Ronald H. Petersen

Botany Department, University of Tennessee, Knoxville  
Tennessee 37916 USA

## Summary

Cultural characteristics of *Auriscalpium vulgare* and *Gloiodon strigosum* are described and key codes furnished.

Of late, renewed interest has been shown in the taxonomy of certain genera of Aphyllophorales included generally in the families Auriscalpiaceae Maas Geesteranus (1963), Hericiaceae Donk (1964), and Clavicornaceae Corner (1970). All three families may be characterized as typically forming gloeoplerous hyphal systems and ornamented, amyloid spores. Within the Auriscalpiaceae, Donk (1964) included *Auriscalpium* (hydroid) *Gloiodon* (hydroid) and *Lentinellus* (agaricoid), but cultures of only *L. cochleatus* (Fr.) Karsten have been described, and these only cursorily (Miller, 1971; Miller & Stewart, 1971). Cultures of *Hericium erinaceum* (Bull. ex Fries) S. F. Gray have been described (Davidson, et al., 1942; as *Hydnum erinaceum*), and various isolates of *Hericium* sp. were described and manipulated by Pinnix (1974), with confusing results. Dodd (1972) reported on cultural characters of *Clavicornia pyridata* (Pers. per Fries) Doty.

The production of clavarioid fruit bodies in culture by *Lentinellus cochleatus* (Miller, 1971; Miller & Stewart, 1971) and *Gloiodon strigosum* (see below); the recent description of *Clavicornia dryophila* (Maas Geesteranus, 1973), by the author of which (Maas Geesteranus, personal communication) it is now considered a *Lentinellus*; the characteristic pyxidate branching pattern of *Clavicornia* fruit bodies; and the micromorphological similarity across all three families, have led to suggestions that the families be combined in various ways (Burdshall, personal communication; Maas Geesteranus, personal communication). It seems to me that before such action is

<sup>1</sup>Contribution no. 460 from the Botanical Laboratories University of Tennessee.

taken, as many data as possible should be in hand, and hence the cultural characteristics of two additional species are herein described.

Cultures were isolated from living fruit bodies, and grown according to the regimen of Nobles (1965), and utilizing her key code. Observations were made with a Wild M20 research phase/bright field microscope.

*Auriscalpium vulgare* S. F. Gray

Key code: (1). 3. 15. 32. 36. 38. 45. (48). 51. 56.

Colony white to pale cream color, covering agar surface in 6 weeks, repent, not visibly forming aerial hyphae, usually with two indistinct zones at approximately 6 mm and 15 mm from inoculum block, each zone 3-4 mm wide, appearing somewhat lighter in color due to more closely packed hyphae and crystalline deposits in medium; gum guaiac test for extracellular oxidases very weak and slow or negative.

Hyphae of advancing edge: submerged hyphae 0.8-1.5  $\mu$  diam, thin-walled, hyaline, clamped, long-celled, branched at nearly 90°; surface hyphae 1.8-3.0  $\mu$  diam, straight to occasionally subhellicoid, thin-walled, invariably and conspicuously clamped, branched acutely, usually with a clamp at the branch base; dead, "empty" hyphae common, short-celled (? with *cloisons de retrait?*), occasionally clamped. Gloeocystidia rare, as below.

Hyphae of mature colony: vegetative hyphae 1.5-3.2  $\mu$  diam, thin-walled, densely packed, short-celled, clamped, often gnarled or subhellicoid, frequently branched at about 45°, with clamp at branch base; contents subgranular to packed with amorphous refringent (under phase contrast) granules; walls often locally encrusted with tiny granules. Gloeocystidia common, 50-85 X 6.5-8.5  $\mu$ , clavate to elongate-clavate, often once or twice lobed, with rounded apices, thin-walled, yellow-refringent under phase contrast, arising from a clamp connection, erect at first but soon falling under its own weight and then lying on agar surface; contents foamy, coccinoidal, pale yellow. Crystalline deposits abundant in medium, as small plate-like or astral crystals randomly scattered.

Culture examined: *Auriscalpium vulgare*. New Minas, Nova Scotia, Canada, 10.1 X .73, on cones of *Pinus banksiana*, on golf course, coll. RHP, Det. RHP and K. A. Harrison, TENN no. 38206.

Observations: Gloeocystidial structures, while not unique to cultures of this taxon, are conspicuous on the colony surface, and in the absence of fruiting (see below) help to distinguish the cultures.

Fruiting was initiated on some original isolates from fruit body teeth within several weeks (on malt agar slants). When vegetative mycelium was used as inoculum, no further fruiting occurred in a subsequent year of subculturing. Conversely, when portions of fruit bodies (teeth, stipe sections, etc.) were used as inoculum, fruiting on the subculture was initiated in about 60 days, and mature fruit bodies developed in an additional 60 days, all on or very near the inoculum (within 3 mm).

In a serendipitous series of events, it was found that a random light source (cultures rotated at random at least once per day before a lateral light source) permitted fruiting, but did not permit pileus formation. When semi-mature fruiting cultures were held in a constant position relative to the same light source, pileus formation followed stipe development normally, with subsequent production of hymenium-covered teeth.

During a malfunction of the illuminated incubator in which fruiting cultures were grown, the temperature reached 54 C, killing all fruiting cultures. Consequently, only vegetative cultures are now maintained in our laboratory.

*Gloiodon strigosum* (Swartz ex Fries) Karsten

Key code: 1. 3. 15. 26. 33. 36. 38. 44. (48). 52.

Colony after six weeks covering agar surface, flat and very minutely granular from inoculum to approximately 4-8 mm, then abruptly farinaceous and very slightly raised; mealy appearance gradually diminishing over 2-3 cm; advancing margin (up to 1.5 cm) appearing filamentous, diffuse, mostly submerged, very delicately silky; zones very subtle, at approximately 6-8 mm, 1.5 and 2.5 cm; color of farinaceous inner zone off-white, of farinaceous outer areas pallid sand color (appreciably darker when grown in light); fruit bodies rudimentary, produced only occasionally, simple, up to 4 mm high, approximately 1.5 mm thick, cylindrical, fleshy tan to cinnamon tan in color (somewhat darker when grown in light). Odor mildly aromatic, anti-septic.

"Lead" hyphae of advancing margin up to 7  $\mu$  diam, somewhat thick-walled (wall up to 1  $\mu$  thick), hyaline, conspicuously clamped, producing narrow hyphae from or in juxtaposition to clamps; narrow submerged hyphae 1.5-2.5  $\mu$  diam, gnarled, tortuous, clamped, copiously branched; narrow surface hyphae appressed, producing differentiated structures, clamped.



Differentiated structures as follows: 1) Basidia 18-22 X 5.5-6.5  $\mu$ , clavate, clamped, hyaline, thin-walled (2)-4-sterigmate, the sterigmata very short, acute; contents homogeneous. 2) Gloeoplerous structures of two types: a) chrysocystidial elements up to 110 X 9  $\mu$ , clamped, elongate-lanceolate to narrowly cylindrical, often with one or more short protuberances produced near origin, refringent under phase contrast; contents opalescent-guttulate, strongly cyanophilous, and b) subspherical to spherical-lobose, up to 25  $\mu$  diam, often with small abrupt lobes or narrow protuberances distally, resembling aborted sterigmata; contents as in cystidia. 3) Asexual sporophores short, up to 30  $\mu$  long, 1.5-2.0  $\mu$  diam, straight, often arising from a mass of gloecystidial elements, produced singly toward the advancing margin, in greater numbers in older portion of mat to form spore "heads."

Asexual spore masses up to 0.5 mm diam, white to pallid sand color, scattered randomly over younger portions of mat, becoming so densely crowded as to appear farinaceous in older areas. Spores 8.5-10.4 X 8.1-9.3  $\mu$ , blown out hyphal tips, without constriction at point of formation, produced singly, subspherical with thick nipple-like protuberance distally, smooth, thin-walled, becoming separated from the sporophore by a septum only late in development (spores released by rupture of basal septum, occasionally with a portion of the subtending sporophore cell attached as a pedicel); contents hyaline to refringent (usually) under phase contrast, strongly cyanophilous.

Fruit bodies produced randomly over colony surface; when mature clavarioid, branched irregularly, up to 1.5 cm high, with minute papillate teeth on lower surface of upper branches, brown where sterile, grey-brown where fertile.

Culture examined: *Gloiodon strigosum*. Lowell, Oregon, 19 X .73, coll. J. L. Dodd, det. M. A. Donk, TENN no. 34822.

Observations: Light apparently plays an important function in fruit body formation in culture. Cultures kept in darkness (except for short inspection periods every few days) for six weeks produced very rare and stunted fruit bodies. Within one week after removal from darkness to normal room lighting, the size of the fruit bodies nearly doubled, branches appeared, teeth were produced on the ventral surface of the upper stipe and lower branches, and significant numbers of fruit body primordia were produced elsewhere on the colony surface. Conversely, in cultures grown in normal room light throughout their history, fruit body initials appeared within 3-4 weeks, and fruit body maturity was reached within six weeks (maturity being measured by ability to produce basidiospores).

## LITERATURE CITED

- Corner, E. J. H. 1970. Supplement to "A monograph of *Clavaria* and allied genera." Beih. Nova Hedwigia 33: 299 pp.
- Davidson, R. W., W. A. Campbell, and D. B. Vaughn. 1942. Fungi causing decay of living oaks in the eastern United States and their cultural identification. USDA Tech. Bull. 785: 65 pp.
- Dodd, J. L. 1972. The genus *Clavicornia*. Mycologia 64: 737-773.
- Donk, M. A. 1964. A conspectus of the families of Aphyllophorales. Persoonia 3: 199-324.
- Maas Geesteranus, R. A. 1963. Hyphal structures in hydnums. II. Koninkl. Nederl. Akad. Wetensch. C 66: 426-457.
- \_\_\_\_\_. 1973. A new *Clavicornia*. Persoonia 8: 213-226.
- Miller, O. K. 1971. The relationship of cultural characters to the taxonomy of the agarics, in Petersen, R. H. Ed. Evolution in the higher Basidiomycetes. University Tennessee Press, pp. 197-215.
- \_\_\_\_\_, and L. Stewart. 1971. The genus *Lentinellus*. Mycologia 63: 333-369.
- Nobles, M. K. 1965. Identification of cultures of wood-inhabiting Hymenomycetes. Canad. J. Bot. 43: 1097-1139.
- Pinnix, J. C. 1974. Cultural characteristics of the genus *Hericium* Pers. ex S. F. Gray. M.S. Thesis, ined, University Tennessee. 138 pp.

A NEW SPECIES OF *OMPHALOTUS*

HOWARD E. BIGELOW

Department of Botany, University of Massachusetts  
Amherst, Massachusetts 01002

ORSON K. MILLER, JR.

Virginia Polytechnic Institute and State University,  
Blacksburg, Virginia 24061

HARRY D. THIERS

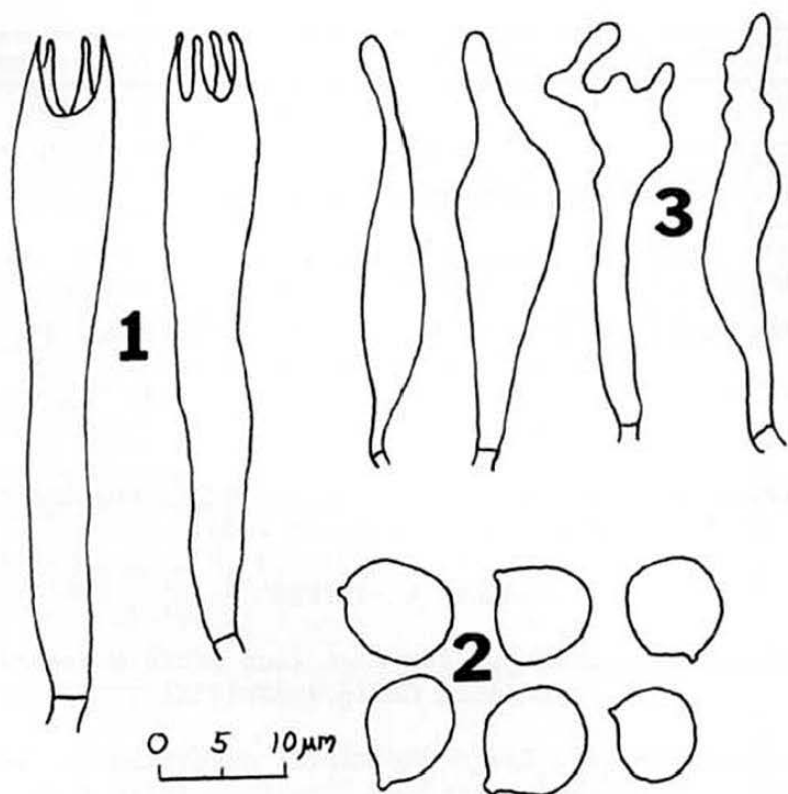
Department of Biology, San Francisco State University,  
San Francisco, California 94132

For many years a large *Omphalotus* occurring on the west coast of North America has been identified variously as *Omphalotus olearius* (Fries) Singer, *Clitocybe illudens* (Schw.) Sacc. or *Monadelphus subilludens* Murr. However, a study of California collections reveals that this western agaric is quite distinct by a number of features from any of the aforementioned taxa and actually represents an undescribed species. The distribution of *Omphalotus olivascens* is not known with certainty, but it is fairly abundant in north-central California.

The colors cited in the following description are from Ridgway (1912).

*Omphalotus olivascens* Bigelow, Miller & Thiers, sp. nov.  
Figs. 1-8.

Pileus 4.5-24 cm latus, convexus tum planus, tandem depressus, margine saepe irregularis, aliquando substriatus, udus, glaber vel radiato-fibrillosus, levis vel rugosus, disco interdum squamosus vel maculatus, obscuro-aurantiacus, vel luteus vel brunneo-croceus tum olivascens; contextus tenuis vel subcrassus, aquosus, lentus, subtenax, olivaceus deinde olivaceo-aurantiacus. Odor et sapor mitis. Lamellae



FIGS. 1-3. *Omphalotus olivascens*. 1. Basidia. 2. Basidiospores. 3. Cheilocystidia.

decurrentes, angustae vel latae, confertae vel distantae, olivaceae demum gilvae, luminescentiae. Stipes 4-22 cm longus, apice 0.7-8 cm crassus, attenuatus deorsum, aliquando compressus, solidus, glaber vel subfibrillosus, olivaceus vel obscuro-sulphureus, tandem ferruginascens. Sporae (6.5-) 7-8 (-8.5) x (5-) 6-6.5 (-7.5)  $\mu\text{m}$ , globosae ad subglobosae vel subellipticae, inamyloideae, in cumulo cremeae. Basidiocarpi caespitosi, ad lignum arborum frondosarum.

Holotypus: prope Boulder Creek, San Mateo County, California, 9 Dec. 1971, H.E. Bigelow 17015 (MASS).

Pileus 4.5-24 cm broad, convex with an inrolled and incurved margin at first, becoming broadly convex to plane, broadly depressed in larger pilei, margin irregular in age to broadly undulate, lobed or incised, arched or recurved

4



5



FIGS. 4-5. *Omphalotus olivascens*. (1/3 nat. size). Photographs by H. D. Thiers.

at times, sometimes short striate, surface moist, glabrous or sometimes radiate with innate fibrils, smooth or rugose, occasionally diffracted scaly on disc or with watery spots, dull orange (nearest "orange") or brownish-orange, disc tinged olive at times ("olive lake," "dull citrine") and generally olivaceous in age; context thin to rather thick (up to 2 cm thick on disc in largest caps), watery, pliant, rather tough, olivaceous when young, dull orange then olivaceous when expanded. Cap surface is dark vinaceous on contact with 3% KOH and gray with  $\text{FeSO}_4$ . Odor not distinctive. Taste mild.

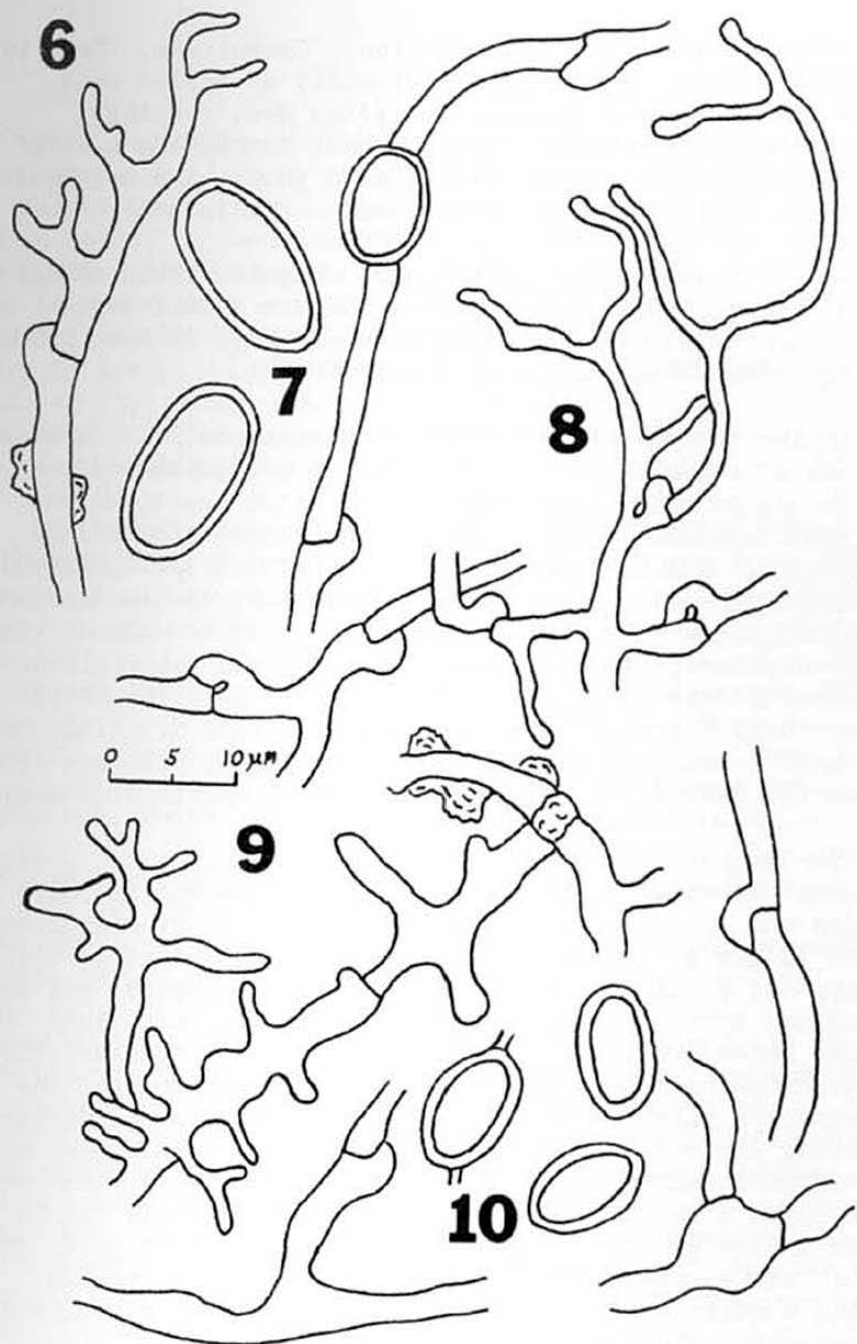
Lamellae long decurrent and also often with decurrent ridges, narrow near pileus margin to broad near stipe (up to 15 mm), close at pileus margin to distant on stipe, intervenose and forked at times, olive mottled with honey yellow when young, becoming somewhat more yellow-orange than pileus (near a dull "capucine yellow") but olivaceous tint usually present. Luminescent.

Stipe 4-22 cm long, apex 0.7-8 cm thick, tapering downward to a point (up to 2 cm in largest specimens), sometimes fused at base, compressed at times, solid (concolorous with surface within), surface uneven, glabrous or somewhat longitudinally fibrillose, olive to olive-yellow or dull sulphur-yellow, rusty brownish stained in age.

Spores (6.5-) 7-8 (-8.5) x (5-) 6-6.5 (-7.5)  $\mu\text{m}$ , globose or subglobose or broadly elliptic, smooth, not amyloid, deposit cream colored ("cream color," "cream buff"). Basidia 36-50 x (5.5-) 7-8 (-10)  $\mu\text{m}$ , 4-spored, some basidia and basidioles with yellow refractive globules, hymenium yellowish in mass in KOH, pseudocystidia occasionally present and numerous on some lamellae, 25-46 x 5-8  $\mu\text{m}$ , lageniform, ventricose-rostrate to irregular in shape (Fig. 3), thin-walled, hyaline and usually shorter than the basidia:

Pileus cutis of cylindric hyphae 1.5-8  $\mu\text{m}$  in diam, thin or thickened walls, some with incrustations, in 3% KOH the incrustations, walls and oleiferous hyphae are yellow (sub-surface layer with greatest concentration of pigment); context yellowish or nearly hyaline, hyphae cylindric or slightly inflated, (3-) 5-12 (-17)  $\mu\text{m}$  diam, walls thin or thickened, rarely finely encrusted; yellow oleiferous hyphae present. Hymenophoral trama of undulate-subparallel hyphae, hyphae cylindric, 2.5-7.5  $\mu\text{m}$  diam, hyaline except for yellow oleiferous hyphae (tissue paler than hymenium). Clamp connections present.





FIGS. 6-10. Cultural characters of *Omphalotus*. 6-8. *Omphalotus olivascens*. 6. Stag-horn branches of aerial hyphae. 7. Broadly elliptical chlamydospores. 8. Intricately branched submerged hyphae. 9-10. *Omphalotus olearius*. 9. Stag-horn branches of aerial hyphae. 10. Broadly elliptical chlamydospores.

Habit, habitat and distribution. Caespitose. Usually on stump or base of stump, occasionally on buried wood (recorded on wood of *Quercus agrifolia* Nee. (encina), *Arctostaphylos* sp. (manzanita), *Cercis canadensis* L. (red bud) and live *Lithocarpus densiflorus* (Hook. & Arn.) Rehd. (tan bark oak). October to February. California.

Material examined. California: Bigelow 17015 (TYPE) (MASS) (SFS), 17017 (VPI) (MASS); R.T.Orr 3038 (VPI); Smith 25 Nov 1970 (MICH); Thiers (no number) 25 Nov. 1970, San Francisco Watershed, California (MICH).

In the field, *O. olivascens* is distinguished from other species of *Omphalotus*<sup>1</sup> by the duller orange to yellow-orange colors which have distinctive olive overtones or stains. Numerous observations on the eastern *Omphalotus* (*Clitocybe*) *illudens* and southern *Omphalotus* (*Monadelphus*) *subilludens*, and reports in the literature on the European *O. olearius* do not mention any olive colors or stains. The color difference is maintained in herbarium material, *O. olivascens* dries much darker than any collections of the other three "species". Usually specimens of *O. olivascens* are more robust and tougher than the others, although sometimes the eastern *C. illudens* may have dimensions as large.

The microscopic characters of *O. olivascens* are similar in many respects to the other species of *Omphalotus*, although the presence of encrusted pigments in *O. olivascens* seems unique at present. Spore measurements usually are larger for *O. olivascens* when taken from deposits, but some specimens have some smaller spores (5-7  $\mu$ m) which lead to ranges which overlap with those of the other species. This is a confusing aspect which requires further study. The cream spore print of *O. olivascens* is not a useful distinguishing character as cream spore prints are known for both *O. illudens* and *O. olearius*, although some collections have pure white deposits. Cystidia and pseudocystidia can be found in all species if the specimens are fairly young and a sufficient number of lamellae are studied. Likewise, yellow oleiferous hyphae and yellow refractive globules in some basidia seem to be present in all taxa.

<sup>1</sup> The relationship between *O. olearius* (DC. ex Fr.) Sing., *Clitocybe illudens* (Schw.) Sacc. and *M. subilludens* Murr. is currently under study by one of us (OKM) using cultures of monosporic isolates.

## CULTURAL STUDIES

Cultures of *O. olivascens* were obtained from multispore and tissue isolates from fruiting bodies collected in California by Dr. Robert T. Orr and by one of the authors (HDT). In addition, cultures of the common *Omphalotus* encountered in eastern North America are described to afford a comparison between these two taxa. This taxon has traditionally been called *Clitocybe illudens* (Schw.) Sacc. and its counterpart in Europe is now referred to as *Omphalotus olearius* (DC. ex Fr.) Sing. (Miller and Farr, 1975). This complex is under study using monokaryotic isolates from Europe and eastern North America.

The cultures were grown on malt-extract agar medium at 20°C and 25°C, according to Nobles (1948). A tannic acid medium (Davidson, et. al., 1938) was used in tests for the presence of polyphenol oxidases, as was gum guaiac solution (Nobles, 1958) on cultures of varying ages. Colors in parentheses are from Ridgway (1912) and those designated by page and block (eg. 4A5) are from Konerup and Wanscher (1967). Cultures are maintained in the Virginia Tech Culture collection (VT) and at the Center for Forest Mycology Research, Forest Products Lab., Madison, Wisconsin.

*Omphalotus olivascens*

Figs. 6-8.

Cultures examined: VT452 (Robert T. Orr 3038, California); VT455 (Harry D. Thiers 35413, California).

Growth characters.--Growth medium, about 5.8-8.6 cm in diam in 14 days at 20°C. Advancing zone of mostly appressed hyphae, after 14 days with a silky appearance just at the margin, white to buff "light ochraceous buff," but the margin somewhat uneven with scalloped appearance. Older part of mat felty forming tufts and becoming somewhat raised near the inoculum plug, buff, "light ochraceous buff" to "ochraceous-buff," (4A5, 4A6) or "clay color" over the tufted area. In some plates a narrow, white zone, 1-2 mm, exists just around the inoculum plug. In age the older mat darkens to brown, "snuff brown" to "sayal brown". In one isolate (VT452) plate evenly brown pigmented, "snuff brown" to "sayal brown" after 20 days; other isolate, (VT455) brown color in a zone around the inoculum plug and in patches or sectors over plate with rest of mat remaining buff. Reverse side of plate bright yellow, "apricot yellow," directly beneath inoculum plug fading somewhat

toward margin to "buff-yellow". After plate is covered, the yellow pigment on the reverse side also fades. Odor distinctly stale after 14 days. On tannic acid agar a strong diffusion zone develops with hyphae growing from inoculum plug onto agar. Gum guaiac turns deep blue in 4 to 10 minutes, reaction more rapid on older cultures. No luminescence observed of cultures up to three months of age.

Hyphal characters.--Advancing zone: hyphae hyaline in Melzer's solution and 3% KOH, 1-3  $\mu\text{m}$  diam, frequently branched, with clamp connections. Older mat with intricately branched, submerged hyphae 0.5-2.5  $\mu\text{m}$  in diam, hyaline to light yellow (Fig. 8). Aerial hyphae range up to 4  $\mu\text{m}$  diam, dense yellow-brown, stag-horn branches develop after 14 days (Fig. 6) with dingy yellow-brown contents in Melzer's solution. Intercalary, broadly elliptical chlamydospores develop in 14 to 21 days (Fig. 7) attaining a size of 9-17.5 x 6-8  $\mu\text{m}$  with slightly thickened walls ( $\pm$  0.5  $\mu\text{m}$  diam), usually becoming detached from connecting hyphal cells and floating free. Oidia not found. Stag-horn branches and other hyphae with deep yellow contents in Melzer's solution developing scattered, amyloid cell walls and amyloid incrustations on the cell walls after 30 days.

*Omphalotus olearius*

Figs. 9-10.

Cultures examined: VT331 (O.K.Miller 6086, Washington, D.C.); VT447 (H.E.Bigelow 17145, Massachusetts).

Growth characters.--Growth moderately rapid, 8-12 cm in diam in 14 days at 25°C. Advancing zone uneven, appressed hyphae give rise to scattered raised hyphae. Older part soon appears corded and plumose, white over the entire mat except for a buff area around the inoculum plug. On close inspection the color results from yellow exudation droplets on the surface of the mat and is not a pigment in the cells. Reverse side of plate white or faintly cream color in areas around the inoculum plug beneath yellow droplets. Odor pleasant, fruity, almost like that of apple skins. On tannic acid agar a moderately strong to strong diffusion zone develops with the hyphae growing slowly from inoculum plug onto the agar. Gum guaiac tinted light grayish blue after 90 minutes or more.

Hyphal characters.--Advancing zone: hyphae hyaline in Melzer's solution and 3% KOH, 1.5-3  $\mu\text{m}$  diam, frequently

branched, with clamp connections. Aerial hyphae up to 3.5  $\mu\text{m}$  diam with multiple-branched, deep yellow, stag-horn branches (Fig. 9) with deep yellow contents in Melzer's solution. Intercalary broadly elliptical chlamydospores develop between 14 and 21 days attaining a size of 9-10.5 x 5-5.5  $\mu\text{m}$ , with slightly thickened walls ( $\pm$  0.5  $\mu\text{m}$  diam), and deep ochraceous in Melzer's solution (Fig. 10), usually detached and floating free. Oidia oblong, 7.6-11.5 x 2-3  $\mu\text{m}$ , appearing after 10 to 30 days, thin-walled, usually hyaline to pale yellow. Small, amorphous bodies develop in 21 days as intercalary swellings. After 50 days, stag-horn branches and other hyphae with deep yellow contents in Melzer's solution develop amyloid walls and amyloid incrustations on the cell walls.

#### SUMMARY

The ochraceous buff to brown pigments which develop in the cultures of *O. olivascens* are never found in cultures of *O. olearius* or *O. illudens* which have only white hyphae. Pale yellow areas in the latter cultures are found, on close examination, to be yellow exudation droplets. *O. olivascens* also develops a bright yellow pigmentation on the reverse side of the culture plates of malt agar while those of *O. olearius* are white or tinted cream color. In addition, *O. olivascens* has stronger tannic acid agar reactions and the gum guaiac reaction is swifter, and has a richer blue color. The microscopic, cultural characters are similar and the distinctive chlamydospores (Figs. 7, 10) are present in *O. olivascens* and *O. olearius* but oidia have not yet been detected in *O. olivascens* cultures. After 30 days, the typical amyloid cell walls and incrustations first reported by Miller (1971) in *Omphalotus* develop in both cultures of *O. olivascens*.

In addition to these very distinctive cultural differences, the olive colors of the sporocarps of *O. olivascens*, both fresh and dried, distinguish it at once from all other taxa in the genus. The spores are generally larger and the cuticular hyphae with yellow incrustations are found only in *O. olivascens*.

#### ACKNOWLEDGMENTS

The authors thank Don Manning and Marie Leimer for valuable technical assistance and Dr. Robert T. Orr of the California Academy of Sciences, San Francisco, California



for his assistance in obtaining cultures on which part of this study was based. We very much appreciate the critical reading of the manuscript by Dr. Alexander H. Smith of the University of Michigan, Ann Arbor, Michigan and Dr. Harold H. Burdsall, Forest Products Laboratory, Madison, Wisconsin.

## LITERATURE CITED

- Davidson, R.W., W.A.Campbell, and Dorothy J. Blaisdell. 1938. Differentiation of Wood-Decaying Fungi by their Reactions on Gallic or Tannic Acid Medium. Jour. Agr. Res. 57:683-695, illus.
- Kornerup, A. and J.H.Wanscher. 1967. Methuen Handbook of Colour. Methuen & Co., Ltd. London. 243 p., 30 pl.
- Miller, O.K. 1971. The Relationship of Cultural Characters to the Taxonomy of the Agarics, p. 197-215. IN "Evolution in the Higher Basidiomycetes", Ronald H. Petersen, Editor. Univ. of Tennessee Press, Knoxville, Tenn. 562 p., illus.
- Miller, O.K. and D.E.Farr. 1975. An Index of the Common Fungi of North America. J. Cramer, Lehre, Germany, 206 p.
- Nobles, M.K. 1948. Studies in Forest Pathology. VI. Identification of Cultures of Wood-rotting Fungi. Can. Jour. Res., C. 26:281-431.
- \_\_\_\_\_. 1958. A Rapid Test for Extracellular Oxidase in Cultures of Wood-inhabiting Hymenomycetes. Can. Jour. Bot. 36:91-99.
- Ridgway, R. 1912. Color Standards and Color Nomenclature, Washington, D.C. 44p., 53 pl.



PSEUDOCOLUS JAVANICUS IN CONNECTICUT AND ITS  
DISTRIBUTION IN THE UNITED STATES

WILLIAM R. BURK

Marriott Library, University of Utah  
Salt Lake City, UT 84103 U.S.A.

During the latter part of July and August 1969, 16 fruiting bodies of Pseudocolus javanicus (Penzig) Lloyd were found in a grassy area under Carya sp. in Gallagher Park, Norwalk, (Fairfield County), Connecticut. Except for 5 specimens which had 4 arms, the receptacles of the other specimens had 3 arms. The fungus was found after rainy periods and for most specimens the mycelial strands of the volva were wrapped around rotting nut shells of Carya sp. Some of the specimens collected are deposited in the Cryptogamic Herbarium of The New York Botanical Garden (NY). The only other occurrence of this phalloid in Connecticut is dubious and known only by a painting.

It is apparent that certain features of P. javanicus vary with different specimens. Sumstine's (1916) description for this fungus which he named Colus schellenbergiae Sumstine should be modified to include a wider range of measurements and other modifications. Sumstine described the fungus as having 3 arms, but it has 3-4 arms with deviation from this range being rare in the U.S.A. The length of the arms varies from (2.5-) 3-6 (-8) cm. The length of the basal stipe measures from 0.5-4 cm but can vary with geographical location and age of the fungus. The hyaline spores are typically ellipsoidal to cylindrical and of uniform size, 1.7-2 X 4.5-5.5  $\mu$ .

The taxonomic history of this fungus is rather confusing. To date from the author's studies P. javanicus is considered to be the valid name. Dring (1973), Reynolds (1967) and Wright (1960) also use this epithet. Williams and Frederick (1964) and Zeller (1949) accept Pseudocolus as a

valid genus. From both published and unpublished information the small phalloid has been found in 8 continental states and Hawaii.

Pseudocolus javanicus was first described in our country by Sumstine (1916) who named the fungus Colus schellenbergiae. This fungus was found in Pittsburgh, Pennsylvania, in July 1915 (NY<sup>1</sup>, type specimen examined). Henry (1966) reported a reappearance of the fungus in the Pittsburgh area in 1957 (CM #19,975). Coker and Rebell (1949) indicated that the phalloid was found in Ridley Park, Pennsylvania in 1948. The fungus was found by Rogerson in 1965 on a fallen, well-rotted log along Brandywine Creek, Chester County, Pennsylvania (NY).

Seaver (1931) found the stinkhorn growing in a small area in The New York Botanical Garden in 1931. Rogerson (1969) indicated finds of the phalloid since 1960 in The New York Botanical Garden wherever wood chip mulch had been used around shrubs (NY, various specimens examined). From Rhode Island the fungus was found at Warwick Neck according to Snell and Dick (1952). Specimens sent to the author from the Kingston, Rhode Island area were found by J.M. Fenstermacher of the University of Rhode Island.

From Summit, New Jersey, Coker and Rebell (1949) reported that the fungus was found on a rotten log toward the end of rainy periods (NCU #10972). Rogerson (1969) reported that the phalloid was found growing in fine leaf mold in Caldwell, New Jersey. That find is based on only a photograph (NY). Dater (1960) found the fungus in a compost heap of leaves and twigs in September 1960 in Ramsey, New Jersey (NY).

In Millbury, Massachusetts, Snell and Dick (1956) reported the clathrate phalloid was found growing on decaying leaves in 1955. Bigelow (1959) reported finding the fungus in July and August 1958, near the University of

---

<sup>1</sup>Specimens that were actually examined are indicated by the herbarium abbreviation as established by Holmgren and Keuken (1974).

Massachusetts campus in Amherst (MASS #6950, 7723). The fungus was found again in the Amherst area in 1961 (MASS #9637) and 1967 (MASS #15733).

From an examination of a specimen (TENN #23098) by the author it is known that the fungus was found by L. R. Hesler in Knoxville, Tennessee in August 1958. Williams (1964) reported findings of the stinkhorn in the summer of 1963 near Atlanta, Georgia. Goos (1970) reported a collection of the fungus near Punaluu, Oahu, Hawaii, in 1969 under a stand of Eucalyptus. The specimen examined was one sent to the author. Also from the author's examination of specimen (NCU #3606) it was discovered that this phalloid was found in March 1940 in Kailua, Oahu, Hawaii, growing in a sugar cane field.

#### Literature Cited

- Bigelow, Howard E. 1959. Interesting fungi from Massachusetts. *Rhodora* 61:127-136.
- Coker, W. C. & G. C. Rebell. 1949. Colus schellenbergiae again. *Mycologia* 41:280-282.
- Dater, E. 1960. "Nature Notes" In The Ramsey Journal, Ramsey, New Jersey, Journal Pub. Co. Sept. 29, p. 8, 12.
- Dring, D. M. 1973. Chapter 24, Gasteromycetes, p. 451-478 In G. C. Ainsworth, Frederick K. Sparrow and Alfred S. Sussman, eds., The fungi; an advanced treatise, vol. IV-B, A taxonomic review with keys; Basidiomycetes and lower fungi. New York, Academic Press.
- Goos, R. D. 1970. Phalloid fungi in Hawaii. *Pacific Science* 24:282-287.
- Henry, L. K. 1966. David Ross Sumstine (1870-1965). *Mycologia* 58:175-178.
- Holmgren, Patricia K. & Wil Keuken. 1974. Index Herbariorum. Part I. The Herbaria of the World. 6th ed. Utrecht, Oosthoek, Scheltema & Holkema, (for the Interna-

- tional Bureau for Plant Taxonomy and Nomenclature).  
vii, 397 p.
- Reynolds, Don R. 1967. A key to known Philippine  
Gasteromycetes. Phil. Agriculturist 51:268-278.
- Rogerson, Clark T. 1969. Personal communication.
- Seaver, Fred J. 1931. A rare phalloid from The New York  
Botanical Garden. Mycologia 23:83-84.
- Snell, Walter H. & Esther A. Dick. 1952. Two phalloids  
from Rhode Island. Mycologia 44:150-151.
- Snell, Walter H. & Esther A. Dick, 1956. An unusual  
phalloid from Massachusetts. Mycologia 48:327.
- Sumstine, David R. 1916. A new species of Colus from  
Pennsylvania. Mycologia 8:183-184.
- Williams, Constance Marion. 1964. Studies on genera of  
clathraceous fungi. M. S. Thesis. Atlanta University,  
Dept. of Biology, iv. 41 p. illus.
- Williams, Constance Marion & Lafayette Frederick. 1964.  
Studies on genera of clathraceous fungi. ASB Bulletin  
11(2):59.
- Wright, Jorge E. 1960. Notas sobre faloideas Sud y  
Centroamericanas. Lilloa 30:339-359.
- Zeller, S. 1949. Keys to the orders, families and genera  
of the Gasteromycetes. Mycologia 41:36-58.

ANGIOPOMA LÉV., 1841, AN EARLIER NAME  
FOR DRECHSLERA ITO, 1930

B. C. SUTTON

Commonwealth Mycological Institute, Kew, England

In the course of compiling data on the generic names of pycnidial and acervular fungi and the verification of relationships of the fungi concerned by studying type collections, a number of surprising nomenclatural and taxonomic anomalies have come to light. Unusual obligate and facultative synonymies occasionally appear, and it is not an unforeseen contingency that sometimes these will involve well-known generic names (Sutton, 1972; Nag Raj & Morgan-Jones, 1972; Punithalingam, 1974). The replacement of common, frequently used generic names by obscure ones that have remained buried for more than 100 years is not in the interests of nomenclatural stability. Consequently when this situation arises it is preferable to conserve the established name, provision for which is allowed in the Code. The alternative measure by which well-known epithets may be recombined with the obscure generic name would lead to extensive name changes and is wholly unnecessary.

Angiopoma Léveillé (1841) was described as follows

'Perithecium membranaceum subcorneum, cyathiforme, ore circulari dehiscens, epiphragmate, fugaci tectum. Thecae septate pedicellatae. Sporae....'. The genus contained a single species, A. campanulatum Lév., described as 'Gregarium; peritheciis elongatis, obconicis, atris, hirsutis. Hab. Versaliis. Ad semina Bromi sterilis. Vere.' A more discursive account of the fungus was provided in the discussion.

Brief accounts without illustrations have appeared in Fries (1849), Saccardo (1884), Lindau (1899) and Allescher (1903) and the names have been listed in compilations by Oudemans (1919), Clements & Shear (1931) and Ainsworth & Bisby (1971). The genus has remained monotypic and no information based on type studies, has so far been presented. It has been assumed by these previous workers that Angiopoma represents a genus of Sphaeropsidales in which pycnidia are superficial, separate, elongated to obconic and hirsute, and that conidia are oblong to fusiform, brown and with several distinct septa. The Angiopoma campanulatum folder in the herbarium of the Royal



Botanic Gardens, Kew (K) contains a single specimen which can be interpreted as a type collection. It is labelled 'Herb. Berk. 1879' and bears an additional label with the following hand-written annotation 'Angiopoma campanulatum, Lév. Ann. Sc. nat.' Dr. R.W.G. Dennis and Dr. D.A. Reid have kindly verified that the handwriting belongs to J. H. Léveillé and since the latter is the author of the genus and species it seems reasonable to deduce that this specimen is certainly authentic for the name and most probably an isotype. The lack of additional data concerning the specimen would seem to preclude a definitive decision over typification of the name, but since in all respects the fungus agrees with the description of Léveillé it is not injudicious to designate this collection as the lectotype for the name. A description of the fungus based on this specimen follows. It verifies the illustrations of conidia and conidiophores made by Berkeley on the type sheet.

Stromata erect, cylindrical, dark-brown to black,  $1200\mu$  high x  $300\mu$  wide, consisting of thick-walled, large-celled pale brown pseudoparenchyma which at the periphery is composed of a layer 1-2 cells thick of dark brown sclerotoid cells. There was no evidence of enlargement at the base and neither ascogenous tissue nor ascospores were found. Conidiophores straight or flexuous, swollen at the base, rarely geniculate, dark brown, paler towards the apices, verruculose,  $225 \times 10\mu$  septate, formed from the sclerotoid cells of the stromata. Conidiogenous cells polytretic, integrated, terminal, sympodial, cicatricized with 1-3 dark brown scars. Conidia solitary, cylindrical, straight, golden brown, obtuse at the apex, base cicatricized, smooth, 5-6 distoseptate,  $45-75 \times 14-17\mu$ .

These observations clearly indicate that A. campanulatum is not pycnidial at all but a hyphomycete. The combination of generic characteristics places it in Drechslera Ito where it can be readily identified as D. verticillata (O'Gara) Shoemaker, conidial Pyrenophora semeniperda (Brittlebank & Adam) Shoemaker. The stromata and conidiophores match perfectly, although the number of distosepta and conidial length are somewhat lower than the dimensions given by Shoemaker (1966) and Ellis (1971). However, the fact that A. campanulatum was described from seeds of Bromus sterilis and forms conidiophores from cylindrical stromata leaves little doubt that A. campanulatum and D. verticillata are conspecific, for the latter is not only the solitary Drechslera species to produce stromata on natural substrata, but is typically recorded as a pleomorphic parasite of cereal seeds and has been reported by Shoemaker (1966) from seeds of Bromus sterilis and other Bromus species.

Angiopoma therefore antedates Drechslera by 89 years and could be taken up in preference to the latter for it has date priority. However, because Angiopoma has remained dormant since its



inception (apart from routine listings in compilations and repetitions of the original diagnosis in subsequent general mycological treatises), and Drechslera has for several years now been used and accepted as the name for an important group of about 50 pathogens of Gramineae, many of which have been the subject of several correlative studies with Pyrenophora Fr. and related genera, it seems preferable to propose the conservation of Drechslera against Angiopoma. I am making a formal proposal to this effect in Taxon. In anticipation that conservation will be approved, the following new combination is proposed for the conidial state of P. semeniperda: - Drechslera campanulata (Lév.) comb. nov. (syn. Angiopoma campanulatum Lév., Ann. Sci. nat., 2 ser., 16 : 235, 1841).

It is a pleasure to acknowledge the useful discussion I have had with Dr. M.B. Ellis, and the assistance in determining the Lévillé handwriting by Dr. R.W.G. Dennis and Dr. D.A. Reid. Dr. R.A. Shoemaker kindly made useful comments on the manuscript prior to submission. The permission of Dr. D.A. Reid (K) to examine collections in his keeping is also acknowledged.

#### References

- Ainsworth, G.C. & Bisby, G.R. (1971). Dictionary of the fungi. Ed. 6. Commonwealth Mycological Institute, Kew.
- Allescher, A. (1903). Rabenhorst's Kryptogamen Flora. 1. Die Pilze. VII. Fungi imperfecti: Gefarbt-sporige Sphaerioideen sowie Nectrioideen, Leptostromaceen, Excipulaceen und der Ordnung der Melanconieen. E. Kummer, Leipzig.
- Clements, F.E. & Shear, C.L. (1931). The genera of fungi. Hafner, New York.
- Ellis, M.B. (1971). Dematiaceous hyphomycetes. Commonwealth Mycological Institute, Kew.
- Fries, E.M. (1849). Summa Vegetabilium Scandinaviae. Uppsala.
- Lévillé, J.H. (1841). Description de quelques espèces nouvelles de Champignons. Ann. Sci. nat., 2 ser. 16 : 235-242.
- Lindau, G. (1899). Engler & Prantl, Die natürlichen Pflanzenfamilien 1 (1\*\*) 1, Fungi imperfecti, Fungi fossiles: 347-523.
- Nag Raj, T.N. & Morgan-Jones, G. (1972). Nomina conservanda proposita (332). Taxon 21: 531-546.
- Oudemans, C.A.J.A. (1919). Enumeratio Systematica Fungorum

1 : 1-1230.

Punithalingam, E. (1974). Studies on Sphaeropsidales in culture.  
II. Mycol. Pap. 136: 1-46.

Saccardo, P.A. (1884). Sylloge fungorum 3. Pavia.

Shoemaker, R.A. (1966). A pleomorphic parasite of cereal seeds,  
Pyrenophora semeniperda. Can. J. Bot. 44 : 1451-1456.

Sutton, B.C. (1972). Nomenclature of Ceuthospora, Pyrenophora  
and Blennoria (Fungi). Taxon 21 : 319-326.

LEPIOTA SENSU LATO IN CALIFORNIA. II. TYPE  
STUDIES OF *LEPIOTA CUPRESSEA* AND *LEPIOTA MARGINATA*

WALTER J. SUNDBERG

Department of Botany, Southern Illinois University,  
Carbondale, Illinois 62901

## SUMMARY

Anatomical features of the type collections of *Lepiota cupresssea* Burlingham and *Lepiota marginata* Burlingham are described and illustrated.

A serious problem presently confronting monographers of *Lepiota* is the lack of accurate information on many anatomical features which were overlooked by earlier workers but are now considered essential for developing clear systematic concepts (Smith, 1966). This paucity of data has been partially overcome with the recent publication of H. V. Smith's (1966) type studies. In an effort to further alleviate this situation, detailed anatomical descriptions of *Lepiota cupresssea* Burlingham and *L. marginata* Burlingham, two California taxa presently known only from their original descriptions (Burlingham, 1945), are presented below.

The two type collections, which were recently rediscovered by Dr. Clark Rogerson who kindly informed me of their availability, are housed at the New York Botanical Garden (NY). The included size ranges were derived from measurement of a minimum of 15 cells or segments. Illustrations were made with the aid of a Leitz drawing tube, and colors in quotation marks are from Ridgway (1912).

*LEPIOTA CUPRESSEA* Burlingham, Mycologia 37: 53. 1945.

Basidiospores (Fig. 3) almost white (dark "waxy yellow")

low", near light "cream color"), and rapidly dextrinoid (dark reddish brown) in mass; 8-10 x 4.6-6  $\mu\text{m}$  (average 9 x 5.6  $\mu\text{m}$ ); ovoid to short ellipsoid, apiculate, occasionally with a subpapillate (superficially cap-like) apex, inequilateral in side view; walls smooth, thickened as seen in KOH-phloxine mounts, often somewhat thicker toward the base than at the apex, apical pore lacking; frequently uniguttulate; hyaline in KOH and dextrinoid (dark reddish brown) when viewed singly in Melzer's reagent.

Basidia 27-33.4 x 7.4-9.5  $\mu\text{m}$  (average 30.5 x 8.4  $\mu\text{m}$ ); 4-spored, clavate; walls smooth; contents scantily and finely granulose (not distinctive); hyaline in KOH and pale yellow in Melzer's reagent.

Cheilocystidia (Fig. 1) abundant; 22-58.7 x 10-15.4  $\mu\text{m}$  (average 37.3 x 12.7  $\mu\text{m}$ ); ventricose to clavate to sphaeropedunculate, often broadly rostrate at the apex when ventricose, many with narrow elongate bases; walls thin, smooth; hyaline to dull pale brown in KOH and pale yellow in Melzer's reagent.

Pleurocystidia lacking.

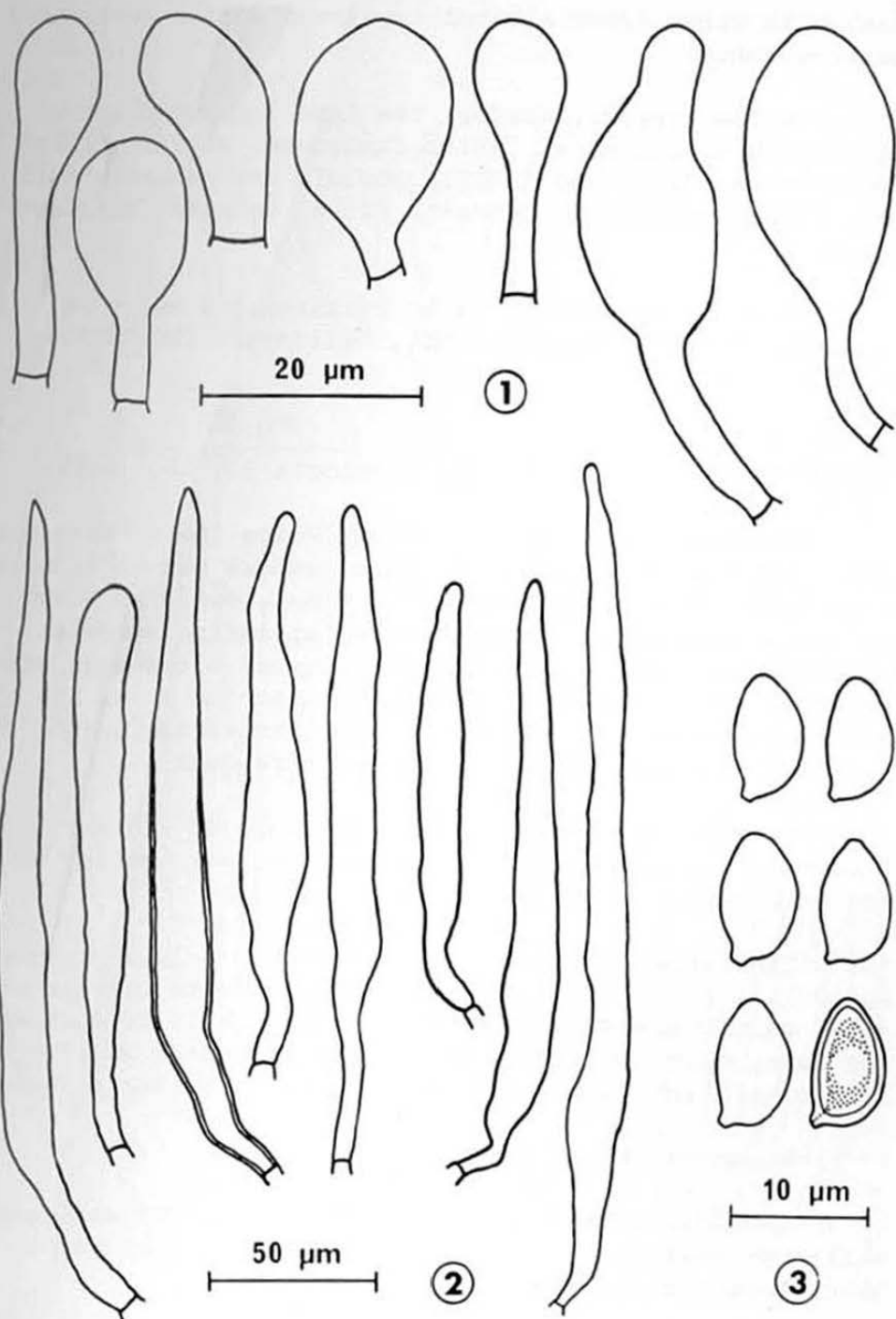
Lamellar trama interwoven, hyaline in KOH and pale yellow in Melzer's reagent; subhymenium subcellular, concolorous.

Pileal trama interwoven; hyaline in KOH and pale yellow in Melzer's reagent.

Cuticle a trichodermium of upright pilocystidia arising from a tightly interwoven layer. Pilocystidia (Fig. 2) 52-279 x 10-18.8  $\mu\text{m}$  (average 155 x 14.5  $\mu\text{m}$ ); very elongate-clavate to elongate-ventricose, apices rounded, usually tapered; walls smooth, occasionally somewhat flexuous, thin above and gradually thickened toward the base; dull pale brown in KOH (pigment in walls) and pale yellowish brown with a granulose but not distinctly colored content in Melzer's reagent. Subcuticular cells tightly interwoven; 4.3-11.5 (-14.4)  $\mu\text{m}$  broad, (average 7.6  $\mu\text{m}$ ), generally narrower than the pilocystidia; often with an irregularly encrusted surface.

Clamp connections lacking.

A pale yellowish brown pigment diffuses out of the



Figs. 1-3. *Lepiota cupresssea*. 1. Cheilocystidia. 2. Pilocystidia. 3. Basidiospores. (Detail as seen in phloxine-stained KOH mount).

tissue in water after alcohol treatment during sectioning preparation.

In the type collection, the lamellae, which were originally described as "white fimbriate, staining first yellow then salmon and finally sepia", are entirely dull brownish olive ("light brownish olive" to near "citrine drab").

Material examined: G. S. Burlingham 9 March 15, 1937, Point Lobos, Monterey Co., California (HOLOTYPE-N.Y.).

*LEPIOTA MARGINATA* Burlingham, Mycologia 37: 55. 1945.

Basidiospores (Fig. 5) almost white (pale "waxy yellow") and rapidly dextrinoid (dark reddish brown) in mass; 6.2-9 x 4.3-5.9  $\mu\text{m}$  (average 7.7 x 5  $\mu\text{m}$ ), ovoid to short ellipsoid, apiculate; walls smooth, appearing somewhat thickened as seen in KOH-phloxine mounts, often with walls somewhat thicker toward the base than at the apex, apical pore lacking; hyaline in KOH and dextrinoid (dark reddish brown) when viewed singly in Melzer's reagent.

Basidia 21.6-31 x 5.6-8  $\mu\text{m}$  (average 26 x 7  $\mu\text{m}$ ); 4-spored, clavate; contents not distinctive; hyaline in KOH and pale yellow in Melzer's reagent.

Cheilocystidia (Fig. 4) 15.4-37.7 x 6-12.4  $\mu\text{m}$  (average 28.4 x 9  $\mu\text{m}$ ); narrowly clavate to clavate to ventricose, rarely almost subsaccate, often broadly to narrowly rostrate, bases sometimes narrow and elongate; walls thin, smooth; hyaline in KOH and pale yellow in Melzer's reagent.

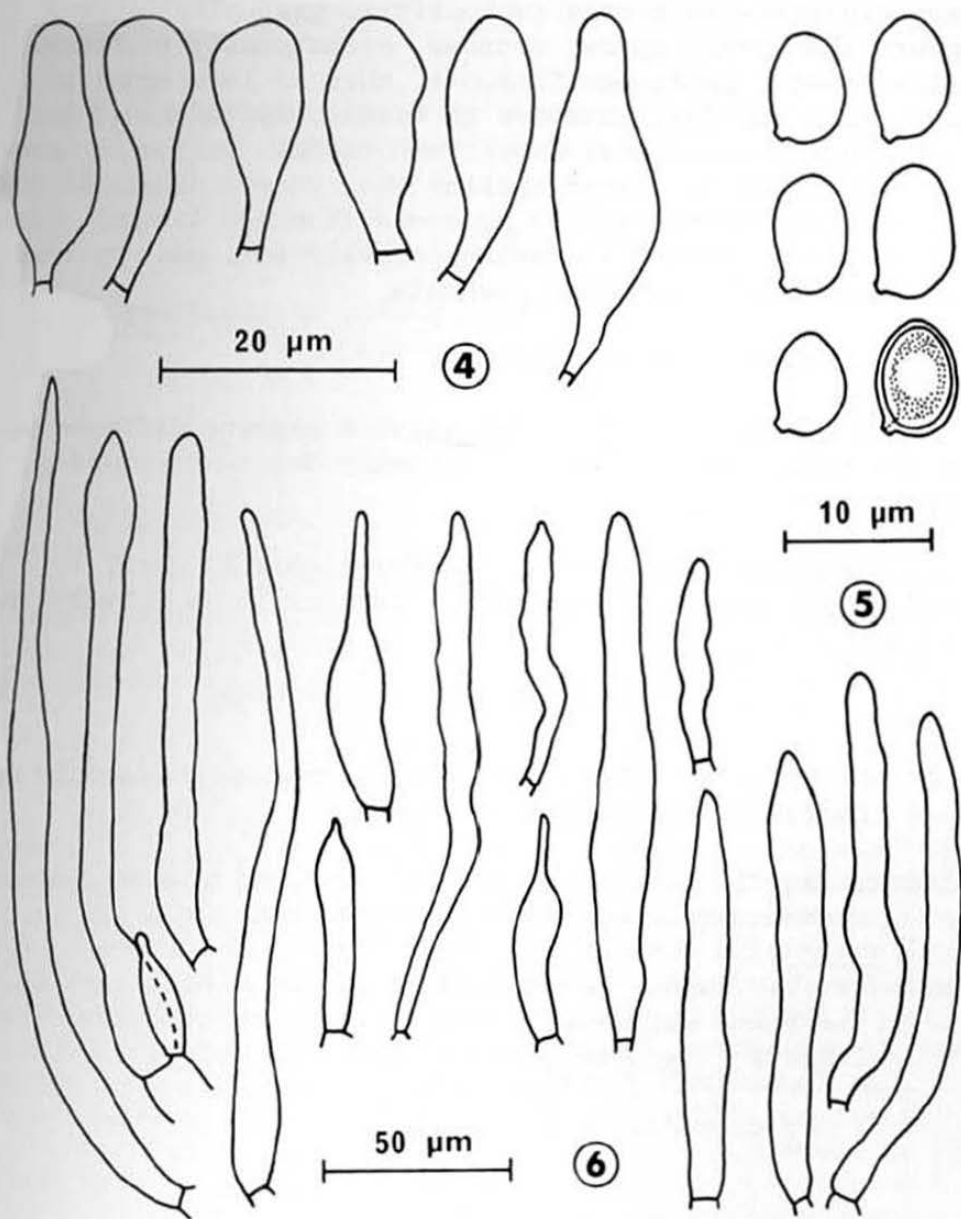
Pleurocystidia lacking.

Lamellar trama interwoven; hyaline in KOH and pale yellow to near hyaline in Melzer's reagent; subhymenium subcellular, concolorous.

Pileal trama tightly interwoven immediately beneath the cuticle, elsewhere loosely interwoven, hyaline in KOH and pale yellow in Melzer's reagent.

Cuticle a trichodermium of upright pilocystidia and infrequent upright hyphae composed of short subterminal





Figs. 4-6. *Lepiota marginata*. 4. Cheilocystidia. 5. Basidiospores. (Detail as seen in phloxine-stained KOH mount). 6. Pilocystidia.

segments and elongate, pilocystidium-like, terminal elements. Pilocystidia and terminal elements (Fig. 6) 45-223 x 7-14.5  $\mu\text{m}$  (average 113 x 10  $\mu\text{m}$ ); elongate-cylindric to very elongate-ventricose (abruptly to gradually tapered toward the apex), apices rounded, occasionally rostrate; walls smooth, sometimes flexuous, more or less equal in some, thin and hyaline above to distinctly thickened and darker below in others; dark brown to pale yellow in mass and pale brown to almost hyaline when viewed singly in KOH. Subcuticular hyphae 4.3-10  $\mu\text{m}$  broad (average 6.5  $\mu\text{m}$ ), often externally encrusted (sometimes heavily so), more or less concolorous with terminal elements.

Clamp connections lacking.

A yellowish brown water soluble pigment diffuses out of the tissue after alcohol treatment during sectioning preparation.

Material examined: G. S. Burlingham 13 April 10, 1937, Point Lobos, Monterey Co., California (HOLOTYPE-N.Y.).

#### LITERATURE CITED

- BURLINGHAM, G. S. 1945. Noteworthy species of *Lepiota* and *Lactaria*. *Mycologia* 37: 53-64.
- RIDGWAY, R. 1912. Color standards and color nomenclature. Washington, D. C. 43 p., 53 plates.
- SMITH, H. V. 1966. Contributions toward a monograph on the genus *Lepiota*, I. Type studies in the genus *Lepiota*. *Mycopath. Mycol. Appl.* 29: 97-117.

A NEW SPECIES OF EOTERFEZIA FROM  
MEXICO AND VENEZUELA<sup>1</sup>

R.S. JENG and R.F. CAIN

Department of Botany, University of Toronto  
Toronto, Canada

## SUMMARY

Eoterfezia perlucida sp. nov., parasitic on the perithecia of species of Arnium and Podospora, is described and illustrated from burro and cow dung. This species is characterized by hyaline ascocarps; globose, evanescent asci; and hyaline, smooth, ellipsoidal ascospores. It differs from E. parasitica in the larger ascospores.

## INTRODUCTION

In a study of coprophilous fungi, clusters of disco-mycete-like ascocarps were observed on collections of burro and cow dung from Mexico and Venezuela. Closer examination revealed that these ascocarps were parasitic on the perithecia of species of Podospora Cesati and Arnium Nits. in Fuckel. Each ascocarp was found to contain numerous globose asci covered by a membrane-like peridium, characteristics typical of the cleistothecial Ascomycota. A comparison with Eoterfezia parasitica Ait. indicated that the two organisms are con-generic. E. parasitica is characterized by being parasitic on perithecia of species of Sordaria Ces. et DeNot., possessing non-ostiolate ascocarps with a thin membranous peridium, and one-celled, hyaline, smooth ascospores measuring 3.0-4.5 x 1.5-2.5 $\mu$ . However, E. parasitica differs in the size of the ascospores, structure of the peridium and the presence of capillitium-like filaments. On account of these differences, our fungus is being described as a new species.

<sup>1</sup> Supported by grants from the National Research Council of Canada.

Eoterfezia is the type genus of the Eoterfeziaceae as established by Atkinson (1902). Besides this taxon, a number of other cleistocarpous genera were included by Malloch and Cain (1971). These included Cleistothelebolus Malloch et Cain, Lasiobolidium Malloch et Cain, Microeurotium Ghatak, Orbicula Cooke and Xeromyces Fraser.

## TAXONOMY

Eoterfezia perlucida Jeng and Cain sp. nov. Figs. 1-4.

Ascocarpi 90-500 $\mu$  diametro crassi, aggregati, primum globosi vel subglobosi, per maturitatem in discoidei vel convexi facti, erminei vel lutei, leves, glabri; peridium membranceum, perlucidum, e stratis duobus compositum. Asci 10-12 $\mu$  diametro magni, octospori, globosi, evanescentes. Ascosporeae 4.9-6.5 x 3.5-4.5 $\mu$  magnae, ellipsoideae, hyalinae, leves, sine foramine germinali. Conidia incognita.

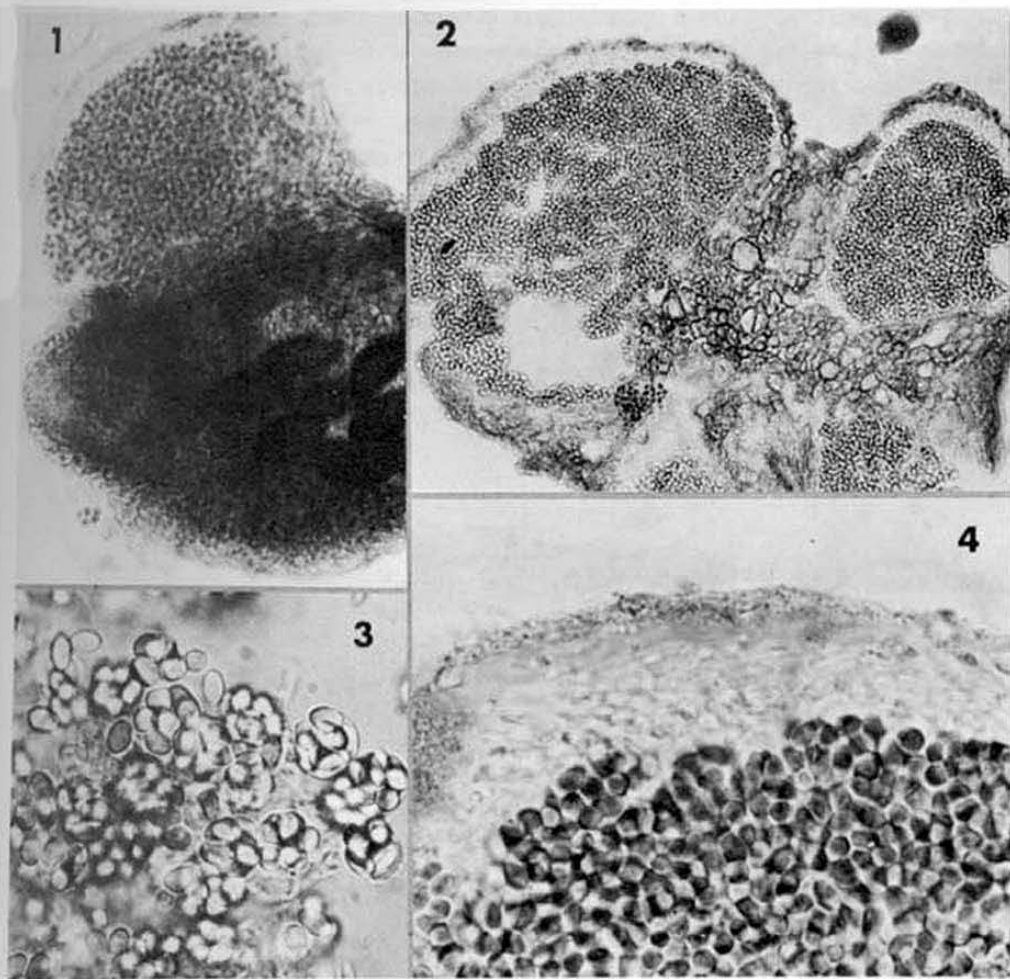
HOLOTYPE: in equorum fimo lectus est, in calle a Manacal ad Los Pocitos vocato, in loco ab Irapa septentrionali-occidentali remoto, in Sucre pago reipublicae Venezuelensis, 13 Quint. 1972, Dumont, Cain, Samuels, Morillo et Farfan VE-4890s. In Torontoensis Universitatis Cryptogamarum herbario.

ETYMOLOGY: Latin, perlucidus = transparent, referring to the transparent character of the peridium.

Ascocarps 90-500 $\mu$  in diameter, arising mostly in clusters from the host peridium, initially globose or subglobose, becoming discoid to convex at maturity, cream to yellowish, smooth, bare. Peridium 14-24 $\mu$  thick, membranaceous, transparent, with cellular structure obscure in surface view, two-layered in cross section; outer peridial layer 4.5-9.0 $\mu$  thick, hyaline, appearing as a fine granular layer in Gurr's mounting medium; inner peridial layer 9.0-15.0 $\mu$  thick, composed of angular, hyaline cells measuring about 3.0 x 5.0 $\mu$ . Asci 10.0-12.0 $\mu$  in diameter, 8-spored, globose, thin-walled, evanescent. Ascospores 4.9-6.5 x 3.5-4.5 $\mu$ , ellipsoidal, hyaline, smooth, without germ pores. Conidial stage unknown.

HABITAT: Parasitic on the perithecia of species of Podospora and Arnium from burro and cow dung.

SPECIMEN EXAMINED: VENEZUELA: Edo Sucre: NW. of Irapa, trail between Manacal and Los Pocitos, burro dung, 13 July 1972, Dumont, Cain, Samuels, Morillo and Farfan VE-4890s



Figs. 1-4. Eoterfezia perlucida (Type). 1. An ascocarp parasitic on the perithecium of Podospora communis. x265. 2. Cross section of several ascocarps showing the masses of ascospores in the ascocarp cavities. xl40. 3. Mature asci and ascospores. x665. 4. Cross section of an ascocarp showing the outer non-cellular peridial layer, the inner pseudo-parenchymatous layer and the masses of ascospores. x590.

(TRTC); Rte. 10, ca. 20 km. S. of Carupano, cow dung, 16 July 1972, Dumont, Cain, Samuels and Morillo VE-5156j (TRTC). MEXICO: San Luis Potosi: Ciudad del Maiz, burro dung, 19 August 1960, Cain, TRTC 36736 (TRTC).

E. perlucida is parasitic on the perithecia of Podospora communis (Speg.) Niessl and Arnium absimile (Cain) Krug et Cain. The new species differs from E. parasitica

in possessing (1) a peridium composed of two layers - the outer being hyaline, granular and non-cellular and the inner pseudoparenchymatous (2) numerous, globose asci with which were associated some hyaline, septate filaments and (3) larger ascospores. Unfortunately the origin of the filaments amongst the asci could not be traced but they are believed to be ascogenous hyphae rather than capillitium-like threads as reported for E. parasitica.

#### ACKNOWLEDGEMENTS

We wish to express our appreciation to Dr. J.C. Krug for assistance in correcting the Latin diagnosis and revising the manuscript.

#### LITERATURE CITED

- Atkinson, G.F. 1902. Three new genera of the higher fungi. Bot. Gaz. 34: 36-43.
- Malloch, D. and R.F. Cain. 1971. Four new genera of cleistothecial Ascomycetes with hyaline ascospores. Can. J. Bot. 49: 847-854.



A NEW SPECIES OF ASCODESMIS FROM VENEZUELA<sup>1</sup>

R.S. JENG and R.F. CAIN

Department of Botany, University of Toronto  
Toronto, Canada

## SUMMARY

Ascodesmis caninus sp. nov. is described and illustrated from dog dung collected in Venezuela. A. caninus is characterized by minute, hemisphaerical apothecia with a poorly developed or reduced excipulum; broadly clavate asci; and globose to subglobose ascospores with walls possessing numerous, tiny pits. This taxon differs from previously known species in possessing pitted ascospores.

## INTRODUCTION

While studying the coprophilous fungi of Venezuela, one apparently undescribed, small, hemisphaerical discomycete was observed. This organism, which was isolated from some dog dung maintained in a moist chamber containing malt-yeast agar, appears to represent a new species of Ascodesmis van Tieghem.

This genus was established by van Tieghem (1876) to accommodate A. nigricans van Tieghem, which is a small operculate discomycete. It is characterized by possessing ascocarps with a poorly developed or reduced excipulum as well as asci and paraphyses which develop from a clump of basal cells. Currently there are five recognized species, four of which were critically studied by Obrist (1961). He, as well as most modern mycologists, considers the genus primitive from an evolutionary viewpoint. The taxon was allocated to the Humariaceae by Obrist, but Korf (1972) considered it to be better placed in the Pyronemataceae.

<sup>1</sup> Supported by grants from the National Research Council of Canada.

## TAXONOMY

Ascodesmis caninus Jeng & Cain sp. nov. Figs. 1-14

Apothecia minuta, hemisphaerica, 300-400 $\mu$ m diametro crassa, dispersa aut aggregata, hyalina, sine excipulo, ex ascis et paraphysibus a cellulis basalibus factis composita. Asci 66-98 x 30-45 $\mu$ m magni, operculati, octospori, unitunicati, in apice late clavati, basin versus in stipitem brevum abrupte contracti. Paraphyses numerosae, septatae, hyalinae, in apice 6.0-7.0 $\mu$ m diametro crassae. Ascospores unicellulares, 15-21 x 12-16 $\mu$ m magnae, globosae vel subglobosae, aggregatae, primum hyalinae, maturitate confirmata brunneae vel atribrunneae, parietibus crassis, foveolas numerosas minutas exhibentes, primum vagina hyalina gelatinosa circumdatae. Conidia incognita.

HOLOTYPUS: in caninorum fimo lectus est, secus flumen Aguas Calientes vocatum, ab oppido Maraval ad septentriones remoto, in loco ab Irapa septentrionali-occidentali vocato, in Sucre pago reipublicae Venezuelensis, 8 Quint. 1972, Dumont, Cain, Samuels, Morillo et Villegas VE-4338b. In Torontoensis Universitatis Cryptogamarum herbario.

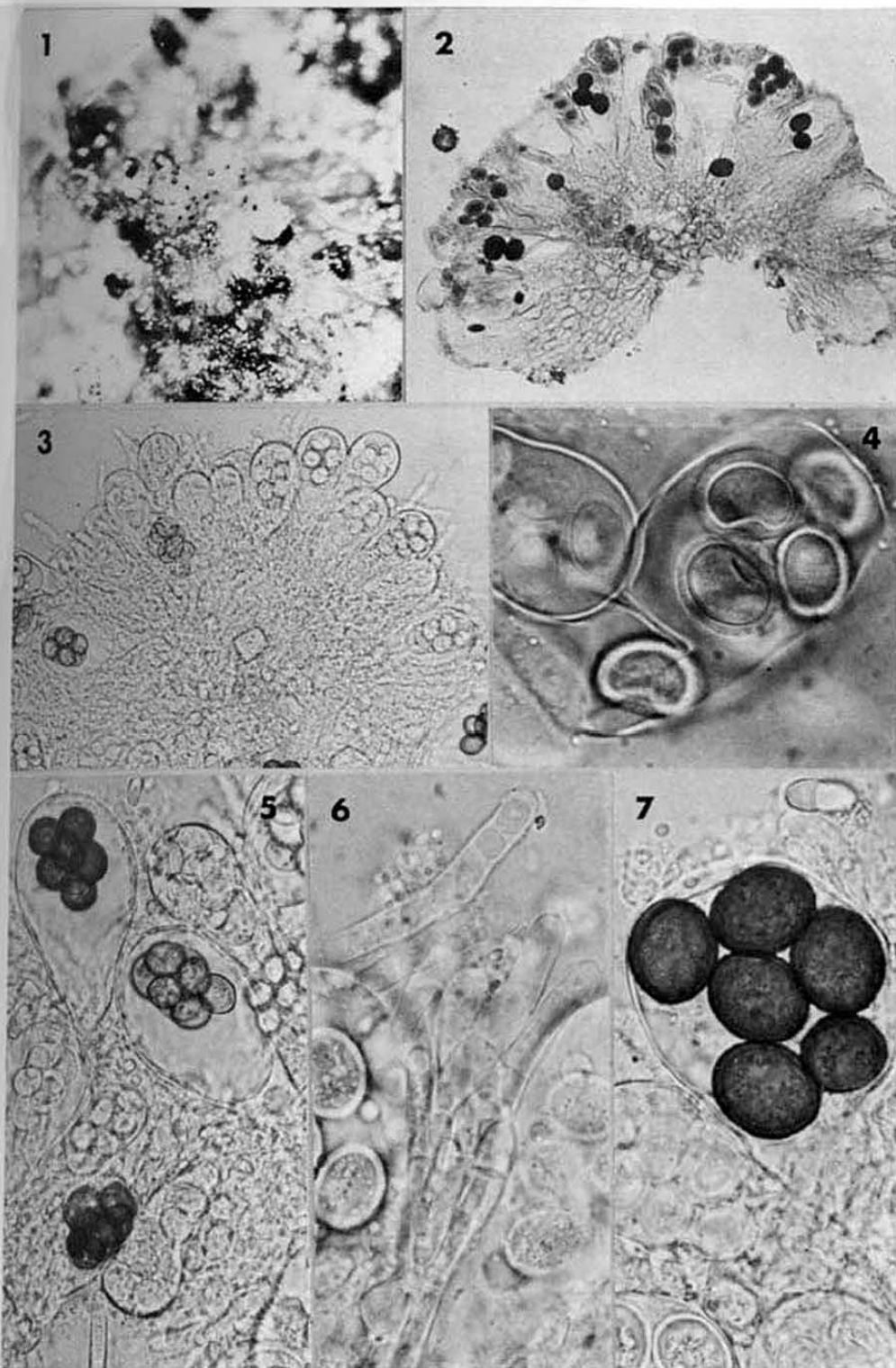
ETYMOLOGY: Latin, caninus = of dogs, referring to the type of substrate.

Apothecia minute, hemispherical, 300-400 $\mu$ m in diameter, scattered or aggregated, hyaline, without excipulum, consisting of asci and paraphyses originating from a clump of basal cells. Asci 66-98 x 30-45 $\mu$ m, operculate, non-amyloid, 8-spored, occasionally less, unitunicate, broadly clavate, rounded above, abruptly contracted below into a short stripe. Paraphyses numerous, stout, septate, hyaline, unbranched, 6.0-7.0 $\mu$ m in diameter at the apex. Ascospores one-celled, 15-21 x 12-16 $\mu$ m, globose to subglobose, crowded together, initially hyaline, becoming brown to dark brown at maturity, thick-walled, with walls ornamented with numerous tiny pits, surrounded by a gelatinous sheath when young. Conidia unknown.

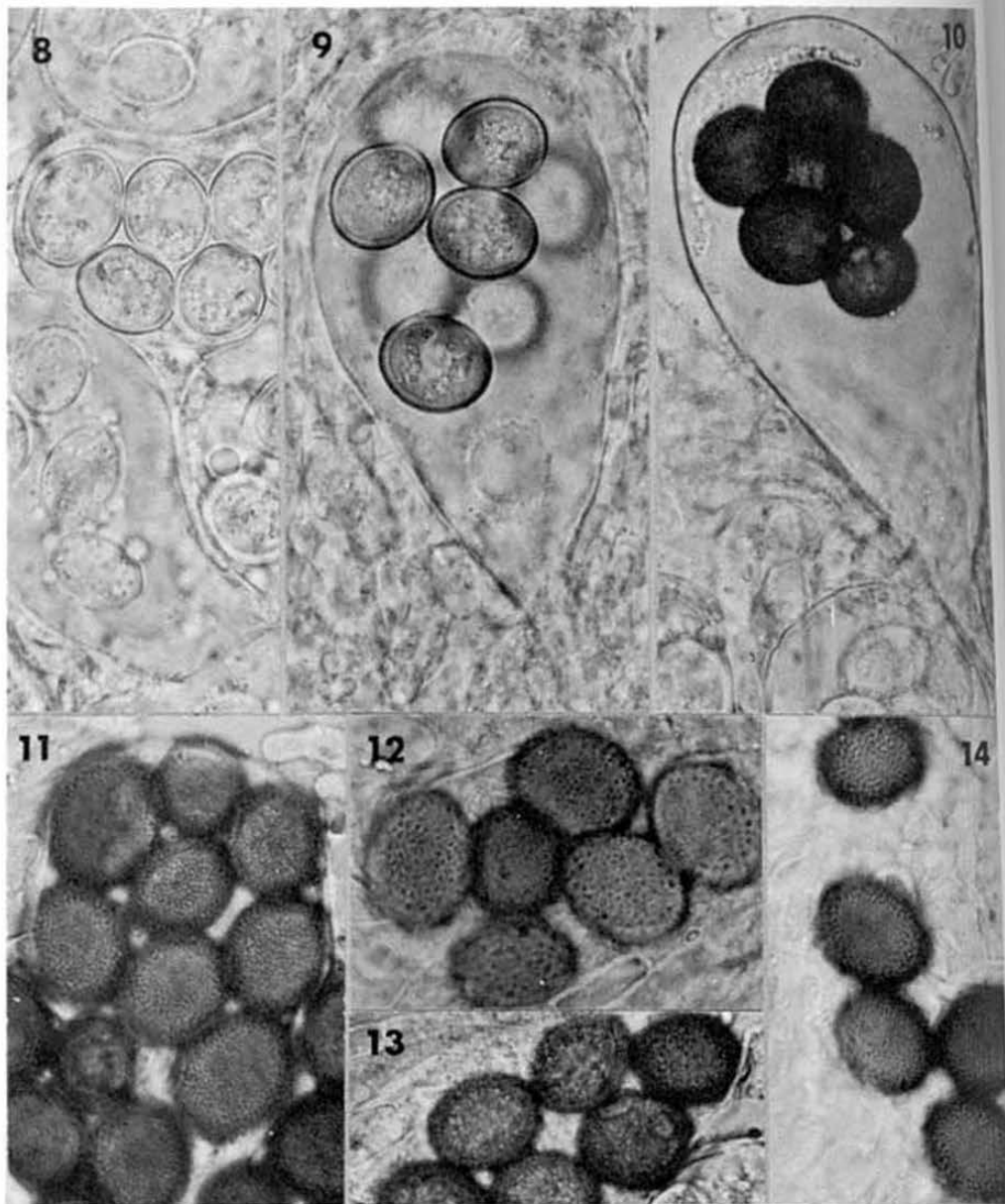
HABITAT: On dog dung.

SPECIMEN EXAMINED: VENEZUELA: Edo. Sucre: NW. of Irapa, half hour walk N. of Maraval, along Rio Aguas Calientes, dog dung, 8 July 1972, Dumont, Cain, Samuels, Morillo and Villegas VE-4338b (TRTC).

Like the other known species of Ascodesmis, our new taxon possesses minute, hemispherical apothecia with a poorly developed excipulum. However, A. caninus can be



Figs. 1-7. *Ascodesmis caninus*. 1. Habit view of apothecia, x24. 2. Longitudinal section of an apothecium, x140. 3. Portion of a squashed apothecium, x140. 4. High magnification of asci containing spores. 5. High magnification of asci containing spores. 6. High magnification of asci containing spores. 7. High magnification of a cluster of dark, spherical spores.



x140. 4. Upper part of an ascus showing young ascospores with gelatinous sheath, x640. 5. Portion of a squashed apothecium, x300. 6. Apical portion of the paraphyses, x640. 7. Mature ascospores, x640.

Figs. 8-14. *Ascodesmis caninus*. 8. Ascospores at the hyaline stage, x640. 9. Pigmented young ascospores, x640. 10. Mature ascospores, x640. 11-14. Mature ascospores showing the pitted walls, x640.

recognized easily by its pitted, thick-walled ascospores which are often variable in number, size and shape. Six to eight-spored asci were observed to be rather common. In contrast to some species of the genus which commonly possess ascospores with a perisporium, those of A. caninus initially are covered by a distinct gelatinous sheath. This gradually becomes invisible as the ascospores reach maturity.

This genus has sometimes been assigned to the Gymnoascaceae because of the simplicity in the structure of the ascocarp. In fact Eleutherascus von Arx, which was considered with the other genera of the Gymnoascaceae, was regarded by von Arx (1971) as a primitive discomycete lacking ascocarps. This genus resembles Ascodesmis in possessing simple ascocarps and ascospores which are ornamented with either spines or short ridges or both. The similarity between these two genera has also been pointed out by Huang (1975) from cultural and morphological observations. Like von Arx (1971), he implies that Eleutherascus may be related to Ascodesmis. The presence in this genus of both operculate asci and more complicated ascocarp initials would exclude Ascodesmis from the Gymnoascaceae. Actually, this family, like Eleutherascus, may be related to the primitive discomycetes.

#### ACKNOWLEDGEMENTS

We wish to express our appreciation to Dr. J.C. Krug for assistance in correcting the Latin diagnosis and revising the manuscript.

#### LITERATURE CITED

- Arx, J.A. von. 1971. Arachniotus and related genera of the Gymnoascaceae. Persoonia 6: 371-380.
- Huang, L.H. 1975. A new species of Eleutherascus from Peruvian soil. Mycologia 67: 293-302.
- Korf, R.P. 1972. Synoptic key to the genera of the Pezizales. Mycologia 64: 937-994.
- Obrist, W. 1961. The genus Ascodesmis. Can. J. Bot. 39: 943-953.
- van Tieghem, Ph. 1876. Sur de développement du fruit des Ascodesmis genre nouveau de l'ordre des Ascomycètes. Bull. Soc. Bot. France. 23: 271-279.



## BOOK REVIEWS (continued from page 354)

Des Amanitaceae (imprimé erronément V. Pluteaceae, p. 162) on ne retient que *Amanita* et *Limacella*, tandis que les Pluteaceae (imprimé erronément Volvariaceae, p. 162) en sont écartées.

Aux Agaricaceae, s'ajoutent cinq genres, *Crucispora* et *Micropsalliota* dans les Agariceae, *Dissoderma*, *Verrucospora* et *Squamanita* dans les Cystodermateae.

Aux Bolbitiaceae, s'ajoutent *Pseudoconocybe* et *Descolea* (des Cortinariaceae). Aux Strophariaceae, s'ajoute *Phaeomarasmius* (aussi des Cortinariaceae). Les Cortinariaceae perdent encore *Simocybe* et *Melanomphalia* qui passent aux Crepidotaceae; et dans celles-ci *Merismodes* est reconnu.

L'auteur s'est efforcé de présenter des synonymies complètes des genres et des taxons supérieurs. Il mentionne aussi un plus grand nombre d'espèces mais renvoie le lecteur aux monographies existantes pour les clés de détermination.

L'auteur a aussi augmenté son introduction et son illustration des acquisitions récentes sur la microscopie électronique des Agaricales.

CORTINARIUS FR. UND NAHE VERWANDTE GATTUNGEN IN SUDAMERIKA, by Meinhard MOSER and Egon HORAK, 628 p., with 9 text-figs., 116 pl. with 677 line-drawing figs., 20 pl. with 134 col. aquarelles. Beihefte zur Nova Hedwigia 52, 1975, ed. J. Cramer, FL-9490 Vaduz, Liechtenstein. DM 250.-

The present book is an important contribution to the taxonomy of *Cortinarius* and related genera gained by the authors from their collecting trips through South America, from Colombia to Argentina, in 1963, in areas characterized by the most typical vegetation, i.e., *Quercus*, *Alnus*, *Nothofagus*, *Eucalyptus* and *Salix*. It provides critical descriptions and excellent illustrations of not less than 296 new species in *Cortinarius*, *Dermocybe* (as a genus), *Rozites* and the new genus *Stephanopus*. Spegazzini's species have been revised as a preliminary. Keys to genera, subgenera, sections, stirps and species are given both in English and in German. The chromatography of the pigments in some species of *Cortinarius* and *Dermocybe*, contributed by Isle Gruber, has allowed the elaboration of a kind of chemotaxonomy of the species studied.

Anyone interested in the taxonomy of this group, in mycorrhizal fungi or in the world mycoflora will have to refer to this book.

The authors dedicate the book to Dr. Rolf Singer on the occasion of his 70th birthday and acknowledge his great contribution to the success of their project.

(continued on page 486)



A NOMENCLATURAL NOTE CONCERNING  
*SARCINOMYCES* LINDNER AND *SARCINOMYCES* OHO

S. C. JONG and D. S. KING

*Mycology Department, American Type Culture Collection*  
*12301 Parklawn Drive, Rockville, Maryland 20852*

## SUMMARY

*Sarcinomyces* Oho in Ota, 1926 (Cryptococcaceae), is a later homonym of *Sarcinomyces* Lindner, 1898 (Dematiaceae). The former is an obligate synonym of *Sarcinosporon* King & Jong, 1975, and the latter is a facultative synonym of *Aureobasidium* Vials & Boyer, 1891.

*Sarcinomyces* Lindner, validly published in Mikrosk. Betriebscontr. 2: 228, 1898, was erected for a single species *S. crustaceus* Lindner. He later added the second species *S. albus* Lindner (1901) to the genus. The genus was assigned to the Dematiaceae of the Moniliales. Saccardo (1906) and Clements and Shear (1931) erroneously quoted Mikrosk. Betriebscontr. 3: 300, 1901, as the valid publication of the genus. Cooke (1959) considered both *S. crustaceus* and *S. albus* to be synonyms of *Aureobasidium pullulans* (de Bary) Arnaud, and therefore *Sarcinomyces* Lindner becomes a facultative synonym of *Aureobasidium* Vials & Boyer. This taxonomic treatment is accepted in the *Dictionary of the Fungi* (Ainsworth, 1971) and by Kendrick and Carmichael (1973).

In 1919 Oho described a fungus isolated from skin scrapings from scrotal dermatoses frequently found in young males in Formosa. The lesion was reproduced experimentally on a human volunteer by inoculation with an isolate of the fungus. Although Oho mentioned the

name *Microsporon brachytomum* in reference to the fungus he described, he indicated that this name was only provisional. We consider that *M. brachytomum* is not validly published per Article 34 of the International Code of Botanical Nomenclature.

Apparently, Ota (1926) was not aware of *Sarcinomyces* Lindner and proposed the generic name *Sarcinomyces* Oho to accommodate Oho's fungus as *Sarcinomyces inkin* Oho. It was clearly stated in Ota's publication that he gave credit to Oho for the new genus and species; this fact has been overlooked by subsequent workers (Mesones and Dodge, 1960; Carmo-Sousa and van Uden, 1967; Carmo-Sousa, 1970; King and Jong, 1975), probably because Ota's publication was in Japanese. They all erroneously cited Oho's original publication, *Kyoto Igaku Zasshi* 16: 15, 1919, as the place and date of valid publication of the fungus and interpreted it as a member of *Sarcinomyces* Lindner. In fact, there is no connection between *Sarcinomyces* Lindner and *Sarcinomyces* Oho.

*Sarcinomyces inkin* Oho was later transferred to *Trichosporon* Behrend as *T. inkin* (Oho) Carmo-Sousa & van Uden (1967). Recently King and Jong (1975) created a new genus *Sarcinosporon* to accommodate *Trichosporon inkin* as *S. inkin* (Oho) King & Jong. They also proposed *Prototheca filamenta* Arnold & Ahearn (1972) to be a synonym of *S. inkin*. That the type strain ATCC 22432 of *P. filamenta* is indeed a fungus has been confirmed by Nadakavukaren and McCracken (1975) using scanning and transmission electron microscope observations. Although *Sarcinomyces* Oho has priority over *Sarcinosporon* King & Jong, the former is a later homonym of *Sarcinomyces* Lindner. Therefore, the correct nomenclator is as follows:

*Sarcinosporon* King & Jong, *Mycotaxon* 3: 92, 1975

≡ *Sarcinomyces* Oho in Ota, *Japanese J. Derm. Urol.* 26: 111, 1926 (non *Sarcinomyces* Lindner, 1898)

*Sarcinosporon inkin* (Oho) King & Jong, *Mycotaxon* 3: 93, 1975

≡ *Sarcinomyces inkin* Oho in Ota, *Japanese J. Derm. Urol.* 26: 111, 1926

= *Trichosporon inkin* (Oho) Carmo-Sousa & van Uden,  
Mycologia 59: 653, 1967

= *Prototheca filamenta* Arnold & Ahearn, Mycologia 64:  
270, 1972.

This work was supported in part by National Science  
Foundation Grant No. DEB75-06286 A01.

#### LITERATURE CITED

- AINSWORTH, G. C. 1971. *Ainsworth & Bisby's Dictionary of the Fungi*. 6th ed. Commonwealth Mycological Institute, Kew, Surrey. 663 pp.
- ARNOLD, P., and D. G. AHEARN. 1972. The systematics of the genus *Prototheca* with description of a new species *P. filamenta*. Mycologia 64: 265-275.
- CARMO-SOUSA, L. DO. 1970. *Trichosporon* Behrend. p. 1309-1352. In J. Lodder (ed.), *The Yeasts*. North Holland Publishing Co., Amsterdam.
- CARMO-SOUSA, L. DO, and N. VAN UDEN. 1967. Reisolation of *Sarcinomyces inkin* and its transfer to the genus *Trichosporon*. Mycologia 59: 653-657.
- CLEMENTS, F. E., and C. L. SHEAR. 1931. *The Genera of Fungi*. H. W. Wilson Co., New York. 496 pp.
- COOKE, W. B. 1959. An ecological life history of *Aureobasidium pullulans* (de Bary) Arnaud. Mycopathol. Mycol. Appl. 12: 1-45.
- KENDRICK, W. B., and J. W. CARMICHAEL. 1973. Hyphomycetes. p. 323-509. In G. C. Ainsworth, F. K. Sparrow, and A. S. Sussman (eds.), *The Fungi*. Vol. IVA. Academic Press, New York.
- KING, D. S., and S. C. JONG. 1975. *Sarcinosporon*: a new genus to accommodate *Trichosporon inkin* and *Prototheca filamenta*. Mycotaxon 3: 89-94.

- LINDNER, P. 1898. Mikroskopische Betriebscontrole in der Gahrungswerben mit einer Einfuhrung in die Hefereinculture, Infectionslehre und Hefenkunde. Ed. 2. 365 pp.
- LINDNER, P. 1901. Mikroskopische Betriebscontrole in der Gahrungswerben mit einer Einfuhrung in die Hefereinculture, Infectionslehre und Hefenkunde. Ed. 3. 468 pp.
- MESONES, H. A., and C. W. DODGE. 1960. *Sarcinomyces inkin* in Brasil. *Mycologia* 52: 800-804.
- NADAKAVUKAREN, M. J., and D. A. McCracken. 1975. *Prototheca filamenta*: a fungus not an alga. *Mycopathologia* 57: 89-91.
- OHO, O. 1919. Ueber das sogenannte "Inkin." *Kyoto Igaku Zasshi* 16: 7-21.
- OTA, M. 1926. Champignons parasites de l'homme. *Japanese J. Derm. Urol.* 26: 111-142.
- SACCARDO, P. A. 1906. *Sylloge fungorum omnium hucusque cognitorum*. Vol. 18. Supplementum universale. Pars VII. Discomycetae-Deuteromycetae. Patavii. 838 pp.

ACICULOCONIDIUM: A NEW HYPHOMYCETOUS GENUS  
TO ACCOMMODATE *TRICHOSPORON ACULEATUM*

D. S. KING and S. C. JONG

*Mycology Department, American Type Culture Collection  
12301 Parklawn Drive, Rockville, Maryland 20852*

SUMMARY

A new genus *Aciculoconidium* and a new combination *A. aculeatum* are proposed to accommodate *Trichosporon aculeatum* Phaff *et al.* The fungus is characterized by filamentous growth and blastoconidia budding singly or successively in chains as in the genus *Candida* and by the production of needle-shaped conidia which terminate the development of spores on the hyphae. Conidia may germinate to produce either the filamentous phase or the yeast phase.

In the course of current investigations into the systematics of the imperfect genus *Trichosporon* Behrend, subcultures of the type strain of *T. aculeatum* Phaff *et al.* (1956) were examined morphologically and nutritionally. Phaff *et al.* figured the needle-shaped cells which distinguish this species but did not describe their function. They also figured individual hyphal segments which they considered arthroconidia. It was due to the latter, as well as true mycelium and blastoconidia, that this fungus was placed in *Trichosporon*. Hedrick and Dupont (1968) and Carmo-Sousa (1970) accepted this species in *Trichosporon*. These workers thus accepted the presence of arthroconidia in this fungus, and Carmo-Sousa figured individual hyphal segments similar to those figured by Phaff *et al.* (1956).

The purposes of this paper are to present morphological observations showing that the needle-shaped cells of this species are holoblastic conidia and to erect a new genus to accommodate this unique fungus.

#### METHODS AND MATERIALS

Cultures. Two subcultures of the type strain isolated by Phaff *et al.* (1956) were examined. ATCC 1554 (NRRL YB4297) was deposited in the American Type Culture Collection (ATCC) by P. DuPont and L. Hedrick in July 1964. ATCC 28680 was deposited by L. do Carmo-Sousa in the Centraalbureau voor Schimmelcultures (CBS) as CBS 5578, and obtained by the ATCC from CBS in February 1975.

Morphology: Media used were CM (Difco corn meal agar), 1/2 CM (1/2 X Difco corn meal agar), GYEP (2% dextrose, 1% Difco peptone, 0.5% Difco yeast extract, with 1.5% Difco agar for solid media), YM (Difco yeast malt agar and broth), MA (Difco malt agar), PDA (500 g potatoes, infusion from 20 g dextrose, 15 g agar, 1 liter distilled water) and M40Y (2% Difco malt extract, 0.5% Difco yeast extract, 40% sucrose, 2% Difco agar). All cultures were incubated at room temperature ( $22 \pm 2$  C).

Slide cultures on CM and GYEP agars were examined at 4 and 7 days. Dalmau cultures on the same media were examined at 4 and 7 days, and at intervals up to 30 days. Additional cultures were grown on 1/2 CM, MA, YM, PDA and M40Y agars to observe variation in morphology. These were examined periodically from 1 to 14 days following inoculation. Cultures in YM broth in cotton plugged flasks were examined 2 and 4 days after inoculation for observation of growth in liquid culture.

Physiology: For inoculations in all physiological tests, the growth after 2 days on 5 ml of YM agar slanted in a test tube was aseptically scraped off and suspended in 6.5 ml of sterile distilled water, and the suspended cells drawn into a sterile disposable syringe equipped with a 20 gauge needle. Each tube of test medium was inoculated with one drop of the suspension. All cultures were incubated at room temperature ( $22 \pm 2$  C).



Carbon assimilation media were similar to those of Wickerham (1951). All sources (see TABLE I) were used at 0.5% in 5 ml of Difco yeast nitrogen base in duplicate test tubes, except raffinose at 1.0%. The pH of all media (including organic acid media) was unadjusted. Cultures were evaluated for presence or absence of growth over a 30-day period of incubation.

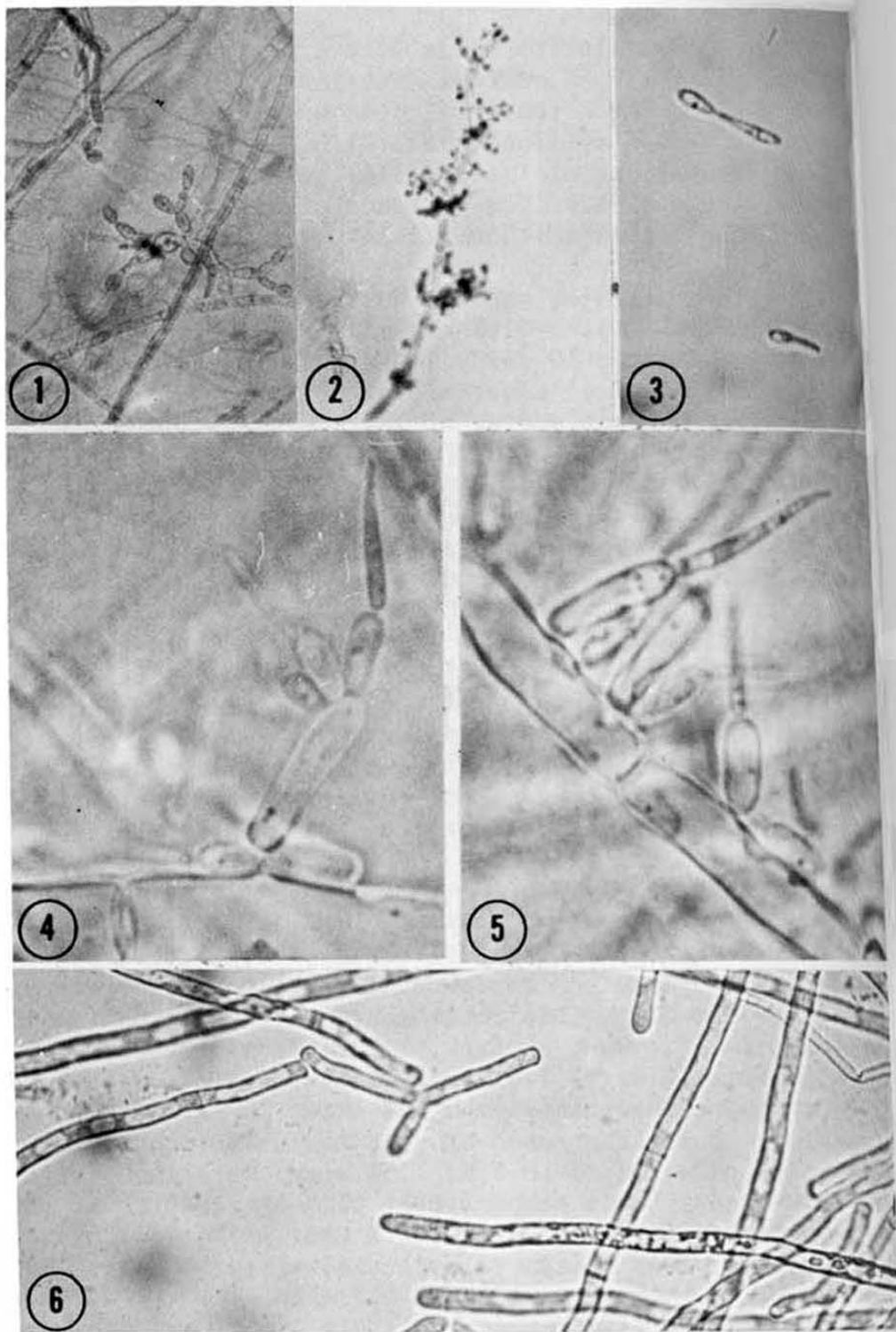
For each nitrogen source, duplicate tubes of 5 ml Difco yeast carbon base with the nitrogen source were inoculated and after 10 days, 1-3 drops from this set were used to inoculate a second set of tubes. The second set contained a basal medium of salts plus vitamins ( $\text{KH}_2\text{PO}_4$ , 1 g;  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ , 0.5 g;  $\text{FeCl}_3$ , 0.6 mg;  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ , 0.9 mg;  $\text{MnSO}_4 \cdot \text{H}_2\text{O}$ , 0.3 mg; biotin, 5  $\mu\text{g}$ ; thiamine, 100  $\mu\text{g}$ ; distilled water, 1 liter) and the nitrogen source. The second set of tubes were examined for growth 10 days after inoculation. Nitrogen sources and quantities used were:  $\text{KNO}_3$ , 0.78%;  $\text{NaNO}_2$ , 0.26%; ethylamine HCl, 0.64%; and as a positive control,  $\text{NH}_4\text{NO}_3$ , 1.0%.

As a test for vitamin-free growth, duplicate tubes of Difco vitamin-free yeast base were inoculated and after 10 days, a second set of tubes containing the salts basal medium and  $\text{NH}_4\text{NO}_3$  (but without added vitamins) was inoculated from the first set and examined for growth after 10 days.

Duplicates of GYEP agar slanted in test tubes were inoculated and examined for growth after incubation for 4 days at 30 and 37 C. Duplicate tubes of arbutin medium (arbutin, 1.25%; yeast extract, 1.25%; ferric ammonium sulfate, 0.125%; agar, 1.0%) were inoculated and incubated at room temperature, then examined after 10 days for darkening. Duplicate tubes of urea medium (Difco urea agar base, pH adjusted to 6.8; 1.5% agar) were inoculated and incubated at room temperature, then examined after 10 days for reddening. Cultures on YM agar in Petri dishes were smelled after 2 days to detect distinctive odors.

## RESULTS AND DISCUSSION

Both strains were morphologically identical. A very rapid, coarse, spreading growth was produced on all solid



Figs. 1-6. *Aciculoconidium aculeatum*. 1. ATCC 28680, chains of blastoconidia on malt agar, 8 da, ca. X 700. 2-6. ATCC 15540. 2. Blastoconidia on malt agar, 8 da,

TABLE I  
PHYSIOLOGICAL TEST RESULTS

ATCC Strain	15540	28680	ATCC Strain	15540	28680
Glucose	+	+	Adonitol	+	+
Galactose	-	-	Dulcitol	-	-
L-sorbose	-	-	D-mannitol	+	+
Maltose	+	+	D-sorbitol	+	-
Sucrose	+	+	$\alpha$ -methyl-D-glucoside	+	+
Cellobiose	+	+	Salicin	+	+
Trehalose	+	+	Inositol	-	-
Lactose	-	-	Lactic acid	-	-
Melibiose	-	-	Citric acid	+	+
Raffinose	-	-	Succinic acid	+	+
Melezitose	+	+	Valine	-	-
Inulin	-	-	Glycine	-	-
Soluble Starch	+	+	Proline	+	+
D-xylose	-	-	Arginine	+	-
L-arabinose	-	-	Nitrate	-	-
D-arabinose	-	-	Nitrite	-	-
D-ribose	-	-	Ethylamine HCl	+	+
L-rhamnose	-	-	Growth at 30 C	+	+
D-glucosamine	+	+	Growth at 37 C	-	-
Ethanol	+	+	Arbutin splitting	+	+
Glycerol	+	-	Urease	-	-
i-erythritol	-	-			

ca. X 310. 3. Needle-shaped conidia germinating to produce a blastoconidium in ethylamine nitrogen assimilation medium, 5 da, ca. X 840. 4-5. Needle-shaped conidia borne on conidiogenous blastoconidia on 1/2 X cornmeal, 2 da, ca. X 1750. 6. Hyphal segments disarticulating in young culture in yeast malt broth, 1 da, ca. X 340.

media. Microscopically, blastoconidia were borne laterally on septate hyphae (Figs. 1 & 2). Developmentally, the blastoconidia either become detached and subsequently reproduce by budding, or produce other blastoconidia in situ, giving rise to short chains (Fig. 1); or give rise to one or more (up to 4) needle-shaped conidia (Figs. 4 & 5). Although the blastoconidia produced on the hyphae may become detached and act as propagules, production of the needle-shaped conidia terminates their development on the hyphae. Also, the needle-shaped conidia do not germinate until they become detached (Fig. 3). The blastoconidia therefore become conidiogenous cells which produce the needle-shaped conidia.

Very large segments of hyphae distinctive in their development were observed on all media (Fig. 6). In some hyphae disarticulation occurs beginning at the proximal end. Distinct chains of arthroconidia typical of the genus *Geotrichum* are therefore not observed. This pattern of disarticulation is a common phenomenon in filamentous fungi in culture. The individual hyphal segments observed in this fungus thus should not be considered conidia.

The two strains differed somewhat in utilization of carbon sources. They did agree in all other physiological tests. Both strains produced a very strong fruity, aromatic odor on YM agar, and failed to grow on vitamin-free medium. ATCC 15540 had a carbon assimilation pattern identical to that given by Phaff *et al.* (1956) and Carmo-Sousa (1970) in the standard description of *Trichosporon aculeatum*. ATCC 28680 deviated from the pattern of ATCC 15540 in failing to utilize arginine, sorbitol, and glycerol.

Physiological change has been noted in cultures maintained in tube cultures and in the freeze-dried state (Wellman and Stewart, 1973; Sveda and Yarrow, 1966). The possibility of change in ATCC 28680 in the freeze-dried state therefore cannot be excluded. Preservation in the frozen state in liquid nitrogen is probably the most preferable method of long-term preservation to reduce the probability of change during maintenance, as well as the best means of preserving viability over a long period.

This species cannot be retained in the genus *Trichosporon* because the needle-shaped holoblastic conidia are prominent, and there is no production of arthroconidia

of the *Geotrichum* type that is associated with the genus *Trichosporon*. Since it does not agree with any previously described hyphomycetous genus, we are erecting a new genus.

*Aciculoconidium* King et Jong, gen. nov.

Fungus hyalinus cum cellulis gemmiferis, mycelia et blastoconidia. Mycelium e hyphis ramosis, septatis compositum. Blastoconidia catenata, continua, ellipsoideae vel subglobosae; conidia terminalis aculeata. Species typica: *A. aculeatum*.

Fungus hyaline, with budding cells, mycelia and blastoconidia. Mycelium composed of branched, septate hyphae. Blastoconidia catenulate, *Candida*-like, subspherical to ellipsoid; terminal conidia needle-shaped, rounded at the proximal end and pointed at the distal end. Hyphomycetes, Fungi Imperfecti.

*Aciculoconidium aculeatum* (Phaff et al.) King et Jong, comb. nov.

≡ *Trichosporon aculeatum* Phaff et al., Antonie van Leeuwenhoek 34: 160, 1956.

Growth on agar media primarily filamentous with regular septa and with usually monopodial branching. Conidia holoblastic, unicellular, hyaline, borne singly or successively in chains similar to *Candida*, subspherical to ellipsoid, 2.5-3.5 X 3.5-8.0  $\mu\text{m}$ , terminated by production of needle-shaped spores which are rounded at the proximal and pointed at the distal end, 0.5-2.0 X 5.5-21.5  $\mu\text{m}$ . Conidia germinating on a variety of media, producing budding yeast cells, 2.0-3.5 X 3.0-7.0  $\mu\text{m}$ .

The type strain ATCC 15540, originally isolated by Phaff et al. (1956) from *Drosophila pinicola* near Mather, California, is preserved by being frozen and stored in liquid nitrogen at -196 C at the ATCC. The lectotype, a dried cornmeal agar plate culture of this strain, has been deposited in the herbarium of the National Fungus Collections, Beltsville, Maryland.

## ACKNOWLEDGMENTS

This work was supported in part by National Science Foundation Grant DEB75-06286 A01 and by Brown-Hazen Grant BH 846 from Research Corporation, New York.

## LITERATURE CITED

- CARMO-SOUSA, L. DO. 1970. *Trichosporon* Behrend. p. 1309-1352. In J. Lodder (ed.), *The Yeasts, a Taxonomic Study*. North-Holland Publishing Co., Amsterdam.
- HEDRICK, L. R., and P. D. DuPONT. 1968. The utilization of L-amino acids as carbon source by yeasts of the genera *Hansenula* and *Trichosporon*. *Antonie van Leeuwenhoek* 34: 465-473.
- PHAFF, H. J., M. W. MILLER, and M. SHIFRINE. 1956. The taxonomy of yeasts isolated from *Drosophila* in the Yosemite region of California. *Antonie van Leeuwenhoek* 22: 145-161.
- SCHEDA, R., and D. YARROW. 1966. The instability of physiological properties used as criteria in the taxonomy of yeasts. *Arch. Mikrobiol.* 55: 209-225.
- WELLMAN, A. M., and G. G. STEWART. 1973. Storage of brewing yeasts by liquid nitrogen refrigeration. *Appl. Microbiol.* 26: 577-583.
- WICKERHAM, L. J. 1951. *Taxonomy of yeasts*. Tech. Bull. U. S. Dep. Agric. No. 1029.



CONTRIBUTION TO THE KNOWLEDGE OF *STACHYBOTRYS*  
AND *MEMNONIELLA* IN CULTURE

S. C. JONG and E. E. DAVIS

*Mycology Department, American Type Culture Collection*  
*12301 Parklawn Drive, Rockville, Maryland*

## ABSTRACT

Members of *Stachybotrys* and *Memmoniella* are morphologically and physiologically closely related and are of worldwide distribution. Many of them are commonly isolated from soil and are capable of utilizing cellulose and damaging fabrics made of plant fibers. Cultures of *Stachybotrys chartarum* and *Memmoniella echinata* have been used for fungus resistance tests in U. S. and British military specifications. Strains of *S. chartarum* are also known to produce toxic compounds which have been reported as agents of stachybotryotoxicosis in animals and man. The toxicants belong to the series of sesquiterpenoid mycotoxins classified as 12,13-epoxy- $\Delta^9$ -trichothecenes. The salient feature both genera have in common is the production of macronematous conidiophores with an apical cluster of several unicellular conidiogenous cells bearing unicellular enteroblastic-phialidic conidia. The main difference between *Stachybotrys* producing slimy heads of conidia and *Memmoniella* producing chains of conidia is in the length of time between formation of the septum in the phialide neck and its splitting when the conidia separate. In *Stachybotrys* the new conidia arise after previous ones are mature and released from the phialide neck, whereas in *Memmoniella* the

new conidia arise in basipetal succession before the previous ones are mature. In the present study fifty strains currently maintained in the American Type Culture Collection (ATCC) were characterized and reidentified to the following species: *Stachybotrys albipes*, *S. bisbyi*, *S. chartarum*, *S. cylindrospora*, *S. dichroa*, *S. kampalensis*, *S. microspora*, *S. nephrospora*, *S. oenantes*, *S. parvispora*, *S. theobromae*, *Memmoniella echinata*, *M. subsimplex*. Each species treated has been redescribed and illustrated. A key is constructed to facilitate the identification of these cultured species. The shape, size and the color and ornamented surface of phialoconidia are principally used to distinguish the species. Two new combinations, *Stachybotrys albipes* (Berk. & Br.) Jong & Davis and *S. microspora* (Mathur & Sankha) Jong & Davis, are proposed. *Stachybotrys sacchari* (Srinivasan) Barron is recommended as a synonym of *S. bisbyi* (Srinivasan) Barron, and *S. reniformis* Tubaki and *S. sinuatophora* Matsushima are synonyms of *S. nephrospora* Hansford.

## TABLE OF CONTENTS

INTRODUCTION . . . . .	412
HISTORICAL TREATMENT OF THE GENERA . . . . .	413
ECONOMIC SIGNIFICANCE . . . . .	415
PHYSIOLOGICAL CHARACTERS . . . . .	417
MORPHOLOGY AND DEVELOPMENT . . . . .	419
PERFECT STATE . . . . .	422
KEY TO THE SPECIES IN CULTURE . . . . .	423
DESCRIPTIONS AND ILLUSTRATIONS . . . . .	425
<i>Stachybotrys albipes</i> . . . . .	425
<i>Stachybotrys bisbyi</i> . . . . .	430
<i>Stachybotrys chartarum</i> . . . . .	433
<i>Stachybotrys cylindrospora</i> . . . . .	440
<i>Stachybotrys dichroa</i> . . . . .	442
<i>Stachybotrys kampalensis</i> . . . . .	447
<i>Stachybotrys microspora</i> . . . . .	448
<i>Stachybotrys nephrospora</i> . . . . .	453
<i>Stachybotrys oenanthes</i> . . . . .	455
<i>Stachybotrys parvispora</i> . . . . .	459
<i>Stachybotrys theobromae</i> . . . . .	460
<i>Memmoniella echinata</i> . . . . .	464
<i>Memmoniella subsimplex</i> . . . . .	471
ACKNOWLEDGMENTS . . . . .	474
LITERATURE CITED . . . . .	475

## INTRODUCTION

The Hyphomycetes, grouped together because of similarities in their morphological appearance, belong to a specially classified group known as the Fungi Imperfecti. The incomplete type of life cycle in the imperfect fungi is identical with the asexual states of the Ascomycetes or of the Basidiomycetes. Ideally, the scientific names of imperfect (asexual) fungi should be discarded and replaced by the names of their perfect (sexual) states according to the natural system. However, some of the imperfect species, recognized as playing important roles in agriculture, industry, medicine and environment, have never been detected in their perfect states. They are among the most common of aquatic and soil fungi. The Hyphomycetes especially are abundant everywhere, many of them being pathogenic to plants, animals and humans. Accordingly, Fungi Imperfecti cannot be disregarded, and they are grouped exclusively in the class Deuteromycetes, which has long been classified independently of the Ascomycetes and the Basidiomycetes.

The necessity of living cultures for characterizing, identifying, and classifying the Hyphomycetes has been emphasized in recent years by the application of new taxonomic criteria related to the nature of conidiogenous cells and the precise method by which conidia are produced (Hughes, 1953; Goos, 1956; Simmons, 1966; Barron, 1968; Tubaki, 1958; Kendrick, 1971; Kendrick & Carmichael, 1973). Although Barron (1968) and Kendrick and Carmichael (1973) have recently applied the new scheme of classification to nearly 600 genera of Hyphomycetes and Ellis (1971a) has provided modern descriptions and illustrations of the common dematiaceous Hyphomycetes, our present knowledge of the new taxonomic criteria still has not come close to satisfying our need in identification of unknown Hyphomycetes. Therefore, much confusion has resulted in the modern literature, when, at different times, mycologists have set up new genera and new species based on different sets of criteria, e.g., superficial or developmental characters, or combinations of both. It is also difficult to correlate the original descriptions in the classical literature with the new scheme because most of them are hopelessly inadequate and without any indication of the method of conidial production. For these reasons, difficulties in determining the identities of Hyphomycetes

in culture are frequently encountered by us in our routine curatorial work at the American Type Culture Collection (ATCC).

The specific aims of the project are: (1) to study as many strains as possible of selected genera of Hyphomycetes which are presently available from reliable culture collections; (2) to determine the identity and morphological variability of each strain and to utilize the results as a basis for resolving the formidable nomenclatural problems associated with Hyphomycetes in culture and in nature; (3) to describe and illustrate the species examined in culture so as to evaluate the more detailed microscopic characters used as criteria in the new scheme of classification; and (4) to construct a key to facilitate the identification of cultured species on a genus by genus approach.

The descriptions, illustrations and keys which result from these studies will be extremely useful in identifying Hyphomycetes in culture, especially those isolated from such materials as soil, water, humans, animals and plants. The present report deals with the genera *Stachybotrys* and *Memmoniella*.

## HISTORICAL TREATMENT OF THE GENERA

The imperfect genus *Stachybotrys* was proposed by Corda (1837) for a single species *S. atra* Corda. He described the genus as follows: "Stipes septus, ramosus; ramis apice ramulis verticillatis, mamillaribus, brevissimis, capitulum formantibus corematis; sporis didymis, homogenesis regulariter postis et capitulo innatis."

A detailed review of the earlier literature of the genus has been presented by Bisby (1943). From critical studies of cultures and herbarium specimens, he emended the genus as having the "Hyphae, phialophores, and phialides hyaline, brightly colored, or dark; strands or ropes of hyphae may be produced. Conidia (slime-spores) one-celled, normally dark and accumulating into a cluster." At that time there were over twenty species proposed in the literature, but Bisby reduced them to two distinct species, viz., *S. atra* and *S. subsimplex* Cooke. The type

species *S. atra* was later identified by Hughes (1958) with *Stilbospora chartarum* Ehrenberg ex Link. *Synsporium* Preuss was considered by Hughes as a synonym of *Stachybotrys*.

*Fuckelina* Saccardo (1875) was created to accommodate the conidial state of *Eriosphaeria raripila* Sacc. as *F. socia* Sacc. Saccardo (1878) later identified *E. raripila* with *Melanopsamma pomiformis* (Pers. ex Fr.) Sacc.; and Ferraris (1909) transferred *F. socia* to *Stachybotrys* as *S. socia* (Sacc.) Sacc.

*Gliobotrys* Höhnel (1902) was erected for a *Stachybotrys*-like species with hyaline conidiophores and conidia olivaceous in masses. The type species *G. alboviridis* Höhnel was later identified by Höhnel (1923) as the conidial state of *Melanopsamma pomiformis* (Booth, 1957). Therefore, *Fuckelina* and *Gliobotrys* must be synonyms and should be considered under *Stachybotrys*.

*Hyalostachybotrys* was established by Srinivasan (1958) to include two hyaline *Stachybotrys*-like fungi. Barron (1964) believed that a genus based on color of the conidia would have no taxonomic validity, and suggested that *Stachybotrys* should include not only the dematiaceous species but also the hyaline forms. He therefore reduced *Hyalostachybotrys* to synonymy with *Stachybotrys*.

The genus *Memmoniella* was erected by Höhnel (1923) to include those fungi which have the conidiophores with an apical cluster of several swollen phialides resembling those of *Stachybotrys* and the black phialoconidia borne in long chains recalling those of *Aspergillus niger* van Tieghem (Galloway, 1933). Although Zuck (1949) found that some isolates of the type species *M. echinata* (Rivolta) Galloway might occasionally produce a *Stachybotrys*-like phase in culture much like the description of *S. subsimplex sensu* Bisby (1943), he considered *Memmoniella* and *Stachybotrys* to be distinct genera. The morphological distinction between these two genera is the disposition of conidia which are in long chains in *Memmoniella* and in slimy masses in *Stachybotrys*. Nevertheless, Smith (1962) considered this distinction not sufficient to warrant separation of the two genera and transferred *M. echinata* to *Stachybotrys*. Kendrick and Carmichael (1973) recently accepted Smith's taxonomic treatment, though the

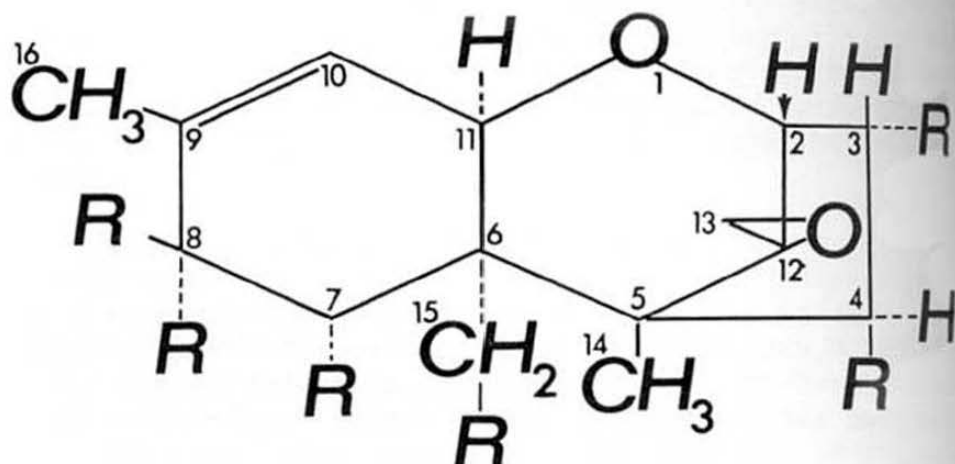


arrangement of conidia was used by them as one of the four independent character sets to characterize and order the hyphomycetous genera for identification. On the other hand, Padwick (1945), Deighton (1960), Matsushima (1971a,b; 1975) and Ellis (1971a) recognized *Memmoniella* as being distinctive from *Stachybotrys*. The culture of the *Memmoniella* examined in the course of the present study remain stable in the characters distinguishable from *Stachybotrys*, therefore we also consider the two genera to be distinct taxa.

### ECONOMIC SIGNIFICANCE

Members of *Stachybotrys* and *Memmoniella* are of worldwide distribution. Many of them are commonly found in soil and are capable of utilizing cellulose and damaging fabrics made of plant fibers. Cultures of the species *S. chartarum* and *M. echinata* have been used for fungus resistance tests in U. S. and British military specifications. Strains of *S. chartarum* (syn. *S. atra*, *S. alternans*) are also known to produce mycotoxins which have been reported as agents of stachybotryotoxicosis in animals and man (Gray, 1971; Rodricks & Eppley, 1974).

According to Forgacs (1965, 1972), stachybotryotoxicosis was first reported in horses from the Ukrainian S.S.R. in 1931. At that time it caused the death of thousands of horses in the Soviet Union. This disease has since been discovered to affect both animals and man, causing cutaneous and mucosal necrosis. It also may bring about leukopenia and agranulocytosis, and may finally affect the heart, causing standstill in systole (Forgacs, 1972; Palyusik, 1970a). The *Stachybotrys* toxins as a group contain certain compounds in common, but they differ somewhat in their chemical structures and biological effects (Korpinen *et al.*, 1974). They belong to the series of sesquiterpenoid mycotoxins classified as 12,13-epoxy- $\Delta^9$ -trichothecenes (Eppley & Bailey, 1973). The following formula shows the structural features of these toxicants.



The toxic compounds can be obtained from oat cultures as well as from synthetic agar cultures of *S. chartarum* by extraction with diethyl ether in a Soxhlet apparatus (Forgacs & Carll, 1962; Palyusik, 1970a, Korpinen & Ylimaki, 1972; Eppley & Bailey, 1973). The degree of toxicity varies in different strains (Forgacs *et al.*, 1958; Palyusik, 1970a; Korpinen & Uoti, 1974). In addition to *S. chartarum*, the fungi which have been shown capable of elaborating 12,13-epoxy- $\Delta^9$ -trichothecenes include *Cephalosporium crotocinigenum*, *Fusarium concolor*, *F. equiseti*, *F. nivale*, *F. scirpi*, *F. tricinctum*, *Gibberella zeae*, *Myrothecium roridum*, *M. verrucaria*, *Trichoderma viride*, and *Trichothecium roseum* (Bamburg & Strong, 1971; Wilson, 1973). These naturally occurring members of the trichothecenes are colorless, crystalline, optically-active solids with low water solubility. They are chemically quite stable when stored under laboratory conditions and are not destroyed by usual cooking procedures (Bamburg & Strong, 1971). A toxic substance extracted from a strain of *S. chartarum* was found to be cytotoxic even at lower concentrations than aflatoxin B<sub>1</sub> (Bodon & Palyusik, 1970).

Feed contaminated with *S. chartarum* is the main source of the agent causing stachybotryotoxicosis in animals. Under field conditions, toxicosis can affect horses, cattle, hens, hippopotamus, bison, sheep, buffaloes, swine and poultry (Palyusik, 1970a; Rodricks & Eppley, 1974). Stachybotryotoxicosis may occur in man exposed to the fungus (Drobotko, 1945). The toxins are said to be absorbed through the skin and by inhalation, and illness may follow exposure from the handling or burning of hay molded by the fungus (Emmons *et al.*, 1970; Rodricks & Eppley, 1974).

### PHYSIOLOGICAL CHARACTERS

Marsh and Bollenbacher (1946) showed that *S. chartarum* (as *S. atra*) and *M. echinata* were similar in many physiological characteristics, including the ability to grow on synthetic medium containing only biotin, glucose and inorganic salts. Perlman (1948) and Jermyn (1953) further confirmed their conclusions, and found that both fungi can utilize some twenty sugars and sugar derivatives as sole sources of carbon for growth. Growth was increased with the addition of traces of iron, zinc or manganese to the medium but was decreased with the addition of nickel, cobalt, chromium or aluminum.

Biotin deficiency was reported to be characteristic of *M. echinata* and *S. chartarum* (Marsh & Bollenbacher, 1946; Perlman, 1948). The absolute requirement of biotin was usually less than 5 µg per liter. However, the presence of aspartic acid in the culture medium was shown to reduce the amount of biotin required (Perlman, 1948). Lilly and Barnett (1951) noted that the variability of cellulolytic activity in strains of *M. echinata* in laboratory tests was possible correlated with biotin deficiency. The relationship between the amounts of sugar and biotin necessary for sporulation was described by Buston and Basu (1948). Less biotin was required for vegetative growth than for sporulation. Sporulation was conditioned by the concentrations of biotin and of the sugars present.

Perlman (1951) reported that *M. echinata* required biotin for spore germination. Growth from a spore inoculum required biotin, which was not replaceable by

desthiobiotin. However, if desthiobiotin was added to a growing culture supplied with limiting amounts of biotin, the desthiobiotin elicited a significant growth response. Since the mycelium is able to convert desthiobiotin to biotin but the spore cannot, the spore germination is affected by growth factor deficiencies (Cochrane, 1958).

Cultural studies done by Barron (1962) also indicated that *S. bisbyi* (as *S. aurantia*) had a rapid growth rate and, on a minimal synthetic medium, required a biotin supplement for normal growth, as reported in both *S. chartarum* and *M. echinata*.

*Stachybotrys chartarum* was found to synthesize humic acid-type polymers (Martin & Haider, 1969). The amino acid composition of *S. chartarum* humic acid was reported to be similar to that of soil humic acids (Ortiz de Serra *et al.*, 1973). Additions of a small amount of clay minerals, especially montmorillonite, to well-aerated cultures of this fungus greatly accelerated growth, glucose utilization, CO<sub>2</sub> evolution, phenol synthesis, and phenolic polymer formation (Filip *et al.*, 1972a,b). Nitrate-N was a poor nitrogen source for *S. chartarum*, but was a relatively good source of N in the presence of montmorillonite (Bordietti *et al.*, 1971).

*Memnoniella echinata* was reported to form acetic acid from carbohydrates (Perlman, 1951).

In tests of the microbiological deterioration of cellulosic fibers, a few strains of *S. chartarum* and *M. echinata* were found to be definitely active (Thom *et al.*, 1934; Greathous *et al.*, 1942; White *et al.*, 1948, 1949; Marsh *et al.*, 1949; Reese *et al.*, 1950).

*Stachybotrys chartarum* synthesizes at least three enzymes capable of hydrolyzing  $\beta$ -glucosidase (Jermyn, 1955a), cellobiase (Youatt, 1958), and cellulase (Thomas, 1956). The specificity of these enzymes and their relationship was summarized by Youatt and Jermyn (1959). *Stachybotrys chartarum* produces the  $\beta$ -glucosidase over a wide range of culture conditions. The induction and biochemistry of this  $\beta$ -glucosidase has been intensively studied by Jermyn (1955a,b,c; 1962; 1965a,b,c; 1966a,b). Thomas (1956) reported that the optimum pH for the crude cellulase preparation from *S. chartarum* was 6.5-8.0.

Cochrane (1958) noted that pectin-polygalacturonase was found to occur in *S. chartarum*.

Of the 27 genera including 52 species of fungi, 6 species of Actinomycetes and 5 genera including 10 species of bacteria tested, Butt and Ghaffer (1972) found that *S. chartarum* (as *S. atra*) was able to inhibit the growth of 95.7% of the fungi, all the Actinomycetes and 83.3% of the bacteria.

## MORPHOLOGY AND DEVELOPMENT

Members of *Stachybotrys* and *Memmoniella* are morphologically and developmentally closely related (Zuck, 1946; White *et al.*, 1949; Campbell, 1975). The unifying feature in common is the production of macronematous conidiophores with an apical cluster of several unicellular conidiogenous cells bearing unicellular enteroblastic-phialidic conidia (Barron, 1968; Kendrick & Charmichael, 1973). The genera differ primarily in the arrangement of the conidia, which are aggregated in slimy heads in *Stachybotrys* and in long persistent chains with the youngest conidium at the basal end of the chain in *Memmoniella* (Ellis, 1971a).

The conidiogenous cells of *Stachybotrys* and *Memmoniella* are considered to be phialides (Hughes, 1953; Tubaki, 1958; Barron, 1968; Ellis, 1971a; Kendrick & Carmichael, 1973). The phialide was defined by Kendrick (1971) as a conidiogenous cells in which at least the first conidium initial is produced within an apical extension of the cell and the conidium is liberated by the rupture of the upper wall. Thereafter, from a fixed conidiogenous locus, the second and subsequent conidia are developed, each clad in an entirely new wall which is not derived from any existing layers of the wall of the conidiogenous cell. Any phialide wall distal to the conidiogenous locus is the collarette. The length of the phialide does not change while conidia are being produced.

However, the electron microscopical studies of phialoconidiogenesis in *Aspergillus clavatus* (Hanlin, 1976), *A. flavus* (Bojović-Cvetić & Vuyičić, 1974), *A. fumigatus* (Ghiorse & Edwards, 1973), *A. giganteus* (Trinci *et al.*, 1968), *A. nidulans* (Oliver, 1972), *A. niger*



(Tsukahara, 1970), *Neurospora crassa* (Lowrey et al., 1967), *Metarrhizium anisopliae* (Hammill, 1972), *Verticillium albo-atrum* and *V. nigrescens* (Buckeley et al., 1969), *Penicillium claviforme* (Zachariah & Fitz-James, 1967; Fletcher, 1971), *P. clavigerum* and *P. corymbiferum* (Fletcher, 1971), *Phialocephala dimorphospora* (Carroll & Carroll, 1974), *Phialophora richardsiae* (Olah & Reisinger, 1974) *Stilbothamnium nudipes* (Roguebert & Abadie, 1973), and *Trichoderma saturnisporum* (Hammill, 1974) have further refined the concept of phialoconidium formation. The characteristic features of phialoconidiogenesis are: (1) the inner cell wall of the conidiogenous cell gives rise to the conidium wall; (2) the successive production of conidia from a fixed conidiogenous locus inside the phialide shows no elongation once its tip is ruptured; (3) the phialoconidia are determined by transverse septa; and (4) the conidia are produced individually as discrete units to form slimy heads, or successive conidia are connected by a common septum to form persistent chains.

Campbell (1972; 1975) published the ultrastructure of conidiogenesis in *Stachybotrys chartarum* (as *S. atra*) and *Memmoniella echinata*. His interpretation and electron micrographs of both fungi appear essentially in agreement with those described for other enteroblastic-phialidic fungi mentioned above.

In *Stachybotrys* conidiophores arise from either intercalary or terminal cells of the mycelium. They are macronematous, morphologically different from purely vegetative hyphae, and determinate, i.e., the growth in length of the conidiophores ceases with the production of the first phialide. As the first phialide enlarges into its typical shape a cross septum is formed. Thereafter other phialides develop successively in a verticillate fashion below this septum, so that the first-formed phialide usually becomes the central one of the group. The wall of the phialide is continuous with the wall of the conidiophore. According to Campbell (1972) the septa which delimit the phialides from the conidiophore have a single central pore.

Phialides are always unicellular, generally cylindrical and usually slightly swollen in the upper portion before they taper to a narrow conidiogenous neck. The forming conidium first appears as a small bulbous



enlargement at the tip of the phialide neck. Since the outer layers of the phialide wall break very soon after the first conidium starts expanding, the opening of the phialide neck becomes the collarette; this is very short, but distinctive even under the light microscope. The growth in length of a phialide ceases with the rupture of the phialide neck. All conidia appear to develop successively in a fixed conidiogenous locus just beneath the opening in a phialide. The wall of the conidia originates from the inner layer of the phialide tip. The succession of conidial formation causes the inward thickening of the inner wall layers of the collarette (Campbell, 1972).

Phialoconidia are always unicellular and acrogenous. The contents of the conidiogenous cell pass through the opening and the conidia take shape immediately on the outside of the collarette. They are enteroblastic in that the outer layers of the phialide wall are not involved in the formation of the conidial wall (Kendrick, 1971; Ellis, 1971). Just prior to dehiscence, a cross-wall is laid down at the base of the mature conidium and at this point the conidium is released from the phialide (Campbell, 1972). Conidia are produced singly and successively as separate units and produce a slime that forms a mucilaginous mass which envelops the tips of the phialides.

As mentioned earlier, *Memmoniella* and *Stachybotrys* differ morphologically in the arrangement of the conidia. Developmentally they are similar, except that the phialoconidia in *Memmoniella* are produced in a basipetal succession and are held to each other by a common septum in long persistent chains. According to Campbell (1975), the main difference between *Memmoniella* which produces chains of conidia and *Stachybotrys* which produces slimy heads is in the length of time between the formation of the septum in the phialide neck and its splitting when the conidia separate. In *Stachybotrys* the new conidia arise after previous ones are mature and have been released from the phialide neck, whereas in *Memmoniella* the new conidia arise in basipetal succession before the previous ones are mature. Essentially the same pattern of development of conidial chains seen in *Memmoniella* is also found in several other imperfect genera, e.g., *Aspergillus*, *Paecilomyces* and *Phialomyces* (Subramanian, 1972).

The shape, size, color, and ornamented surface of phialoconidia are used principally to distinguish the species of *Stachybotrys* and *Memmoniella*.

#### THE PERFECT STATE

*Melanopsamma pomiformis* (Pers. ex Fr.) Sacc. is the only ascomycetous fungus known to have a *Stachybotrys* conidial state. This relationship was established by earlier workers on the basis of the association of conidia and perithecial stromata in nature. According to Booth (1957), the first cultural verification was made in 1944 by E. W. Mason who found *Stachybotrys socia* Sacc. from single ascospore cultures of *M. pomiformis*. Booth further confirmed Mason's cultural evidence and discussed the taxonomic dispositions of this fungus, including perfect and imperfect states, in detail. The pertinent literature dealing with this relationship is summarized briefly and chronologically as follows:

- 1805 Albertini and Schweinitz first reported the possible conidial state of *Sphaeria pomiformis* Pers.
- 1871 Berkeley and Broome described *S. pomiformis* with the conidial state *Sporocybe albipes* Berk. & Br.
- 1875 Saccardo created a new name *Fuckelina socia* Sacc. for the conidial state of *Eriosphaeria raripila* Sacc. which was later identified by Saccardo (1877) with *Sphaeria pomiformis*.
- 1822 Saccardo combined *Melanopsamma pomiformis* with *Sporocybe albipes* as its conidial state and placed *F. socia* as a synonym.
- 1886 Saccardo described *F. socia* with a note that it was a conidial state of *M. pomiformis* and possibly identical with *S. albipes*.
- 1909 Ferraris transferred *Fuckelina socia* to *Stachybotrys* and proposed the new combination *Stachybotrys socia* (Sacc.) Sacc.
- 1912 Ferraris listed *Stachybotrys socia* as the conidial state of *Melanopsamma pomiformis*.

- 1923 Höhnelt found *Gliobotrys albiviridis* Höhnelt (1902) associated with perithecia of *M. pomiformis* and identified the former with *Sporocybe albipes* and *Fuckelina socia*. A new combination *Fuckelina albipes* (Berk. & Br.) Höhnelt was made.
- 1957 Booth gave a detailed account of the conidial state of *M. pomiformis* with the description and illustration from single ascospore cultures. The disposition of the conidial state was discussed. He considered *Sporocybe albipes* (= *Fuckelina albipes*), *Fuckelina socia* (= *Stachybotrys socia*), and *Gliobotrys albiviridis* synonyms, but did not make a new combination.
- 1958 Hughes listed *Stachybotrys socia* as the conidial state of *M. pomiformis*.
- 1968 Verona and Mazzucchetti reproduced Booth's description and drawing of the conidial state of *M. pomiformis* under the name *Stachybotrys socia*.

No perfect states in the life history of any species of *Memnoniella* have been reported.

#### KEY TO THE SPECIES OF *STACHYBOTRYS* AND *MEMNONIELLA* IN CULTURE

(Based on cultures grown on cornmeal agar except *S. theobromae* which is on potato dextrose agar)

- |    |  |                      |
|----|--|----------------------|
| 1. | Phialoconidia in chains ( <i>Memnoniella</i> ) . . . . .               | 2                    |
| 1. | Phialoconidia in mucilaginous masses ( <i>Stachybotrys</i> ) . . . . . | 3                    |
| 2. | Mature conidia mostly 3-6 $\mu$ m in diameter . . . . .                | <i>M. echinata</i>   |
| 2. | Mature conidia mostly 6-9 $\mu$ m in diameter . . . . .                | <i>M. subsimplex</i> |
| 3. | Mature conidia colorless . . . . .                                     | <i>S. bisbyi</i>     |
| 3. | Mature conidia green or olive gray . . . . .                           | 4                    |

4. Mature conidia green, more  
than 12  $\mu\text{m}$  in width . . . . . *S. theobromae*
4. Mature conidia olive gray,  
less than 9  $\mu\text{m}$  in diameter . . . . . 5
5. Surface of mature conidia  
smooth-walled . . . . . *S. albipes*
5. Surface of mature conidia coarsely  
roughened or striated or banded  
and ridged . . . . . 6
6. Mature conidia spherical . . . . . *S. microspora*
6. Mature conidia not spherical . . . . . 7
7. Surface of mature conidia  
with striation . . . . . *S. cylindrospora*
7. Surface of mature conidia coarsely  
roughened, without striation . . . . . 8
8. Mature conidia 5-6 X 3-3.5  $\mu\text{m}$  . *S. parvispora*
8. Mature conidia larger, more than  
7  $\mu\text{m}$  in length and 4  $\mu\text{m}$  in width . . . . . 9
9. Mature conidia reniform or ellipsoidal  
to reniform . . . . . 10
9. Mature conidia ovate to ellipsoidal . . . . . 11
10. Mature conidia reniform,  
10-12 X 5-6  $\mu\text{m}$  . . . . . *S. nephrospora*
10. Mature conidia ellipsoidal to  
reniform, 9-10 X 5-7  $\mu\text{m}$  . . . . . *S. oenantes*
11. Mature conidia showing banded or  
ridged roughenings . . . . . *S. chartarum*
11. Mature conidia not as above . . . . . 12
12. Mature conidia ovate,  
7.5-10 X 5-7  $\mu\text{m}$  . . . . . *S. dichroa*
12. Mature conidia ellipsoidal,  
10-14 X 6-7  $\mu\text{m}$  . . . . . *S. kampalensis*

## DESCRIPTIONS AND ILLUSTRATIONS

*Stachybotrys albipes* (Berk. & Br.) Jong & Davis, comb. nov.

≡ *Sporocybe albipes* Berk. & Br., Ann. Mag. Nat. Hist. 8: 19. 1971.

≡ *Fuckelina albipes* (Berk. & Br.) Höhnelt, Zbl. Bakt. Bd. 60, p. 13. 1923.

= *Fuckelina socia* Sacc., Nuovo G. Bot. Ital. 7: 326. 1875.

≡ *Stachybotrys socia* (Sacc.) Sacc. in Ferraris, Ann. Mycol. 7: 283. 1909.

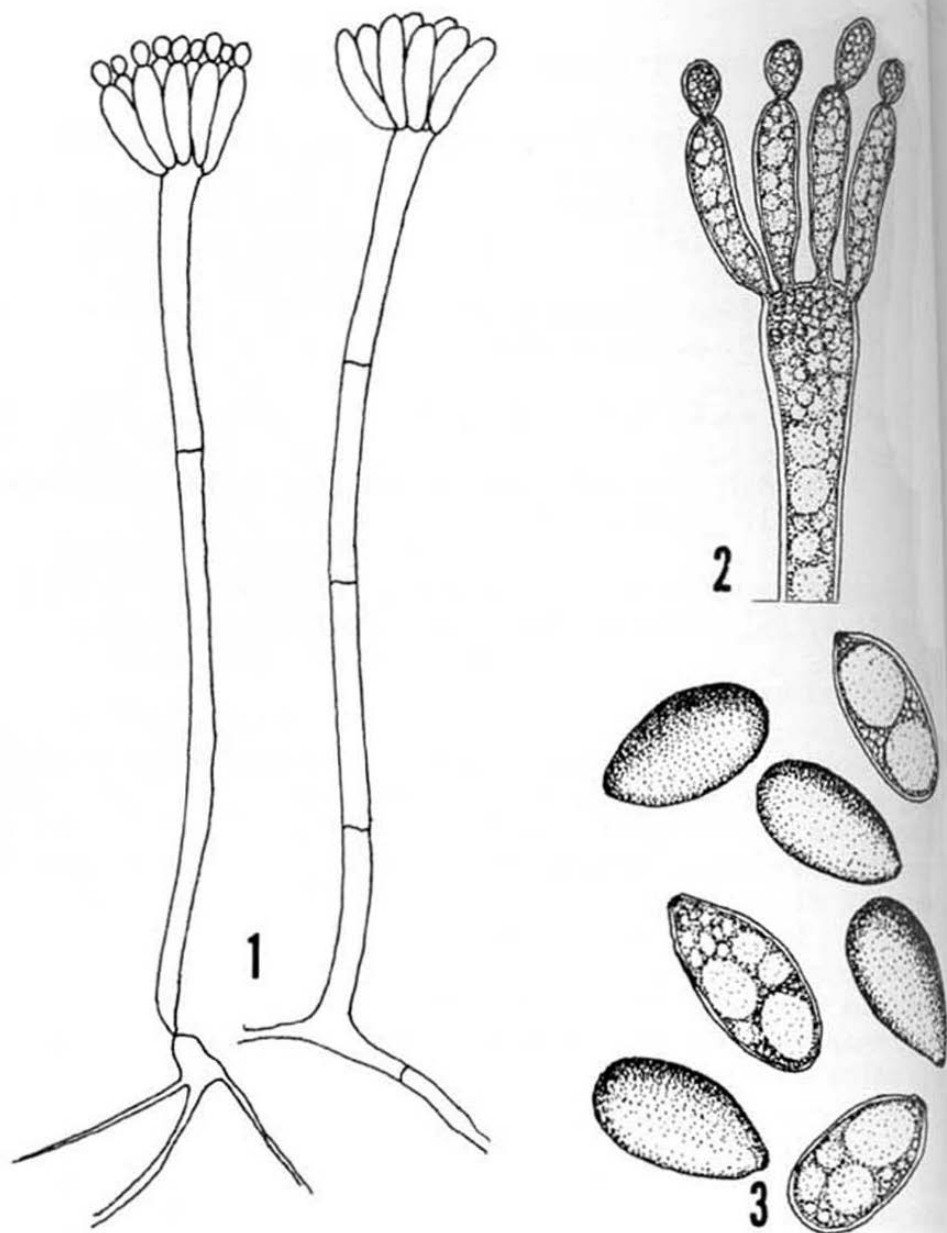
= *Gliobotrys alboviridis* Höhnelt, S. B. Akad. Wiss. Wien, Abt. 1, 111: 1048. 1902.

Figures 1-6.

Growth on cornmeal agar extremely restricted, attaining a diameter of 2 cm in 3 weeks. The surface of colony downy, uniformly dense, white, becoming dark granulate as conidia develop. Margin of colony distinct due to the absence of conidia, colorless, with compact submerged hyphae. No staining of medium in advance of mycelium. Reverse at first uncolored, later becoming olive green. Conidia produced abundantly a week following inoculation, first in the center, then centrifugally toward the margin of colonies.

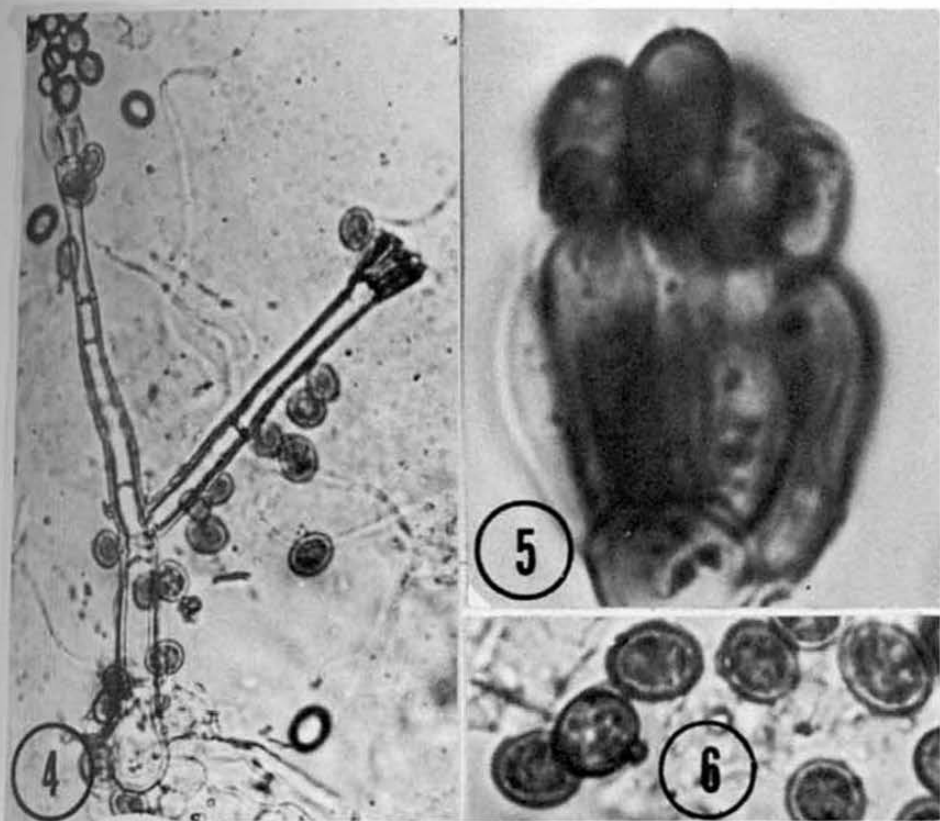
Conidiophores determinate, macronematous, singly or in small groups, erect, straight or slightly curved, simple, occasionally branched, 3-7  $\mu\text{m}$  wide, the basal cell slightly inflated and attenuate toward the tip, usually smooth throughout the length, but sometimes minutely rough-walled at the upper parts, slightly enlarged at the apex which bears terminal phialides in a whorl of 6-10 around a central phialide.

Phialides enteroblastic, determinate, discrete, unicellular, subclavate, hyaline, smooth-walled, 9-16 X 3-5  $\mu\text{m}$ , with inconspicuous collarettes.



Figures 1-3. *Stachybotrys albipes* ATCC 18873.  
 1. Conidiophores with terminal phialides and phialoconidia, ca. X 500. 2. Phialides in a whorl of 4. ca. X 1,200.  
 3. Phialoconidia with a smooth surface. ca. X 2,400.





Figures 4-6. *Stachybotrys albipes* ATCC 18873.

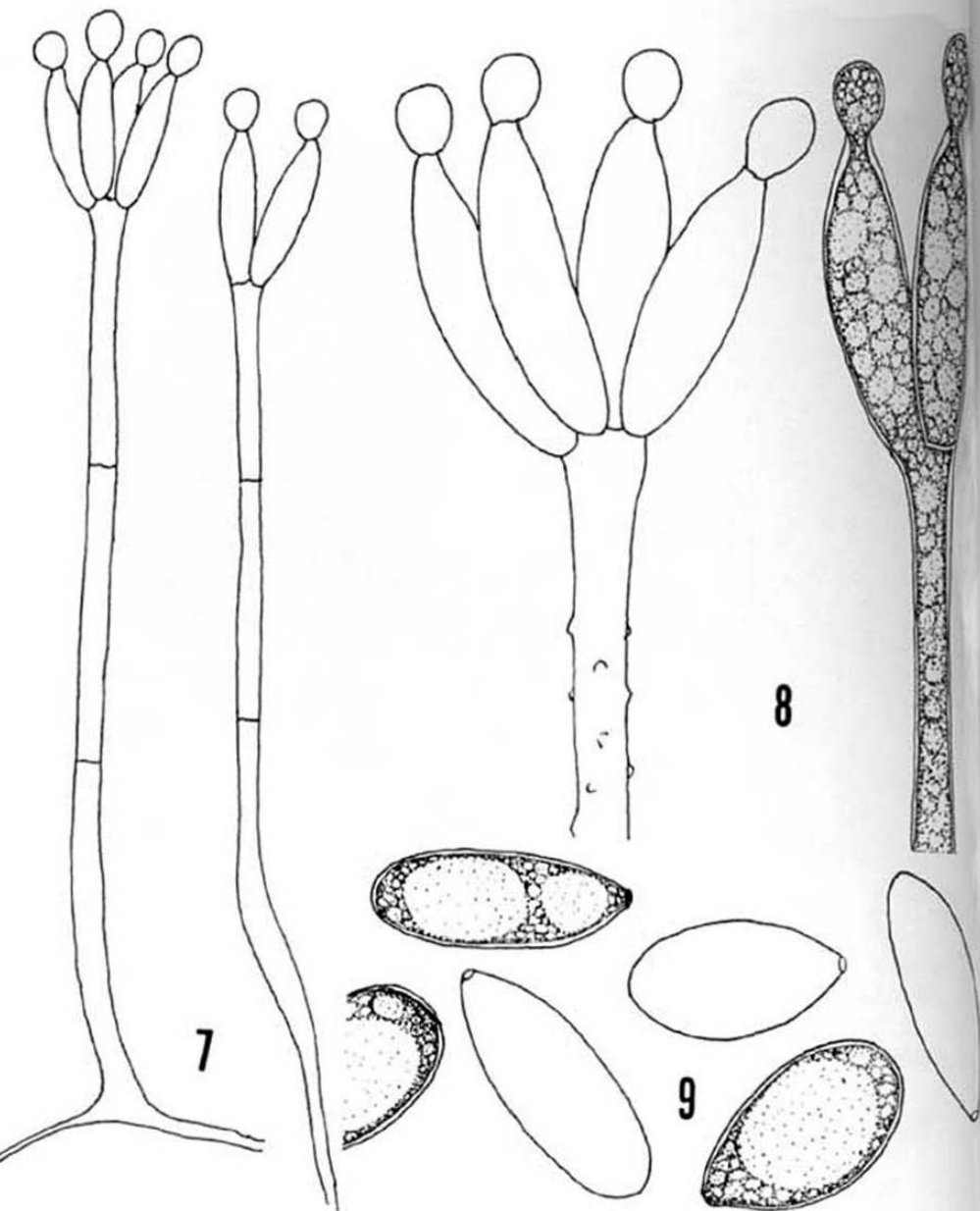
4. Conidiophores with phialides and phialoconidia.

ca. X 250. 5. Phialides with phialoconidia. ca. X 2,000.

6. Phialoconidia. ca. X 1,200.

Phialoconidia acrogenous, aggregated in slimy masses, unicellular, at first hyaline, when mature, dark olive gray, smooth-walled, ovate, size variable, 4-12 X 3-6  $\mu$ m, mostly 7-9 X 5-6  $\mu$ m.

**REMARKS:** The perfect state of this fungus is known to be *Melanopsamma pomiformis* (Pers. ex Fr.) Sacc. Booth (1957) has discussed the taxonomic dispositions of this fungus, including perfect and imperfect states, in detail. As the summary of the dispositions of the conidial state listed above, it appears that the name *Stachybotrys socia* is evidently preceded by *Sporocybe albipes* Berk. & Br. Since

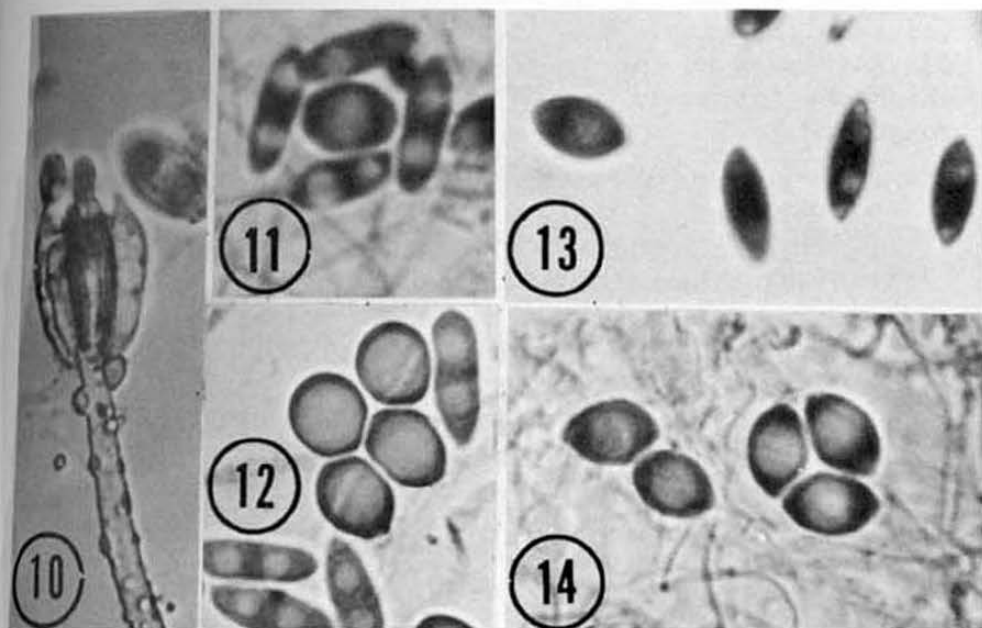


Figures 7-9. *Stachybotrys bisbyi* ATCC 22173.

7. Conidiophores with phialides and phialoconidia.

ca. X 800. 8. Phialides. ca. X 2,000. 9. Phialoconidia.

Note the size and shape. ca. X 2,000.



Figures 10-14. *Stachybotrys bisbyi* from cotton blue in lactic acid mounts. 10. Phialides (ATCC 18825). ca. X 1,000. 11-14. Phialides. Note the size and shape. ca. X 1,000. 11. ATCC 18874. 12. ATCC 22215. 13-14. ATCC 22173.

Booth did not make a new combination, *Stachybotrys albipes* (Berk. & Br.) Jong & Davis is herein given in accordance with Articles 33 and 59 of the International Code of Botanical Nomenclature (Stafleu *et al.*, 1972).

The culture (ATCC 18873) studied is a single ascospore isolate of *M. pomiformis* which was originally isolated by Booth (1957) from *Ulmus* sp. in Fountains Abbey Woods, Yorkshire. This culture was received from Commonwealth Mycological Institute (CMI) as *Melanopsamma pomiformis* (Pers. ex Fr.) Sacc. IMI 56,393. It produces only a *Stachybotrys* state in culture. Growth and sporulation occur on cornmeal agar at temperatures in the range of 15 to 30 C. It grows on cellulose agar, but no clearing of the medium indicates that it is not a cellulose-decomposing strain. Morphologically,

*Stachybotrys albipes* is akin to *S. dichroa* in having thick-walled simple conidiophores, but they can be distinguished by the ornamentation of the spore wall on which the former is smooth and the latter is coarsely roughened.

*Stachybotrys bisbyi* (Srinivasan) Barron, *Mycologia* 56: 315. 1964.

≡ *Hyalostachybotrys bisbyi* Srinivasan, *J. Indian Bot. Soc.* 37: 341. 1958.

= *Hyalostachybotrys sacchari* Srinivasan, *J. Indian Bot. Soc.* 37: 341. 1958.

≡ *Stachybotrys sacchari* (Srinivasan) Barron, *Mycologia* 56: 315. 1964.

= *Stachybotrys aurantia* Barron, *Can. J. Bot.* 40: 258. 1962.

Figures 7-14.

Colonies on cornmeal agar covering Petri dish plates in 2 weeks. The surface downy, uniformly dense, white, covered by a pale gray to salmon pink powdery bloom of conidial masses. Margin of colony not distinct, with compact hyphae. No staining of medium in advance of mycelium. Conidia produced abundantly a week after inoculation of plates. Cultures tending to lose the ability to produce conidia after several transfers.

Conidiophores determinate, macronematous, solitary or in groups, erect, straight or slightly curved, simple or branched, 2-5 septate, hyaline, up to 200  $\mu\text{m}$  long, 3-4  $\mu\text{m}$  wide, the basal cell slightly inflated, attenuate toward the tip, sometimes minutely rough-walled at the upper parts, sometimes more or less smooth throughout the length, slightly enlarged at the apex which bears terminal phialides in a whorl of 3-8 around a central phialide.

Phialides enteroblastic, determinate, discrete, unicellular, subclavate, hyaline, smooth-walled, 10-17 X 4-6  $\mu\text{m}$ , with conspicuous collarettes.

Phialoconidia acrogenous, aggregated in slimy masses, hyaline, smooth-walled, one-celled, one to three guttulate, lemon-shaped or fusiform, 8-14 X 6-9  $\mu\text{m}$  or 10-16 X 3-6  $\mu\text{m}$ .

REMARKS: Bisby (1943) first reported a hyaline form of *Stachybotrys* isolated from soil by J. E. Machacek in Winnipeg, Canada. He called it a "pink *Stachybotrys*." When he knew Machacek later found a few more similar cultures from soil in Manitoba, Bisby (1945) suggested that it might represent a new genus and species.

Srinivasan (1958) concurred with Bisby's suggestion and created a new genus *Hyalostachybotrys* to accommodate these hyaline fungi resembling *Stachybotrys*. He described two species based on his own isolates from tropical South India. The type species, *H. bisbyi*, was isolated from rhizosphere of *Erianthus munja* Michaux and of *E. arundinaceus* Michaux. The "pink *Stachybotrys*" (IMI 10945) originally isolated from soil by Machacek was also disposed as *H. bisbyi*. The second species, *H. sacchari*, was a weak pathogen of sugar cane sheaths and was also isolated from the rhizosphere of sugarcane. The delimitation of these two species was primarily based on size and shape of phialospores. Srinivasan also clearly indicated that there were variations among the cultures studied by him in the amount of aerial mycelium, color of spore masses, branching of the conidiophores and in the size and shape of conidia.

Unaware of Srinivasan's work, Barron (1926) described a new soil hyphomycete, *Stachybotrys aurantia* Barron, which is identical with Srinivasan's *H. bisbyi*. Barron (1964) later disagreed with Srinivasan's creation of the genus *Hyalostachybotrys* because he believed that a genus based on color of the conidium would have no taxonomic validity. He therefore relegated *Hyalostachybotrys* to synonymy with *Stachybotrys*, and considered both of Srinivasan's species as *Stachybotrys*.

In the present study the following hyaline *Stachybotrys* isolates were studied.

- ATCC 18825: received from L. W. Durrell, Colorado State Univ. (as *S. bisbyi*), isolated by W. A. Kreutzer from rhizosphere of Western wheat grass, Society Islands.
- ATCC 18850 = IMI 100,544 (as *S. sacchari*): isolated by B. L. Mathur, from soil, India.
- ATCC 18853 = IMI 116,426 (as *S. sacchari*): isolated by A. H. Moubasher from soil, Egypt.
- ATCC 18874 = IMI 91,211 (as *S. sacchari*): isolated by J. R. Anderson from *Saccharum officinarum*, S. Africa.
- ATCC 18885 = IMI 10,945 (as *S. bisbyi*): isolated by Machacek from soil, Canada.
- ATCC 22172 = CBS 363.58 (as *S. bisbyi*): isolated by H. J. Swart from soil mangrove swamps, Mozambique.
- ATCC 22173 = CBS 399.65 (as *S. bisbyi*): isolated by I. Focke from *Zea mays* root.
- ATCC 22215: received from M. Morrall, Univ. of Saskatchewan (as *Stachybotrys* sp.), isolated from roots of grasses, Canada.
- ATCC 22701: isolated by T. Matsushima from rotton wood, Papua-New Guinea (as *S. aurantia* MFC-2833).
- ATCC 22702: isolated by T. Matsushima from soil, Papua-New Guinea (as *S. aurantia* MFC-4097).

Because of the extreme variability in the conidial morphology of these isolates, a clear differentiation of *S. bisbyi* and *S. sacchari* seems impossible. According to Srinivasan (1958), the size of conidia is 10.0-16.4 X 5.0-11.6  $\mu\text{m}$  for *S. bisbyi* and 7.6-11.6 X 2.6-3.7  $\mu\text{m}$  and 6.5-10.8 X 5.3-8.5  $\mu\text{m}$  for *S. sacchari*. However, the description and illustration of *S. bisbyi* (as *S. aurantia*) given by Barron (1962) shows that it also properly fits the description and illustration of *S. sacchari* given by Srinivasan. It is apparent that in the past the concept



of both species is overlapped and possibly one is the morphological variant of the other.

The species description presented is primarily based upon the strain ATCC 22173. Indeed, all the strains examined produce both globose and fusiform types of conidia, but most often they are dominated by one type depending on culture conditions such as media, temperature, light and age of cultures. The conidial size, 10-16 X 3-6  $\mu\text{m}$  for fusiform and 8-14 X 609  $\mu\text{m}$  for lemon-shaped, includes those of *S. bisbyi* and *S. sacchari* originally described by Srinivasan. Since *S. bisbyi* is the type species of the genus *Hyllostachybotrys* and has a priority over *S. sacchari*, it is herein recommended that *S. sacchari* be considered a synonym of *S. bisbyi*.

Two additional hyaline species were described by Rifai (1964, 1974) from Java. *Stachybotrys bambusicola* Rifai was recovered on the fallen culm sheath of cultivated bamboo and *S. palmijunci* Rifai was on a decaying stem of the rattan *Daemonorhops melanochaetes* Bl. In both species the conidiophores are reddish brown and capable of elongating by proliferations; the phialoconidia are hyaline or subhyaline but pink in masses. They have only been recorded from the type locality and there are no cultures available for further studies. According to Rifai (1974), the two Javanese species are closely related but differ in size and shape of phialoconidia.

*Stachybotrys chartarum* (Ehrenb. ex Link) Hughes, Can. J. Bot. 36: 812. 1958.

≡ *Stilbospora chartarum* Ehrenb., Sylvae Myc. Berol. pp. 9, 21. 1818.

≡ *Oidium chartarum* Ehrenb. ex Link, Linn. Spec. Plant., IV, 6(1): 124. 1824.

≡ *Oospora chartarum* (Ehrenb. ex Link) Wallr., Flora Crypt. German. 2: 184. 1833.

= *Stachybotrys atra* Corda, Icon. Fung. 1: 21. 1837.

= *Aspergillus alternatus* Berk., Ann. Mag. Nat. Hist. 1: 262. 1838.

- = *Sporocybe lobulata* Berk., Ann. Mag. Nat. Hist. 6: 434. 1841.
- ≡ *Stachybotrys lobulata* (Berk.) Berk., Outlines Brit. Fung. p. 343. 1860.
- = *Synsporium biguttatum* Preuss, Klotzschii Herb. Viv. Mycol., No. 1285, anno 1849.
- = *Stachybotrys altermans* Bon., Handb. Myk. 117. Fig. 185. 1851.
- = *Memnonium sphaerospermum* Fuckel, Symb. Mycol. p. 358. 1870.
- = *Stachybotrys scabra* Cooke & Harkness, Grevillea 12: 96. 1884.
- = *Stachybotrys asperula* Masee & Cooke, Grevillea 16: 26. 1887.
- = *Stachybotrys verrucosa* Cooke & Masee, Grevillea 16: 102. 1888.
- = *Stachybotrys atrogrisea* Ellis & Ev., J. Mycol. 4: 106. 1888.
- = *Trichosporum effusum* (Corda) Sacc. subsp. *binucleatum* Karst., Hedwigia 29: 272. 1890.
- = *Stachybotrys gracilis* Em. March., Bull. Soc. Belg. Micro. 7: 265. 1894.
- = *Stachybotrys pulchra* Speg., Rev. Agr. y Veter. La Plata. p. 248. 1896.
- = *Stachybotrys elasticae* Koord., Botan. Untersuch. Java Pilza. p. 227. Fig. 37. 1907.
- = *Stachybotrys dakotensis* Sacc., Atti Mem. R. Acad. Sci., Lett., Arti, Padova. 33: 174. 1917.
- = *Stachybotrys voglinii* Cif., Ann. Mycol. 20: 48. 1922.

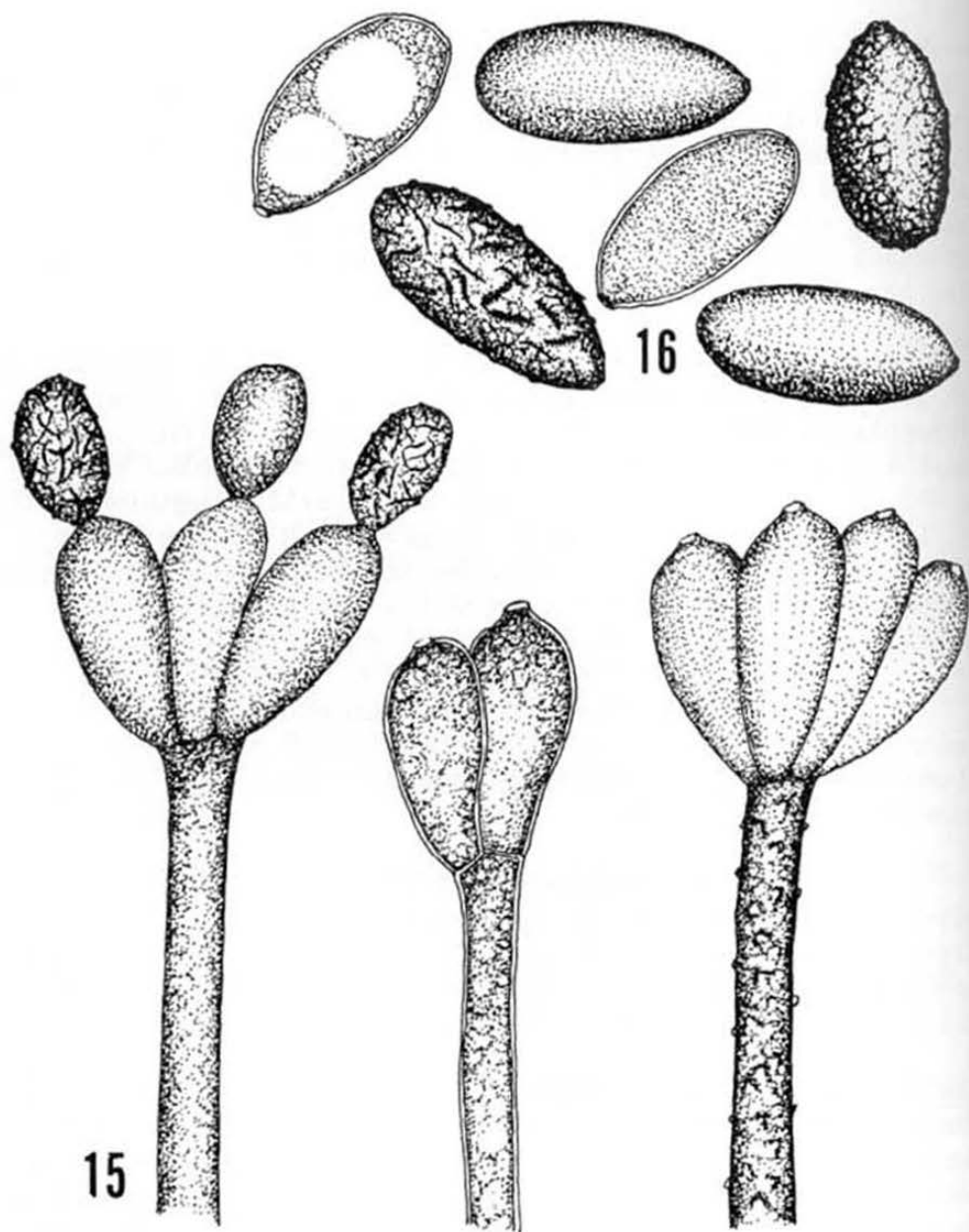
Colonies on cornmeal agar covering Petri-dish plates in 3 weeks, appressed, uniformly dense, uncolored at first, becoming dull dark, covered by a dark powdery bloom of conidial masses. Margin of colony distinct due to the absence of conidia, white, with compact hyphae. No staining of medium in advance of mycelium. Conidial production in abundance 3 days following inoculation on the plates.

Conidiophores determinate, macronematous, solitary or in groups, erect, straight or slightly curved, simple or irregularly branched, 2-4 septate, hyaline at the base, dark olivaceous toward the apex, length variable, up to 1,000  $\mu\text{m}$  long, 3-6  $\mu\text{m}$  wide, the basal cell slightly inflated, sometimes minutely rough-walled at the upper parts, sometimes more or less smooth throughout the length, slightly enlarged at the apex which bears terminal phialides in a whorl of 3-9 around a central phialide.

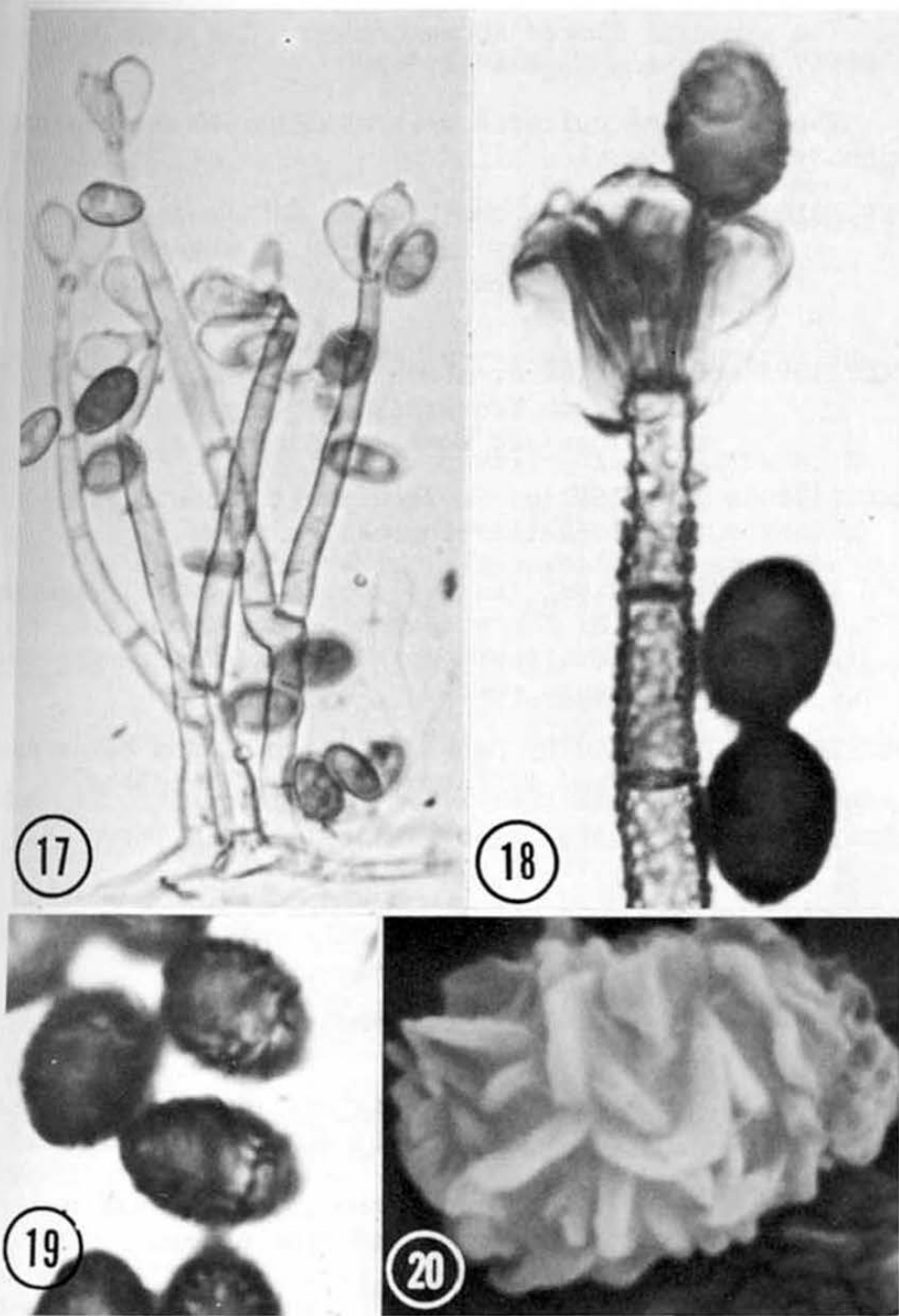
Phialides enteroblastic, determinate, discrete, unicellular, at first hyaline, later dark olivaceous, obovate or ellipsoid, smooth-walled, 9-14 X 4-6  $\mu\text{m}$ , with conspicuous collarettes.

Phialoconidia acrogenous, arising singly and successively as separate units, aggregated in slimy masses, at first hyaline, when mature, dark olive gray, more or less opaque, smooth-walled or showing banded or ridged, ellipsoidal, unicellular, 7-12 X 4-6  $\mu\text{m}$ .

REMARKS: *Stachybotrys atra*, the type species of the genus *Stachybotrys*, was first described by Corda (1837) with two-celled conidia. From critical studies of cultures and herbarium specimens, Bisby (1943) emended both generic and species descriptions with one-celled phialoconidia. Because of the great variability in the morphology of *S. atra* examined in culture, Bisby reduced more than ten *Stachybotrys* species which he thought were based on such morphological variants to synonyms with *S. atra*. Hughes (1958) later reexamined the type material of *S. atra* and identified it with *Stachybotrys chartarum* (Ehrenb.) Hughes. However, the correct combination should be *S. chartarum* (Ehrenb. ex Link) Hughes, in accordance with Article 13 of the International Code of Botanical Nomenclature (Stafleu *et al.*, 1972).



Figures 15-16. *Stachybotrys chartarum* ATCC 11716.  
15. Phialides. Note the conspicuous terminal openings through which phialoconidia are being produced. ca. X 1,500. 16. Phialoconidia. Note the ridged or banded surface. ca. X 2,500.



Figures 17-20. *Stachybotrys chartarum* ATCC 11716.  
 17. Branching habit of conidiophores. ca. X 1,000.  
 18. Phialides. ca. X 2,000. 19-20. Phialoconidia  
 featuring a ridged or banded surface. 19. Regular  
 light micrograph. ca. X 2,000. 20. Scanning electron  
 micrograph. ca. X 6,000.

The synonyms listed above are compiled from opinions of Bisby (1943) and Hughes (1958).

The following cultures were studied and are considered to be *S. chartarum*.

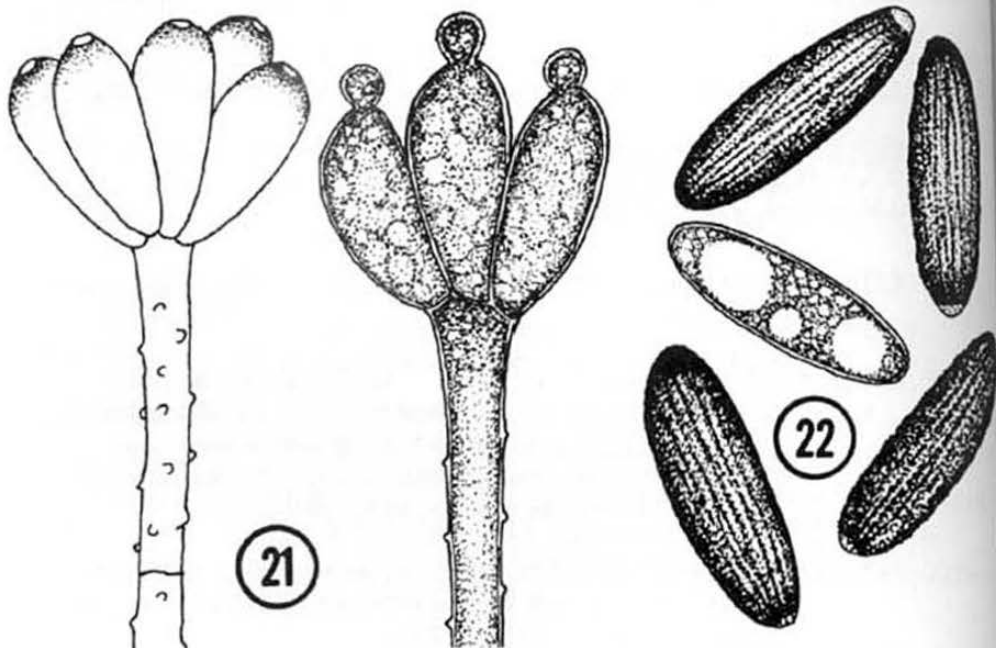
- ATCC 9182 = NRRL 1877 = QM 1274 (as *S. atra*): isolated by W. Crozier from paper, Washington, D. C.; used in United States for testing mildew proofing.
- ATCC 11695 = QM 94d (as *S. atra*): isolated by E. T. Reese from Trousers, New Guinea; used in cellulose and wool decomposition.
- ATCC 11716 = IFO 5369 (as *S. lobulata*): isolated by Y. Sasaki (F-14) from coal, Japan.
- ATCC 16026 = IMI 82,021 (as *S. atra*) = QM 8401: isolated by R. M. Everett from cotton fabric, U. K.; meets British specifications for fungus resistance tests.
- ATCC 18541: isolated by Carol A. Shearer from balsa wood submerged in Patuxent River, Maryland.
- ATCC 18836 = IFO 7222: isolated by K. Tubaki (TC-63-1), Japan.
- ATCC 18842 = CBS 222.46 (as *S. atra*): isolated by M. B. Bok from flax fibre.
- ATCC 18843 = CBS 324.65 (as *S. atra*): isolated by CBS staff from tile.
- ATCC 18844 = CBS 328.37 (as *S. atra* var. *brevicaulis*): isolated by O. Verona from paper.
- ATCC 18845 = CBS 329.37 (as *S. atra* var. *genuina*): isolated by O. Verona from paper.
- ATCC 18846 = CBS 330.37 (as *S. atra* var. *lobulata*): isolated by O. Verona from paper.
- ATCC 18847 = CBS 341.35 (as *S. atra*): isolated by N. F. Conant.
- ATCC 18875 = IMI 42,310 (as *S. atra*): isolated in Peshawa, India.



- ATCC 18979: isolated by O. Fassatiava (as *S. alternans* CCF 584).
- ATCC 22127: isolated by D. Mallock from woodchuck dung.
- ATCC 22218 = IMI 136,344 (as *S. atra* var. *microspora*): isolated by C. V. Subramanian from soil, India.
- ATCC 22703: isolated by T. Matsushima (MFC-2762) from soil, Goroka.
- ATCC 26303 = QM 1533 (as *S. atra*): isolated by W. L. White from old cardboard dumped in wasteland; produces 12,13-epoxy- $\Delta^9$ -trichothecenes as the mycotoxins responsible for stachybotryotoxicosis (Eppley & Bailey, 1973).
- ATCC 26384: isolated by A. Ylimaki from barley, Finland; agent of stachybotryotoxicosis of laboratory animals (Korpinen, 1973).
- ATCC 26385: isolated by A. Ylimaki from wheat, Finland; agent of stachybotryotoxicosis of laboratory animals (Korpinen, 1973).
- ATCC 26386: isolated by A. Ylimaki from commercial pig feed, Finland; agent of stachybotryotoxicosis of laboratory animals (Korpinen, 1973).

The distinguishing feature of this species is the mature phialoconidia showing a ridged or banded surface and their size.

All the strains studied grow and sporulate well on CMA and rabbit food agar at temperatures in the range of 10 to 37 C. The upper limit of temperature for spore germination is also 37 C. Production of clearing by growth on cellulose agar medium indicates that it is a strong cellulose-decomposing fungus. ATCC 9182 and ATCC 16026 are being used for fungus resistance tests in U. S. and British military specifications.



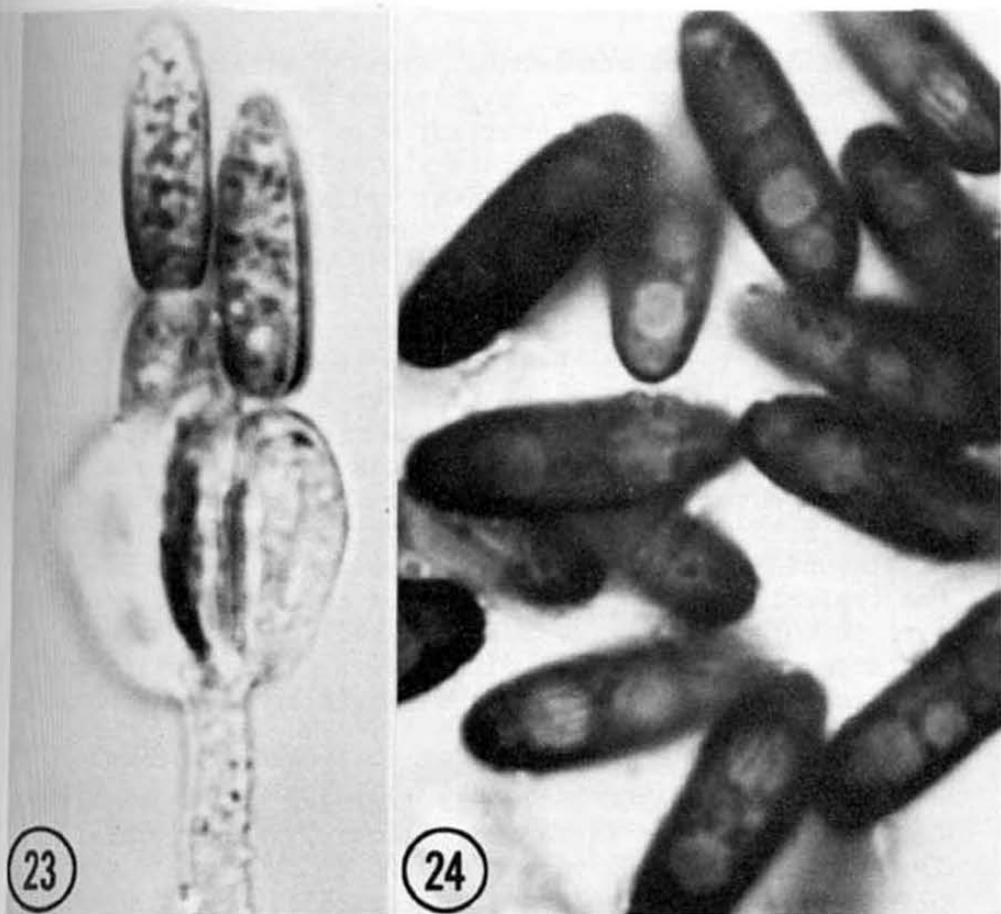
Figures 21-22. *Stachybotrys cylindrospora* ATCC 18851.  
 21. Phialides. ca. X 2,000. 22. Phialoconidia. Note  
 striations running along the length of conidia. ca. X  
 2,000

*Stachybotrys cylindrospora* Jensen, Cornell Univ. Agr. Exp.  
 Sta. Bull. 315: 496. 1912.

≡ *Stachybotrys atra* Corda var. *cylindrospora* (Jensen)  
 Rayss & Borut, Mycopath. Mycol. Appl. 10: 168. 1956.

Figures 21-24.

Colonies on cornmeal agar covering Petri-dish plates  
 in 3 weeks, downy to felty, colorless at first, becoming  
 dark, with a granulate surface as conidial production  
 commences. Margin of colony not distinct, with compact  
 hyphae and very few conidia. Reverse stained yellowish  
 pink. Conidia produced in abundance a week after  
 inoculation of plates.



Figures 23-24. *Stachybotrys cylindrospora* ATCC 18851.  
 23. Phialides. ca. X 2,000. 24. Phialoconidia showing delicate striations. ca. X 2,000.

Conidiophores determinate, macronematous, solitary or in groups, erect, straight or slightly curved, simple or irregularly branched, 3-5 septate, hyaline at the base, slightly olivaceous toward the apex, length variable, up to 200  $\mu\text{m}$  long, 3-5  $\mu\text{m}$  wide, the basal cell slightly inflated, attenuate toward the tip, sometimes minutely rough-walled at the upper parts, sometimes more or less smooth throughout the length, slightly enlarged at the apex which bears terminal phialides in a whorl of 3-9 around a central phialide.

Phialides enteroblastic, determinate, discrete, unicellular, subclavate, dark olivaceous at the tip, smooth-walled, 11-16 X 4-5  $\mu\text{m}$ , with conspicuous collarettes.

Phialoconidia acrogenous, arising singly and successively as separate units, aggregated in slimy masses, at first hyaline and smooth-walled, when mature, dark olive gray, surface showing delicate striations running obliquely along the length of the conidia, cylindrical, long and narrow, 2 to 4 times as long as broad, unicellular, 13-16 X 4-6  $\mu$ m, usually containing two oil drops.

REMARKS: *Stachybotrys cylindrospora* was first discovered by Jensen in 1912 from soil in New York state. Since the original description of this species showed so much resemblance to that of *S. chartarum* (as *S. atra*), Bisby (1943) suggested that they were possibly synonymous. Rayss and Borut (1956) later recognized the fungus as a variety of *S. chartarum* (as *S. atra*) mainly by the phialoconidia which are cylindrical and thinner than in the typical variety. In studies of the flora of organic soil in Ontario, Canada, Barron (1961) obtained several isolates which agree well with Jensen's description and suggested that *S. cylindrospora* should be recognized as a distinct species.

The culture ATCC 16276 was isolated by W. Gams from wheat field soil in Kitzeberg, Germany, and determined by G. L. Hennebert as *S. cylindrospora*. ATCC 18851 (= IMI 85,334) was isolated and identified by G. L. Barron (1961) from peat soil in Quelph, Canada. Both strains studied appear to be quite distinctive from the type species *S. chartarum* in having phialoconidia, as the specific epithet indicates, long and narrow, and the surface featuring delicate striations running obliquely along the length of the conidia. The fungus is now known in Europe, Japan, North America, British Solomon Islands (Matsushima, 1971a; 1975), and is well established in different climate regions of the world. Thus, it has been shown that this species is a clearly defined fungus taxon.

The temperature range for growth and conidial germination of the fungus is from 15 to 30 C. No production of clearing by growth on the cellulose agar medium indicates that it is not a cellulose-decomposing fungus.

*Stachybotrys dichroa* Grove, J. Bot. Lond. 24: 201. 1886.

Figures 25-30.

Growth on cornmeal agar extremely restricted, attaining a diameter of 2 cm in 3 weeks. The surface of colony downy, orange, with little or no aerial mycelium. Margin of colony not distinct, with compact hyphae. Reverse stained bright orange. Conidial production usually sparse, confined to the central part of the colony. Cultures tending to lose their ability to produce conidia after several transfers.

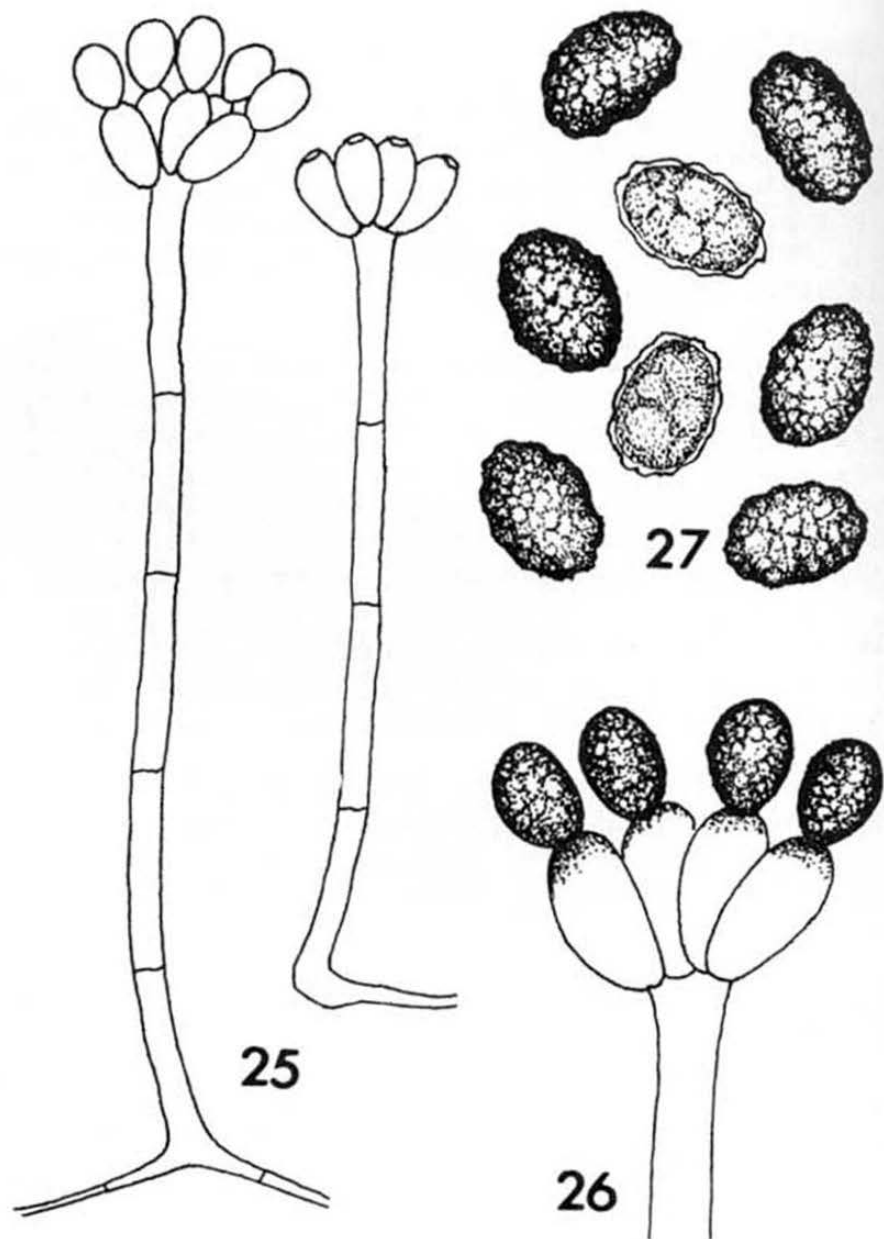
Conidiophores determinate, macronematous, solitary or in groups, erect, straight or slightly curved, simple, 2-7 septate, hyaline, thick-walled, length variable, up to 210  $\mu\text{m}$  long, 4-9  $\mu\text{m}$  wide, the basal cell slightly inflated, attenuated toward the tip, usually smooth throughout the length, slightly enlarged at the apex which bears terminal phialides in a whorl of 4-6 around a central phialide.

Phialides enteroblastic, determinate, discrete, unicellular, subclavate, hyaline, smooth-walled, 8-10 X 5-6  $\mu\text{m}$ , with conspicuous collarettes.

Phialoconidia acrogenous, arising singly and successively as separate units, aggregated in slimy masses, at first hyaline, when mature, dark olive gray, more or less opaque, coarsely roughened, unicellular, ovate, 7.5-10 X 5-7  $\mu\text{m}$ .

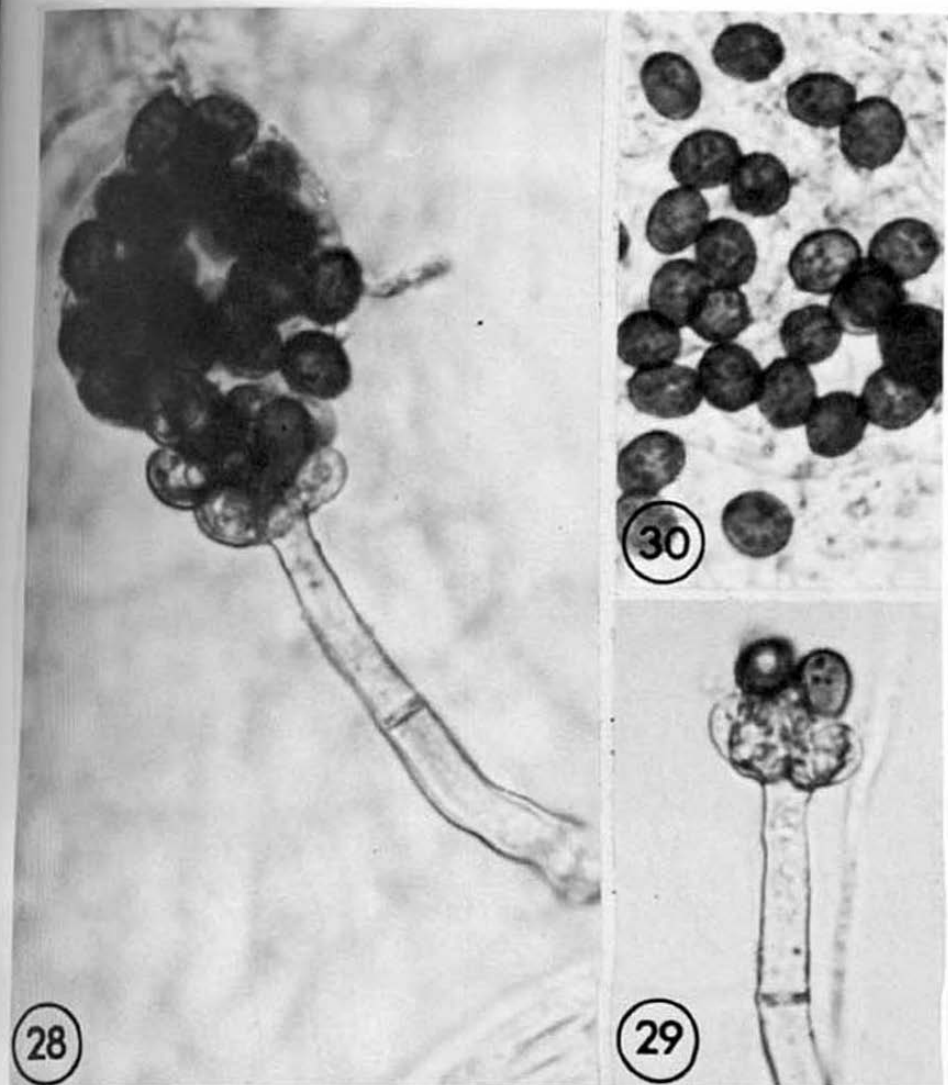
REMARKS: On examination of Grove's type material, Bisby (1943) first concluded that *S. dichroa* was young *S. chartarum* (as *S. atra*). However, Bisby and Ellis (1949) later recognized *S. dichroa* as a taxonomically distinct species after studying six collections from different localities, including two in culture. The fungus is easily distinguished by its habitat, cultural characteristics and the thick-walled simple conidiophores. According to Bisby and Ellis (1949), it is not uncommon on dead stems of herbaceous plants in England. It has not been found from soil.

The culture ATCC 18913 (=IMI 17,506) studied was isolated by M. B. Ellis from a dead herbaceous stem and further studied by Bisby and Ellis (1949). It grows and sporulates on cornmeal agar at temperatures in the range of 15 to 26 C. The upper limit of temperature for spore germination is 30 C. Production of clearing by growth on cellulose agar medium indicates that it is a cellulose-decomposing fungus.

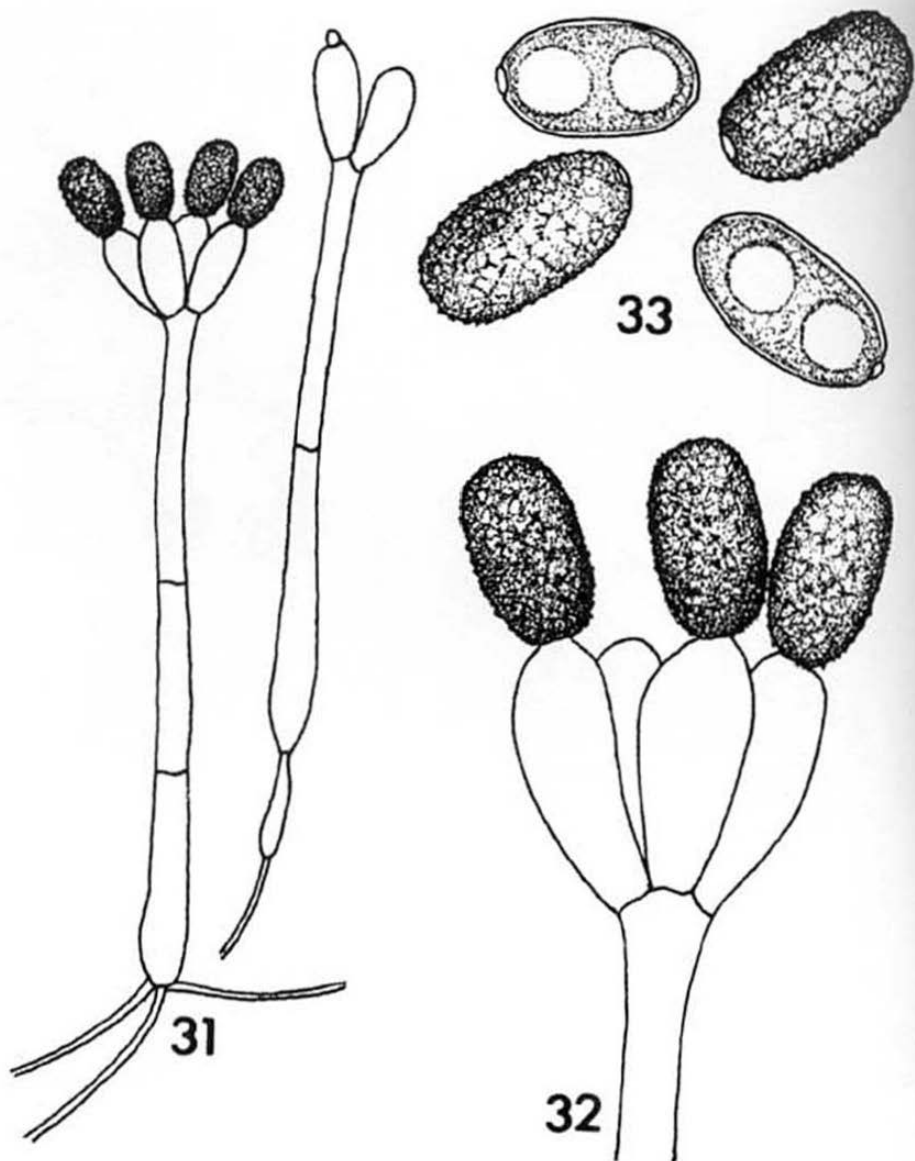


Figures 25-27. *Stachybotrys dichroa* ATCC 18913.  
 25. Conidiophores with phialides and phialoconidia. ca. X 500. 26. Phialides. ca. X 1,500. 27. Phialoconidia. ca. X 1,800.

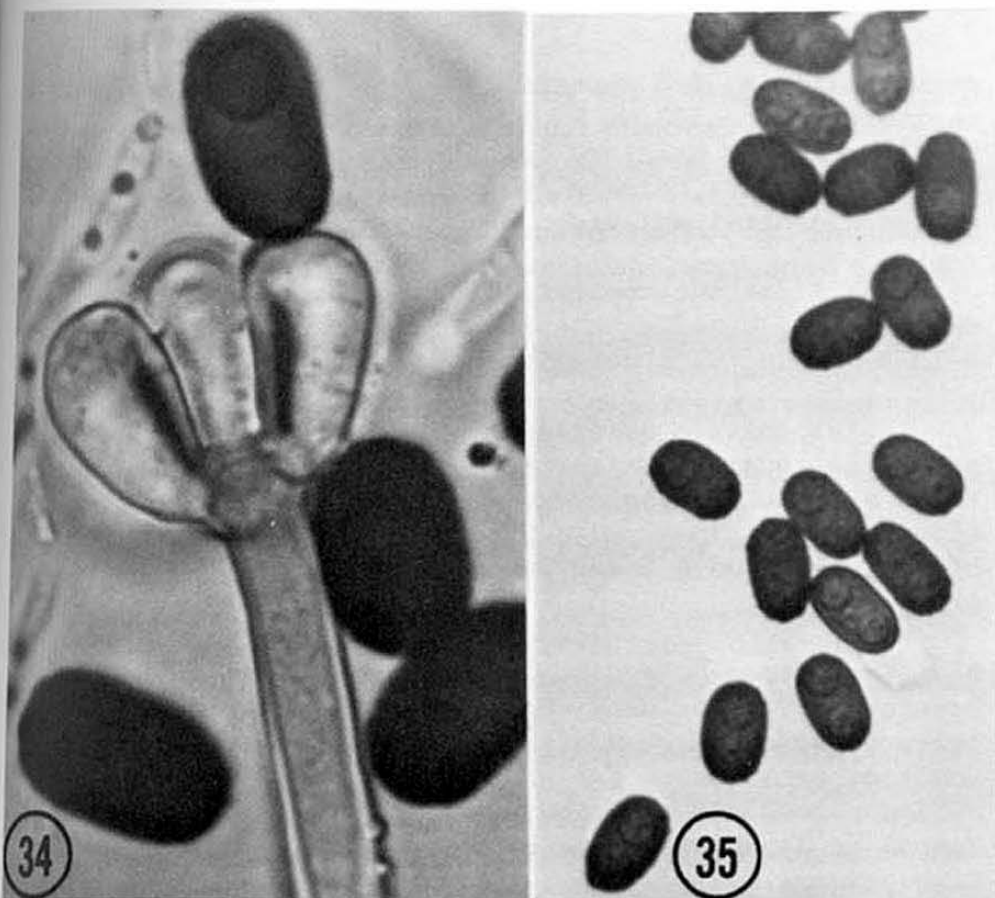




Figures 28-30. *Stachybotrys dichroa* ATCC 18913.  
 28. Conidiophore with terminal phialides bearing a slimy mass of conidia. ca. X 1,000. 29. Phialides with phialoconidia. ca. X 1,000. 30. Mature phialoconidia featuring a coarsely roughened surface. ca. X 1,000.



Figures 31-33. *Stachybotrys kampalensis* ATCC 22705.  
31. Conidiophores with phialides and phialoconidia. ca. X 800. 32. Phialides and phialoconidia. ca. X 2,000.  
33. Phialoconidia. ca. X 2,000.



Figures 34-35. *Stachybotrys kampalensis* ATCC 22705.  
 34. Phialides and phialoconidia. ca. X 2,000.  
 35. Phialoconidia. ca. X 1,000.

*Stachybotrys kampalensis* Hansford, Proc. Linn. Soc. Lond.  
 155: 45. 1943.

Figures 31-35.

Growth on cornmeal agar somewhat restricted, reaching 3 cm in diameter in 2 weeks, appressed, uniformly dense, uncolored at first, becoming dull dark, covered by a dark bloom of conidial masses. Margin of colony distinct due to the absence of conidia, with compact hyphae. No staining of medium in advance of mycelium. Conidial production abundant 3 days following inoculation on the plates.

Conidiophores determinate, macronematous, usually solitary but occasionally in groups, straight or slightly

curved, simple, 1-3 septate, hyaline, thick-walled, length variable, up to 180  $\mu\text{m}$  long, 4-8  $\mu\text{m}$  wide, smooth throughout the length, the basal cell inflated, tapering toward the apex which bears terminal phialides in a whorl of 4-8 around a central phialide.

Phialides enteroblastic, determinate, discrete, unicellular, hyaline, obovate to ellipsoid, smooth-walled, 9-13 X 6-7  $\mu\text{m}$ , with conspicuous collarettes.

Phialoconidia acrogenous, arising singly and successively as separate units, aggregated in slimy masses, at first hyaline and smooth-walled, when mature, dark olivaceous to almost black, heavily verrucose, ellipsoidal, unicellular, 10-14 X 6-7  $\mu\text{m}$ , usually containing two oil drops.

REMARKS: *Stachybotrys kampalensis* was first discovered by Hansford (1943) on dead wood in Uganda. Hughes (1952) later reported three additional collections from the Gold Coast on petioles of *Carica papaya* L. and stems of *Hibiscus esculentus* L. Matsushima (1975) also found this fungus in Japan on leaves of *Puerariae hirsutae* and *Musae paradisiacae*.

The strain ATCC 22705 studied was isolated by Matsushima (1971) from forest soil in New Guinea. The strain ATCC 32255, a subculture of CBS 388.73, was isolated from *Euphorbia tirukalli*. The identity of both strains has been further confirmed by a comparative study with the Hansford's type material deposited at the Kew Herbarium (K), England. They grow and sporulate on cornmeal agar at temperatures in the range of 15 to 30 C. No production of clearing on the cellulose agar medium indicates that the fungus does not decompose cellulose.

*Stachybotrys microspora* (Mathur & Sankhla) Jong & Davis, comb. nov.

≡ *Stachybotrys atra* Corda var. *microspora* Mathur & Sankhla, Sci. Culture 32: 93. 1966.

Figures 36-40.

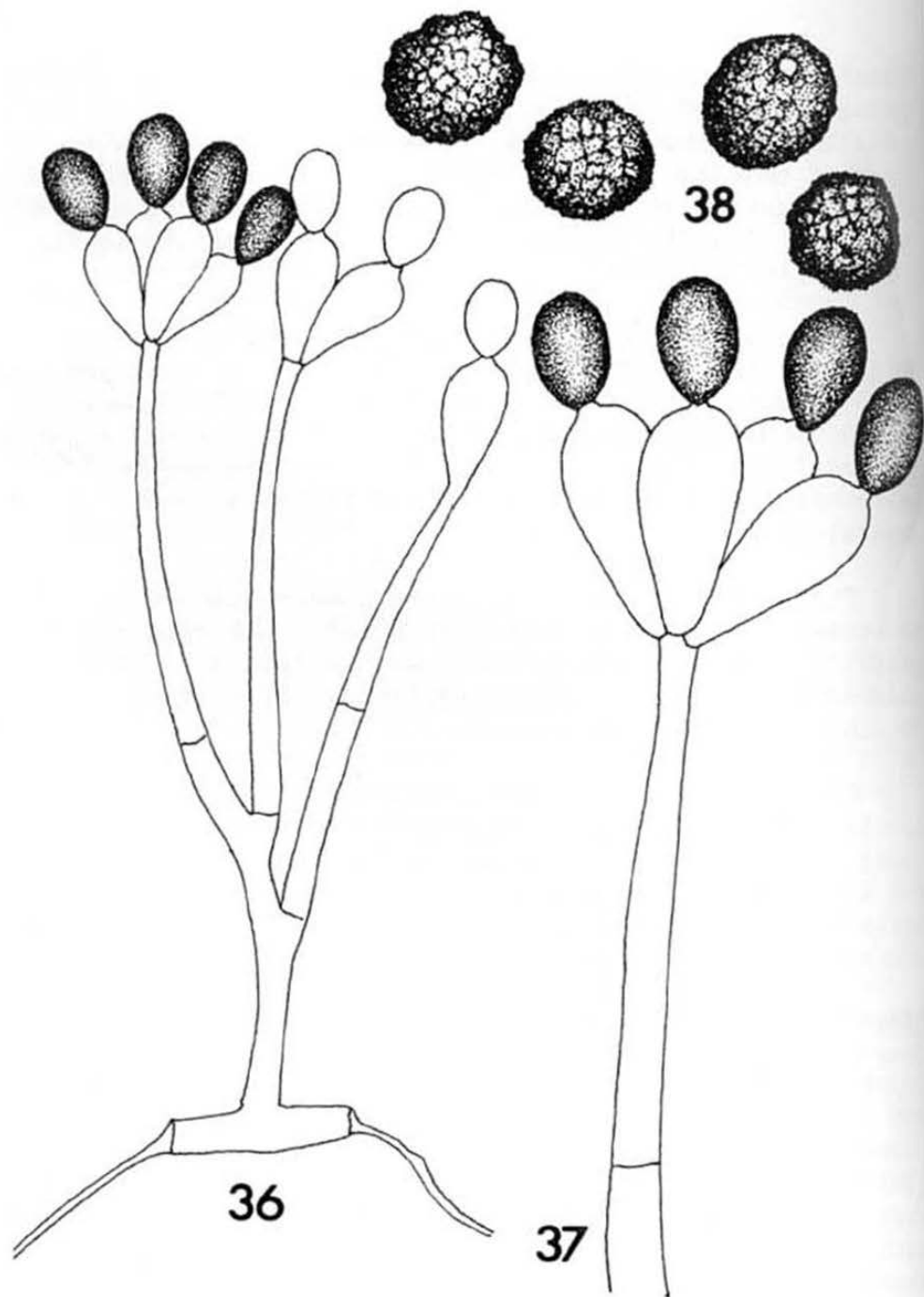
Colonies on cornmeal agar covering Petri-dish plates in 3 weeks, appressed, uniformly dense. Central parts of colonies becoming dull dark, covered by a dark powdery bloom of conidial masses. Margin of colonies not distinct, with compact hyphae. No staining of medium in advance of mycelium. Conidial production abundant, confined to the central part of the colony.

Conidiophores determinate, macronematous, solitary or in groups, irregularly dark olivaceous toward the apex, up to 55  $\mu\text{m}$  long, 2-4  $\mu\text{m}$  wide, usually smooth throughout the length, sometimes minutely rough-walled at the upper parts, the basal cell inflated, tapering toward the apex which bears terminal phialides in a whorl of 2-6 around a central phialide.

Phialides enteroblastic, determinate, discrete, clustered in a verticillate arrangement, unicellular, slightly dark olivaceous, obovate to pyriform, smooth-walled, 8-9 X 4-5  $\mu\text{m}$ , with conspicuous collarettes, detachable from conidiophores.

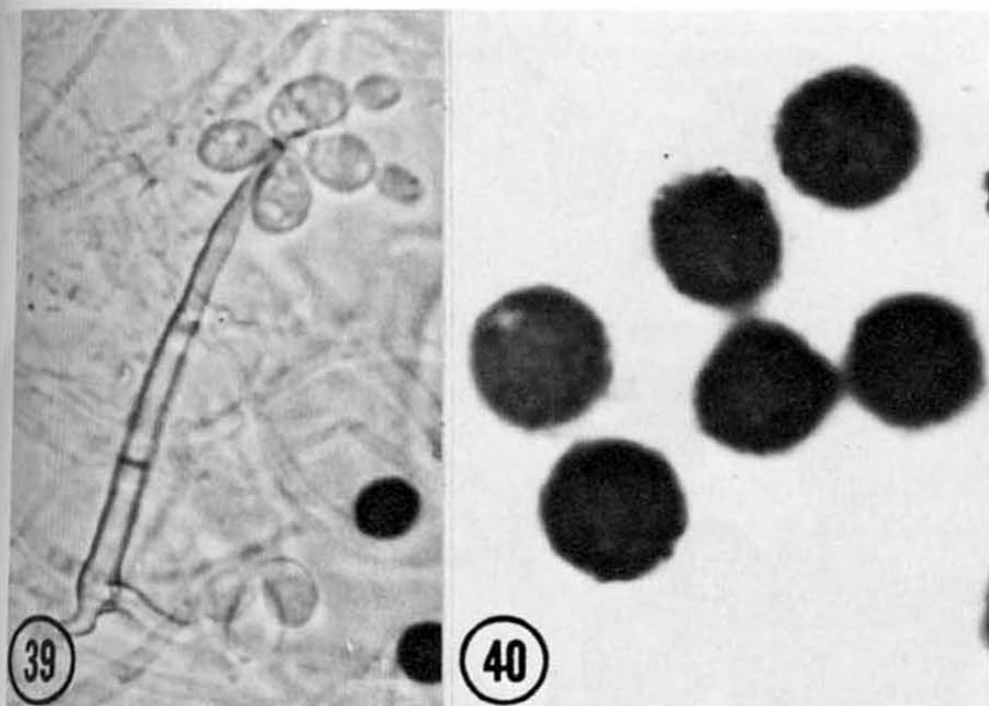
Phialoconidia acrogenous, arising singly and successively as separate units, aggregated in slimy masses, when young appearing as more or less elliptical or pyriform 6-8 X 4-5  $\mu\text{m}$ , becoming globose, 5-6  $\mu\text{m}$  in diameter at maturity, dark olive gray, more or less opaque, coarsely roughened, unicellular.

REMARKS: Mathur and Sankhla (1966) first discovered this fungus from soil in Jaipur, India, and described it as *Stachybotrys atra* Corda var. *microspora* Mathur & Sankhla. The dried type culture of this fungus was deposited in the herbarium of the Commonwealth Mycological Institute (IMI 91,933). An examination of this plate culture shows that it is mixed with *Stachybotrys chartarum*. Fortunately, each can be identified in accordance with its colony characteristics. A permanent slide made from a colony of *S. atra* var. *microspora* of this type material has been deposited in the herbarium of the National Fungus Collections (BPI), Beltsville, Maryland. The strain ATCC 18852 (=IMI 124,902) was isolated by D. McDonald from *Arachis hypogaea* rhizosphere in Zaria, N. Nigeria, in 1967. It is in full agreement with the type material. Since the culture characteristics, conidia and conidiophores are easily distinguished from those of *S. chartarum*, we would



Figures 36-38. *Stachybotrys microspora* ATCC 18852.  
36. Branching habit of a conidiophore with phialides and phialoconidia. ca. X 1,500. 37. Phialides. ca. X 2,000.  
38. Mature phialoconidia. ca. X 2,000.



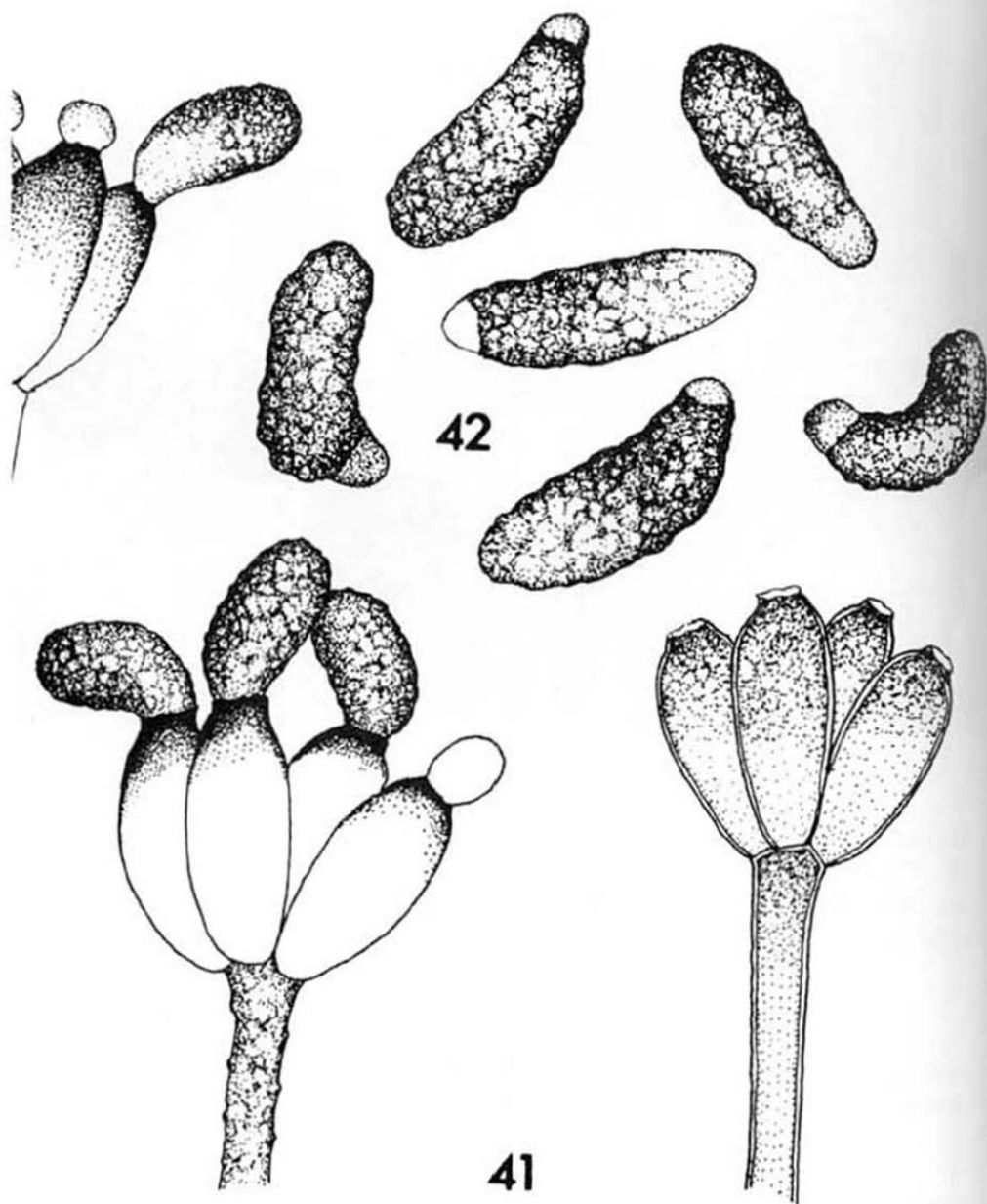


Figures 39-40. *Stachybotrys microspora* ATCC 18852.  
 39. Growth habit of a conidiophore. ca. X 1,000. 40.  
 40. Mature phialoconidia featuring a coarsely roughened  
 surface. ca. X 2,000.

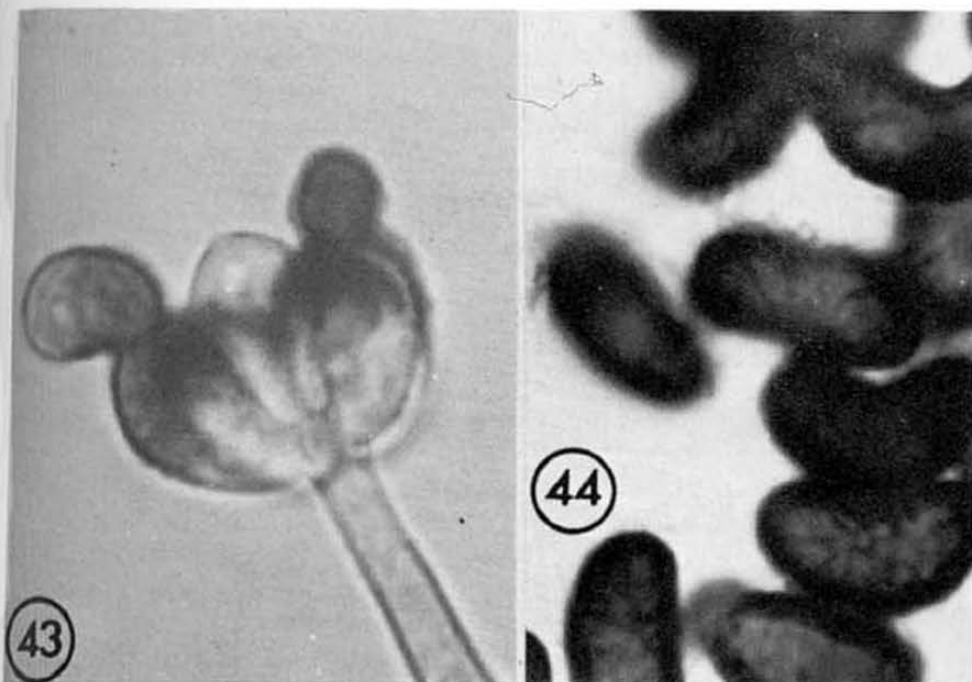
recognize it as a species and make a new combination  
*Stachybotrys microspora* (Mathur & Sankhla) Jong & Davis.

The strain ATCC 22218 originally designated as *S.*  
*atra* var. *microspora* at the Commonwealth Mycological  
 Institute as IMI 136,344 appears to be a typical *S.*  
*chartarum* and is now disposed under the latter name at  
 the ATCC.

The temperature range for growth and conidial germi-  
 nation of ATCC 18852 is from 15 to 37 C. No clearing on  
 cellulose agar medium by growth reveals that the fungus  
 is unable to utilize the cellulose as a main carbon source.



Figures 41-42. *Stachybotrys nephrospora* ATCC 18839.  
41. Phialides. ca. X 3,000. 42. Phialoconidia. ca. X 3,000.



Figures 43-44. *Stachybotrys nephrospora* ATCC 18839.  
 43. Phialides showing wide terminal openings through which phialoconidia are being produced. ca. X 3,000. 44. Comma-shaped phialoconidia featuring a coarsely roughened surface. ca. X 3,000.

*Stachybotrys nephrospora* Hansford, Proc. Linn. Soc. London  
155: 45. 1943.

= *Stachybotrys reniformis* Tubaki, Trans. Mycol. Soc. Japan  
4: 86. 1963.

= *Stachybotrys sinuatophora* Matsushima, Bull. Nat. Sci.  
 Mus. Tokyo 14: 476. 1971.

Figures 41-44.

Growth on CMA somewhat restricted, attaining a diameter of 4-5 cm in 3 weeks, appressed, uniformly dense, uncolored at first, becoming dark granulate as conidial production commences. Margin of colony distinct due to

the absence of conidia, white, with compact hyphae. No staining of medium in advance of mycelium. Reverse olive green. Conidial production abundant a week following inoculation, first in the center, then centrifugally toward the margin of colonies, becoming zonate.

Conidiophores determinate, macronematous, solitary or in groups, erect, straight or slightly curved, simple, occasionally branched, 2-4 septate, at first hyaline, becoming olivaceous at the upper parts, up to 400  $\mu\text{m}$  long, 3-5  $\mu\text{m}$  wide, sometimes minutely rough-walled at the upper parts or throughout the length, sometimes more or less smooth throughout, slightly enlarged at the apex which bears terminal phialides in a whorl of 4-9 around a central phialide.

Phialides enteroblastic, determinate, discrete, unicellular, olivaceous, obovate or ellipsoid, smooth-walled, 10-12 X 5-6  $\mu\text{m}$ , with conspicuous collarettes.

Phialoconidia acrogenous, arising singly and successively as separate units from an open growing point at the apex of the phialide, bent away outwardly from the axis even horizontally sliming down at once to form a mucilaginous black mass which envelopes the tips of the phialides, at first hyaline and smooth-walled, when mature, dark olive, more or less opaque, coarsely roughened, unicellular, reniform or comma-shaped, 10-12 X 4-5  $\mu\text{m}$ .

REMARKS: *Stachybotrys nephrospora* was first discovered by Hansford (1943) on dead wood in Kamplala, Uganda. The type specimen (Hansford 1114) was deposited in the Kew Herbarium (K), Royal Botanic Garden, England. It is readily recognized by the reniform phialoconidia which develop obliquely or even horizontally from the wide open apex of the phialide. Tubaki (1963) described a new species, *Stachybotrys reniformis*, from the decayed leaves of an herb (Labiatae) in Ambo, Yaki Island, Japan. Since the shape and size of phialoconidia agree fairly well with those of *S. nephrospora*, Verona and Mazzucchetti (1968) suggested that *S. reniformis* and *S. nephrospora* were possibly synonymous.

Matsushima (1971a,b) recently isolated a similar fungus from Goroka soil, Papua-New Guinea; however, he described it as a new species, *Stachybotrys simatophora*

Matsushima. This isolate (MFC-2690) was deposited in the ATCC and given accession number ATCC 22706.

The description presented is based upon the type culture (ATCC 18839 = IFO 7067) of *S. reniformis* which was obtained from Institute for Fermentation (IFO) in Osaka, Japan. No culture is available for *S. nephrospora* which is known from the type collection only. Comparative studies of the type specimen of *S. nephrospora* and the type cultures of both *S. reniformis* and *S. sinuatophora* have led to the conclusion that they are identical. It is therefore proposed that *S. reniformis* Tubaki, 1963, and *S. sinuatophora* Matsushima, 1971, be regarded as later, facultative synonyms of *S. nephrospora* Hansford, 1943.

Both ATCC 18839 and ATCC 22706 grow and sporulate well on cornmeal agar at temperatures ranging from 15 to 30 C. However, ATCC 18839 is capable of producing cellulase on the cellulose agar medium and ATCC 22706 is unable to do so.

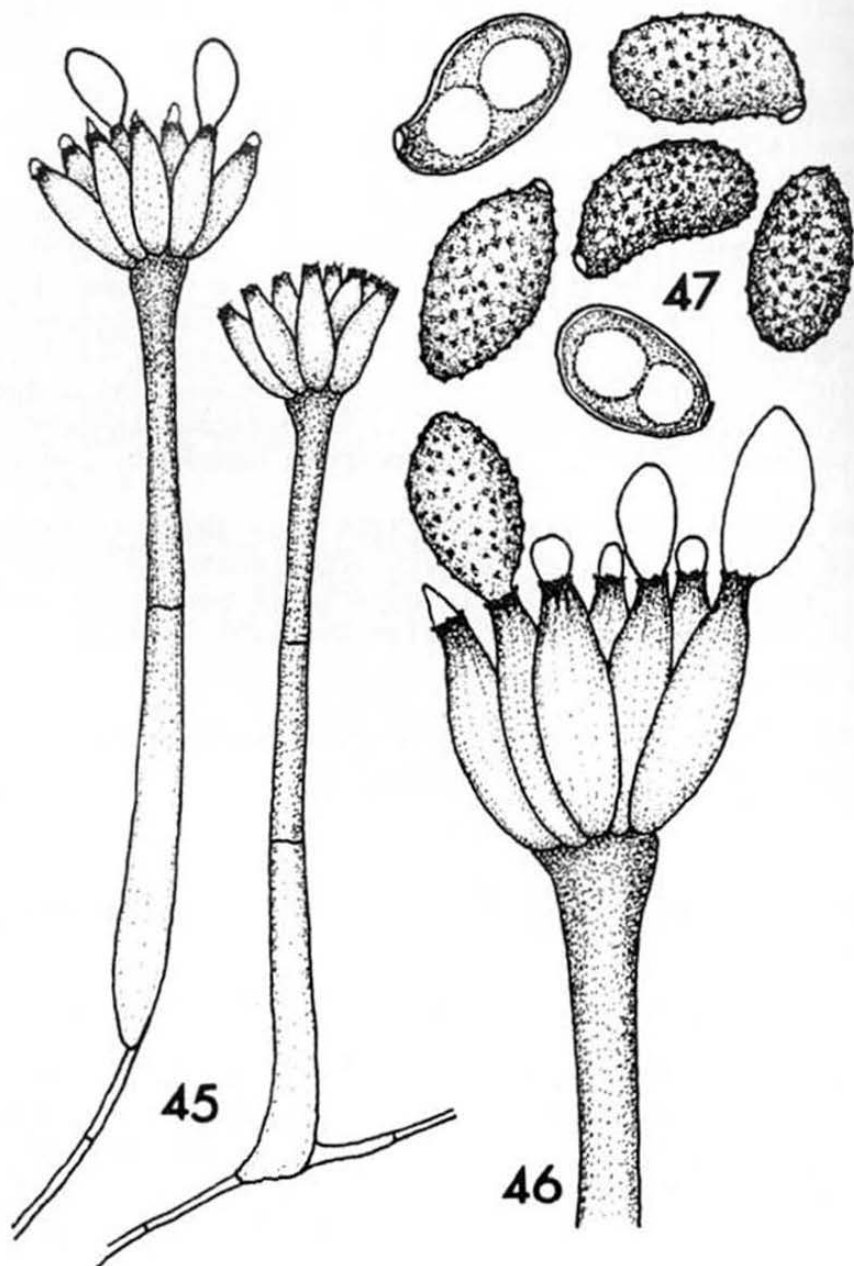
*Stachybotrys nephrospora* is characterized by its synpodially branched conidiophores and its reniform phialoconidia.

*Stachybotrys oenantes* M. B. Ellis, CMI Mycol. Papers 125: 29. 1971.

Figures 45-49.

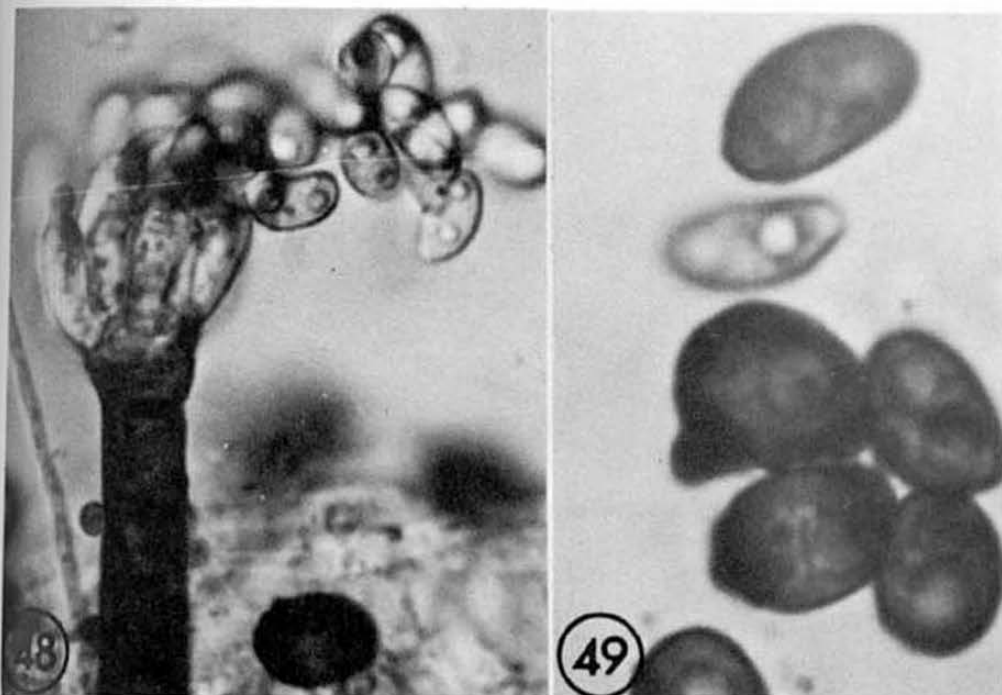
Growth on CMA somewhat restricted, reaching 3 cm in diameter in 2 weeks. The surface of colony downy, orange at first, becoming dark granulate at the central part of the colony as conidia develop. Reverse stained bright orange. Conidia produced abundant a week after inoculation of plates.

Conidiophores determinate, macronematous, erect, straight or slightly curved, simple, 1-2 septate, smoke gray to black, smooth-walled, up to 190  $\mu$ m long, 5-7  $\mu$ m wide, slightly enlarged at the apex which bears terminal phialides in a whorl of 8-20 around a central phialides.



Figures 45-47. *Stachybotrys oenanthes* ATCC 22844.  
 45. Conidiophores with phialides and phialoconidia. ca. X 1,000. 46. Phialides and phialoconidia. ca. X 2,000.  
 47. Mature phialoconidia. ca. X 2,000.





Figures 48-49. *Stachybotrys oenanthes* ATCC 22844.

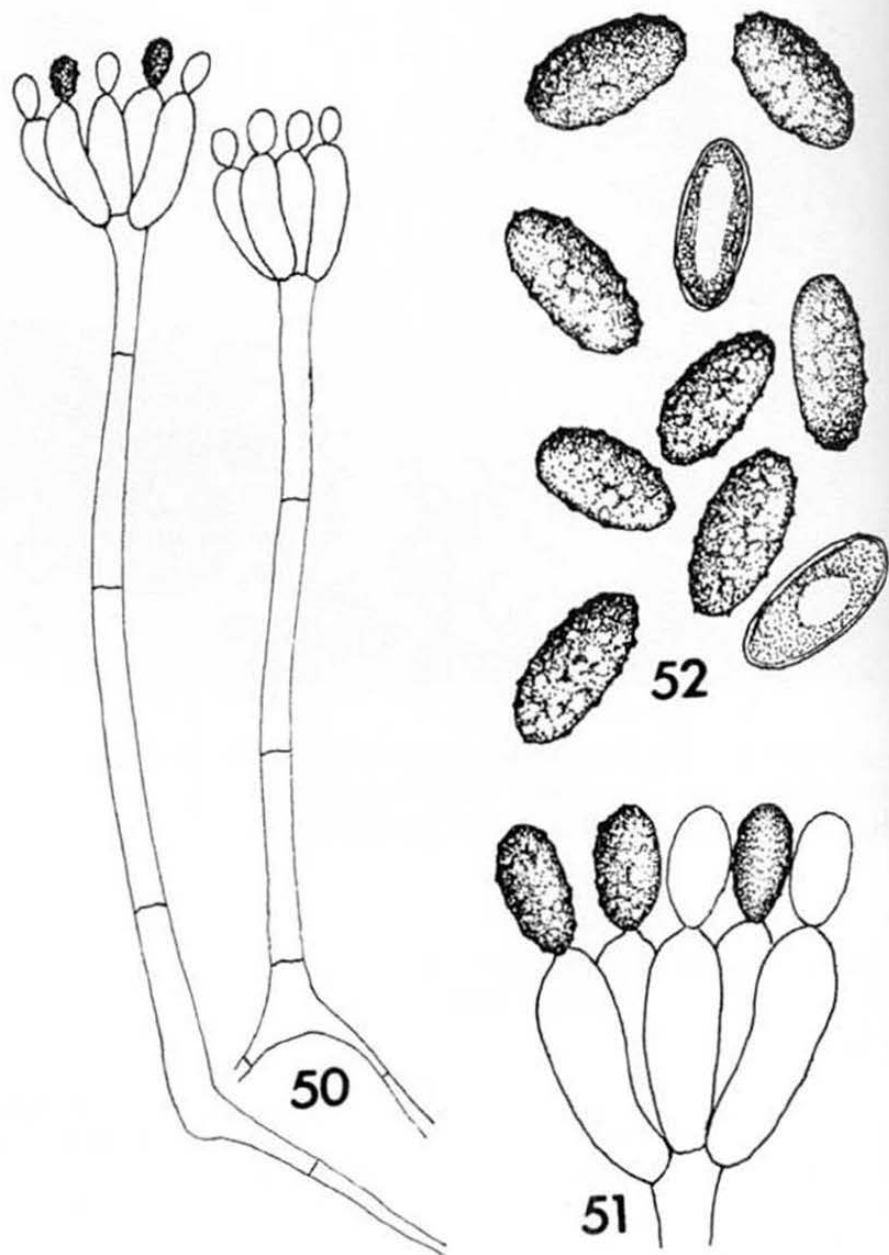
48. Phialides and immature phialoconidia. ca. X 1,500.

49. Mature phialoconidia. ca. X 2,000.

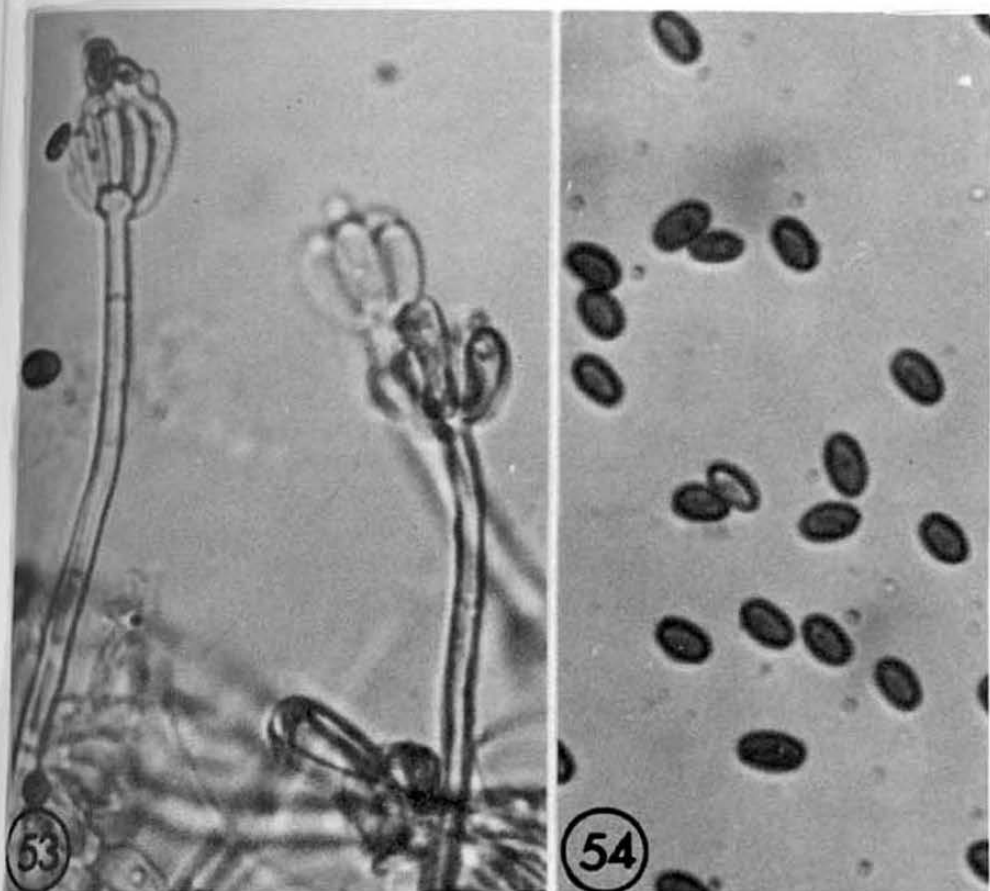
Phialides enteroblastic, determinate, discrete, unicellular, cylindrical, smoke gray to black, smooth-walled, 10-20 X 5-7  $\mu$ m, with conspicuous collarettes.

Phialoconidia acrogenous, arising singly and successively as separate units, aggregated in slimy masses, at first hyaline and smooth-walled, when mature smoke gray to black, heavily verrucose, ovoid to reniform, sometimes obliquely attenuate at the base, 9-10 X 5-7  $\mu$ m.

**REMARKS:** The strain ATCC 22844 (=IMI 16,185) studied is the type culture isolated by M. B. Ellis (1971) from dead stems of *Oenanthe crocatae* in Quernsey. It grows and sporulates on CMA at temperatures in the range of 10 to 24 C. The upper limit of temperature for spore germination is 30 C. No production of clearing on the cellulose agar medium by growth indicates that it is not a cellulose-decomposing fungus.



Figures 50-52. *Stachybotrys parvispora* ATCC 18877.  
50. Conidiophores with phialides and phialoconidia. ca. X 1,000. 51. Phialides and phialoconidia. ca. X 3,000.  
52. Mature phialoconidia. ca. X 3,000.



Figures 53-54. *Stachybotrys parvispora* ATCC 18877.

53. Growth habit of conidiophores. ca. X 1,000.

54. Phialoconidia. ca. X 1,000.

*Stachybotrys parvispora* Hughes, CMI Mycol. Papers 48: 74.  
1952.

Figures 50-54.

Growth on cornmeal agar somewhat restricted, reaching 4 cm in diameter in 3 weeks. Colonies felty to silky, white at first, becoming olive green in areas of copious conidial production. Margin of colony distinct, white, with compact hyphae. Reverse stained light orange. Conidia produced in abundance a week after inoculation of plates.

Conidiophores determinate, macronematous, solitary or in groups, erect, straight or slightly curved, simple, occasionally branched, 3-5 septate, hyaline, smooth-walled, up to 200  $\mu\text{m}$  long, 2-5  $\mu\text{m}$  wide, the basal cell slightly inflated, attenuated toward the tip, slightly enlarged at the apex which bears terminal phialides in a whorl of 4-10 around a central phialide.

Phialides enteroblastic, determinate, discrete, clustered in a verticillate arrangement, unicellular, subclavate, hyaline, smooth-walled, 8-11 X 3-4  $\mu\text{m}$ , with conspicuous collarettes.

Phialoconidia acrogenous, arising singly and successively as separate units, aggregated in slimy masses, at first hyaline, when mature, dark olive gray, more or less opaque, coarsely roughened, unicellular, ovate, 5-6 X 3-3.5  $\mu\text{m}$ .

REMARKS: *Stachybotrys parvispora* was originally described by Hughes (1952) from dead leaves of *Ananas*, *Ficus* and *Setariae* from the Gold Coast of tropical Africa. It is readily recognized by the small dark olive phialoconidia 3 to 6  $\mu\text{m}$  long by 3 to 3.5  $\mu\text{m}$  wide. The strains ATCC 18877 (=IMI 62,388) and ATCC 18876 (=IMI 106,334) studied were secured from the Commonwealth Mycological Institute; the former was isolated from soil in Congo and the latter from root of *Hevea* in Malaya. Both fit Hughes' original description.

The growth temperature range for ATCC 18877 is narrow, 20 to 30 C. However, the upper limit of temperature for conidial germination is 37 C. No clearing of the cellulose agar medium by growth of this fungus indicates that it is unable to decompose cellulose.

*Stachybotrys theobromae* Hansf., Proc. Linn. Soc. Lond. 155: 45. 1943.

Figures 55-60.

Growth on potato dextrose agar covering the Petri-dish plates in 3 weeks, fleecy to velvet lanose with various degrees of luxuriance, gleaming white, becoming dark granulate as conidial production commences. Margin of

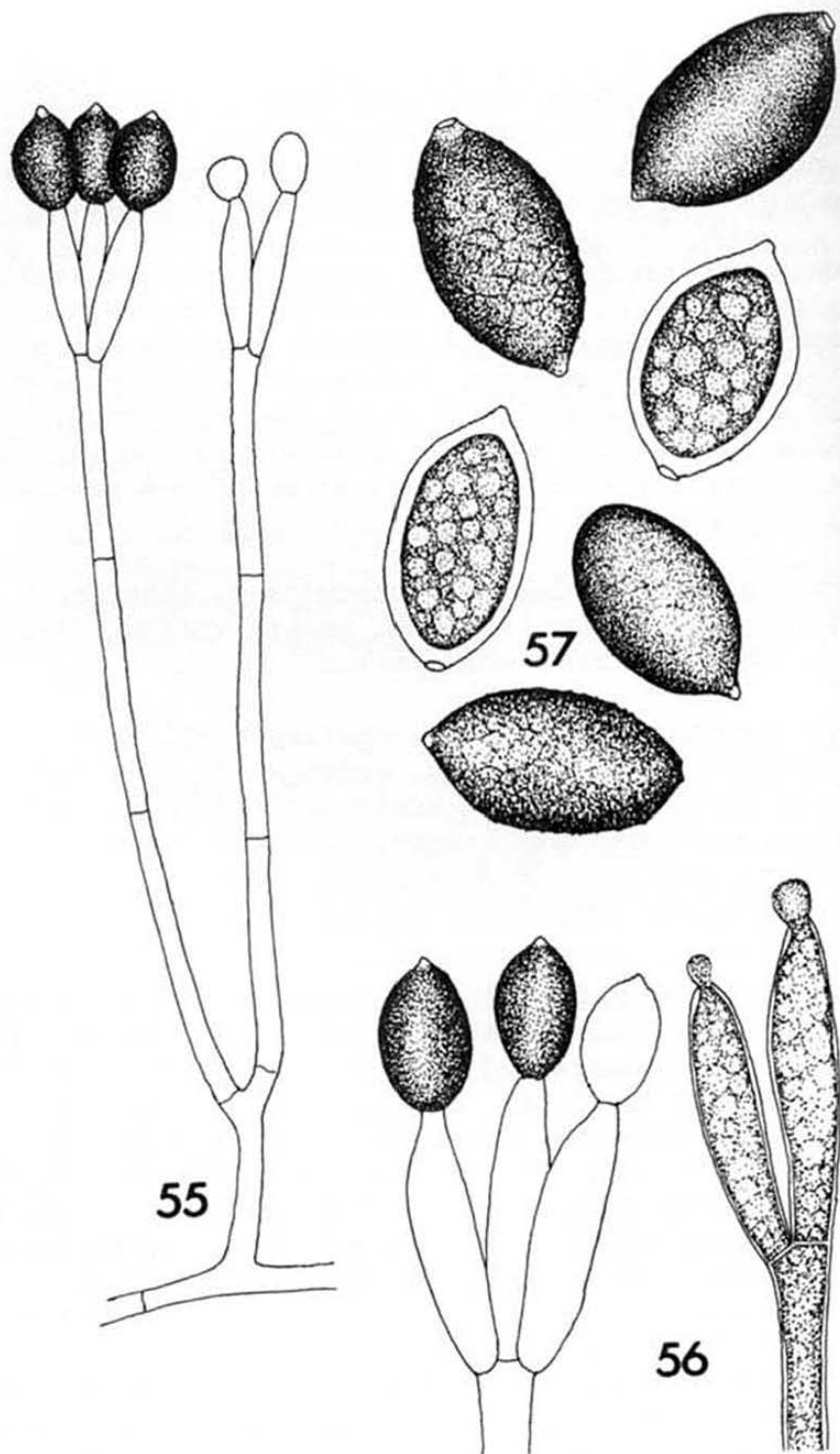
colony distinct, lobed, peripheral hyphae dispersed. No staining of medium in advance of mycelium. Reverse at first uncolored, later becoming olive. Conidia produced in abundance two weeks after inoculation of plate.

Conidiophores determinate, macronematous, solitary or in groups, erect, straight or slightly curved, simple or irregularly branched, 6-14 septate, hyaline, length variable, up to 400  $\mu\text{m}$  long, 3-5  $\mu\text{m}$  wide, the basal cell slightly inflated, attenuate toward the tip, smooth throughout the length, slightly enlarged at the apex which bears a terminal phialide or in a group of 3-4 around a central phialide.

Phialides enteroblastic, determinate, discrete, unicellular, subclavate, hyaline, smooth-walled, 15-23 X 4-5  $\mu\text{m}$ , with conspicuous collarettes.

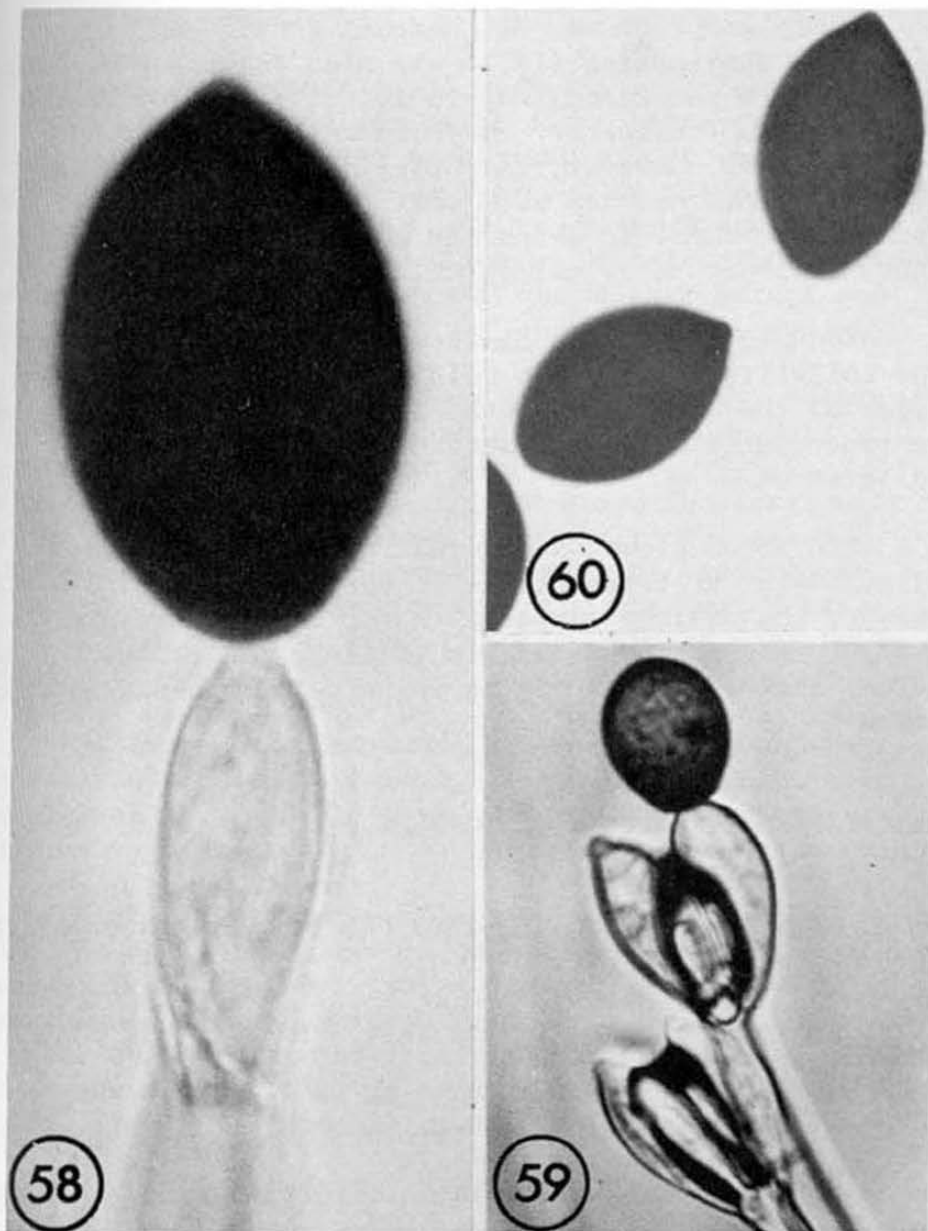
Phialoconidia acrogenous, arising singly and successively as separate units, aggregated in slimy masses, at first hyaline and smooth-walled, when mature, dark green, more or less opaque, coarsely roughened, unicellular, oval, 16-28 X 12-16  $\mu\text{m}$ , usually with a well-marked apical apiculus.

REMARKS: The fungus was first discovered by Hansford (1943) on branches of *Theobroma cacao* L. in Uganda. The phialoconidia are described as 15-18 X 20-28  $\mu\text{m}$  on phialides 7-10 X 12-28  $\mu\text{m}$ . Hughes (1952) reported several collections from the Gold Coast on twigs of *Hura crepitans* L. and on branches and dead dry empty pods of *Theobroma cacao*. Hughes described and illustrated the phialoconidia with a well-marked basal apiculus. Hughes' figures were reproduced by Verona and Mazucchetti (1968). However, careful examinations of strain ATCC 18905 (=IMI 105,321) which was originally isolated by T. H. Williams from *Theobroma cacao* in Tuaran, Sabah, Malaysia, and the type specimen deposited with the Kew Herbarium (K) indicate that the apiculus is apical instead of basal. This species differs from other *Stachybotrys* species studied by having large, dark green phialoconidia on hyaline phialides and conidiophores.



Figures 55-57. *Stachybotrys theobromae* ATCC 18905. 55. Conidiophores with terminal phialides and phialoconidia. ca. X 500. 56. Phialides and phialoconidia. ca. X 800. 57. Phialoconidia with a well-marked apical apiculus. ca. X 1,200.





Figures 58-60. *Stachybotrys theobromae* ATCC 18905. 58. Phialide bearing a terminal phialoconidium with a well-marked apical apiculus. ca. X 2,300. 59. Phialides. ca. X 800. 60. Mature phialoconidia. ca. X 1,000.

*Stachybotrys crassa* El. Marchal (1895) and *S. nilagirica* Subramanian (1957) are also described as having large globose phialoconidia, 16-18  $\mu$ m in the former and 15.4-28  $\mu$ m in the latter. Unfortunately, neither have been cultured. However, the original descriptions and figures of both species show that they are quite distinct from *S. theobromae* in which the phialoconidia are oval and with a well-marked apical apiculus.

*Stachybotrys crassa* has been reported only from the type collection on dung in Belgium. Bisby (1943) in his review of the genus considered it a doubtful species unless the type specimen can be examined, or the species rediscovered.

ATCC 18905 grows and sporulates well on potato dextrose agar at temperatures in the range of 20 to 30 C. However, the maximum temperature for conidial germination is 37 C. The fungus is unable to clear the cellulose agar medium, indicating that it is not a cellulose-decomposing fungus.

*Memmoniella echinata* (Riv.) Galloway, Trans. Brit. Mycol. Soc. 18: 165. 1933.

≡ *Penicillium echinatum* Riv., Dei Parassiti Vegetali, p. 451. 1873.

≡ *Haplographium echinatum* (Riv.) Sacc., Syll. Fung. 307. 1886.

≡ *Stachybotrys echinata* (Riv.) Smith, Trans. Brit. Mycol. Soc. 45: 392. 1962.

= *Periconia papyrogena* Sacc., Michelia 1: 273. 1878.

≡ *Stachybotrys papyrogena* (Sacc.) Sacc., Fungi ital. Tab. 900. 1881.

≡ *Sterigmatobotrys papyrogena* (Sacc.) Oud., Nederl. Kruidk. Arch., II, 4: 548. 1886.

= *Memmoniella aterrima* Höhnelt, Zbl. Bakt. (Abt. II) 60: 16. 1923.

Figures 61-66.

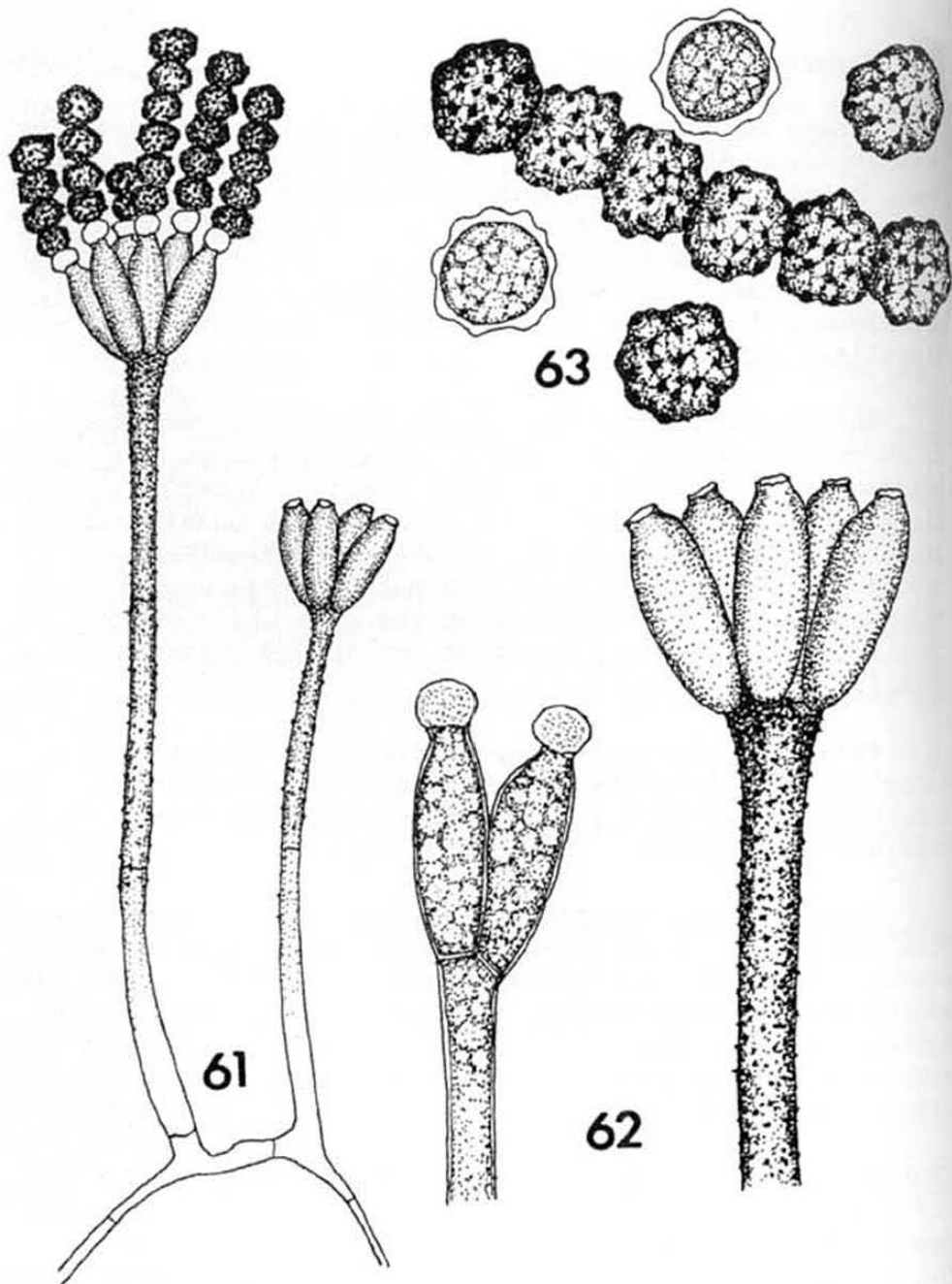
Growth on cornmeal agar somewhat restricted, reaching 5 cm in diameter in 3 weeks, at first submerged and colorless, becoming downy and dark granulate as conidial production commences. Margin of colony not distinct, with submerged hyphae and few conidia. Reverse stained yellowish brown to brownish gray. Conidia produced in abundance 2 days after inoculation on agar plates and sterilized rabbit dung.

Conidiophores determinate, macronematous, solitary or in groups, erect, straight or slightly curved, unbranched, 1-3 septate, at first hyaline, later olivaceous, 70-90  $\mu\text{m}$  long, 3-5  $\mu\text{m}$  wide, the basal cell slightly inflated, sometimes minutely rough-walled throughout the length, sometimes more or less smooth throughout, slightly enlarged at the apex which bears terminal phialides in a whorl of 6-9 around a central phialide.

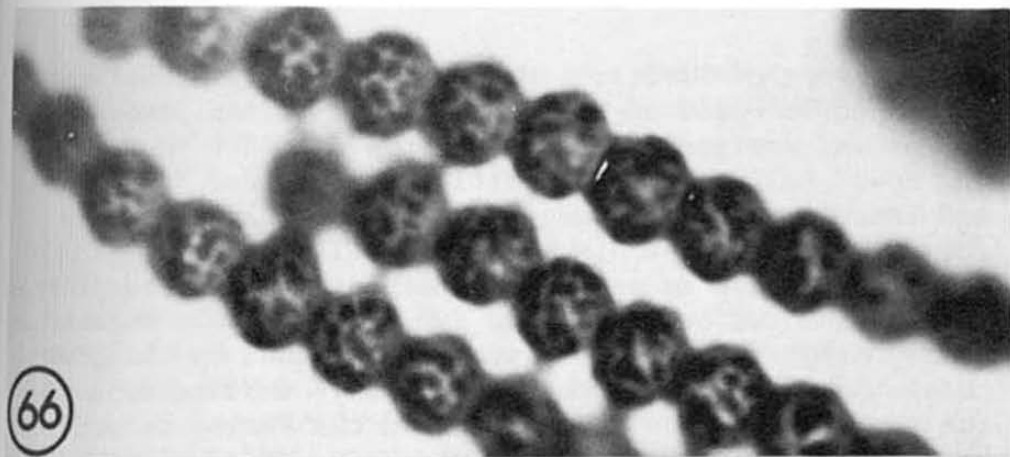
Phialides enteroblastic, determinate, discrete, unicellular, pale olivaceous, obovate or ellipsoid, smooth-walled, 7-10 X 3-4  $\mu\text{m}$  with conspicuous wide terminal collarettes.

Phialoconidia acrogenous, arising in basipetal succession and remaining attached to one another by a common septum in long persistent chains, at first hyaline and smooth-walled, when mature, dark olive gray, more or less opaque, coarsely warted, continuous, octagonal-globose in side view and circular in outline in end view, dry (not in slime), 3-6  $\mu\text{m}$  in diameter.

REMARKS: Rivolta (1873) first discovered this fungus on hay and wheat culms in Northern Italy and described it as *Penicillium echinatum* Rivolta (not *P. echinatum* Dale). The description and figure given by Rivolta indicated that the distinguishing feature of this fungus was the black catenulate phialoconidia resembling those of *Aspergillus niger* and the conidiophores with penicillate heads resembling those of *Stachybotrys*. However, Saccardo (1186) later transferred Rivolta's species from *Penicillium* Link to *Haplographium* Berk. & Br. which is characterized by slimy masses of blastoconidia borne singly at the apex of dark conidiophores with penicillate heads (Barron, 1968).



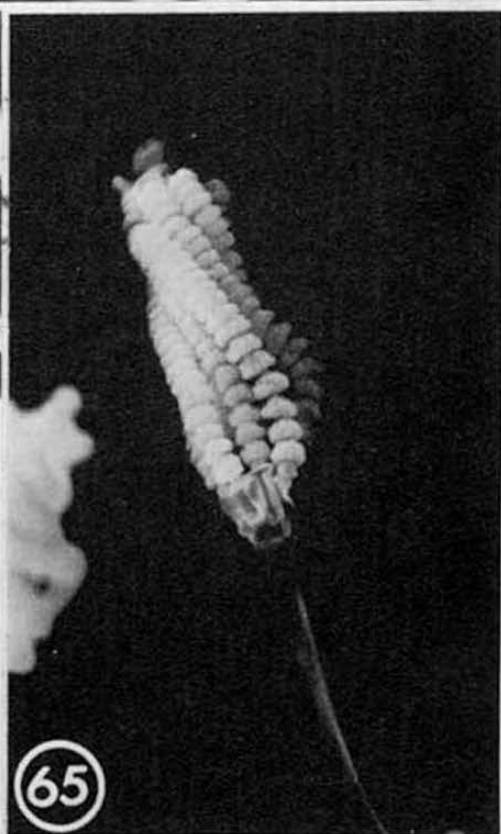
Figures 61-63. *Memmoniella echinata* ATCC 11974.  
 61. Conidiophores with terminal phialides and phialoconidia in chains. ca. X 600. 62. Phialides. ca. X 1,200.  
 63. Phialoconidia. ca. X 2,400.



66



64



65

Figures 64-66. *Memmoniella echinata* ATCC 11974.  
 64. Growth habit of conidiophores. ca. X 200.  
 65. Scanning electron micrograph of phialides with phialoconidia in chains. ca. X 600. 66. Mature phialoconidia in chains. Note a coarsely warty surface. ca. X 2,000.

Unaware of Rivolta's work, Höhnel (1923) described this species based on his isolate from cotton yarn in Vienna and designated it as *Memmoniella aterrима* gen. and sp. nov. Galloway (1933) critically reviewed Rivolta's and Höhnel's works and accepted Höhnel's genus, making the combination *M. echinata* (Riv.) Galloway for his isolate obtained as an air contaminant in the laboratory. He also pointed out that this fungus is closely related to *Stachybotrys* from which it is distinguished by the globose phialoconidia borne in chains. Further examinations of the type material of *M. aterrима* in the Farlow herbarium by Linder (Galloway, 1933) and by White *et al.* (1949) have confirmed Galloway's decision that *P. echinatum* and *M. aterrима* belong to the same species.

Upon reexamination of Galloway's original culture of *M. echinata*, Bisby (1943) suggested the possibility that *M. echinata* might be an unusual or abnormal form of *Stachybotrys subsimplex* in which slime production was reduced to allow retention of the conidia in chains. However, Bisby (1945) later recognized *M. echinata* as being distinctive from *S. subsimplex* after studies of several new cultures from different localities. Although Zuck (1949) found that some isolates of *Memmoniella* occasionally producing a *Stachybotrys*-like phase much like the description of *S. subsimplex sensu* Bisby (1943), he considered *M. echinata* a distinct species since some of his cultures had remained stable for eight years in the characters Galloway listed for *M. echinata*. Padwick (1945) accepted *M. echinata* and redescribed it based on his isolate from cotton cardage in Cawnpore, India. Padwick's description was recently reproduced by Verona and Mazzucchetti (1968).

The species concept of *S. subsimplex* has recently been clarified by Deighton (1960) who points out that the type material (IMI 10,941) has globose catenulate phialoconidia resembling those of *M. echinata* from which it differs in its larger phialoconidia. It is obviously not a *Stachybotrys*-like phase of *M. echinata* but a distinct species of *Memmoniella*. Deighton therefore made the new combination *Memmoniella subsimplex* (Cooke) Deighton. Nonetheless, Smith (1962) would relegate *Memmoniella* to synonymy with *Stachybotrys*, making a new combination *Stachybotrys echinata* (Riv.) Smith for *M. echinata* (Riv.) Galloway. Because the culture studied in the present work



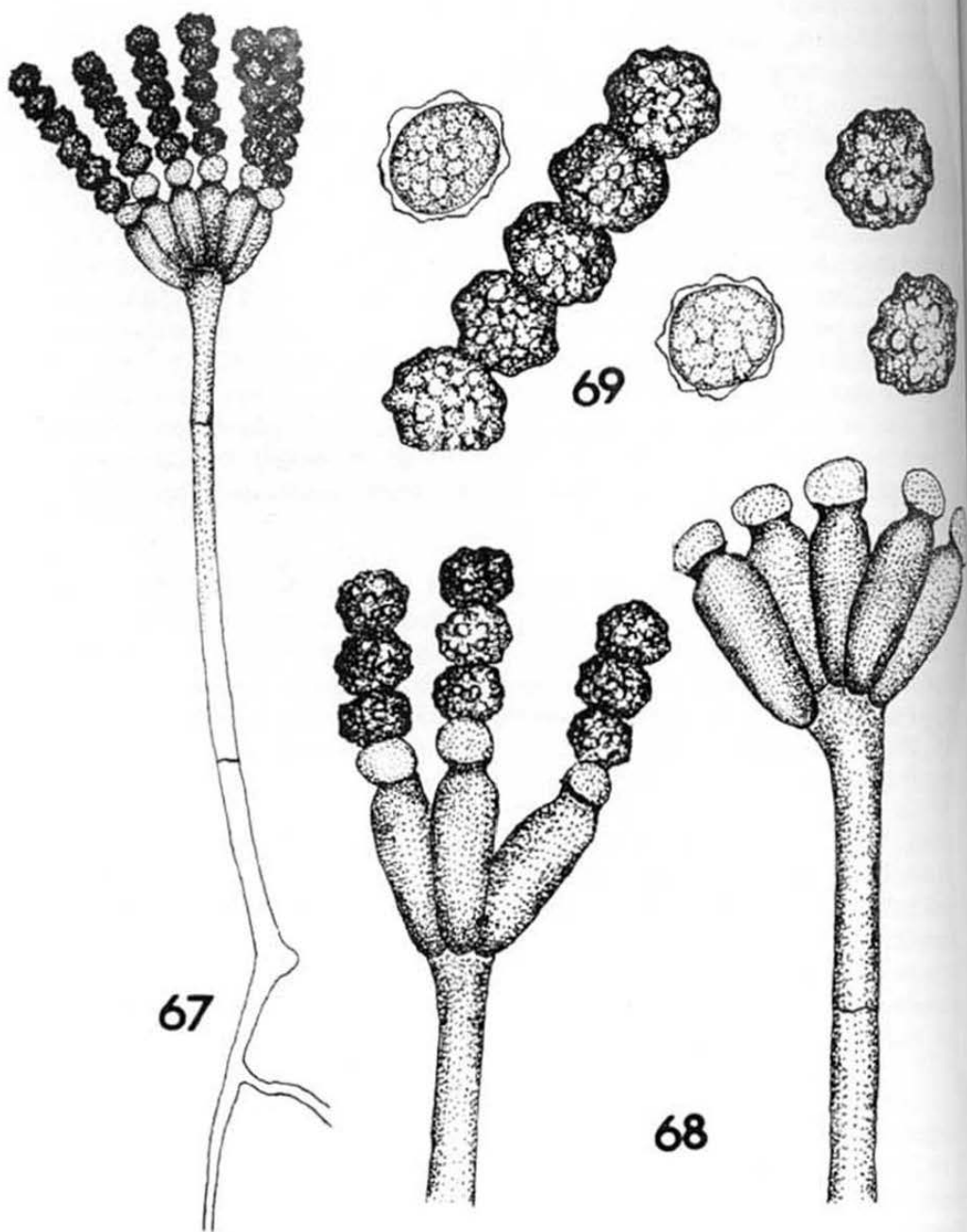
also appears to remain stable in the characters defining *Memmoniella*, we recognize *Memmoniella* and *Stachybotrys* as distinct genera but very closely related.

The nomenclatural synonyms of *Memmoniella echinata* listed above are compiled from the opinion of Smith (1962).

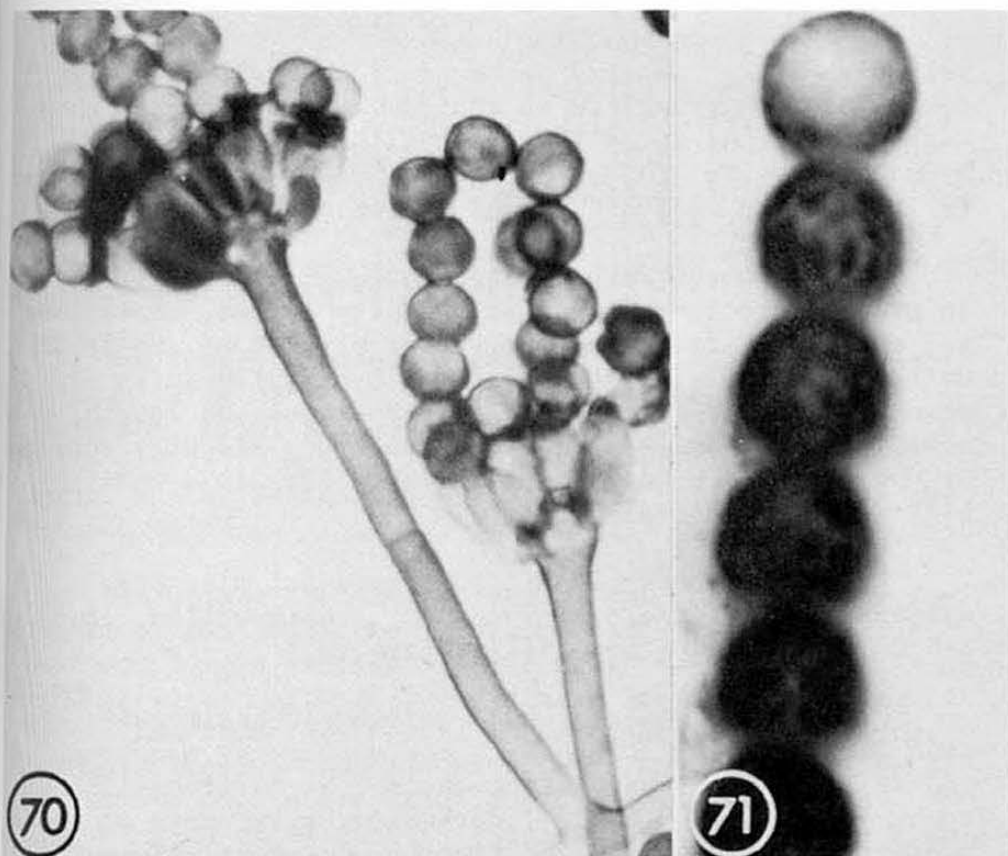
An excellent report on the history, distribution and economic significance of *M. echinata* has been published by White, Yeager and Shotts (1949). From an analysis of samples of deteriorated fabrics received from numerous military installations around the tropical belt of the world and from the United States, and after examinations of isolates from such samples, and of herbarium specimens, they concluded that *M. echinata* is a tropical cellulose-loving species that is able to utilize cellulose as a major carbon source.

The strain ATCC 11974 studied was obtained from E. G. Simmons as QM 1225 of the U. S. Army Natick Laboratories, Natick, Massachusetts. This strain was also included by McQuade (1963) in his studies of morphogenetic responses of fungi to factorily arranged variation in concentrations of  $\text{NH}_4\text{Cl}$ ,  $\text{K}_2\text{HPO}_4$  and glucose. It grows and sporulates well on cornmeal agar at temperatures in the range of 15 to 30 C. The upper limit of temperature for conidial germination is 37 C. Production of clearing by growth on the cellulose agar medium reveals that it is a strong cellulose-decomposing fungus. ATCC 11974 is being used for fungus resistance tests in U. S. military specifications. The other two strains (ATCC 22697 and ATCC 22698) studied were isolated by T. Matsushima from forest soil in Papua-New Guinea.

Two additional species of *Memmoniella* have been reported from India. *Memmoniella levispora* Subramanian (1954) has conidia with smooth walls, 3-7  $\mu\text{m}$  in diameter and also been recovered from Pakistan (Ellis, 1971). *Memmoniella zingiberis* Rao has conidia with roughened walls, 4.4-6.8  $\mu\text{m}$  in diameter. According to the description and figure given by Rao (1962), it is quite possible that *M. zingiberis* is a synonym of *M. echinata*. Unfortunately, neither *M. levispora* nor *M. zingiberis* is available in culture.



Figures 67-69. *Memmoniella subsimplex* ATCC 18838.  
 67. Conidiophore with terminal phialides and phialoconidia  
 in chains. ca. X 500. 68. Phialides. ca. X 1,000.  
 69. Mature phialoconidia. ca. X 1,600.



Figures 70-71. *Memmoniella subsimplex* ATCC 18838.  
 70. Phialides with phialoconidia in chains. ca. X 800.  
 71. Mature phialoconidia in chains. Note a coarsely  
 warty surface. ca. X 2,000.

*Memmoniella subsimplex* (Cooke) Deighton, CMI Mycol. Papers  
 78: 5. 1960.

= *Stachybotrys subsimplex* Cooke, Grevillea 12: 33.  
 1883.

= *Haplographium musae* Sawada, Nat'l. Taiwan Univ. Coll.  
 Agric. Spec. Publ. 8: 193. 1959.

Figures 67-71.

Growth on cornmeal agar somewhat restricted, reaching  
 4 cm in diameter in 3 weeks, submerged, colorless to

yellowish pink. Central parts of old colonies becoming downy and dark granulate as conidial production commences. Margin of colony not distinct, hyaline, with submerged hyphae. Reverse stained orange to brown. Conidia produced in abundance a week after inoculation of the plate.

Conidiophores determinate, macronematous, solitary or in groups, erect, straight or slightly curved, unbranched, 1-3 septate at first hyaline, later olivaceous, up to 220  $\mu\text{m}$  long, 3-4  $\mu\text{m}$  wide, the basal cell slightly inflated, sometimes minutely rough-walled throughout the length, sometimes more or less smooth throughout, slightly enlarged at the apex which bears terminal phialides in a whorl of 5-12 around a central phialide.

Phialides enteroblastic, determinate, discrete, unicellular, ellipsoid, olivaceous, smooth-walled, 12-15  $\times$  5-6  $\mu\text{m}$ , with conspicuous collarettes.

Phialoconidia acrogenous, arising in basipetal succession and remaining attached to one another by a common septum in long persistent chains, at first hyaline and smooth-walled, when mature, dark olive gray, more or less opaque, coarsely warted, continuous, octagonal-globose in side view and circular in outline from the end view, dry (not in slime), 6-9  $\mu\text{m}$  in diameter.

REMARKS: In reviewing the genus *Stachybotrys*, Bisby (1943) tentatively emended *S. subsimplex* Cooke to include *Memmoniella echinata* (Riv.) Galloway. Zuck (1946) later amplified Bisby's suggestion, indicating that *M. echinata* in culture may sometimes produce a *Stachybotrys*-like phase similar to the description of *S. subsimplex sensu* Bisby. As pointed out by Bisby and Ellis (1949), this leaves the name *Stachybotrys* as doubtful, unless it refers to the *Stachybotrys*-like phase of *Memmoniella echinata*.

However, the type material of *S. subsimplex* in the Kew Herbarium (K) was reexamined by Deighton (1960) who found that it is not a *Stachybotrys*-like phase of *M. echinata* but a distinct species of *Memmoniella*. He therefore transferred Cooke's species from *Stachybotrys* to *Memmoniella* as *M. subsimplex* (Cooke) Deighton. Phialoconidia of this fungus differ from those of *Stachybotrys chartarum* (as *S. atra*) and other *Stachybotrys* species in being slightly flattened along the axis from the base

to the apex instead of being elongated along this axis, and in not sliming down at once into a mucilaginous mass, but instead, remaining for a period attached in long chains. Deighton also pointed out that it is obviously closely related to *M. echinata* from which it differs in its larger phialoconidia, (6)7-8(9)  $\mu\text{m}$  in diameter, as against 4-5.5(6)  $\mu\text{m}$  in *M. echinata*.

The fungus commonly occurs on dead *Musa* leaves and on dead parts of other host plants in the tropics (Deighton, 1960; Sawada, 1959). It was also recorded by Joffe (1967) from soil in a citrus fertilizer trial in Israel and by Matsushima (1971a) from forest soil in the Solomon Islands.

The strain ATCC 18838 studied was obtained from K. Tubaki of the Institute for Fermentation, Osaka, Japan, as *Stachybotrys echinata* (Riv.) Smith (IFO 7525). ATCC 22699 and ATCC 22700 both were isolated by T. Matsushima from forest soil in British Solomon Islands. Morphologically, they fit with Deighton's description of *M. subsimplex* and are readily distinguishable by the predominance of catenulate phialoconidia, and their size. During the course of the present work, we have not seen a *Stachybotrys*-like phase in these cultures. The growth temperature range of ATCC 18838 is very narrow, 24 to 30 C. The upper limit of temperature for conidial germination is also 30 C. The fungus is able to decompose cellulose and utilize it as a sole carbon source.

## ACKNOWLEDGMENTS

We wish to thank Dr. Agnes H. S. Onions, of Commonwealth Mycological Institute, Kew, England, for the loan of the dried type culture of *Stachybotrys atra* var. *microspora* and Dr. P. S. Green, of the Royal Botanic Garden, Kew, England, for the type specimens of *S. kampalensis*, *S. nephrospora* and *S. theobromae*. Thanks are also due to all the contributors who deposited the cultures studied in the ATCC Mycology Collection.

Appreciation is extended to Dr. J. L. Crane, of the Illinois Natural History Survey, Urbana, Illinois, for his painstaking review of the manuscript, bibliographic assistance and for the scanning electron micrographs of the phialoconidia of *S. chartarum* and *Memmoniella echinata*.

We are grateful to Dr. Emory G. Simmons, former chairman of the ATCC Advisory Committee of the Collection of Fungi, to Dr. Chester R. Benjamin and Dr. Constantine J. Alexopoulos, former members of the ATCC Board of Trustees, for their critical review of the manuscript.

We are also grateful to Professor Richard P. Korf for his careful editing and final arrangement of the manuscript.

This work was supported in part by National Science Foundation Grants BMS75-06286 and DEB75-06286 A01 and by Brown-Hazen Grant BH 846 from Research Corporation, New York.



## LITERATURE CITED

- ALBERTINI, I. B., and L. D. SCHWEINITZ. 1805. *Conspectus Fungorum in Lusatae superioris agro Niskiensi crescentium*. Lipsiae 29: 34.
- BAMBURG, J. R., and F. M. STRONG. 1971. 12-13-epoxy epoxytrichothecenes. p. 207-292. In S. Kadis, A. Ciegler, and S. Ajl (eds.) *Microbial Toxins*, Vol. VII. Academic Press, New York.
- BARRON, G. L. 1961. Studies on species of *Helicodendron*, *Oidiendron* and *Stachybotrys* from soil. *Can. J. Bot.* 39: 1563-1571.
- BARRON, G. L. 1962. *Stachybotrys aurantia* sp. nov. from soil. *Can. J. Bot.* 40: 257-261.
- BARRON, G. L. 1964. A note on the relationship between *Stachybotrys* and *Hyalostachybotrys*. *Mycologia* 56: 313-316.
- BARRON, G. L. 1968. *The Genera of Hyphomycetes from Soil*. The Williams & Wilkins Co., Baltimore, 364 pp.
- BERKELEY, J. M., and C. E. BROOME. 1871. Notices of British fungi. *Ann. Mag. Nat. Hist. Ser. 4*, 7: 425.
- BISBY, G. R. 1943. *Stachybotrys*. *Trans. Brit. Mycol. Soc.* 26: 133-143.
- BISBY, G. R. 1945. *Stachybotrys* and *Memmoniella*. *Trans. Brit. Mycol. Soc.* 28: 11-12.
- BISBY, G. R., and M. B. ELLIS. 1949. *Stachybotrys dichroa* Grove. *Trans. Brit. Mycol. Soc.* 32: 158-161.
- BODON, L., and M. Palyusik. 1970. Cytotoxicity of toxic extracts from the fungus *Stachybotrys alternans*. *Acta Vet. Acad. Sci. Hung.* 20: 289-294.
- BONDIETTI, E., J. P. MARTIN, and K. HAIDER. 1971. Influence of nitrogen source and clay on growth and phenolic polymer production by *Stachybotrys* species, *Hendersonula toruloides*, and *Aspergillus sydowi*. *Soil Sci. Soc. Amer. Proc.* 35: 917-922.

- BOJOVIĆ-CVETIĆ, D., and R. VUJIĆIĆ. 1974. Ultrastructure of conidiophores in *Aspergillus flavus*. Trans. Br. Mycol. Soc. 63: 131-135.
- BOOTH, C. 1957. Studies of Pyrenomycetes. II. *Melanopsamma pomiformis* and its *Stachybotrys* conidia. CMI Mycol. Papers 68: 16-27.
- BUCKLEY, P. M., T. D. WYLLIE, and J. E. DEVAY. 1969. Fine structure of conidia and conidium formation in *Verticillium albo-atrum* and *V. nigrescens*. Mycologia 61: 240-250.
- BUSTON, H. W., and S. N. BASU. 1948. Some factors affecting the growth and sporulation of *Chaetomium globosum* and *Memmoniella echinata*. J. Gen. Microbiol. 2: 162.
- BUTT, Z. L., and A. CHAFFAR. 1972. Inhibition of fungi, Actinomycetes and bacteria by *Stachybotrys atra*. Mycopath. Mycol. Appl. 47: 241-251.
- CAMPBELL, R. 1972. Ultrastructure of conidium ontogeny in the Deuteromycete fungus *Stachybotrys atra* Corda. New Phytol. 71: 1143-1149.
- CAMPBELL, R. 1974. The ultrastructure of the formation of chains of conidia in *Memmoniella echinata*. Mycologia 67: 760-769.
- CARROLL, G. C., and F. E. CARROLL. 1974. The fine structure of conidium development in *Phialocephala dimorphospora* Can. J. Bot. 52: 2119-2128.
- COCHRANE, V. W. 1958. *Physiology of Fungi*. John Wiley & Sons, Inc., New York, 524 pp.
- CORDA, A. C. I. 1837. *Icones Fungorum hucusque cognitorum*. I. p. 21, f. 278B.
- DEIGHTON, F. C. 1960. African fungi. I. CMI Mycol. Papers 78: 1-43.
- DROBOTKO, V. G. 1945. Stachybotryotoxicosis, a new disease of horses and man. Ann. Rev. Soviet Med. 2: 238-242.

- ELLIS, M. B. 1971a. *Dematiaceous Hyphomycetes*. Commonwealth Mycological Institute, Kew, England, 608 pp.
- ELLIS, M. B. 1971b. *Dematiaceous Hyphomycetes*. X. CMI Mycol. Papers 125: 1-30.
- EMMONS, C. W., C. H. BINFORD, and J. P. UTZ. 1970. *Medical Mycology*. 2nd ed. Lea & Febiger, Philadelphia. 508 pp.
- EPPLEY, R. M., and W. J. BAILEY. 1973. 12-13-epoxy- $\Delta^9$ -trichothecenes as the probable mycotoxins responsible for stachybotryotoxicosis. *Science* 181: 758-760.
- FERRARIS, T. 1909. Osservazioni micrologiche su specie del gruppo Hyphales (Hyphomycetes). *Ann. Mycol.* 7: 273-286.
- FERRARIS, T. 1912. *Flora Italica, Hyphales*. p. 246.
- FILIP, Z., K. HAIDER, and J. P. MARTIN. 1972a. Influence of clay minerals on growth and metabolic activity of *Epicoccum nigrum* and *Stachybotrys chartarum*. *Soil Biol. Biochem.* 4: 135-145.
- FILIP, Z., K. HAIDER, and J. P. MARTIN. 1972b. Influence of clay minerals on the formation of humic substances by *Epicoccum nigrum* and *Stachybotrys chartarum*. *Soil Biol. Biochem.* 4: 147-154.
- FLETCHER, J. 1971. Conidium ontogeny in *Penicillium*. *J. Gen. Microbiol.* 67: 207-214.
- FORGACS, J. 1965. Stachybotryotoxicosis and moldy corn toxicosis. p. 87-93. In G. N. Wogan (ed.), *Mycotoxins in Foodstuffs*. MIT Press, Cambridge, Massachusetts.
- FORGACS, J. 1972. Stachybotryotoxicosis. p. 95-128. In S. Kadis, A. Ciegler, S. J. Ajl (eds.). *Microbial Toxins*. Vol. VIII. Academic Press, New York.
- FORGACS, J., and W. T. CARLL. 1962. Mycotoxicoses. *Adv. Vet. Sci.* 7: 273-293.

- FORGACS, J., W. T. CARLL, A. S. HERRING, and W. R. HINSHAW. 1958. Toxicity of *Stachybotrys atra* for animals. Trans. N. Y. Acad. Sci. 20: 787-808.
- GALLOWAY, L. D. 1933. Note on an unusual mould fungus. Trans. Brit. Mycol. Soc. 18: 163-166.
- GHIORSE, W. C., and E. R. EDWARDS. 1973. Ultrastructure of *Aspergillus fumigatus* conidia development and maturation. *Protoplasma* 76: 49-59.
- GOOS, R. D. 1956. Classification of the Fungi Imperfecti. Proc. Iowa Acad. Sci. 63: 311-320.
- GRAY, W. D. 1971. *The Use of Fungi as Food and in Food Processing*. CRC Press, Cleveland, Ohio. 113 pp.
- GREATHOUSE, G. A., D. E. KLEMME, and H. D. BARKER. 1942. Determining the deterioration of cellulose caused by fungi. Ind. Eng. Chem., Anal. Ed. 14: 614-620.
- HAMMILL, T. M. 1972. Electron microscopy of phialoconidiogenesis in *Metarrhizium anisopliae*. Amer. J. Bot. 59: 317-326.
- HAMMILL, T. M. 1974. Electron microscopy of phialides and conidiogenesis in *Trichoderma saturnisporum*. Amer. J. Bot. 61: 15-24.
- HANLIN, R. T. 1976. Phialide and conidium development in *Aspergillus clavatus*. Amer. J. Bot. 63: 144-155.
- HANSFORD, C. G. 1943. Contributions toward the fungus flora of Uganda. V. Fungi Imperfecti. Proc. Linn. Soc., Lond. 155: 34-67.
- HÖHNEL, FRANZ VON. 1902. Fragmente zur Mycologie (I Mitteilung) Sitzungsber. Kaiser. Akad. Wiss. Wien, Mathem.-Naturwiss. Kl., Abt. I, 111: 987-1056.
- HÖHNEL, FRANZ VON. 1923. *Memmoniella* Höhn. n.g. Centralbl. Bakt. 2, 60: 16-17.
- HUGHES, S. J. 1952. Fungi from the Gold Coast. I. CMI Mycol. Papers 48: 1-91.

- HUGHES, S. J. 1953. Conidiophores, conidia and classification. *Can. J. Bot.* 31: 577-659.
- HUGHES, S. J. 1958. Revisiones Hyphomycetum aliquot cum appendice de nominibus rejiciendis. *Can. J. Bot.* 36: 727-836.
- JENSEN, C. W. 1912. Fungus flora of soil. Cornell Agr. Exp. Sta. Bull. 315: 414-501.
- JERMYN, M. A. 1953. Fungal cellulases. III. *Stachybotrys atra*. Growth and enzyme production on non-cellulosic substrates. *Aust. J. Biol. Sci.* 6: 48-49.
- JERMYN, M. A. 1955a. Fungal cellulases. IV. Production and purification of an extracellular  $\beta$ -glucosidase *Stachybotrys atra*. *Austral. J. Biol. Sci.* 8: 541-562.
- JERMYN, M. A. 1955b. Fungal cellulases. V. Enzymic properties of *Stachybotrys atra*  $\beta$ -glucosidase. *Austral. J. Biol. Sci.* 8: 563-576.
- JERMYN, M. A. 1955c. Fungal cellulases. VI. Substrates and inhibitor specificity of  $\beta$ -glucosidase of *Stachybotrys atra*. *Austral. J. Biol. Sci.* 8: 577-602.
- JERMYN, M. A. 1962. Acceptor competition as means of distinguishing between possible enzymic mechanisms using the  $\beta$ -glucosidase of *Stachybotrys atra*. *Austral. J. Biol. Sci.* 15: 248-261.
- JERMYN, M. A. 1965a. Fungal cellulases. XI. The nature of the inductive process for aryl  $\beta$ -glucosidase in *Stachybotrys atra*. *Austral. J. Biol. Sci.* 18: 387-415.
- JERMYN, M. A. 1965b. Fungal cellulases. XII. Relation of the amino acid analyses of mycelium of *Stachybotrys atra* and of its  $\beta$ -glucosidase to the *S*-aminoethyl-L-cysteine effect on induction. *Austral. J. Biol. Sci.* 18: 417-423.

- JERMYN, M. A. 1965c. Fungal cellulases. XIII.  
Specificity of the induction of the  $\beta$ -glucosidase of *Stachybotrys atra*. Austral. J. Biol. Sci. 18: 425-436.
- JERMYN, M. A. 1966a. Fungal cellulases. XVII. The behaviour of t-butyl alcohol, pinacol and methanol as acceptors for the  $\beta$ -glucosidase of *Stachybotrys atra*. Austral. J. Biol. Sci. 19: 927-933.
- JERMYN, M. A. 1966b. Fungal cellulases. XIX.  
Polyhydroxylic acceptors for the  $\beta$ -glucosidase of *Stachybotrys atra*. Austral. J. Biol. Sci. 19: 1153-1165.
- JOFFE, A. Z. 1967. The mycoflora of a light soil in a citrus fertilizer trial in Israel. Mycopath. Mycol. Appl. 32: 209-230.
- KENDRICK, W. B. 1971. *Taxonomy of Fungi Imperfecti*. Univ. of Toronto Press, Toronto, 309 pp.
- KENDRICK, W. B., and J. W. CARMICHAEL. 1973.  
Hyphomycetes. p. 323-509. In G. C. Ainsworth, F. K. Sparrow, and A. S. Sussman (eds.), *The Fungi*. Vol. IVA. Academic Press, New York.
- KORPINEN, E. L., M. KURKINEN, M. NUMMI, and T. M. ENARI. 1974. Studies of *Stachybotrys alternans*. III. Chromatographic separation and tissue culture toxicity test of stachybotrys toxins. Acta Path. Microbiol. Scand. Sect. B. 82: 7-11.
- KORPINEN, E. L., and J. UOTI. 1974. Studies on *Stachybotrys alternans*. II. Occurrence, morphology and taxigenicity. Acta Path. Microbiol. Scand. Sect. B. 82: 1-6.
- KORPINEN, E. L., and A. YLIMAKI. 1972. Discovery of taxicogenic *Stachybotrys chartarum* strains in Finland. Experientia (Basel) 28: 108-109.
- LILLY, V. G., and H. L. BARNETT. 1951. *Physiology of the Fungi*. McGraw-Hill Co., New York, 464 pp.



- LOWRY, R. J., T. L. DURKEE, and A. S. SUSSMAN. 1967. Ultrastructural studies of microconidium formation in *Neurospora crassa*. *J. Bacteriol.* 94: 1757-1763.
- MARCHAL, ELIE. 1895. Champignons coprophiles de Belgique. VII. *Bull. Soc. Roy. de Bot. Belgique* 34: 125-149.
- MARTIN, J. P., and K. HAIDER. 1969. Phenolic polymers of *Stachybotrys atra*, *Stachybotrys chartarum* and *Epicoccum nigrum* in relation to humic acid formation. *Soil Sci.* 107: 260-270.
- MARSH, P. B., and I. BOLLENBACHER. 1946. Vitamin requirements of *Memmoniella* and *Stachybotrys*. *Amer. J. Bot.* 33: 245-249.
- MARSH, P. B., K. BOLLENBACHER, M. L. BUTLER, and K. B. RAPER. 1949. The fungi concerned in fiber deterioration. II: Their ability to decompose cellulose. *Text. Res. J.* 19: 462-484.
- MATHUR, B. L., and H. C. SANKHLA. 1966. A new variety of *Stachybotrys atra* from Rajasthan soil. *Science & Culture* 32: 93-94.
- MATSUSHIMA, T. 1971a. *Microfungi of the Solomon Islands and Papua-New Guinea*. The Nippon Printing & Publishing Co., Osaka. 78 pp. + 169 figs. & 48 pls.
- MATSUSHIMA, T. 1971b. Some interesting Fungi Imperfecti. *Bull. Nat. Sci. Mus. Tokyo* 14: 460-480.
- MATSUSHIMA, T. 1975. *Icones Microfungorum A Matsushima Lectorum*. The Nippon Printing & Publishing Co., Osaka. 209 pp. + 415 pls.
- McQUADE, A. B. 1963. Morphogenesis and nutrition in the *Memmoniella-Stachybotrys* group of fungi. *J. Gen. Microbiol.* 30: 429-435.
- OLAH, G. M., and O. REISINGER. 1974. Etude ultrastructurale et cytochimique de l'appareil sporifere chez *Phialophora richardsiae*. *Can. J. Bot.* 52: 2473-2480.

- OLIVER, P. T. P. 1972. Conidiophore and spore development in *Aspergillus nidulans*. J. Gen. Microbiol. 73: 45-54.
- ORTIZ DE SERRA, M. I., F. J. SOWDEN, and M. SCHNITZER. 1973. Distribution of nitrogen in fungal "humic acids." Can. J. Soil Sci. 53: 125-127.
- PADWICK, G. W. 1945. Notes on Indian fungi. III. CMI Mycol. Papers 12: 1-15.
- PALYUSIK, M. 1970a. Biological test for the toxic substance of *Stachybotrys alternans*. Acta Vet. Acad. Sci. Hung. 20: 57-67.
- PALYUSIK, M. 1970b. Experimental Stachybotryotoxicosis of young chicks. Sabouraudia 8: 4-8.
- PERLMAN, D. 1948. On the nutrition of *Memnoniella echinata* and *Stachybotrys atra*. Amer. J. Bot. 35: 36-41.
- PERLMAN, D. 1951. On the effects of biologically active agents on fungi at different stages of growth. Amer. J. Bot. 38: 652-658.
- RAO, V. G. 1962. Some new records of Fungi Imperfecti from India. Sydowia 16: 41-45.
- RAYSS, T., and S. BORUT. 1956. Contribution to the knowledge of soil fungi in Israel. Mycopath. Mycol. Appl. 10: 142-174.
- REESE, E. T., R. G. H. SIU, and H. S. LEVINSON. 1950. Biological degradation of soluble cellulose derivatives. J. Bacteriol. 59: 485-497.
- RIFAI, M. A. 1964. *Stachybotrys bambusicola* sp. nov. Trans. Brit. Mycol. Soc. 47: 269-272.
- RIFAI, M. A. 1974. Another pink-spored and brown-stalked species of *Stachybotrys*. Reinwardtia 8: 537-540.
- RIVOLTA, S. 1873. Dei Parassiti Vegetali, come introduzione allo studio delle malattie parassitarie e delle alterazioni dell' alimento degli animali domestici. Torino, Italy. 592 pp.

- RODERICKS, J. V., and R. M. EPPLEY. 1974. *Stachybotrys* and stachybotryotoxicosis. p. 181-197. In I. F. H. Purchase (ed.), *Mycotoxins*. Elsevier Scient. Publ. Co., New York.
- ROQUEBERT, M. F., and M. M. ABADIE. 1973. Etude ultra-structurale de la sporogénèse chez un micromycète: *Stilbothamnium nudipes* Haum. C. R. Acad. Sci. Paris 276: 2883-2885.
- SACCARDO, P. A. 1875. Fungi venti novi vel critici. Ser. II. Nuovo Giorn. Bot. Ital. 7: 299-329.
- SACCARDO, P. A. 1878. Commentarium mycologicum fungos in primis italicos illustrans. Michelia I: 277-356.
- SACCARDO, P. A. 1882. *Sylloge fungorum omnium hucusque cognitorum*. 1. Published by the author, Patavii, Italy. 767 pp.
- SACCARDO, P. A. 1886. *Sylloge fungorum omnium hucusque cognitorum*. 4. Published by the author, Patavii, Italy. 807 pp.
- SAWADA, K. 1959. *Descriptive Catalogue of Taiwan (Formosan) Fungi*. XI. National Taiwan Univ. Coll. Agric. Spec. Publ. No. 8. Taipei, Taiwan. 268 pp + 12 Pls.
- SIMMONS, E. G. 1966. The theoretical bases for classification of the Fungi Imperfecti. Quart. Rev. Biol. 41: 113-123.
- SMITH, G. 1962. Some new and interesting species of microfungi. III. Trans. Brit. Mycol. Soc. 45: 387-394.
- SRINIVASAN, K. V. 1958. Fungi of the rhizosphere of sugarcane and allied plants. I. *Hyalostachybotrys* gen. nov. J. Indian Bot. Soc. 37: 334-342.
- STAFLEAU, F. A., et al. (ed.). 1972. *International Code of Botanical Nomenclature* adopted by the Eleventh International Botanical Congress, Seattle, August 1969. Regnum Vegetabile 82: 1-426.

- SUBRAMANIAN, C. V. 1954. Fungi Imperfecti from Madras. VI. J. Indian Bot. Soc. 33: 36-42.
- SUBRAMANIAN, C. V. 1957. Hyphomycetes. IV. Proc. Indian Acad. Sci. 46: 324-335.
- SUBRAMANIAN, C. V. 1972. Conidial chains, their nature and significance in the taxonomy of Hyphomycetes. Curr. Sci. 41: 43-49.
- THOM, C., H. HUMFELD, and H. P. HOLMAN. 1934. Laboratory tests for mildew-resistance of outdoor cotton fabrics. Am. Dyestuff. Repr. 23: 581-586.
- THOMAS, R. 1956. Fungal cellulases. VII. *Stachybotrys atra*: Production and properties of the cellulolytic enzyme. Austral. J. Biol. Sci. 9: 159-183.
- TRAVERSO, J. B. 1912. *Flora Italica*, Pyrenomycetae. p. 685.
- TRINCI, A. P., A. PEAT, and G. H. BANBURY. 1968. Fine structure in *Aspergillus giganteus* Wehmer. Ann. Bot. (Lond.) 32: 241-249.
- TSUKAHARA, T. 1970. Electron microscopy of conidiospore formation in *Aspergillus niger*. Sabouraudia 8: 93-97.
- TUBAKI, K. 1958. Studies on Japanese Hyphomycetes. V. Leaf and stem group with a discussion of the classification of Hyphomycetes and their perfect stages. J. Hattori Bot. Lab. 20: 142-244.
- TUBAKI, K. 1963. Notes on the Japanese Hyphomycetes. I. *Chloridium*, *Clonostachy*, *Ishmospora*, *Pseudobotrytis*, *Stachybotrys* and *Stephanoma*. Trans. Mycol. Soc. Japan 7: 83-90.
- VERONA, O., and G. MAZZUCCHETTI. 1968. *Microfunghi della cellulosa e della carta attivata' e inquadramento sistematico*. I. Generi "Stachybotrys" e "Memmoniella." Roma, Italy. 111 pp.

- WHITE, W. L., R. T. DARBY, G. M. STECHERT, and K. SANDERSON. 1948. Assay of cellulolytic activity of molds isolated from fabrics and related items exposed in the tropic. *Mycologia* 40: 34-84.
- WHITE, W. L., C. C. YEAGER, and H. SHOTTS. 1949. History, distribution and economic significance of the cellulose-destroying fungus *Memmoniella echinata*. *Farlowia* 3: 399-423.
- WILSON, B. J. 1973. 12,13-epoxytrichothecenes: Potential toxic contaminants of foods. *Nutrition Reviews* 31: 169-172.
- YOUATT, G. 1958. Fungal cellulases. IX. Growth of *Stachybotrys atra* on cellulose production of a  $\beta$ -glucosidase hydrolyzing cellobiose. *Aust. J. Biol. Sci.* 11: 209-217.
- YOUATT, G., and M. A. JERMYN. 1959. Enzymes splitting  $\beta$ -glucosidic linkages in *Stachybotrys atra*. p. 397-409. In D. L. Ray (ed.), *Marine Boring and Fouling Organisms*. University of Washington Press, Seattle.
- ZACHARIAH, K., and P. C. FITZ-JAMES. 1967. The structure of phialides in *Penicillium claviforme*. *Can. J. Microbiol.* 13: 249-256.
- ZUCK, R. K. 1946. Isolates intermediate between *Stachybotrys* and *Memmoniella*. *Mycologia* 38: 69-76.

## BOOK REVIEWS (continued from page 396)

STUDIES ON HIGHER FUNGI, A COLLECTION OF PAPERS DEDICATED TO DR. ALEXANDER H. SMITH ON THE OCCASION OF HIS SEVENTIETH BIRTHDAY, par Howard E. BIGELOW et Harry D. THIERS, éditeurs, 372 p., 12 figs., 78 pl. bl.-n. & coul. Beihefte zur Nova Hedwigia 51, 1975, ed. J. Cramer, FL-9490 Vaduz, Liechtenstein. DM 250.-

En l'honneur de Alexander H. Smith, les auteurs ne pouvaient mieux offrir que cet imposant ensemble de 26 contributions sur la taxonomie des Basidiomycètes venant de ses disciples mycologues et parmi les plus réputés et d'une sur les Ascomycètes (*Helvella* par Nancy Smith Weber), précédé du récit vivant des souvenirs mycologiques de Madame Helen V. Smith.

Parmi les travaux taxonomiques, on retiendra d'abord les revisions de genres ou de parties de genres, notamment de *Russula* subsect. *Emeticinae* (R. L. Shaffer), *Cortinarius* sect. *Dermocybe* (J. F. Ammirati & M. S. Gilliam), *Cortinari* subgen. *Telamonia* (K. H. McKnight), *Hygrophoropsis*, *Cantharellula*, *Myxomphalia* et *Omphaliaster* (H. E. Bigelow), *Panellus* et *Dietyopanus* (H. H. Burdsall, Jr. & O. K. Miller, Jr.), *Suillus* (H. D. Thiers) et *Alpova* et *Rhizopogon* (J. M. Trappe). De nouvelles espèces sont aussi décrites dans ces genres et les suivants, *Campanella*, *Melanomphalia*, *Pleurotus*, *Amanita*, *Naematoloma*, *Cantharellus*, *Boletopsis* et *Tomentella*.

On ne peut oublier les études plus spéculatives, mais non moins intéressantes, sur les affinités entre les Agaricales et les Gastéromycètes, *Amanita* et *Torrendia* (C. Bas) ou *Smithiogaster* n.g. (J. E. Wright), ou entre genres ou espèces dans les Gastéromycètes (L. E. Hawker; J. M. Trappe), dans les Bolbitiaceae (R. Watling), dans *Pluteus* R. L. Homola) ou dans *Suillus* (H. D. Thiers). Mentionnons aussi les observations ultrastructurales sur deux Bolets (H. Clemençon) à verser au dossier de la future 'ultracytotaxonomie.'

ON MUCOR MUCEDO, MUCOR FLAVUS AND RELATED SPECIES, par M. A. A. SCHIPPER, 33 p.; 7 figs. Studies in Mycology, No. 10, Sept. 1975. Centraalbureau voor Schimmelcultures, Baarn, Pays-Bas. Hfl. 10.-

Dans le but de revoir la spéciation des *Mucor* sur la base de l'interfertilité des souches et la variation morphologique de l'appareil sporangial, l'auteur explore cette fois les espèces des sections *Mucor* et *Flavus* de Zycha. L'interfertilité des souches types permet d'établir la synonymie de *Mucor albo-ater* avec *M. piriformis*, et de *M. peacockensis* et *M. attenuatus* avec *M. mucedo*.

Parmi les autres espèces acceptées, *Mucor saturninus*, *M. plasmaticus* et *M. flavus* ont produit des zygosporés, tandis que *M. aligarensis*, *psychrophilus*, *strictus* et *minutus* restent sporangiales.

(continued on page 552)



# MYCOTAXON

Vol. III, No. 3, pp. 487-551

April-June 1976

## FUNGI THAT DECAY MESQUITE IN SOUTHERN ARIZONA<sup>1/</sup>

R. L. GILBERTSON

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

H. H. BURDSALL, Jr.

*Center for Forest Mycology Research  
Forest Products Laboratory, Forest Service  
U.S. Department of Agriculture, Madison, Wisconsin 53705*

E. R. CANFIELD<sup>2/</sup>

*College of Forestry, Wildlife, and Range Sciences  
University of Idaho, Moscow, Idaho 83843*

### SUMMARY

Forty-eight species of lignicolous Basidiomycetes are reported from mesquite in Arizona. *Phellinus badius* and *Inonotus texanus* are the main causes of heartrot in living mesquite. Three new species, *Hypochnicium prosopidis*, *Mycocacia austro-occidentale*, and *Poria baboquivariensis* are described.

Common mesquite (*Prosopis juliflora* (Sw.) DC.) is a woody member of the Leguminosae with a wide distribution in the Southwest. It occurs most frequently as a spreading shrub on drier sites but also becomes a tree with a trunk 1 to 4 feet in diameter and up to 50 feet in height along streams. Benson (1941) considers the species to be composed of 3 intergrading varieties; var. *glandulosa*, var.

---

<sup>1/</sup> University of Arizona Agricultural Experiment Station  
Journal article No. 2594

<sup>2/</sup> Formerly, Visiting Assistant Professor, Department of  
Plant Pathology, University of Arizona.

*torreyana*, and var. *velutina*. We have made no effort to distinguish between these varieties as hosts of the wood decay fungi discussed below. Screwbean mesquite (*P. pubescens* Benth.) occurs in some localities in southeastern Arizona but we have not investigated the fungi on this species.

In southern Arizona common mesquite is distributed from the fringe of the Sonoran Desert to the adjoining desert-grasslands, and upward to the lower portion of the oak-woodland zone. At lower elevations it is associated with other woody legumes such as catclaw acacia (*Acacia greggii* Gray), whitethorn acacia (*A. constricta* Benth.), yellow palo verde (*Cercidium microphyllum* (Torr.) Rose and Johnston), and blue palo verde (*C. floridum* Benth.). Other associates include several species of prickly pear and cholla cacti (genus *Opuntia*), the giant saguaro cactus (*Carnegiea gigantea* (Engelm.) Britt. et Rose) and creosote bush (*Larrea tridentata* (DC.) Coville). Along stream beds it is associated to some extent with a great diversity of hardwood trees. Among these are Fremont cottonwood (*Populus fremontii* S. Wats.), Arizona walnut (*Juglans major* (Torr.) Heller), velvet ash (*Fraxinus velutina* Torr.), desert willow (*Chilopsis linearis* (Cav.) Sweet), Arizona sycamore (*Platanus wrightii* S. Wats.), Goodding willow (*Salix gooddingii* Ball), and others. At its highest elevational range it is an infrequent associate of Emory oak (*Quercus emoryi* Torr.) in the lower portion of the oak-woodland zone.

Decay of heartwood in living mesquite is due mainly to two fungi, *Phellinus badius* and *Inonotus texanus*, both of which cause a white rot. Their mode of entrance into the heartwood is unknown. Tunnels of the mesquite borer (*Megacyllene antennatus* (White)) are a possible infection court. Both *P. badius* and *I. texanus* are restricted in their American distribution to the arid Southwest. *Inonotus texanus* is not known to occur elsewhere, but *P. badius* is widely distributed throughout the tropical regions of the world.

Dead branches of mesquite might seem an unlikely place for the development of wood-rotting fungi. However, a very distinctive group of species has adapted to this dry environment and is generally found wherever mesquite grows. The four most important branch decay fungi are *Peniophora tamaricicola*, *Byssomerulius corium*, *Peniophora albobadia*,

and *Exidiopsis leucophaea*. Other species frequently found fruiting on dead branches are *Peniophora nuda*, *Phanerochaete tuberculata*, *Phanerochaete arizonica*, and *Phanerochaete allantospora*. All of these fungi produce basidiocarps that remain dry and dormant over long periods of little or no precipitation and low humidity. Following precipitation during the summer and winter rainy periods, they revive and begin sporulation very quickly. Basidiocarps of all of the branch decay fungi mentioned above (except for *Exidiopsis leucophaea*, a Heterobasidiomycete) have a typical euhymenium and have no specialized structures that enable them to remain viable over dry, hot periods. It is of interest that no species of *Aleurodiscus* or *Laeticorticium* are found on branches of mesquite although members of these genera are found on dead branches of trees at higher elevations in the Southwest and in more northern latitudes. Apparently the catahymenium and thick-walled resting probasidia found in many species of these genera are not adapted to survival over long periods in a hot, dry climate.

A number of other fungi have been found on dead fallen branches, dead standing trees, and fallen mesquite. *Phellinus ferruginosus*, *Poria tarda*, and *Antrrodia heteromorpha* are probably the most important decay fungi on dead, fallen mesquite wood.

Our observations indicate that the fungi treated here are all associated with white rots except *Antrrodia heteromorpha*, *Panus fulvidus* and *Coniophora eremophila*.

In the descriptions that follow, capitalized color names are from Ridgway (1912). The collectors cited by initials are R. L. Gilbertson (RLG), E. R. Canfield (ERC), and H. H. Burdsall, Jr. (HHB). A few collections by others are cited, and in these cases the collector's name is given.

Research by Gilbertson and Canfield was supported by McIntire-Stennis project No. 2016-4166-23 in the University of Arizona Agricultural Experiment Station.

## CHECKLIST OF FUNGI THAT DECAY MESQUITE IN SOUTHERN ARIZONA

## TREMELLALES

1. *Dacrymyces minor* Pk.
2. *Eridiopsis calcea* (Pers.) Wells
3. *Eridiopsis leucophaea* (Bres.) Wells
4. *Platygløea mycophila* Burds. et Gilbertson
5. *Platygløea peniophorae* Bourd. et Galz.
6. *Tremella simplex* Jacks. et Martin

## APHYLLOPHORALES

## Coniophoraceae

7. *Coniophora eremophila* Lindsey et Gilbertson

## Corticaceae

8. *Athelia coprophila* (Wakef.) Jülich
9. *Byssomerulius corium* (Fr.) Parm.
10. *Byssomerulius sulphureus* (Burt) Lindsey
11. *Hyphoderma amoenum* (Burt) Donk
12. *Hyphoderma* sp. (RLG 10255)
13. *Hyphodontia quercina* (Fr.) J. Erikss.
14. *Hyphodontia sambuci* (Pers. ex Fr.) J. Erikss.
15. *Hypochnicium bombycinum* (Sommerf. ex Fr.) J. Erikss.
16. *Hypochnicium prosopidis* Burds.
17. *Mycocacia austro-occidentale* Canf.
18. *Odontia pruni* Lasch
19. *Peniophora albobadia* (Schw. ex Fr.) Boidin
20. *Peniophora nuda* (Fr.) Bres.
21. *Peniophora tamaricicola* Boidin et Malençon
22. *Phanerochaete allantospora* Burds. et Gilbertson
23. *Phanerochaete arizonica* Burds. et Gilbertson
24. *Phanerochaete chrysorhizon* (Torr.) Buntington et Gilbertson
25. *Phanerochaete tuberculata* (Karst.) Parm.
26. *Phlebia ochraceofulva* (Bourd. et Galz.) Donk

## Cyphellaceae

27. *Henningsomyces candidus* (Pers.) O. Kuntze

## Ganodermataceae

28. *Ganoderma lucidum* (Leyss. ex Fr.) Karst.

## Hymenochaetaceae

29. *Hymenochaete arida* Karst.  
 30. *Hymenochaete rubiginosa* Dicks. et Lev.  
 31. *Inonotus texanus* Murr.  
 32. *Phellinus badius* (Berk.) G. H. Cunn.  
 33. *Phellinus ferruginosus* (Schrad. ex Fr.) Bourd. et Galz.  
 34. *Phellinus gilvus* (Schw.) Pat.

## Lachnocladiaceae

35. *Vararia tropica* Welden

## Polyporaceae

36. *Antrodia heteromorpha* (Fr.) Donk  
 37. *Polyporus arcularius* Batsch ex Fr.  
 38. *Poria apacheiensis* Gilbertson et Canf.  
 39. *Poria baboquivariensis* Gilbertson  
 40. *Poria latemarginata* (Dur. et Mont.) Cke.  
 41. *Poria medulla-panis* (Jacq. sensu Pers.) Bres.  
 42. *Poria subincarnata* (Pk.) Murr.  
 43. *Poria tarda* (Berk.) Cke.  
 44. *Funalia gallica* (Fr.) Bond. et Sing.

## Stereaceae

45. *Lopharia crassa* (Lév.) Boidin

## Thelephoraceae

46. *Tomentella coerulea* (Bres.) Hoehn. et Litsch.

## AGARICALES

47. *Marasmius siccus* (Schw.) Fr.  
 48. *Panus fulvidus* Bres.

## KEY TO WOOD-ROTTING BASIDIOMYCETES ON MESQUITE IN ARIZONA

- |    |  |                            |
|----|--|----------------------------|
| 1. | Basidia septate or bifurcate . . . . .                                 | 2                          |
| 1. | Basidia not septate or bifurcate, of the<br>homobasidium type. . . . . | 7                          |
| 2. | Basidia bifurcate. . . . .   | 1. <i>Dacrymyces minor</i> |
| 2. | Basidia septate. . . . .   | 3                          |

- 3. Basidia transversely septate. . . . . 4
- 3. Basidia vertically septate . . . . . 5
  - 4. Basidia with one septum; basidiospores spherical . . . . . 4. *Platygløea mycophila*
  - 4. Basidia with three septa; basidiospores ellipsoid . . . . . 5. *Platygløea peniophorae*
- 5. Basidiocarps gelatinous; parasitic on other fungi; basidia one- or two-celled. . . 6. *Tremella simplex*
- 5. Basidiocarps not gelatinous; not parasitic on other fungi; basidia four-celled at maturity. . 6
- 6. Basidiocarps discoid, with a hirsute, inrolled margin; hymenial surface purplish-gray. . . . . 3. *Exidiopsis leucophaea*
- 6. Basidiocarps broadly effused, chalky white . . . . . 2. *Exidiopsis calcea*
- 7. Hymenium lining the inner surface of united tubes . . . . . 8
- 7. Hymenium not lining the inner surface of united tubes . . . . . 21
- 8. Upper surface of pileus crustlike, often appearing varnished; basidiospores truncate, with a pitted exospore. . . 28. *Ganoderma lucidum*
- 8. Upper surface neither crustlike nor appearing varnished or basidiocarps not pileate; basidiospores not as above. . . . . 9
- 9. Basidiocarp tissue brown, permanently blackening in KOH solution . . . . . 10
- 9. Basidiocarp tissue white to pale colored, not permanently blackening in KOH solution. . . . . 13
  - 10. Setae abundant in the hymenium; basidiospores hyaline . . . . . 11
  - 10. Setae not present in the hymenium; basidiospores pigmented . . . . . 12
- 11. Basidiocarps resupinate; setae large, up to 65 um long; basidiospores oblong. . . . . 33. *Phellinus ferruginosus*
- 11. Basidiocarps pileate; setae small, up to 30 um long; basidiospores ovoid . . . . . 34. *Phellinus gilvus*
- 12. Basidiocarps annual; upper surface cracking concentrically and radially into rectangular scales. . . . . 31. *Inonotus texanus*
- 12. Basidiocarps perennial; upper surface becoming blackened and rimose. . . . 32. *Phellinus badius*



13. Basidiocarps stipitate, sessile, effused-reflexed, or occasionally resupinate; basidiospores large, cylindrical, over 7  $\mu\text{m}$  long . . . . . 14
13. Basidiocarps always resupinate; basidiospores subglobose to ellipsoid, or if cylindrical, not over 5  $\mu\text{m}$  long . . . . . 16
14. Basidiocarps stipitate .37. *Polyporus arcularius*
14. Basidiocarps not stipitate . . . . . 15
15. Basidiocarps small; pores 1-3 per mm; upper surface tomentose to glabrous; associated with a brown cubical rot . . . . . 36. *Antrodia heteromorpha*
15. Basidiocarps becoming much larger; pores commonly over 1 mm diam; upper surface hispid; associated with a uniform white rot. . . . . 44. *Funalia gallica*
16. Generative hyphae with simple septa. . . . . 17
16. Generative hypae with clamp connections. . . . . 18
17. Pore surface pink on fresh specimens; basidiospores short-cylindrical. . . . . 43. *Poria tarda*
17. Pore surface white to cream-colored; basidiospores broadly ellipsoid to ovoid. . . . . 40. *Poria latemarginata*
18. Hyphal system monomitic, only nodose-septate generative hyphae present . . . . . 19
18. Hyphal system dimitic, with thick-walled skeletal or binding hyphae . . . . . 20
19. Basidiocarps orange; basidiospores minutely echinulate. . . . . 39. *Poria baboquivariensis*
19. Basidiocarps white to cream-colored; basidiospores smooth . . . . . 39. *Poria apacheriensis*
20. Basidiospores ovoid, often truncate, dextrinoid in Melzer's reagent . . . . . 41. *Poria medulla-paris*
20. Basidiospores allantoid, negative in Melzer's reagent . . . . . 42. *Poria subincarnata*
21. Hymenium lining inner surface of individual, white, tubular basidiocarps. . . . . 27. *Henningsomyces candidus*
21. Hymenium not lining individual tubes. . . . . 22
22. Basidiocarps stipitate; hymenophore in form of radial gills . . . . . 23
22. Basidiocarps resupinate or effused-reflexed; hymenophore not as above . . . . . 24
23. Basidiocarps fragile, with dark brown filamentous stipe and reddish-brown cap; basidiospores 13-16 x 4-5  $\mu\text{m}$ . . . . . 47. *Marasmius siccus*
23. Basidiocarps not fragile, cap and stipe pale tan to cream-colored; basidiospores 12-15 x 6-6.5  $\mu\text{m}$ . . . . . 48. *Panus fulvidus*

24. Basidiocarp tissue becoming permanently black in KOH; setae present in hymenium. . . . . 25
24. Basidiocarp tissue not becoming black in KOH; setae not present in hymenium. . . . . 26
25. Basidiospores cylindrical; hyphae loosely arranged. . . . . 29. *Hymenochaete arida*
25. Basidiospores ovoid; hyphae compactly arranged. . . . . 30. *Hymenochaete rubiginosa*
26. Basidiospores pale brown . . . . . 27
26. Basidiospores hyaline. . . . . 28
27. Basidiospores echinulate, negative in Melzer's reagent . . . . . 46. *Tomentella coerulescens*
27. Basidiospores smooth, dextrinoid in Melzer's reagent . . . . . 7. *Coniophora eremophila*
28. Hymenial surface merulioid, with irregular shallow folds and ridges . . . . . 29
28. Hymenial surface smooth, tuberculate, or distinctly hydnceous . . . . . 30
29. Basidiocarps resupinate to effused-reflexed; upper surface grayish, tomentose; hymenial surface tan to reddish-purple . . . . . 9. *Byssomerulius corium*
29. Basidiocarps resupinate, with abundant rhizomorphs; hymenial surface bright yellow. . . . . 10. *Byssomerulius sulphureus*
30. Hymenial surface distinctly hydnceous . . . . . 31
30. Hymenial surface smooth or tuberculate . . . . . 34
31. Basidiocarps bright orange-yellow; rhizomorphs present . . . . . 24. *Phanerochaete chrysorhizon*
31. Basidiocarps white to cream-colored or pale buff; rhizomorphs not present . . . . . 32
32. Hyphae with simple septa only, clamp connections not present. . . . . 18. *Odontia pruri*
32. Hyphae with abundant clamp connections . . . . . 33
33. Hymenial surface with smooth, well-developed cylindrical teeth; heavily incrusted hyphae imbedded in inner tissue of teeth; hymenial cystidia absent . . . . . 17. *Mycocacia austro-occidentale*
33. Hymenial surface with short, fimbriate teeth; cystidia present, cylindrical or capitate. . . . . 13. *Hyphodontia quercina*
34. Dichohyphidia abundant in hymenial region and subiculum. . . . . 35. *Vararia tropica*
34. Dichohyphidia not present. . . . . 35
35. Hyphae with simple septa only, clamp connections lacking . . . . . 36
35. Hyphae with abundant clamp connections. . . . . 39

36. Cystidia not present in the  
hymenium . . . . . 25. *Phanerochaete tuberculata*
36. Cystidia present in the hymenium . . . . . 37
37. Hymenial surface purple when fresh, drying  
brown; cystidia thick-walled, heavily  
incrusted . . . . . 45. *Lopharia crassa*
37. Hymenial surface cream-colored to pale buff;  
cystidia thin-walled, not incrusted . . . . . 38
38. Basidiospores allantoid, 10-11.5 x  
2.5-3  $\mu\text{m}$  . . . . . 22. *Phanerochaete allantospora*
38. Basidiospores cylindric, 6.5-7 x  
2-2.5  $\mu\text{m}$  . . . . . 23. *Phanerochaete arizonica*
39. Heavily incrusted cystidia imbedded in subiculum  
and in hymenium; imbedded or projecting  
gloeocystidia also present. . . . . 40
39. Cystidia if present, not heavily incrusted;  
gloeocystidia absent. . . . . 42
40. Basidiocarps resupinate or effused-reflexed;  
hymenial surface dark purplish-brown with  
whitish margin . . . . . 19. *Peniophora albobadia*
40. Basidiocarps always resupinate;  
hymenial surface pale purplish-gray  
or pink when fresh; margin  
concolorous . . . . . 41
41. Basidiocarps pink when fresh, becoming  
cinereous and extensively cracked into small  
rectangular blocks on drying; dendrohyphidia  
present . . . . . 21. *Peniophora tamaricicola*
41. Basidiocarps pale purplish-gray when  
fresh and on drying; dendrohyphidia not  
present . . . . . 20. *Peniophora nuda*
42. Cystidia not present . . . . . 43
42. Cystidia present . . . . . 44
43. Basidiocarps fleshy, crustlike on drying;  
basidiospores broadly ellipsoid, 7-10 x  
5-6.5  $\mu\text{m}$  . . . . . 15. *Hypochnicium bombycinum*
43. Basidiocarps arachnoid, fragile; basidiospores  
subglobose, 5-6 x 4-4.5  $\mu\text{m}$  . . . . . 8. *Athelia coprophila*
44. Cystidia of two types, some acicular and  
others capitate. . . . . 14. *Hypodontia sambuci*
44. Cystidia of one type . . . . . 45
45. Cystidia acicular, thin-walled, 4-5  $\mu\text{m}$  diam and  
projecting to 30  $\mu\text{m}$  . . . . . 26. *Phlebia ochraceofulva*
45. Cystidia clavate or moniliform, thin- to  
thick-walled, up to 10  $\mu\text{m}$  diam and projecting  
to 70  $\mu\text{m}$  or over. . . . . 46

46. Basidiospores broadly ellipsoid, up to 8.5  $\mu\text{m}$  wide. . . . . 16. *Hypochnicium prosopidia*
46. Basidiospores narrowly ellipsoid, up to 6  $\mu\text{m}$  wide. . . . . 47
47. Basidiospores cylindrical-ellipsoid, 11-13 x 5.5-6  $\mu\text{m}$ . . . . . 11. *Hyphoderma anoenum*
47. Basidiospores broadly ellipsoid to ovoid, 5-6.5 x 4-4.5  $\mu\text{m}$ . . . . 12. *Hyphoderma* sp. (RLG 10255)

1. DACRYMYCES MINOR Pk., Ann. Rept. N.Y. State Mus. 30:49, 1877.

Basidiocarps discoid to slightly cerebriform, gelatinous, pale orange-yellow to olivaceous yellow, up to 1 mm diam, attached by a central point; hyphae imbedded in a gelatinous matrix, thin-walled, 2-4  $\mu\text{m}$  diam, simple-septate; basidia (Fig. 1a) bifurcate, up to 70  $\mu\text{m}$  long; basidiospores (Fig. 1b) broadly allantoid, 12-13 x 5-6  $\mu\text{m}$ , becoming 1-3 septate, hyaline, negative in Melzer's reagent.

*Dacrymyces minor* is found on dead branches of a number of desert trees and shrubs. The associated rot has not been determined. Some of the basidiocarps of *D. minor* in ERC 71-48 were found parasitized by *Platygløea peniophorae* and *Tremella simplex*, described as collections ERC 71-48a and 71-48b, respectively in this paper.

Voucher specimens: ERC 71-48 and HHB 5945, Santa Rita Expt. Range, Santa Rita Mts., Pima County; HHB 5954, Redington Rd., east of Tucson, Pima County.

2. EXIDIOPSIS CALCEA (Pers.) Wells, Mycologia 53:348, 1961.

*Sebacina calcea* (Pers.) Bres., Fungi Trid. 2:64. 1892.

Basidiocarps broadly effused, thin, hard and crust-like, at first small spots, then coalescing to form patches to 1-1.5 x 15-20 cm, cracking extensively to expose the substrate; hymenial surface white to grayish-white, smooth, shiny; margin minutely fimbriate, sometimes abrupt; hyphae of two kinds, one narrow, branched and sinuous, 1-1.5  $\mu\text{m}$  diam, aseptate, the other branched, 3-5  $\mu\text{m}$  diam, with clamp connections, these giving rise to basidia; basidia (Fig. 2a, 2b) with a basal clamp, subglobose to ellipsoid, be-



Fig. 1. *Dacrymyces minor* (ERC 71-48). a, basidia; b, basidiospores.

coming longitudinally septate, 4-celled at maturity, 12-15 x 15-25  $\mu\text{m}$ , epibasidia up to 35  $\mu\text{m}$  long; basidiospores (Fig. 2c) broadly allantoïd, 16-20 x 6-8  $\mu\text{m}$ , smooth, hyaline, negative in Melzer's reagent.

*Exidiopsis calcea* occurs on dead branches of a number of trees and shrubs from the desert to the coniferous forest zones. It is associated with a white rot.

Voucher specimens:  
RLG 10538, 10541, ERC 71-359, San Pedro River at Camp Grant Wash, Pinal County.

3. EXIDIOPSIS LEUCOPHAEA (Bres.) Wells, Mycologia 53: 352. 1961.

Basidiocarps disciform, cupulate, 1-6 mm diam, single to densely gregarious and crowded; margins free, densely tomentose-hirsute with matted white hairs; hymenial surface smooth, Light Grayish-Vinaceous or Light Vinaceous Fawn (grayish-pink), margin paler; hyphae of abhymenial surface hyaline, thin-to thick-walled, unbranched, aseptate, 2-4  $\mu\text{m}$  diam, with very slight wall thickening, somewhat refractive, difficult to separate, clamp connections present but obscure; subhymenial hyphae gelatinized and difficult to separate; dendrohyphidia (Fig. 3b, 3c) almost cylindrical or lobed, up to 8  $\mu\text{m}$  diam, others profusely branched, 2.5-3.5  $\mu\text{m}$  diam; basidia (Fig. 3a) ellipsoid, longitudinally septate, 20-30 x 13-15  $\mu\text{m}$ , with obscure basal clamps, usually proliferating through the clamp, with 4 stout epibasidia, these 3.5-5  $\mu\text{m}$  diam, up to 30  $\mu\text{m}$  long; basidiospores (Fig. 3d) cylindrical to broadly allantoïd, 15-20 x 6-7.5  $\mu\text{m}$ , smooth, hyaline, negative in Melzer's reagent, prominently apiculate.

*Exidiopsis leucophaea* is common on dead branches of



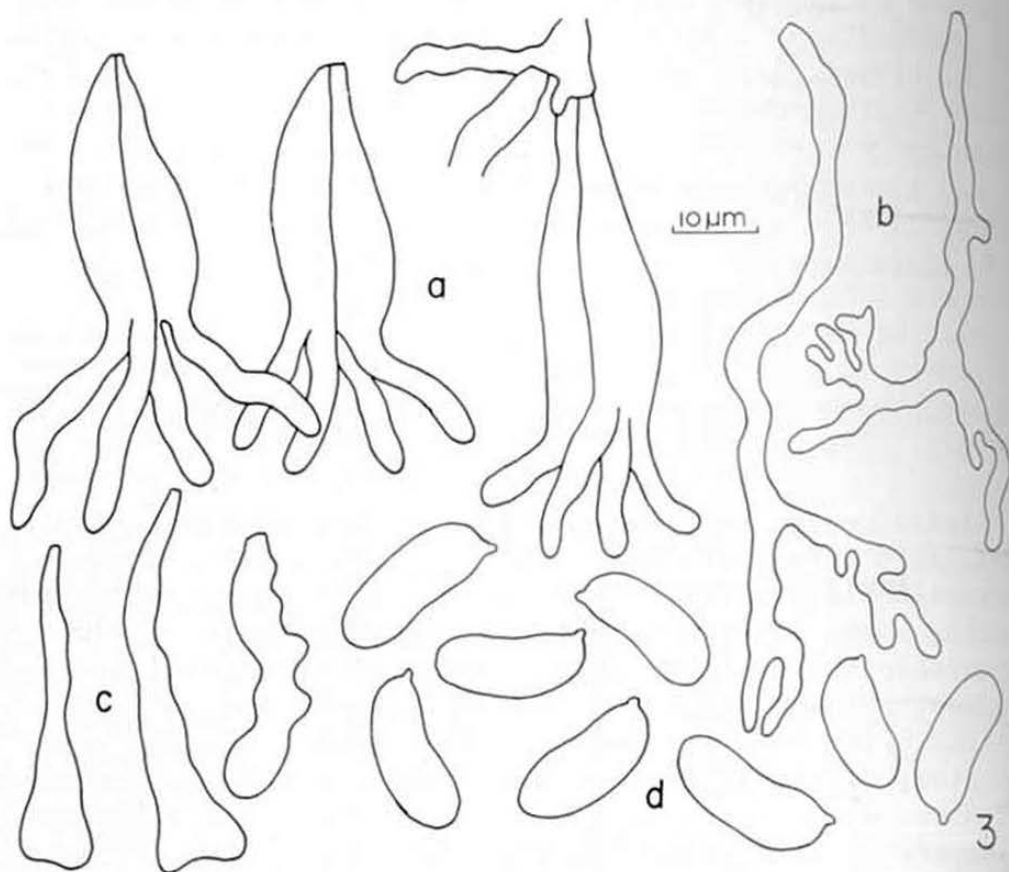
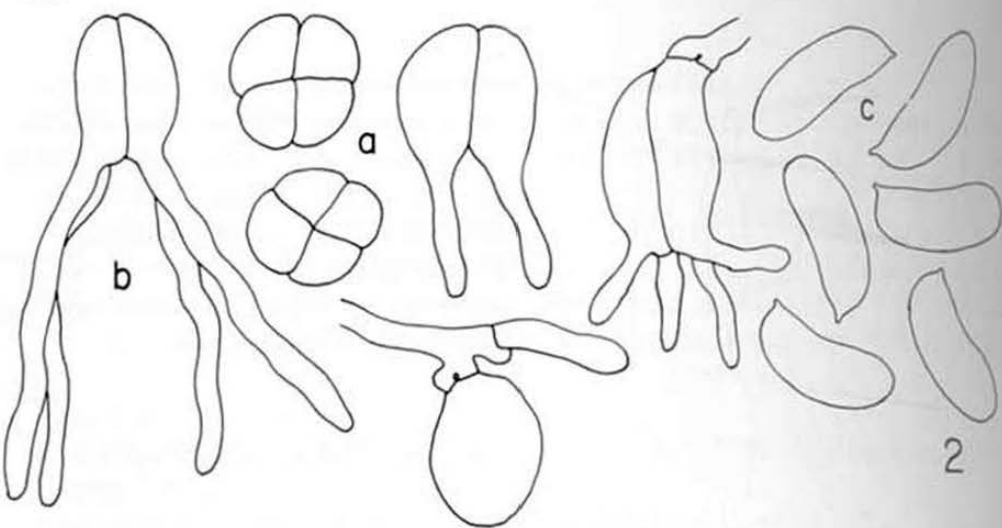


Fig. 2. *Exidiopsis calcea* (ERC 71-131). a, basidia in various stages of development; b, mature basidium; c, basidiospores. Fig. 3. *Exidiopsis leucophaea* (ERC 71-47). a, basidia; b, dendrohyphidia; c, unbranched hyphidia; d, basidiospores.



mesquite and has been found on a number of other Sonoran Desert trees and shrubs. It is associated with a white rot.

Voucher specimens: RLG 10215, ERC 71-47, ERC 71-135, Santa Rita Expt. Range, Santa Rita Mts., Pima County; RLG 10497, near Kitt Peak Junction, Papago Indian Reservation, Santa Cruz County; RLG 10550, San Pedro River near Camp Grant Wash, Pinal County.

4. PLATYGLOEA MYCOPHILA Burds. et Gilbertson, Mycologia 66:702-706. 1974.

Basidiocarps circular, appressed pustules, up to 2 mm diam, on *Peniophora tamaricicola* Boidin et Malenc., immature areas and margin white and pubescent when dry, mature areas yellowish-brown and smooth when dry; subicular hyphae 4-7  $\mu\text{m}$  diam, in hymenium of *Peniophora tamaricicola*, simple septate, regularly branched, with walls up to 2  $\mu\text{m}$  thick, slightly refractive; basidia (Fig. 4a) arising directly from subicular hyphae, oval to cylindrical, 10-25 x 6-9  $\mu\text{m}$ , with slightly thickened walls, septate at base; metabasidium cut off from probasidium by basal septum, 24-40 x 5-7  $\mu\text{m}$ , cylindrical, protruding from among elements of the *Peniophora* hymenium, 1-septate, 2-sterigmate, sterigmata 10-25 x 5-7  $\mu\text{m}$ ; basidiospores (Fig. 4b) 7-9  $\mu\text{m}$  diam, globose to subglobose, thin-walled, hyaline, smooth, negative in Melzer's reagent, with large apiculus, germination by repetition (Fig. 4c).

*Platygløea mycophila* is known only as a parasite on *Peniophora tamaricicola* on dead branches of mesquite and desert broom (*Baccharis sarothroides* Gray).

Voucher specimens: HHB 5948a, HHB 5953a, Redington Rd. Rd., Rincon Mts., Pima County; RLG 10577, Peck Canyon, Tumacacori Mts., Santa Cruz County.

5. PLATYGLOEA PENIOPHORAE Bourd. et Galz., Bul. Soc. Mycol. France 25:17. 1909.

Parasitizing *Dacrymyces minor* and not producing a basidiocarp distinct from that of the host; hyphae embedded in hymenium of host, 1-2  $\mu\text{m}$  diam, with clamps; basidia (Fig. 5a) straight or curved, 30-50 x 6-9  $\mu\text{m}$ , becoming 3-septate, sterigmata filiform, up to 75  $\mu\text{m}$  long; basidiospores (Fig. 5b) cylindrical-ellipsoid, hyaline, 8-9 x 4-4.5

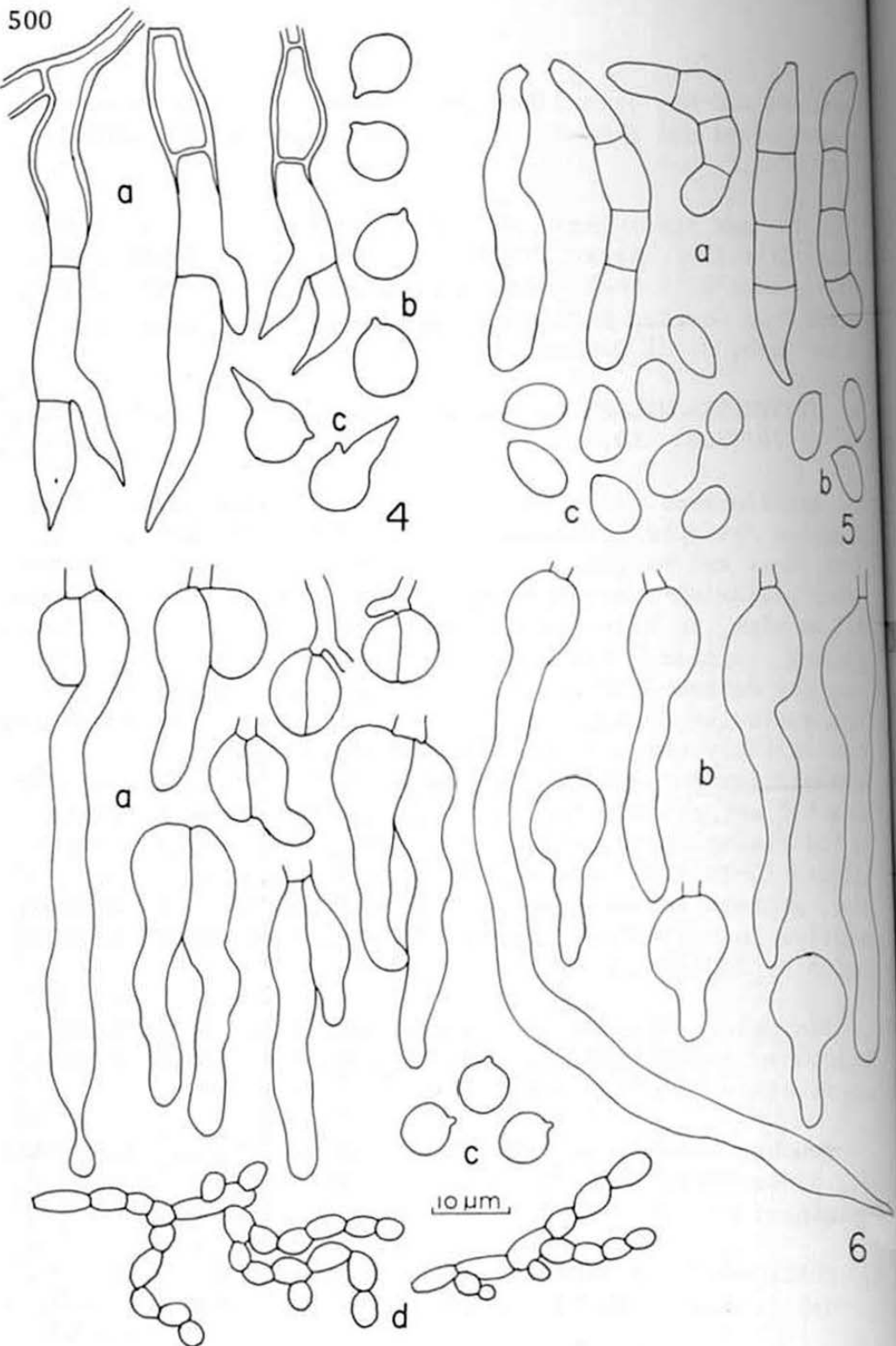


Fig. 4. *Platygiolea mycophila* (RLG 10056). a, basidia; b, basidiospores; c, germinating basidiospores. Fig. 5. *Platygiolea peniophorae* (ERC 71-48A). a, basidia; b, basidiospores, c, conidia. Fig. 6. *Tremella simplex* (ERC 71-48B). a, two-celled basidia; b, one-celled basidia; c, basidiospores; d, conidia.

$\mu\text{m}$ , negative in Melzer's reagent; hymenial conidia (Fig. 5c) abundant, variable in shape, some attenuated at one end, others ellipsoid to subglobose, thick walled, hyaline, negative in Melzer's reagent, 7-12 x 5-7  $\mu\text{m}$ .

Voucher specimens: ERC 71-48a, parasitizing *Dacrymyces minor* on mesquite branches, Santa Rita Exp. Range, Santa Rita Mts., Pima County.

6. TREMELLA SIMPLEX Jacks. et Martin, Mycologia 32:687. 1940.

Basidiocarps gelatinous, discoid or pulvinate, less than 1 mm diam, very inconspicuous and difficult to distinguish from the host basidiocarps (*Dacrymyces minor*); hyphae septate, lacking clamps; conidial branches abundant, moniliform, conidia subglobose to ellipsoid, 3-5  $\mu\text{m}$  long; basidia globose, 9-16  $\mu\text{m}$  diam, some becoming 2-celled (Fig. 6a) with a single vertical septum and producing 1 or 2 epibasidia, others remaining one-celled (Fig. 6b), producing a single epibasidium; epibasidia 3-6  $\mu\text{m}$  diam, up to 100  $\mu\text{m}$  long; basidiospores (Fig. 6c) 6-7  $\mu\text{m}$  diam, globose, with a prominent apiculus, hyaline, negative in Melzer's reagent; conidia (Fig. 6d) catenulate, ellipsoid, 2.5-6 x 2-3  $\mu\text{m}$ .

*Tremella simplex* and *Platyglœa peniophorae* were found on basidiocarps of *Dacrymyces minor* in the same collection on mesquite branches.

Voucher specimen: ERC 71-48B, Santa Rita Expt. Range, Santa Rita Mts., Pima County.

7. CONIOPHORA EREMOPHILA Lindsey et Gilbertson, Mycotaxon 2:86. 1975.

Basidiocarps fragile, easily separated, becoming widely effused; hymenial surface smooth, colored Light Brownish Olive by the massed basidiospores; hymenial tissue soft and floccose over a white, arachnoid lower subiculum; margin with fine white mycelial strands from subiculum; subicular hyphae (Fig. 7a) simple-septate or with very rare clamps (Fig. 7c), hyaline, thin-walled, mostly 2-6  $\mu\text{m}$  diam but with some cells inflated up to 10  $\mu\text{m}$  (Fig. 7b), some lightly incrustated; basidia (Fig. 7d) clavate, usually sinuous, often with a basal swelling, 4-sterigmate, 50-55

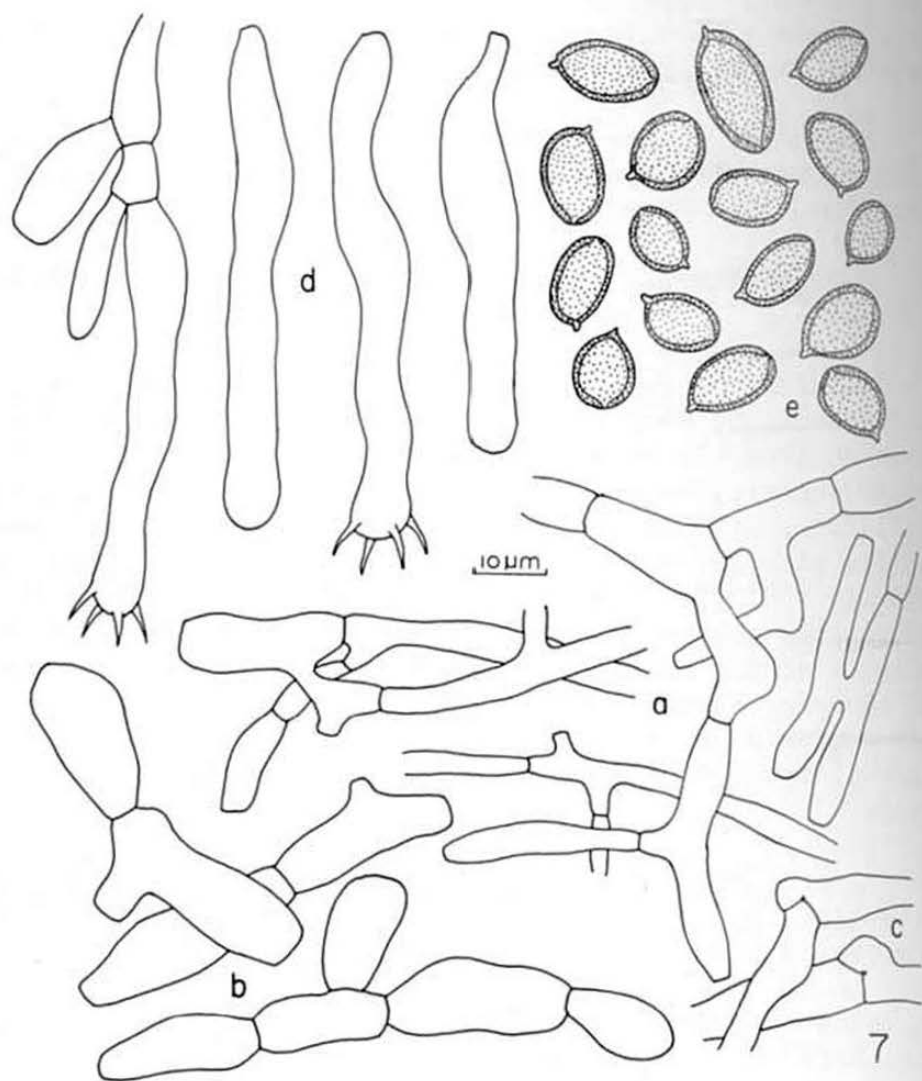


Fig. 7. *Coniophora eremophila* (RLG 10925). a, uniform subicular hyphae; b, closely septate, swollen subicular hyphae; c, nodose-septate subicular hyphae; d, basidia; e, basidiospores.

x 6-8  $\mu\text{m}$ , with a basal septum, sterigmata up to 7  $\mu\text{m}$  long; basidiospores (Fig. 7e) brownish-olive in mass, pale yellow in KOH, dextrinoid in Melzer's reagent, thick-walled, oval to broadly cylindrical, with a prominent peg-like apiculus and apical germ pore, 7.5-14 x 5-9  $\mu\text{m}$ .

*Coniophora eremophila* occurs on other Sonoran Desert

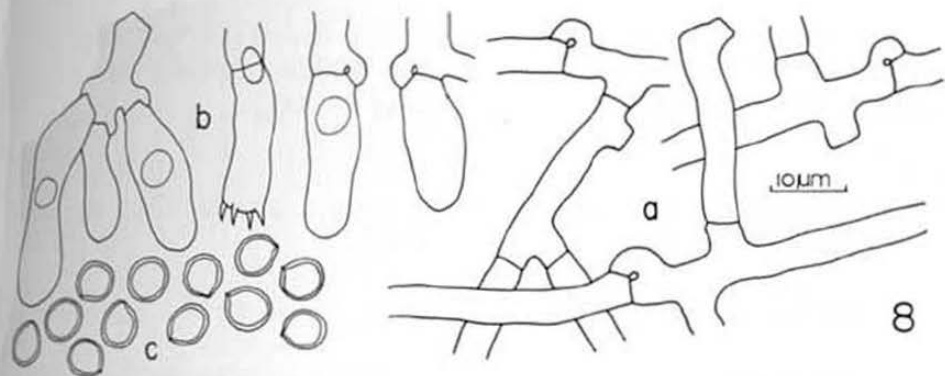


Fig. 8. *Athelia coprophila* (RLG 10926). a, subicular hyphae; b, basidia; c, basidiospores.

plants, including *Carnegiea gigantea* (Engelm.) Britt. et Rose (saguaro), *Olneya tesota* Gray (ironwood), and *Sambucus mexicana* Presl (Mexican elder), and is associated with a brown rot.

Voucher specimen: RLG 10925, Canyon del Oro, Santa Catalina Mts., Pinal County (TYPE).

8. *ATHELIA COPROPHILA* (Wakef.) Jülich, Willdenowia 7:66. 1972.

*Corticium coprophilum* Wakef., Trans. Brit. Mycol. Soc. 6:480. 1916.

Basidiocarps becoming widely effused, thin, soft, tomentose, easily separated; hymenial surface grayish-white, smooth to slightly tuberculate, under 30X lens appearing interrupted with arachnoid subiculum and mycelial strands visible below hymenium; hyphal system monomitic; subicular hyphae (Fig. 8a) thin-walled, with simple septa and occasional clamps, 3-5  $\mu\text{m}$  diam; clamps abundant in subhymenial hyphae; basidia (Fig. 8b) cylindrical to clavate, 4-sterigmate, 19-30 x 5-7  $\mu\text{m}$ , with a basal clamp; basidiospores (Fig. 8c) subglobose, 5-6 x 4-4.5  $\mu\text{m}$ , hyaline, smooth, thick-walled, negative in Melzer's reagent.

*Athelia coprophila* is associated with a white rot of fallen mesquite.

Voucher specimens: RLG 10387, Aravaipa Canyon, Galliuero Mts., Pinal County; RLG 10926, Canyon del Oro, Santa Catalina Mts., Pinal County (ARIZ).

9. BYSSOMERULIUS CORIUM (Fr.) Parm., Akad. Sci. Estonian SSR, Biol. Sci. 16:383. 1967.

*Merulius corium* Fr., Elenchus Fung. 1:58. 1828.

Basidiocarps effused to narrowly reflexed; upper surface white, tomentose; hymenial surface waxy, reticulately poroid, pale buff to dark cinnamon-brown or reddish-purple; subicular hyphae (Fig. 9a) 3-5  $\mu$ m diam, simple-septate, with thin to slightly thickened walls, distinct near the substratum, often gelatinizing and agglutinated in the subhymenial layer; cystidia none; basidia (Fig. 9b) narrowly clavate, 40-50 x 6-7  $\mu$ m, 4-sterigmate, with a basal septum; basidiospores (Fig. 9c) cylindrical to cylindrical-ellipsoid, 6-8.5 x 3-4.5  $\mu$ m, hyaline, smooth, negative in Melzer's reagent.

*Byssomerulius corium* causes a white rot of dead branches. This is one of the most important branch decay fungi on mesquite, and is generally conspicuous wherever mesquite is found.

Voucher specimens: RLG 7761, Patagonia-Lochiel Rd., Patagonia Mts., Santa Cruz County; RLG 9311, Buenos Aires, Baboquivari Mts., Santa Cruz County; ERC 71-54, Santa Rita Exp. Range, Santa Rita Mts., Pima County.

10. BYSSOMERULIUS SULPHUREUS (Burt) Lindsey, Univ. Ariz. Agr. Expt. Sta. Tech. Bul. 209, p. 5. 1973.

*Merulius sulphureus* Burt, Ann. Missouri Bot. Gard. 4: 333. 1917.

Basidiocarps effused up to 5 cm, soft, fragile, easily separated from the substrate, associated with abundant yellow mycelium and slender white to yellow rhizomorphic strands in the litter under the wood; hymenial surface shallowly merulioid, bright lemon-yellow when fresh, (Barium Yellow to Pale Lemon Yellow), cracking on drying to expose the white arachnoid subiculum; hyphal system monomitic; subicular hyphae (Fig. 10a) 3-4.5  $\mu$ m diam, simple-



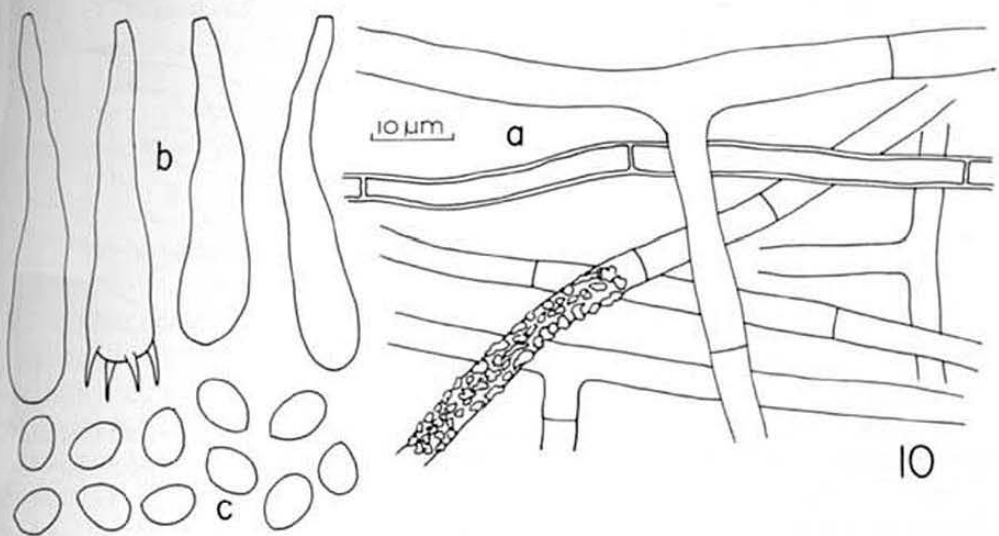
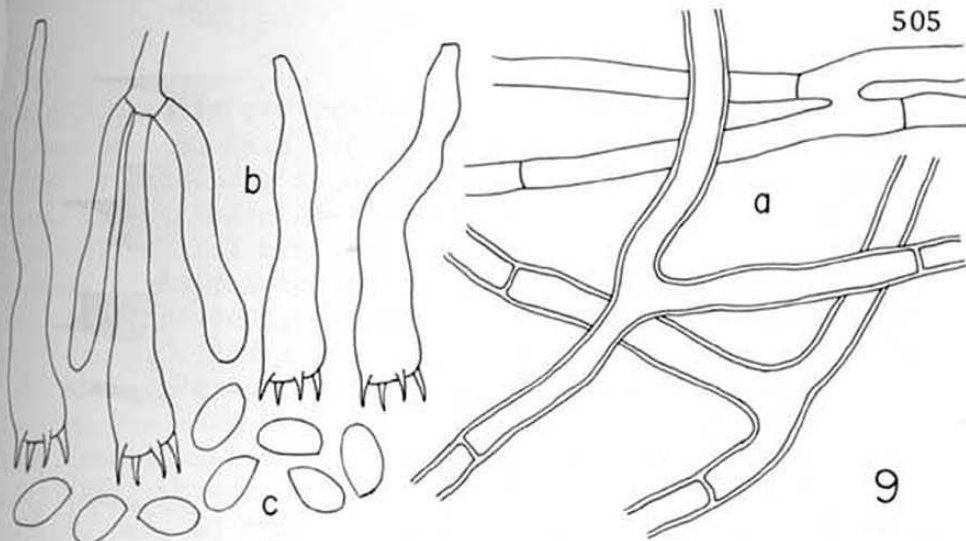


Fig. 9. *Byssomerulius corium* (RLG 7761). a, subicular hyphae; b, basidia; c, basidiospores. Fig. 10. *Byssomerulius sulphureus* (RLG 10499). a, subicular hyphae; b, basidia; c, basidiospores.

septate, with occasional branching, thin-walled; cystidia none; hyphidia in hymenial layer slender, contorted, some lobed or sparsely branched, 40-60 x 2-4 µm; basidia (Fig. 10b) narrowly clavate, with a basal septum, 35-40 x 6-7 µm, 4-sterigmate; basidiospores (Fig. 10c) ellipsoid, 6-8 x 4-5 µm, hyaline, smooth, negative in Melzer's reagent.

*Byssomerulius sulphureus* was originally described from

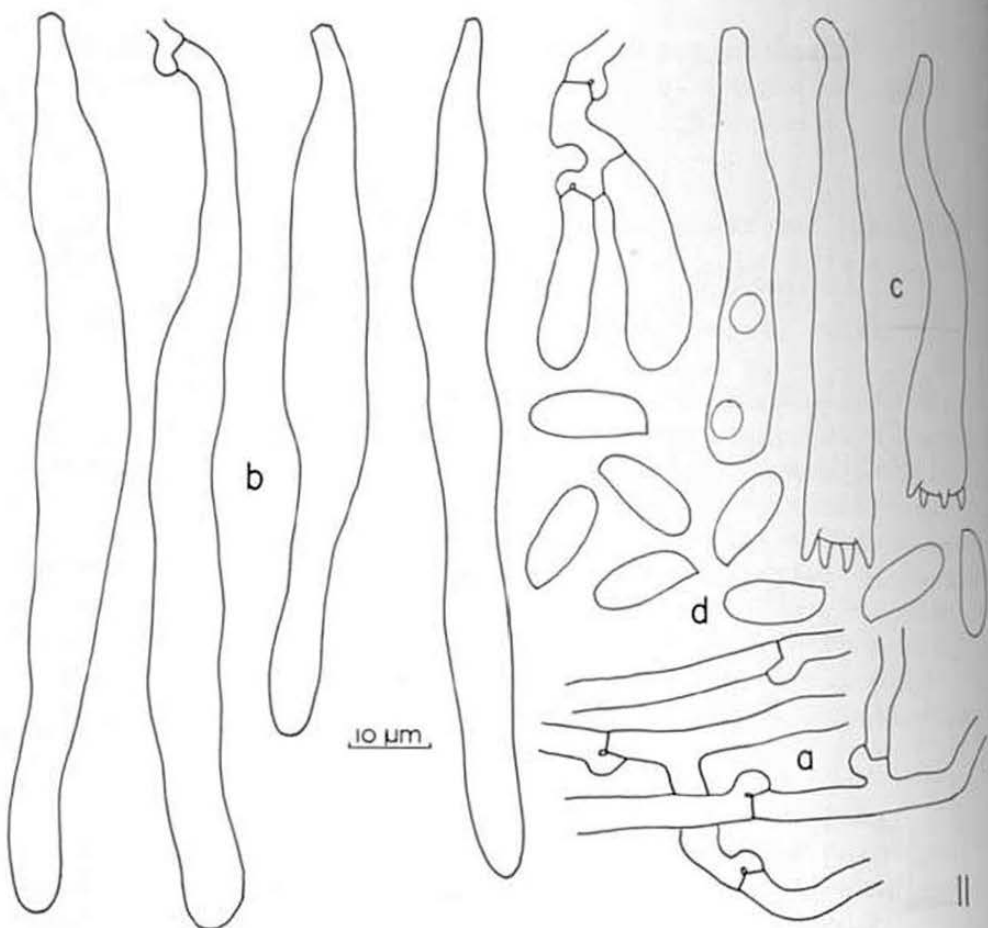


Fig. 11. *Hyphoderma amoenum* (ERC 71-21). a, subicular hyphae; b, cystidia; c, basidia; d, basidiospores.

Florida and is apparently known elsewhere only from Arizona. It has also been found on ironwood (Gilbertson, et al., 1974) and is associated with a white rot.

Voucher specimens: RLG 10498, Rest Area near Kitt Peak Rd., Ariz. Rt. 86, Pima County; HHB 5852, and 5856, Santa Rita Exp. Range, Santa Rita Mts., Pima County; RLG 10929, Canyon del Oro, Santa Catalina Mts., Pinal County.

11. *HYPHODERMA AMOENUM* (Burt) Donk, *Fungus* 27:14. 1957.

*Peniophora amoena* Burt, *Ann. Missouri Bot. Gard.* 12: 276. 1925.

Basidiocarps effused up to 2 cm, adnate; hymenial surface smooth, Pale Pinkish Buff to Cartridge Buff, finely tomentose, cracking on drying to reveal white subiculum; margin white, tomentose; hyphal system monomitic; subicular hyphae (Fig. 11a) hyaline, thin-walled, with clamps, 2.5-4  $\mu\text{m}$  diam, lightly incrustated with hyaline crystals; cystidia (Fig. 11b) frequent, cylindrical, 65-100 x 5-8  $\mu\text{m}$ , with a basal clamp, tapered slightly to the apex, some with constrictions, projecting to 70  $\mu\text{m}$ ; basidia (Fig. 11c) clavate, 4-sterigmate, 38-44 x 7.5-9  $\mu\text{m}$ , with a basal clamp, sterigmata up to 7  $\mu\text{m}$  long and 2  $\mu\text{m}$  wide at the base; basidiospores (Fig. 11d) cylindrical, 9-13 x 5-6  $\mu\text{m}$ , hyaline, smooth, thin-walled, negative in Melzer's reagent.

*Hyphoderma amoenum* is associated with a white rot of dead branches of a number of Sonoran Desert trees and shrubs.

Voucher specimen: KJM 331, Canyon del Oro, Santa Catalina Mts., Pinal County.

12. *HYPHODERMA* sp. (RLG 10255).

Basidiocarps effused up to 5 cm, waxy, adnate, cracking on drying; hymenial surface pale buff, slightly tuberculate, cystidiate under a 30X lens; hyphal system monomitic; subicular hyphae (Fig. 12a) thin-walled, with clamps, 3-5  $\mu\text{m}$  diam, some (Fig. 12b) irregularly contorted; cystidia (Fig. 12c) frequent, cylindrical to narrowly clavate, with uniformly slightly thickened walls, 80-130 x 4-10  $\mu\text{m}$ , with a basal clamp; basidia (Fig. 12d) clavate, 4-sterigmate, 35-40 x 6-7  $\mu\text{m}$ , with a basal clamp; basidiospores (Fig. 12e) broadly ellipsoid to ovoid, 5-6.5 x 4-4.5  $\mu\text{m}$ , hyaline, smooth, negative in Melzer's reagent.

*Hyphoderma* sp. (RLG 10255) is associated with a white rot of dead, fallen mesquite. The small basidiospores and large cystidia are a combination of characters not found in any species of *Hyphoderma* known to us. The single small specimen is not an adequate basis for describing a new taxon although the microscopic structures are well developed and distinctive.

Voucher specimen: RLG 10255, Redington, San Pedro Valley, Pima County.

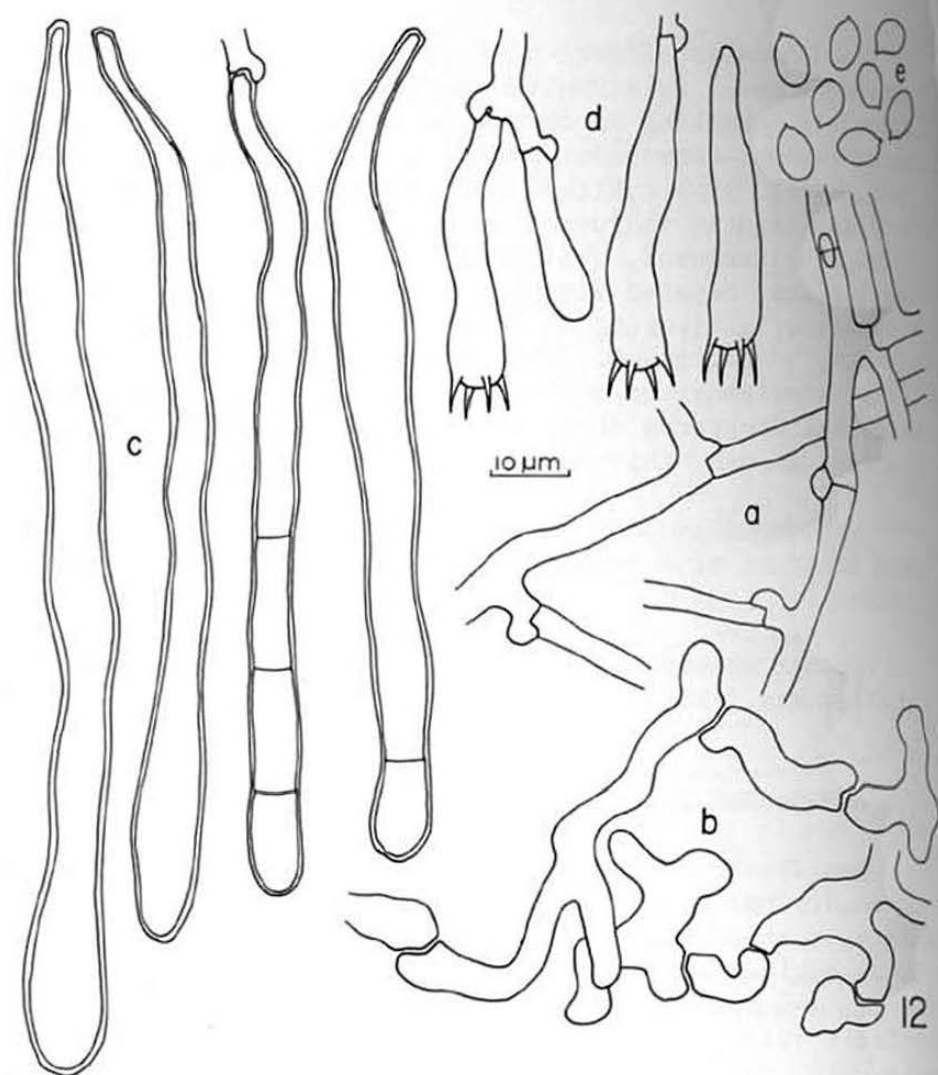


Fig. 12. *Hyphoderma* sp. (RLG 10255). a, uniform subicular hyphae; b, contorted subicular hyphae; c, cystidia; d, basidia; e, basidiospores.

13. *HYPHODONTIA QUERCINA* (Fr.), J. Erikss., *Symb. Bot. Upsalienses XVI*: 1, p. 105, 1958.

*Radulum quercinum* Fr., *Hym. Eur.*, p. 623. 1874.

Basidiocarps effused up to 8 cm, adnate, cracking to expose white byssoid subiculum; hymenial surface white to Cream Color, with crowded short teeth that appear fimbriate

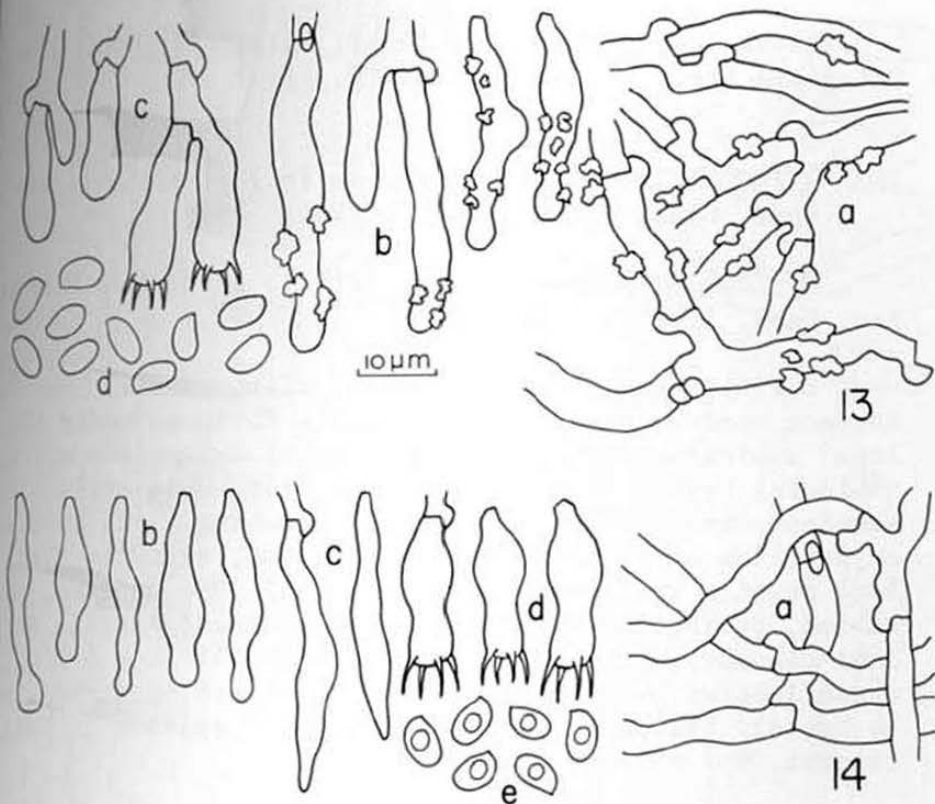


Fig. 13. *Hyphodontia quercina* (RLG 10042). a, subicular hyphae; b, cystidia; c, basidia; d, basidiospores.

Fig. 14. *Hyphodontia sambuci* (ERC 71-61). a, subicular hyphae; b, capitatae cystidia; c, acicular cystidia; d, basidiospores.

at apices under 30X lens; margin thinning out; subiculum very thin, white, soft; hyphal system monomitic; subicular hyphae (Fig. 13a) 2.5-4 µm diam, with abundant clamps, with frequent branching, loosely interwoven, moderately thick-walled; cystidia (Fig. 13b) abundant in hymenial layer, irregularly cylindrical or slightly swollen at the apex, 3-5 µm diam, projecting up to 10 µm, smooth or lightly incrustated with coarse crystals; basidia (Fig. 13c) clavate with median constriction, 17-20 x 4.5-5.5 µm, 4-sterigmate; basidiospores (Fig. 13d) cylindrical-oblong, 6-7.5 x 2.5-3 µm, hyaline, smooth, negative in Melzer's reagent.

*Hyphodontia quercina* is associated with a white rot of dead, decorticated branches on standing plants.

Voucher specimen: RLG 10042, Patagonia-Lochiel Rd., Patagonia Mts., Santa Cruz County.

14. *HYPHODONTIA SAMBUCI* (Pers. ex Fr.) J. Erikss., Symb. Bot. Upsalienses XVI:1, p. 104. 1958.

*Peniophora sambuci* (Pers. ex Fr.) Burt, Ann. Missouri Bot. Gard. 12:233. 1926.

Basidiocarps broadly effused, soft, adnate; hymenial surface smooth, pellicular, minutely farinose under 30X lens; subiculum white, byssoid; hyphal system monomitic; subicular hyphae (Fig. 14a) 2-4  $\mu\text{m}$  diam, thin-walled, with abundant clamps, with occasional branching, with abundant crystalline material; cystidia frequent, acicular (Fig. 14c) or with swollen apices (Fig. 14b), 3-4  $\mu\text{m}$  diam, thin-walled, projecting slightly, not incrustated; basidia (Fig. 14d) clavate, with median constriction, 15-20 x 6-7  $\mu\text{m}$ , 4-sterigmate; basidiospores (Fig. 14e) cylindric-ellipsoid to broadly ellipsoid, smooth, hyaline, negative in Melzer's reagent, 6-7 x 3.5-4.5  $\mu\text{m}$ .

*Hyphodontia sambuci* is associated with a white rot of dead branches.

Voucher specimen: ERC 179, Patagonia - Lochiel Rd., Patagonia Mts., Santa Cruz County.

15. *HYPOCHNICIUM BOMBYCINUM* (Sommerf. ex Fr.) J. Erikss., Symb. Bot. Upsalienses XVI:1, p. 101. 1958.

*Corticium bombycinum* (Sommerf. ex Fr.) Karst., Hedwigia 32: 120. 1893.

Basidiocarps becoming broadly effused, adnate; hymenial surface smooth to slightly tuberculate or raduloid, Cream Color to Light Buff or watery grayish-white before drying; margin arachnoid to fibrillose; hyphal system monomitic; subicular hyphae (Fig. 15a) hyaline, thin- to slightly thick-walled, with clamps, 2-4.5  $\mu\text{m}$  diam; cystidia none; basidia (Fig. 15b) clavate, 4-sterigmate, 50-60 x 9-11  $\mu\text{m}$ , with a basal clamp; basidiospores (Fig. 15c) broadly ellipsoid, 7-10 x 5-6.5  $\mu\text{m}$ , smooth, hyaline, negative in Melzer's reagent, with slightly thickened walls.



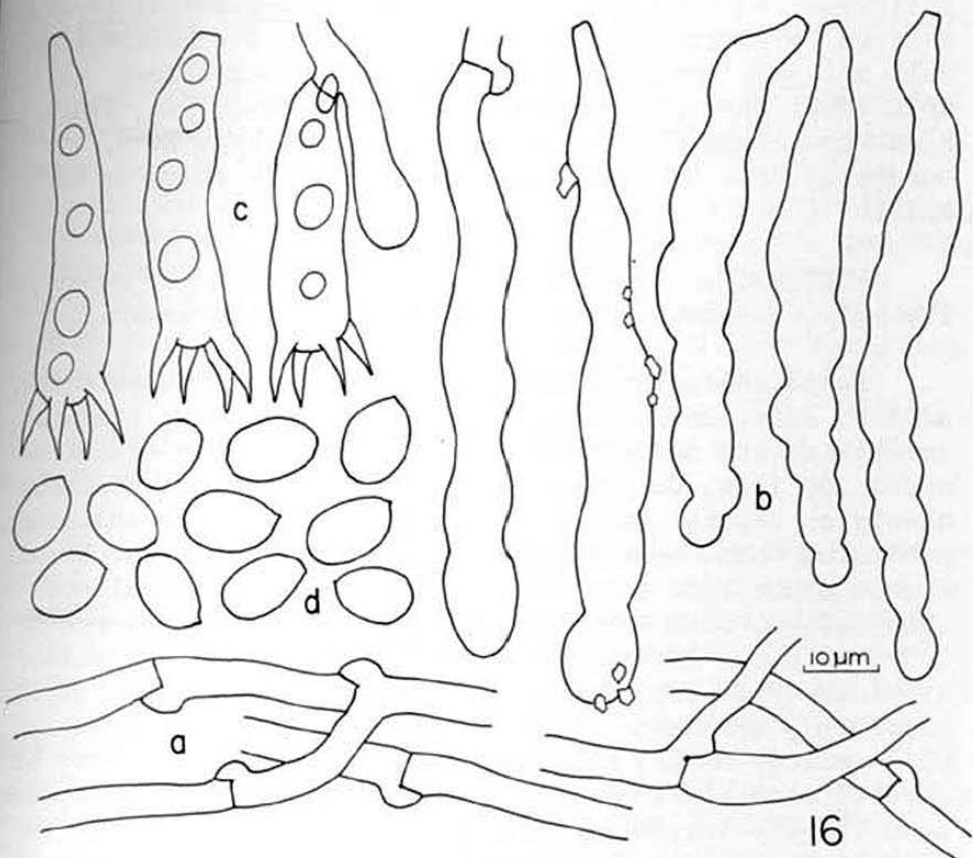
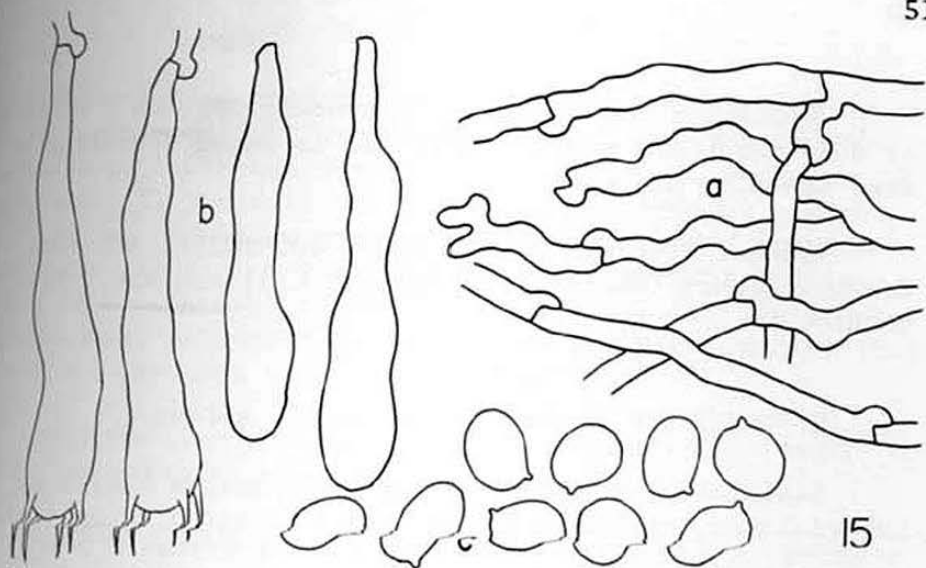


Fig. 15. *Hypochnicium bombycinum* (RLG 10398). a, subicular hyphae; b, basidia; c, basidiospores. Fig. 16. *Hypochnicium prosopidis* (HHB 8479). a, subicular hyphae; b, moniliform cystidia; c, basidia; d, basidiospores.

*Hypochnicium bombycinum* is associated with a white rot of dead hardwoods and conifers and is found occasionally on dead mesquite branches.

Voucher specimens: RLG 10394 and 10398, Aravaipa Canyon, Nature Conservancy Reserve, Galliuro Mts., Pinal County.

16. HYPOCHNICIUM PROSOPIDIS Burdsall, sp. nov.

Basidiocarpus effusus, mollis; hymenium laevis vel tuberculatus, cremea vel roseo-cremea; margo albus, arachnoideus; hyphis systematis monomitica; hyphae 2.5-4  $\mu$ m diam, fibulatae, tenuitunicatae; cystidia inclusa, moniliformae, 60-85 x 5-10  $\mu$ m; basidia late-clavata, 40-45 x 8-11  $\mu$ m, 4-sterigmatibus; basidiosporae late-ellipsoideae, 9-12 x 5.5-8.5  $\mu$ m, hyalinae, laeves, non-amyloidae. HOLOTYPUS: in ligno *Prosopis juliflora* (Sw.) DC., Santa Rita Mts., Pima County, Arizona, U.S.A., leg. H. H. Burdsall, Jr., No. 8479; in herb. CFMR; isotypus in herb. ARIZ.

ETYMOLOGY: from *Prosopis* (generic name for mesquite), the only substrate on which *H. prosopidis* is known.

Basidiocarps effused up to 6 cm, up to 0.2 mm thick, adnate, soft, crumbling on sectioning when dry; hymenial surface smooth to slightly tuberculate, finely tomentose under 30X lens, Cartridge Buff to Pinkish Buff, cracking deeply on drying; margin white, arachnoid to farinaceous; subiculum thin, concolorous with hymenial surface; hyphal system monomitic; subicular hyphae (Fig. 16a) hyaline, thin-walled, with abundant clamps and frequent branching, 2.5-4  $\mu$ m diam, lightly incrustated with hyaline crystals; cystidia (Fig. 16b) arising at various levels in subiculum, completely imbedded or projecting slightly from hymenium, thin-walled, nearly cylindrical, moniliform, with few or several constrictions, 60-85 x 5-10  $\mu$ m, with a basal clamp, some lightly incrustated with large crystals, negative in sulfuric benzaldehyde; basidia (Fig. 16c) broadly clavate, 4-sterigmate, 40-45 x 8-11  $\mu$ m, with a basal clamp, sterigmata up to 2  $\mu$ m diam at base and up to 8  $\mu$ m long; basidiospores broadly ellipsoid, 9-12 x 5.5-8.5  $\mu$ m, smooth, hyaline, with slightly thickened walls, negative in Melzer's reagent.

*Hypochnicium prosopidis* is morphologically similar to *H. bombycinum* but differs in having moniliform cystidia. Cystidia of other species of *Hypochnicium* (*H. analogum*, *H. geogenium*, *H. punctulatum*, and *H. sphaerosporum*) are not moniliform. Basidiospores of *H. analogum* and *H. punctulatum* are globose to subglobose with tuberculate walls. Those of *H. sphaerosporum* are also globose but are smooth. *Hypochnicium geogenium* basidiospores are much smaller (6.5-8 x 4.5-5  $\mu$ m) than those of *H. prosopidis*.

*Hypochnicium prosopidis* is associated with a white rot of fallen mesquite branches.

Voucher specimen: Holotype previously mentioned.

17. MYCOACIA AUSTRO-OCCIDENTALE Canfield, sp. nov.

Fructificatio annua, resupinata, hydncea, cremea vel pallido-bubalina; aculei cylindrici, 1-3 mm longi; margo cremea, tenua, fimbriata; hyphae fibulatae, 2.5-3.5  $\mu$ m diam, aliquae incrustatae; cystidia nulla; basidia clavata, 4-sterigmatibus, 20-21 x 5-6  $\mu$ m; basidiosporae ellipsoideae, 4-4.5 x 2-2.5  $\mu$ m, tunica hyalina, levi, non-amyloidea.

HOLOTYPUS: in ligno *Prosopis juliflora* (Sw.) DC., Arizona Highway 86, prope Kitt Peak Rd., Pima County, Arizona, leg. R. L. Gilbertson No. 10501, in herb. CFMR.

ETYMOLOGY: from Southwest, referring to the southwestern United States.

Basidiocarps adnate, effused; hymenial surface strongly hydnceous, pale buff to cream, teeth cylindric, simple or confluent, smooth, apices entire or minutely fimbriate, up to 3 mm long; margin thinning out, cream-colored, minutely fimbriate; hyphal system monomitic; subicular hyphae (Fig. 17a) with abundant clamps, thin-walled, with occasional branching, 2.5-3.5  $\mu$ m diam; cystidia none; some heavily incrustated hyphae imbedded in inner tissue of teeth, these not projecting from hymenial layer; basidia (Fig. 17b) clavate, 20-21 x 5-6  $\mu$ m, 4-sterigmate; basidiospores (Fig. 17c) ellipsoid, 4-4.5 x 2-2.5  $\mu$ m hyaline, smooth, negative in Melzer's reagent.

*Mycocacia austro-occidentale* is associated with a white rot of fallen mesquite trunks.

Voucher specimen: holotype previously mentioned.

18. ODONTIA PRUNI Lasch, in Rabenhorst, Fungi. Europ. Exsiccati No. 1514. 1872.

Basidiocarps becoming broadly effused, adnate; hymenial surface Pale Ochraceous Buff to Cinnamon-Buff, hydnceous, the teeth minute, finely fimbriate at apex; margin thinning out; hyphal system monomitic; subicular hyphae (Fig. 18a) simple-septate, thin-walled, 2-5  $\mu\text{m}$  diam, fascicles of heavily incrustated hyphae (Fig. 18b) present in inner tissue of teeth and extending to the apex, some entirely imbedded, others projecting, the entire fascicle up to 30  $\mu\text{m}$  diam; cystidia none; narrow, sinuous or lobed hymenial elements (Fig. 18c) present, barely projecting, 2-3  $\mu\text{m}$  diam; basidia (Fig. 18d) clavate, 4-sterigmate, 35-45 x 6-7  $\mu\text{m}$ , with a basal septum; basidiospores (Fig. 18e) ellipsoid, 7-8 x 4-5  $\mu\text{m}$ , hyaline, smooth, negative in Melzer's reagent.

*Odontia pruni* is associated with a white rot of dead hardwoods over a wide elevational range in the Southwest. Jülich (1974) transferred *O. pruni* to the genus *Hyphoderma*. The lack of clamps casts doubt on this relationship and we prefer to retain the older name for the present.

Voucher specimen: HHB 5971-A, Redington, San Pedro Valley, Pima County.

19. PENIOPHORA ALBOBADIA (Schw. ex Fr.) Boidin, Rev. Mycol. 26:164. 1961.

*Stereum albobadium* (Schw. ex Fr.) Fr., Epicr. Syst. Mycol., p. 551. 1838.

Basidiocarps thin, usually effused, 1 to 3 mm at first, enlarging and coalescing to 15-20 x 2-5 cm, occasionally reflexed, upper surface of reflexed portions brown, silky to strigose; hymenial surface dark brown with areas of purplish-brown (Drab) to cinnamon brown, fading to vinaceous-brown or gray-brown (Drab Gray); margin pale buff to white, tomentose to velutinous; hyphal system dimitic; generative hyphae (Fig. 19a) hyaline to pale brownish in KOH, with clamps, 3-5  $\mu\text{m}$  diam; skeletal hyphae (Fig. 19b) thick-walled, brownish in KOH, aseptate, with frequent

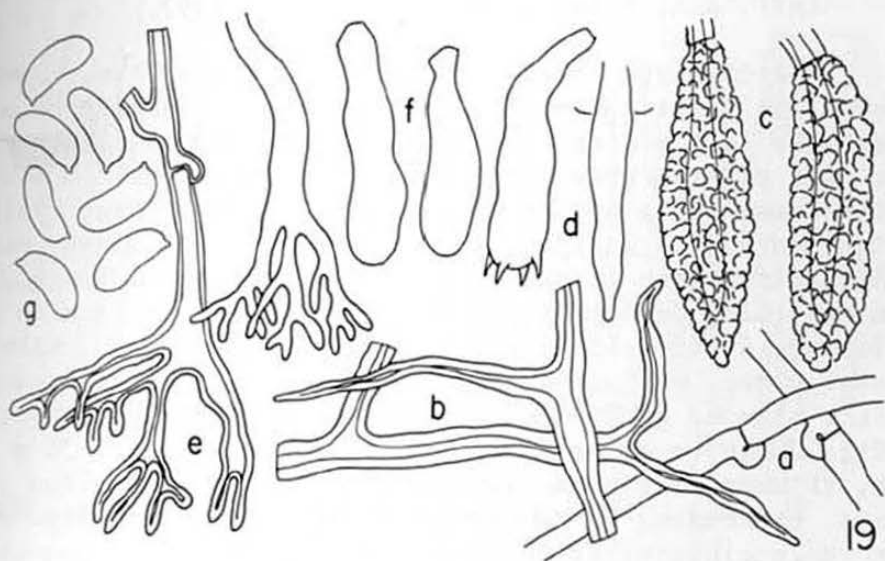
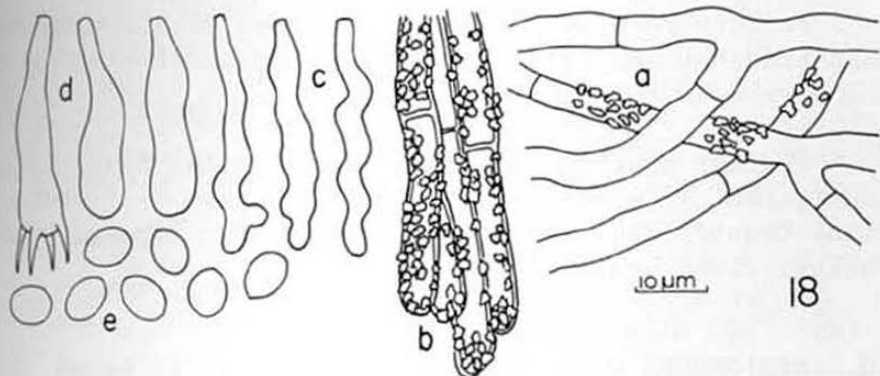
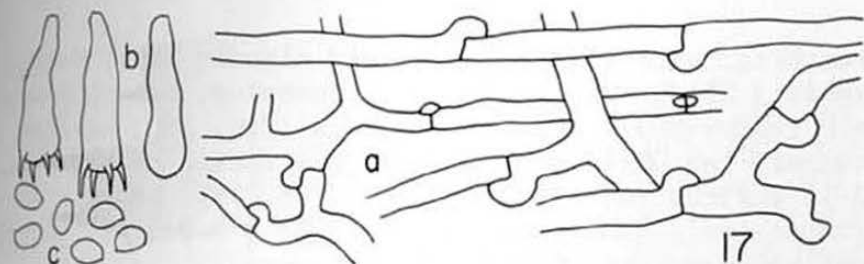


Fig. 17. *Mycoacia austro-occidentale* (RLG 10501). a, subicular hyphae; b, basidia; c, basidiospores. Fig. 18. *Odontia pruni* (HHB 5971A). a, subicular hyphae; b, fascicle of incrusted hyphae; c, sinuous or lobed hymenial elements; d, basidia; e, basidiospores. Fig. 19. *Peniophora albobadia* (ERC 87). a, generative hyphae; b, dendritic skeletal hyphae; c, incrusted cystidia; d, thin-walled, fusoid cystidium; e, dendrohyphidia; f, basidia; g, basidiospores.



branching, narrowing down to very slender tips; dendrohyphidia (Fig. 19e) abundant in hymenium, branched apices pale yellow-brown in KOH; cystidia (Fig. 19c) hyaline, conical, incrusting, imbedded or projecting up to 20  $\mu\text{m}$ , 12-15 x 25-30  $\mu\text{m}$ ; basidiospores (Fig. 19g) broadly cylindrical and slightly curved, 10.5-13 x 3.5-5  $\mu\text{m}$ , smooth, hyaline, negative in Melzer's reagent.

*Peniophora albobadia* is associated with a white rot of dead branches and fallen wood of a number of hardwood trees and shrubs in the Southwest.

Voucher specimens: ERC 87, Patagonia, Santa Cruz County; ERC 177, Box Canyon, 10 miles east of Florence, Pinal County; RLG 10543, Camp Grant Wash, San Pedro River Valley, Pinal County.

20. PENIOPHORA NUDA (Fr.) Bres., Atti I. R. Accad. Sci. Lett. Art. Agiati, ser. 3, 3:114. 1897.

Basidiocarps becoming broadly effused, thin, crustaceous, at first in small patches, then coalescing to cover areas up to 1 x 4 cm, hymenial surface smooth, light gray to pale pinkish gray; margin abrupt; hyphal system monomitic; subicular hyphae (Fig. 20a) 2-3.5  $\mu\text{m}$  diam, hyaline, with frequent branching, thin-walled or with slight wall thickening, with clamps; gloecystidia (Fig. 20b) imbedded in subiculum or occasionally in hymenium, pyriform to subglobose, 40-50 x 15-25  $\mu\text{m}$ , hyaline, thick-walled, with a basal clamp, with granular to globular contents, becoming light blue to dark blue in sulfuric benzaldehyde; cystidia (Fig. 20c,d) scattered in hymenium, subulate, 25-35 x 5-6  $\mu\text{m}$ , thin-walled, some heavily incrusting with hyaline crystals, protruding 10  $\mu\text{m}$  beyond basidia; basidia (Fig. 20e) narrowly clavate, slightly sinuous, 30-40 x 5-6  $\mu\text{m}$ , hyaline, thin-walled, 4-sterigmate, some regenerating by percurrent proliferation, occasionally with transverse septa; basidiospores (Fig. 20f) cylindrical to allantoid, 13-15 x 3-3.5  $\mu\text{m}$ , hyaline, thin-walled, smooth, negative in Melzer's reagent.

*Peniophora nuda* is associated with a white rot of dead branches on many hardwood species.

Voucher specimen: RLG 8442, Sonoita Creek, near Patagonia, Santa Cruz County.



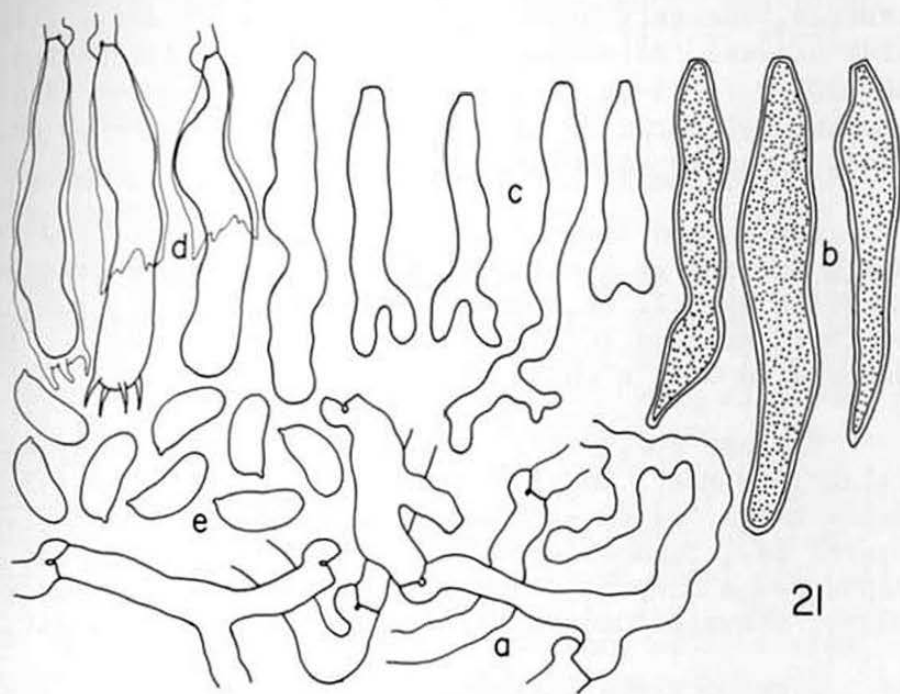
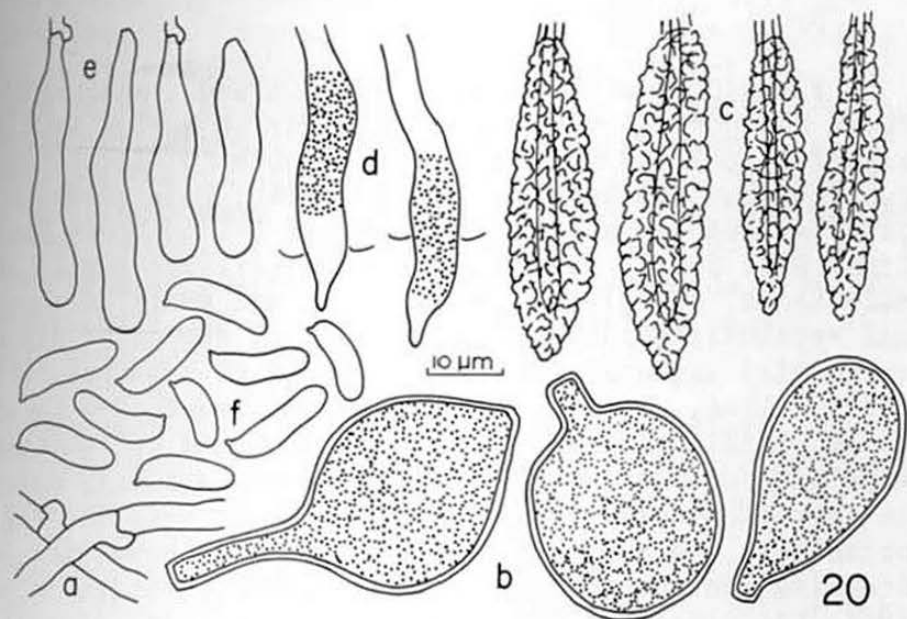


Fig. 20. *Peniophora nuda* (RLG 8442). a, subicular hyphae; b, gloeocystidia; c, incrustated cystidia; d, thin-walled, fusoid cystidia; e, basidia; f, basidiospores. Fig. 21. *Peniophora tamaricicola* (RLG 10496). a, subicular hyphae; b, gloeocystidia; c, dendrohyphidia; d, basidia; e, basidiospores.

21. PENIOPHORA TAMARICICOLA Boidin et Malençon, Rev. Mycol. 26:153. 1961.

Basidiocarps becoming broadly effused, adnate, drying tough and horny, cracking extensively on drying into small angular blocks; hymenial surface smooth to distinctly tuberculate, pruinose, pink when fresh, pale purplish-gray on dried specimens (Pale Smoke Gray, Pallid Mouse Gray or Light Gull Gray); margin abrupt and fertile; subiculum pale brown, hymenial layer distinct and white in longitudinal sections; hyphal system monomitic, subicular hyphae (Fig. 21a) agglutinated and difficult to separate, thin- to thick-walled, all with inconspicuous clamps, 3-4  $\mu\text{m}$  diam; gloeocystidia swollen, vesicular, imbedded in subiculum, some with refractive granular contents, strongly positive in sulfuric benzaldehyde; hymenial gloeocystidia (Fig. 21b) occasional, barely projecting, acuminate, some with refractive contents, weakly to distinctly positive in sulfuric benzaldehyde; dendrohyphidia (Fig. 21c) lightly incrustated, sparsely branched, 2-3  $\mu\text{m}$  diam; basidia (Fig. 21d) clavate, developing by percurrent proliferation, 25-40(-50) x 7-7.5  $\mu\text{m}$ , 4-sterigmate; basidiospores (Fig. 21e) smooth, cylindrical to allantoid, 10.5-11.5 x 4-4.5  $\mu\text{m}$ , hyaline, negative in Melzer's reagent.

*Peniophora tamaricicola* was recently reported from North America as a major decay fungus on dead branches of mesquite as well as a number of other desert shrubs in southern Arizona (Gilbertson and Burdsall, 1975). It is associated with a white rot.

Voucher specimens: HHB 6223, Guadalupe Canyon, Peloncillo Mts., Cochise County; RLG 10055, Santa Rita Expt. Range, Santa Rita Mts., Pima County; RLG 10577, Peck Canyon Rd., Tumacacori Mts., Santa Cruz County; ERC 71-271, Peppersauce Canyon, Santa Catalina Mts., Pima County; RLG 10388, Aravaipa Canyon, Galliuro Mts., Pinal County.

22. PHANEROCHAETE ALLANTOSPORA Burds. et Gilbertson, Mycologia 66:780. 1974.

Basidiocarps effused in small confluent crustaceous patches, adnate; hymenial surface Pale Yellow-Orange to Light Buff, smooth to slightly tuberculate, cracking on drying to expose white subiculum; margin thinning out, white, narrow, sterile; subiculum white, soft; hyphal sys-

tem monomitic; subicular hyphae (Fig. 22a) loosely arranged, septate, lacking clamps, with frequent branching, 2-4.5  $\mu\text{m}$  diam, walls slightly thickened, smooth, or incrustated with pale yellow granules; cystidia (Fig. 22b) infrequent, cylindrical, tapering to the apex, smooth, thin-walled, hyaline, 50-125 x 5.5-8  $\mu\text{m}$  and projecting to 15  $\mu\text{m}$ , pale yellowish-brown granules on imbedded portion; basidia (Fig. 22c,d) clavate, hyaline, thin-walled, 22-27 x 6-6.5  $\mu\text{m}$ , 4-sterigmate, with a basal septum; basidiospores (Fig. 22e) allantoid, 10-11.5 x 2.5-3  $\mu\text{m}$ , hyaline, smooth, thin-walled, negative in Melzer's reagent.

*Phanerochaete allantospora* is associated with a white rot of dead branches on several desert trees and shrubs in Arizona.

Voucher specimens: ERC 69, Cottonwood Springs, Sonoita Creek, Santa Cruz County; ERC 71-258, Nature Conservancy Area, Aravaipa Canyon, Pinal County; RLG 10540, 10542, Camp Grant Wash, San Pedro River Valley, Pinal County.

23. PHANEROCHAETE ARIZONICA Burds. et Gilbertson, Mycologia 66:785. 1974.

Basidiocarps effused up to 8 cm, adnate; hymenial surface becoming raduloid with scattered rounded projections, cream-colored to pale buff (Light Buff), minutely cystidiate under 30X lens, cracking on drying to expose a white, arachnoid subiculum below; margin white, thin, fibrillose; hyphal system monomitic; subicular hyphae (Fig. 23a) hyaline, septate, lacking clamps at most septa, thin- to thick-walled, heavily incrustated with hyaline crystals, with frequent branching, 3-7  $\mu\text{m}$  diam; cystidia (Fig. 23b) nearly cylindrical, tapering to apex, 50-80 x 4-6  $\mu\text{m}$ , thin-walled, with a basal septum; basidia (Fig. 23c) clavate, 4-sterigmate, 25-30 x 5-7  $\mu\text{m}$ , with a basal septum; basidiospores (Fig. 23d) cylindrical, hyaline, thin-walled, negative in Melzer's reagent, smooth, 5-7 x 2.5-3  $\mu\text{m}$ .

*Phanerochaete arizonica* is associated with a white rot of dead branches and fallen stems of several desert trees and shrubs.

Voucher specimen: RLG 10393, Guadalupe Canyon,

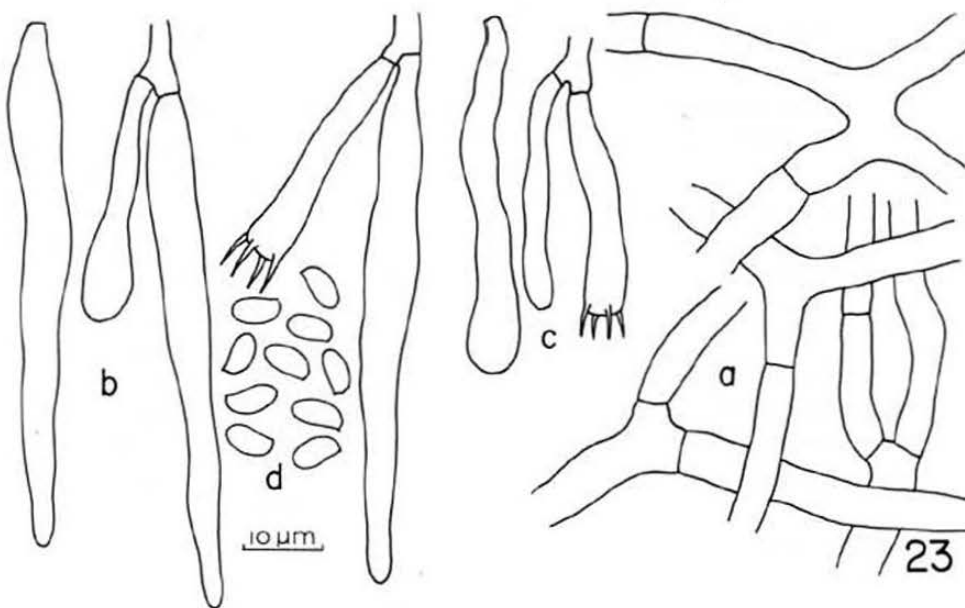
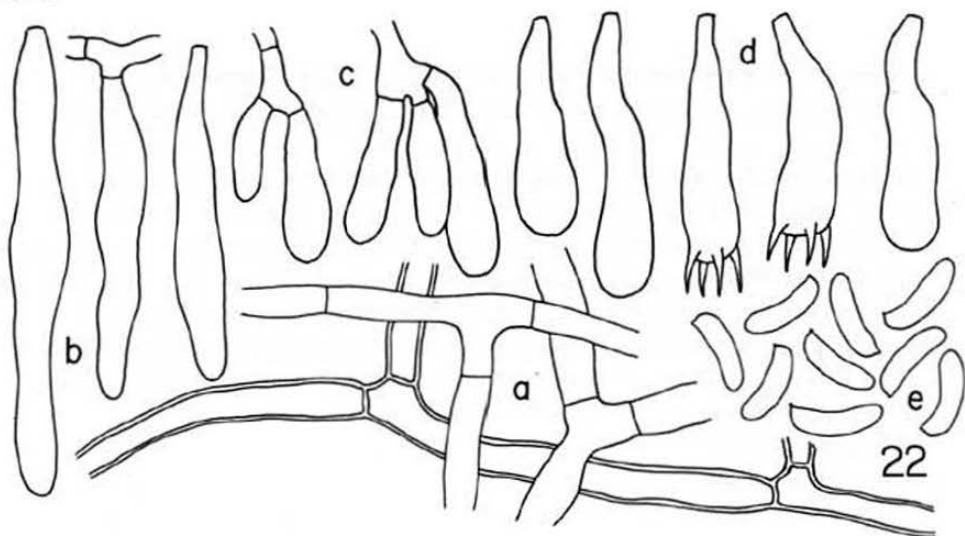


Fig. 22. *Phanerochaete allantospora* (ERC 69). a, subicular hyphae; b, cystidia; c, immature basidia; d, mature basidia; e, basidiospores. Fig. 23. *Phanerochaete arizonica* (RLG 10383). a, subicular hyphae; b, cystidia; c, basidia; d, basidiospores.

24. PHANEROCHAETE CHRYSORHIZON (Torr.) Gilbertson et Budington, Southwestern Nat. 17(4):417. 1973.

*Hydnium chrysothizon* Torr., in Eaton, Manual of Botany, ed. 3, p. 309. 1822.

Basidiocarps effused in small patches, fragile, pelliculose, easily separated from the substratum; hymenial surface bright orange-yellow to cream-colored, becoming strongly hydnceous, teeth cylindrical, up to 1 mm long; margin rhizomorphic with orange-yellow to white, plumose fans of radiating hyphal strands in arachnoid mycelium; yellow to cream rhizomorphs usually present on substratum and in adjacent soil and litter; hyphal system monomitic; subicular hyphae with abundant septa (Fig. 24a) and occasional single or double clamp connections (Fig. 24b,c), smooth or lightly incrustated, 4-8  $\mu\text{m}$  diam; cystidia (Fig. 24d) few, cylindrical, 35-40 x 4-4.5  $\mu\text{m}$ , thin-walled, projecting to 25  $\mu\text{m}$ ; basidia (Fig. 24e) clavate, 4-sterigmate, with a basal septum, 20-30 x 5.5-7  $\mu\text{m}$ ; basidiospores (Fig. 24f) oblong, 5-6 x 4-4.5  $\mu\text{m}$ , hyaline, smooth, negative in Melzer's reagent.

*Phanerochaete chrysothizon* is associated with a white rot of fallen hardwoods and is also common on dead cotton roots in Arizona.

Voucher specimens: RLG 10507, Sycamore Canyon, Baboquivari Mts., Papago Indian Res., Santa Cruz County; RLG 10391, Aravaipa Canyon, Galliuro Mts., Pinal County; RLG 10887 and 10888, Pima Canyon, Santa Catalina Mts., Pima County; RLG 10794, Sierra Vista, Cochise County.

25. PHANEROCHAETE TUBERCULATA (Karst.) Parm. Conspect. Syst. Corticiacearum, p. 83. 1968.

*Corticium tuberculatum* Karst., Hedwigia 35:45. 1896.

Basidiocarps becoming broadly effused, adnate, membranous; hymenial surface tuberculate, deeply cracked when dry, Cinnamon-Buff to Clay-Color; margin thinning out, white, arachnoid; hyphal system monomitic, subicular hyphae (Fig. 25a) thin-walled, hyaline, simple-septate, sometimes incrustated, 3.5-5  $\mu\text{m}$  diam; cystidia none; basidia (Fig. 25b) clavate, 4-sterigmate, simple-septate at base, 25-35 x 5-6  $\mu\text{m}$ ; basidiospores (Fig. 25c) ellipsoid, 6-9 x 3.5-5  $\mu\text{m}$ ,

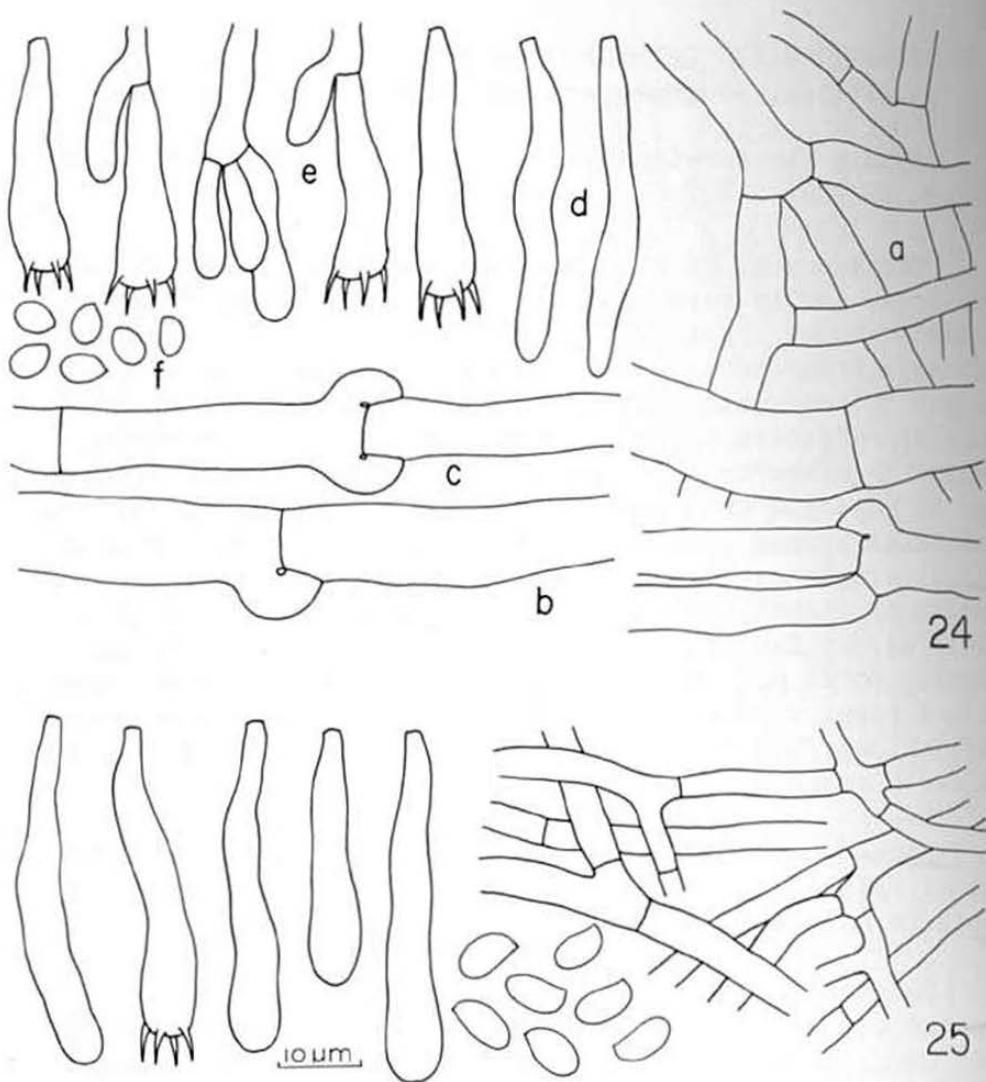


Fig. 24. *Phanerochaete chrysorhizon* (RLG 10391) a, simple-septate subicular hyphae; b, subicular hyphae with single clamps; c, subicular hypha with double clamp; d, cystidia; e, basidia; f, basidiospores.

Fig. 25. *Phanerochaete tuberculata* (RLG 10082). a, subicular hyphae; b, basidia; c, basidiospores.

hyaline, smooth, negative in Melzer's reagent.

*Phanerochaete tuberculata* is associated with a white rot of dead branches or wood on the ground. It has been found on wood of a number of shrubs and trees in the Sonoran and Mohave deserts and plays an important role in the desert ecosystem.



Voucher specimens: RLG 10082, Cascabel, San Pedro River Rd., Cochise County; D. C. Rhodes P-016A, Patagonia, Santa Cruz County; HHB 5971, Redington, San Pedro Valley, Pima County.

26. PHLEBIA OCHRACEOFULVA (Bourd. et Galz.) Donk, Fungus 27:12. 1957.

Basidiocarps broadly effused, soft-waxy, adnate; hymenial surface pale pinkish-buff to orange-buff when fresh, drying light buff, slightly tuberculate, appearing pilose under 30X lens; hyphal system monomitic; subicular hyphae (Fig. 26a) somewhat agglutinated, thin-walled, hyaline, with clamps, some much contorted and irregularly lobed, up to 10  $\mu\text{m}$  diam; cystidia (Fig. 26b) abundant, subulate, 18-22 x 4-5  $\mu\text{m}$ , thin-walled, not incrustated, with a basal clamp; basidia (Fig. 26c) clavate, 4-sterigmate, 20-25 x 5-6  $\mu\text{m}$ , with a basal clamp; basidiospores (Fig. 26d) oblong, 5-6.5 x 3-3.5  $\mu\text{m}$ , hyaline, smooth, negative in Melzer's reagent.

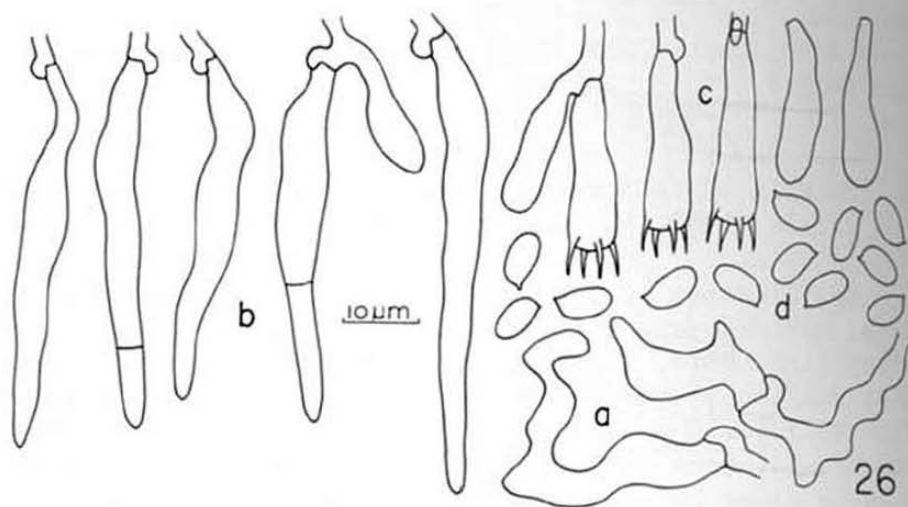
*Phlebia ochraceofulva* is associated with a white rot of fallen mesquite.

Voucher specimen: RLG 10494, Rest Area on Ariz. Highway 85 near Kitt Peak Rd., Pima County.

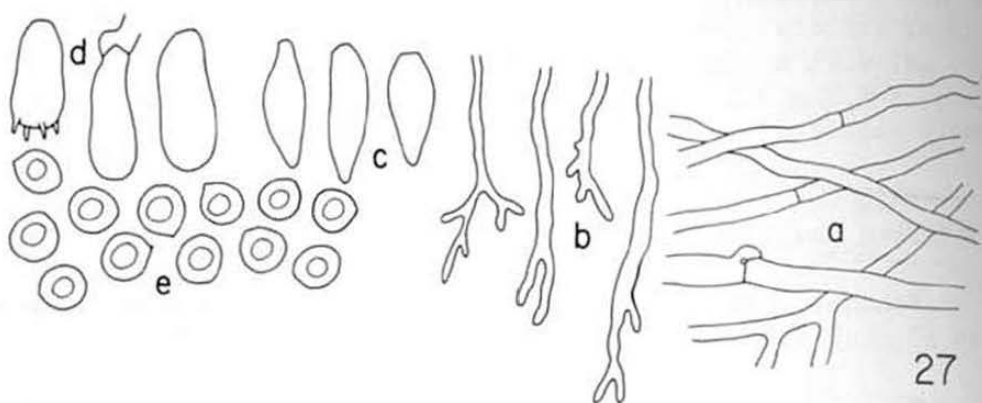
27. HENNINGSOMYCES CANDIDUS (Pers.) O. Kuntze, Rev. Gen. Pl. 3:483. 1898.

*Solenia candida* Pers., Myc. Eur. 1:334. 1822.

Basidiocarps consisting of individual tubes that are separate from each other or closely packed and confluent, white, minutely tomentose on the outer surface, about 600-700  $\mu\text{m}$  long and 160-200  $\mu\text{m}$  diam; apical pore usually conspicuous; hymenium continuous on inner surface, about 22  $\mu\text{m}$  thick; hyphal system monomitic; hyphae (Fig. 27a) 2-4  $\mu\text{m}$  diam, thin-walled, with simple septa and obscure clamps, agglutinated and difficult to separate; apically branched slender hyphae on outer surface (Fig. 27b), branched at the apex, 1.5-2  $\mu\text{m}$  diam; fusiform cystidioles (Fig. 27c) abundant, up to 25 x 5  $\mu\text{m}$ , scarcely projecting; basidia (Fig. 27d) broadly clavate, 14-17 x 6-7  $\mu\text{m}$ ; basidiospores (Fig. 27e) subglobose, 4 x 5  $\mu\text{m}$ , hyaline, thin-walled,



26



27

Fig. 26. *Phlebia ochraceofulva* (RLG 10494). a, subicular hyphae; b, cystidia; c, basidia; d, basidiospores. Fig. 27. *Henningsomyces candidus* (RLG 8437). a, hyphae from wall of basidiocarp; b, branching hyphae from outer surface of basidiocarp; c, fusoid cystidioles; d, basidia; e, basidiospores.

smooth, negative in Melzer's reagent.

*Henningsomyces candidus* is associated with a white rot of fallen stems.

Voucher specimen: RLG 8437, Sonoita Creek, 6 miles east of Patagonia, Santa Cruz County.

28. *GANODERMA LUCIDUM* (W. Curt. ex Fr.) Karst., Rev. Mycol. 3:17. 1881.

Basidiocarps annual, sessile to laterally substipitate, applanate, 15 cm or more broad, upper surface with thin varnished crust at maturity, dark reddish brown, typically covered with powdery layer of basidiospores deposited by air currents; margin acute, narrowly sterile below; context at first creamy white, becoming dark purple brown in older portions, zonate, up to 3 cm thick at base; tube layer purple-brown, sharply distinct from context, up to 1 cm thick; pore surface creamy white at first, becoming light buff, staining dark purple-brown on bruising; pores circular to angular, 4-5 mm, with thick dissepiments; pileus surface 25-30  $\mu$ m thick, a dense palisade of clavate, reddish-brown, thick-walled hyphal end cells (Fig. 28c) up to 7-11  $\mu$ m diam; hyphal system dimitic; contextual skeletal hyphae (Fig. 28b) hyaline to pale golden brown, thick-walled, aseptate, with frequent dendritic branching, branch tips tapering to less than 1  $\mu$ m diam, main hyphae up to 7  $\mu$ m diam; contextual generative hyphae (Fig. 28a) 2-2.5  $\mu$ m diam, hyaline, thin-walled, with clamps; tramal skeletal hyphae (Fig. 28d) pale greenish brown, thick-walled, aseptate, 2-3.5  $\mu$ m diam, also some slender, thick-walled, branching, hyaline, aseptate hyphae 1-1.5  $\mu$ m diam; tramal generative hyphae 2-2.5  $\mu$ m diam, hyaline, thin-walled; basidia (Fig. 28e) broadly ellipsoid, 12-15 x 10-11  $\mu$ m, 4-sterigmate; basidiospores (Fig. 28f) ellipsoid, 9-12 x 5.5-8  $\mu$ m, truncate at apex, pale brown in KOH, with thick, pitted exospore; negative in Melzer's reagent.

*Ganoderma lucidum* is associated with a white root and butt rot of living mesquite and is found on other native southwestern desert trees and exotic ornamental trees and shrubs. The basidiocarps develop at or near the ground line.

Voucher specimen: RLG 11223, Univ. Ariz. Farm, Campbell Avenue, Tucson, Pima County.

29. *HYMENOCHAETE ARIDA* Karst., in Sacc., Syll. Fung. 9: 228. 1891.

Basidiocarps resupinate, effused up to 12 cm, adnate;

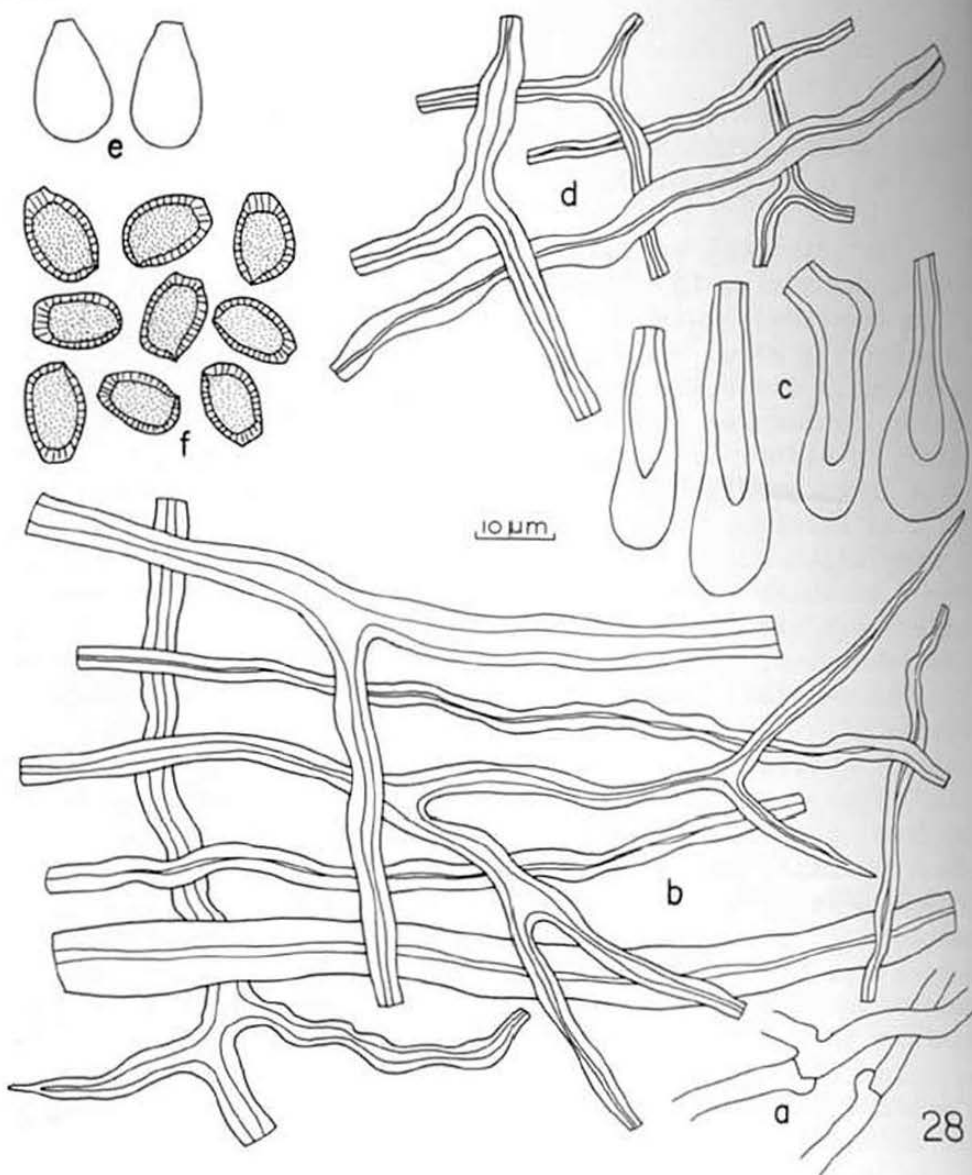


Fig. 28. *Ganoderma lucidum* (RLG 11223). a, contextual generative hyphae; b, contextual skeletal hyphae; c, thick-walled, clavate hyphal ends from pileus surface; d, tramal skeletal hyphae; e, basidia; f, basidiospores.

hymenial surface brown (Sudan Brown), smooth, setulose under 30X lens, margin abrupt, fertile; subicular hyphae (Fig. 29a) brown, darkening in KOH, simple-septate, moderately thick-walled, loosely arranged, with frequent branching, 3-5  $\mu\text{m}$  in diam; setae (Fig. 29b) abundant, in a single layer, subulate, thick-walled, 60-100 x 5-8  $\mu\text{m}$ , projecting

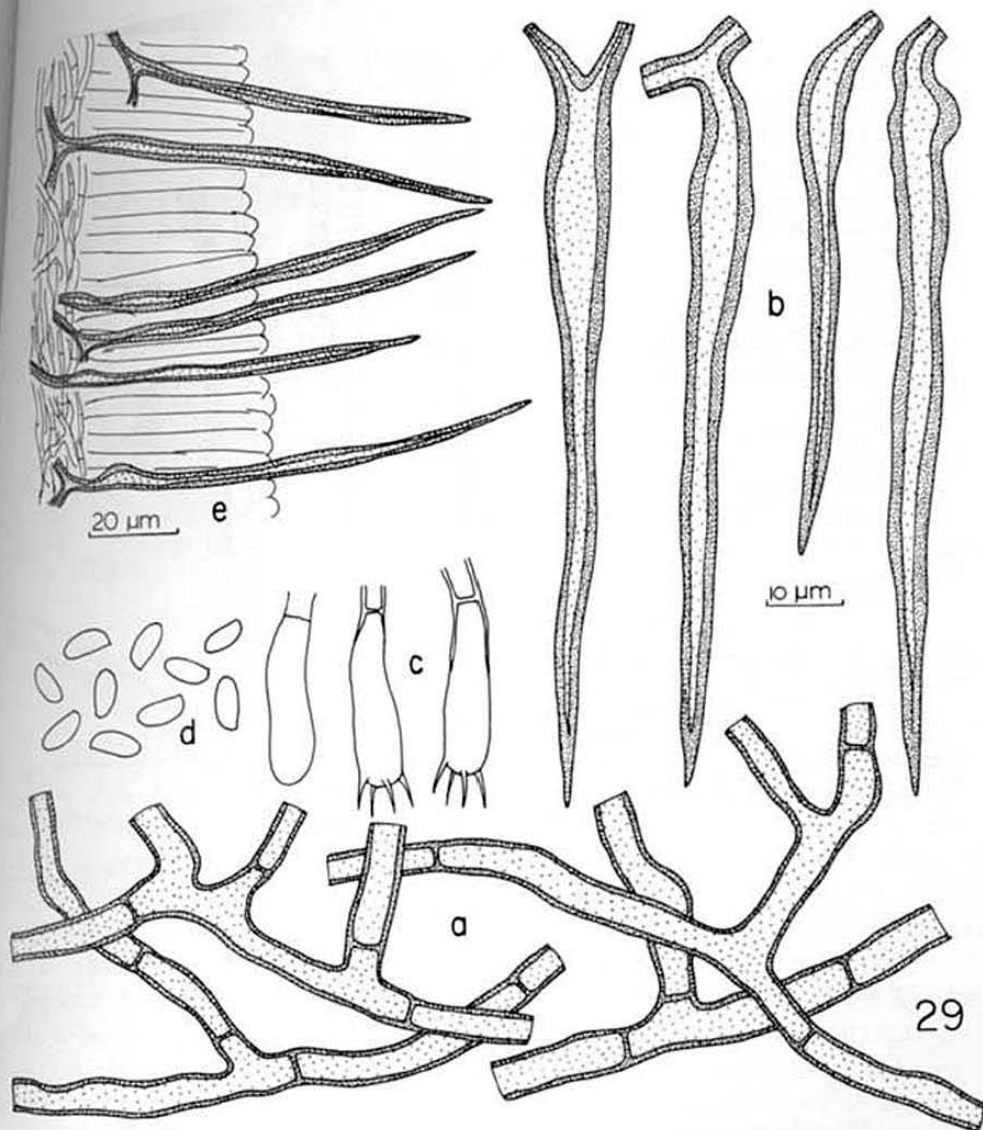


Fig. 29. *Hymenochaete arida* (HHB 8693). a, subicular hyphae; b, setae; c, basidia; d, basidiospores; e, schematic drawing of hymenium.

up to 60  $\mu\text{m}$ , straight or curved; basidia (Fig. 29c) clavate, 4-sterigmate, 20-22  $\times$  5-6  $\mu\text{m}$ , with a basal septum; basidiospores (Fig. 29d) cylindrical, 5-7  $\times$  2-2.5  $\mu\text{m}$ , hyaline, smooth, negative in Melzer's reagent.

*Hymenochaete arida* is associated with a white rot of hardwood and conifer logs and slash.

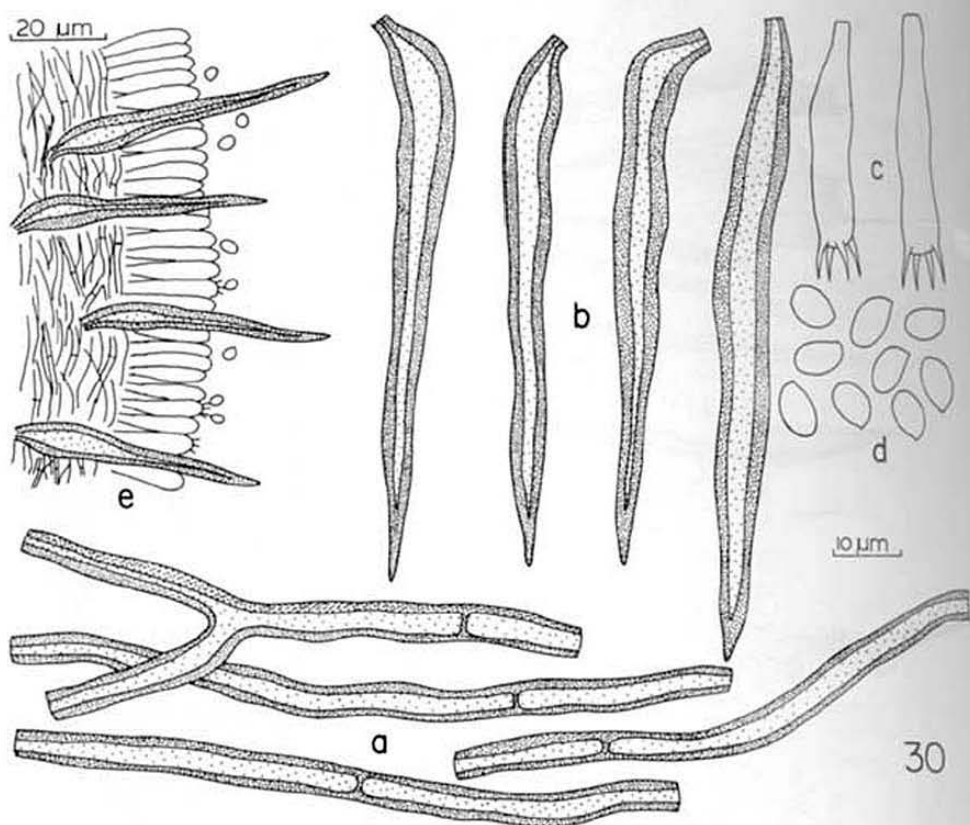


Fig. 30. *Hymenochaete rubiginosa* (RLG 10867). a, subicular hyphae; b, setae; c, basidia; d, basidiospores; e, schematic drawing of hymenium.

Voucher specimen: HHB 8693, Sycamore Canyon, Atascosa Mts., Santa Cruz County.

30. HYMENOCHAETE RUBIGINOSA Dicks. et Lév., Ann. Sci. Nat. Bot. ser. 3. 5:151. 1846.

Basidiocarps broadly effused to effused-reflexed, reflexed up to 5 mm; pileus thin, upper surface dark brown to dark reddish-brown, finely tomentose, concentrically zonate; hymenial surface Buffy Brown to Olive-Brown or Saccardo's Umber, smooth; margin sterile, reddish-brown with yellowish-brown outer edge; subicular hyphae (Fig. 30a) tightly interwoven, reddish-brown, 2-4  $\mu$ m diam, thin- to thick-walled, simple-septate, darkening in KOH; setae (Fig. 30b) abundant, subulate, 60-80 x 5-7  $\mu$ m, arising in



subhymenium, thick-walled, reddish-brown, aseptate, darkening in KOH; basidia (Fig. 30c) broadly clavate, 25-30 x 5-6.5  $\mu\text{m}$ , 4-sterigmate, hyaline at apex, yellow-brown at base; basidiospores (Fig. 30d) broadly ovoid, 5.5-7 x 3.5-4.5  $\mu\text{m}$ , hyaline, thin-walled, smooth, negative in Melzer's reagent.

*Hymenochaete rubiginosa* is associated with a white root and butt rot of living mesquite. The basidiocarps develop at the ground line and are inconspicuous.

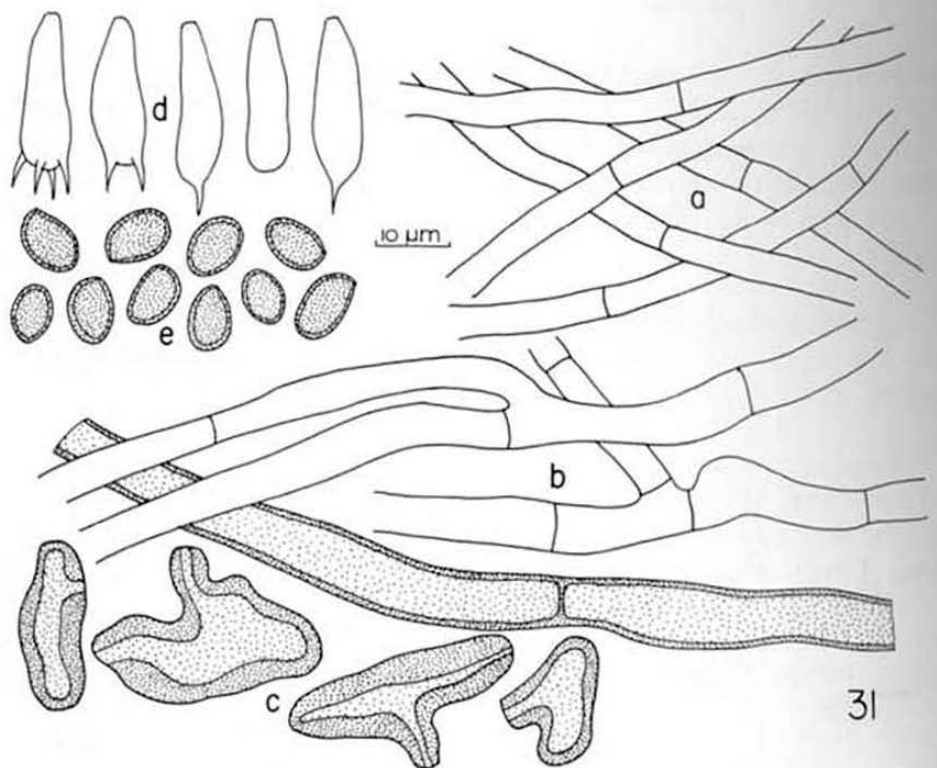
Voucher specimens: HHB 8417, at base of living mesquite, lower Sabino Canyon, Santa Catalina Mts., Pima County; RLG 10865, 10867 and 10872, at base of living mesquite, Lower Bear Canyon, Santa Catalina Mts., Pima County.

31. *INONOTUS TEXANUS* Murr., Torrey Bot. Club. Bul. 31:597. 1904.

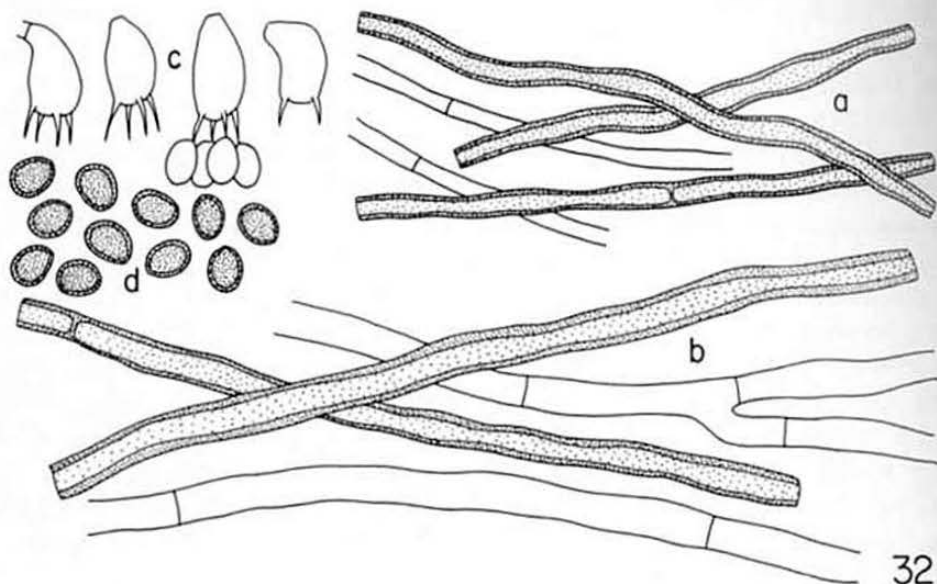
Basidiocarps annual, sessile, unguulate to applanate, up to 6 x 8 x 5 cm; upper surface pale brown, glabrous or soon becoming so, cracking radially and concentrically to form angular scales; context with distinct granular core of intermixed white and brown tissue; fibrous context yellowish-brown, up to 1 cm thick; tube layer concolorous with fibrous context, up to 3.5 cm thick, brittle; hyphae of fibrous context (Fig. 31b) hyaline to dark brown, thin- to thick-walled, simple-septate, some with rare branching, 3-6  $\mu\text{m}$  diam, others contorted and much branched, 2.5-4  $\mu\text{m}$  diam; hyphae of granular core (Fig. 31c) dark brown in KOH, thick-walled, contorted and swollen, breaking readily into short fragments up to 20  $\mu\text{m}$  diam; tramal hyphae (Fig. 31a) mostly hyaline or pale yellowish, thin-walled, 2-4  $\mu\text{m}$  diam; setae absent; basidia (Fig. 31d) clavate, 4-sterigmate, 7-8  $\mu\text{m}$  diam; basidiospores (Fig. 31e) ovoid to broadly ellipsoid, 6-8(-9) x 5-6.5(-7)  $\mu\text{m}$ ; dark yellowish-brown, with slightly thickened walls, negative in Melzer's reagent; spore print rusty brown.

*Inonotus texanus* causes a white rot of the heartwood of living trees. It is also found on catclaw acacia (*Acacia greggii* Gray), a common associate of mesquite in southern Arizona.

Voucher specimens: RLG 7043 and 7045, Santa Rita Expt. Range, Santa Rita Mts., Pima County; RLG 8947,



31



32

Fig. 31. *Inonotus texanus* (RLG 10508). a, tramal hyphae; b, hyphae from fibrous context; c, thick-walled, contorted hyphae from granular core; d, basidia; e, basidiospores. Fig. 32. *Phellinus badius* (RLG 7737). a, tramal hyphae; b, contextual hyphae; c, basidia; d, basidiospores.

Sonoita Creek, Santa Cruz County; ERC 174, Ruby, Atascosa Mts., Santa Cruz County; ERC 71-71, Old Spanish Trail near Colossal Cave, Pima County; RLG 10508 and 10510, Forestry Cabin Trail, Baboquivari Mts., Papago Indian Res., Pima County.

32. PHELLINUS BADIUS (Berk.) G. H. Cunn., New Zealand Dept. Sci. Ind. Res. Bull. 164. p. 233. 1965.

*Fomes badius* (Berk.) Cke., Grevillea 14:18. 1885.

Basidiocarps perennial, sessile, dimidiate, to 6 x 7 x 3.5 cm; upper surface quickly becoming blackened and rimose, margin yellowish-brown, tomentose, up to 1.5 cm wide; pore surface yellowish-brown, smooth; pores circular to angular, 3-5 per mm, with smooth, entire dissepiments; context bright yellowish-brown, firm, fissile, faintly zonate, up to 2 cm thick; tube layers concolorous, not distinct from context, up to 2 cm thick; contextual hyphae (Fig. 32b) simple-septate, some thin-walled, pale brown, 4-6  $\mu\text{m}$  diam, some thick-walled, dark brown, 3-9  $\mu\text{m}$  diam; tramal hyphae (Fig. 32a) similar; basidia (Fig. 32c) broadly clavate, up to 12-14 x 6-7  $\mu\text{m}$ , sterigmata 5-6  $\mu\text{m}$  long; setae absent; basidiospores (Fig. 32d) ovoid, 5-7 x 4-6  $\mu\text{m}$ , dark reddish-brown with slightly thickened walls, negative in Melzer's reagent.

*Phellinus badius* causes a white rot of the heartwood of living trees. The decayed wood becomes pale yellow with brown mycelium developing in shrinkage cracks as decay progresses.

Voucher specimens: RLG 7834, Baboquivari Peak Rd., Papago Indian Res., Pima County; ERC 71-89, Sonoita Creek, Patagonia, Santa Cruz County; N. Simmons, Tule Desert, Yuma County; ERC 71-72, Colossal Cave Area, Rincon Mts., Pima County.

33. PHELLINUS FERRUGINOSUS (Schrad. ex Fr.) Bourd. et Galz., Hym. France. p. 625. 1928.

*Poria ferruginosa* (Schrad. ex Fr.) Karst., Rev. Mycol. 3, 9:18. 1881.

Basidiocarps annual or perennial, becoming widely

effused, tough to soft-spongy, adnate; margin often appearing setulose under a lens, up to 2 cm wide; pore surface ferruginous, the pores circular, usually 7-9 per mm, but in some unusual specimens 2-3 per mm, with thick, tomentose dissepiments; context yellowish-brown, azonate, soft-fibrous, up to 1.5 mm thick; tube layer slightly darker than the context or concolorous, continuous with the context, up to 2 mm thick; contextual hyphae (Fig. 33a) simple-septate, hyaline or pale yellow and thin-walled to dark brown and thick-walled, 2-4  $\mu\text{m}$  diam; tramal hyphae similar; setal hyphae usually present in marginal tissue, dark reddish-brown, thick-walled, tapering to a point, unbranched, 5-8  $\mu\text{m}$  diam; basidia (Fig. 33c) clavate, 4-sterigmate, 11-14 x 4.5-6.5  $\mu\text{m}$ , hyaline, with a basal septum; setae (Fig. 33b) abundant in hymenium, mostly subulate, thick-walled, 25-65 x 6-8  $\mu\text{m}$ ; basidiospores (Fig. 33d) cylindrical or short-oblong, 5-7 x 3-3.5  $\mu\text{m}$ , hyaline, smooth, negative in Melzer's reagent.

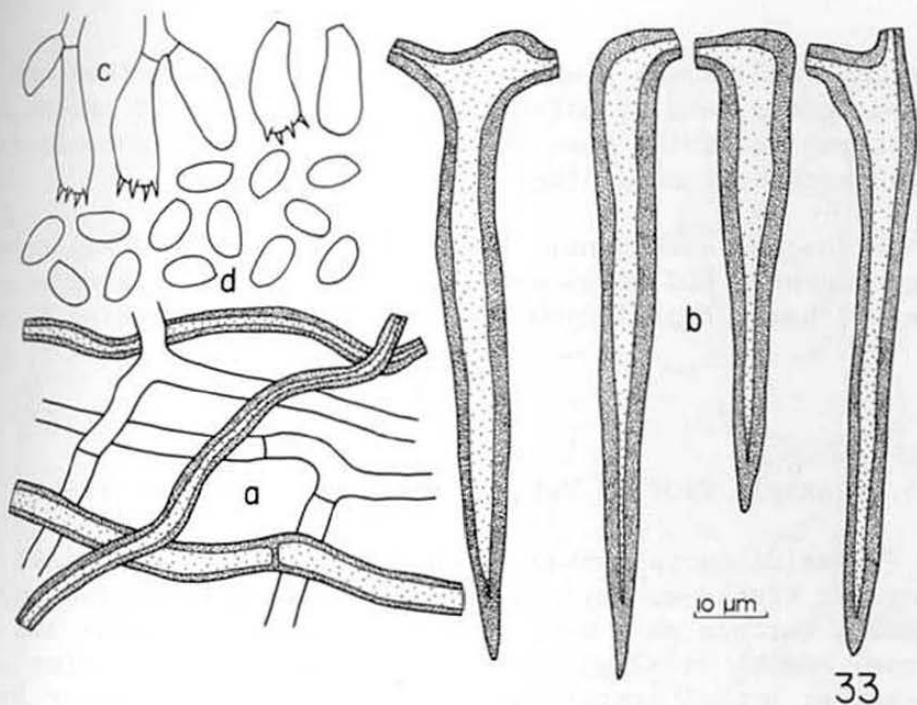
*Phellinus ferruginosus* causes a white rot of fallen trunks and branches.

Voucher specimens: RLG 7044, Santa Rita Expt. Range, Santa Rita Mts., Pima County; ERC 71-78, Redington-Benson Rd., San Pedro Valley, Cochise County; RLG 10385, and ERC 71-257, Aravaipa Canyon, Galliuro Mts., Pinal County.

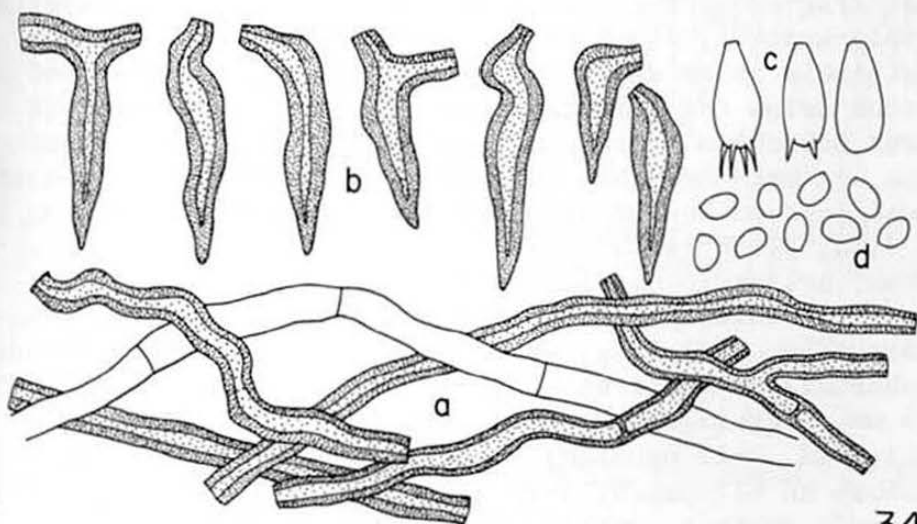
34. PHELLINUS GILVUS (Schw.) Pat., Ess. Tax. Hym., p. 97. 1900.

*Polyporus gilvus* (Schw.) Fr., Elench. Fung. 1:104. 1828.

Basidiocarps perennial or annual, sessile; upper surface pale yellowish-brown to reddish-brown and tomentose, becoming smooth to warted, blackening with age, sometimes zonate especially near margin; pore surface purplish-brown, pores circular, 6-8 per mm; context bright golden yellow, fibrous, up to 2 cm thick; contextual hyphae (Fig. 34a) pale yellow, thin-walled, and septate to reddish-brown, thick-walled, and infrequently septate, rarely branched, 2.5-6.5  $\mu\text{m}$  diam; tramal hyphae similar; setae (Fig. 34b) abundant, subulate, 20-30 x 5-6  $\mu\text{m}$ , reddish-brown, thick-walled, bifurcate or not at base, projecting up to 15  $\mu\text{m}$ ; basidia (Fig. 34c) broadly clavate, 8-11 x 5-7  $\mu\text{m}$ , 4-sterigmate, with a basal septum; basidiospores (Fig. 34d)



33



34

Fig. 33. *Phellinus ferruginosus* (ERC 71-257). a, contextual hyphae; b, setae; c, basidia; d, basidiospores. Fig. 34. *Phellinus gilvus* (ERC 86). a, contextual hyphae; b, setae; c, basidia; d, basidiospores.

ovoid, hyaline,  $4-5 \times 2.5-3.5 \mu\text{m}$ , negative in Melzer's reagent.

*Phellinus gilvus* is a common fungus on a number of stream-bank hardwoods at lower elevations in southern

Arizona and causes a white heartrot of living trees and also decays dead standing and fallen trees. It causes a butt rot in living mesquite with basidiocarps inconspicuous near the ground line.

Voucher specimens: ERC 71-86, Sonoita Creek, Santa Cruz County; RLG 10869 and 10873, at base of living mesquite, Lower Bear Canyon, Santa Catalina Mts., Pima County.

35. VARARIA TROPICA Welden, Mycologia 57:516. 1965.

Basidiocarps annual, effused, cracking into small angular blocks on drying, soft and easily sectioned; hymenial surface pale buff, minutely tomentose under 30X lens, smooth or slightly tuberculate; margin thinning out, fertile; hyphal system dimitic; generative subicular hyphae (Fig. 35a) thin- to moderately thick-walled, hyaline, simple-septate, 2.5-4  $\mu\text{m}$  diam; dichohyphidia (Fig. 35b) dextrinoid in Melzer's reagent, abundant, concentrated in a zone below the hymenial region but also scattered in lower subiculum, with thickened walls, profusely branched with ultimate branches tapering to slender curved apices, basal portion 2-4  $\mu\text{m}$  diam and slender apices less than 1  $\mu\text{m}$  diam; gloeocystidia (Fig. 35c) mostly imbedded, elongated, cylindric or with swollen portions, negative in sulfuric benzaldehyde, thin-walled, 70-90 x 6-12  $\mu\text{m}$ ; basidia (Fig. 35d) in a catathymenium, arising from imbedded probasidia at different levels, thick-walled at base, 25 x 6-8  $\mu\text{m}$ , 4-sterigmate; probasidia (Fig. 35e) globose to ellipsoid, 9-12  $\mu\text{m}$  diam; basidiospores (Fig. 35f) subglobose to ellipsoid, 9-12 x 7-9  $\mu\text{m}$ , hyaline, negative in Melzer's reagent, smooth, with slightly thickened wall and a blunt, prominent apiculus.

*Vararia tropica* was originally described from Puerto Rico, and has not been reported previously from western North America. It is associated with a white rot of dead branches.

Voucher specimen: RLG 10950, near Arizona State Rd. 289, 5 mi. west of Arivaca, Santa Cruz County.



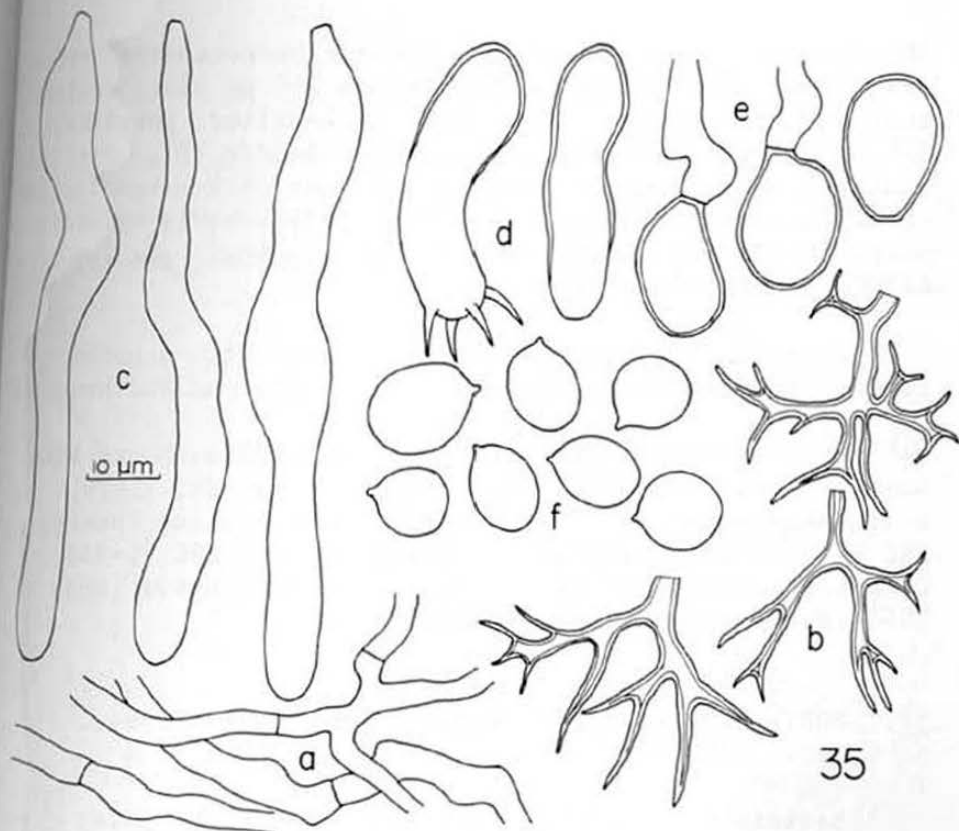


Fig. 35. *Vararia tropica* (RLG 10950). a, subicular hyphae; b, dichohyphidia; c, gloeocystidia; d, basidia; e, probasidia; f, basidiospores.

36. *ANTRODIA HETEROMORPHA* (Fr.) Donk, *Persoonia*, 4:339. 1966.

*Trametes heteromorpha* (Fr.) Bres., in Neuman, *Wis. Geol. Nat. Hist. Sur. Bul.* 33:40. 1914.

Basidiocarps annual, usually effused-reflexed, often effused or sessile; pilei solitary or imbricate; reflexed portion dimidiate to elongate, up to 3 x 20 x 1.5 cm; surface of pileus ivory white to pale brown, glabrous to slightly tomentose; margin even, sometimes abrupt, concolorous with pileus surface; pore surface concolorous with upper surface, dull, pores angular to circular, 1 to 3 per mm; dissepiments at first thick and entire, thin and lacerate with age; context ivory-colored, corky, up to 6 mm

thick; hyphal system dimitic; generative contextual hyphae (Fig. 36a) thin-walled, with clamps, 2-4  $\mu\text{m}$  diam; contextual skeletal hyphae (Fig. 36b) thick-walled, aseptate, 3-6  $\mu\text{m}$  diam; tramal hyphae similar; basidia (Fig. 36c) clavate, 4-sterigmate, 30-40 x 9-10  $\mu\text{m}$ ; with a basal clamp; cystidia none; basidiospores (Fig. 36d) broadly cylindrical, slightly curved, 12-16.5 x 5-7.5  $\mu\text{m}$ , hyaline, smooth, negative in Melzer's reagent.

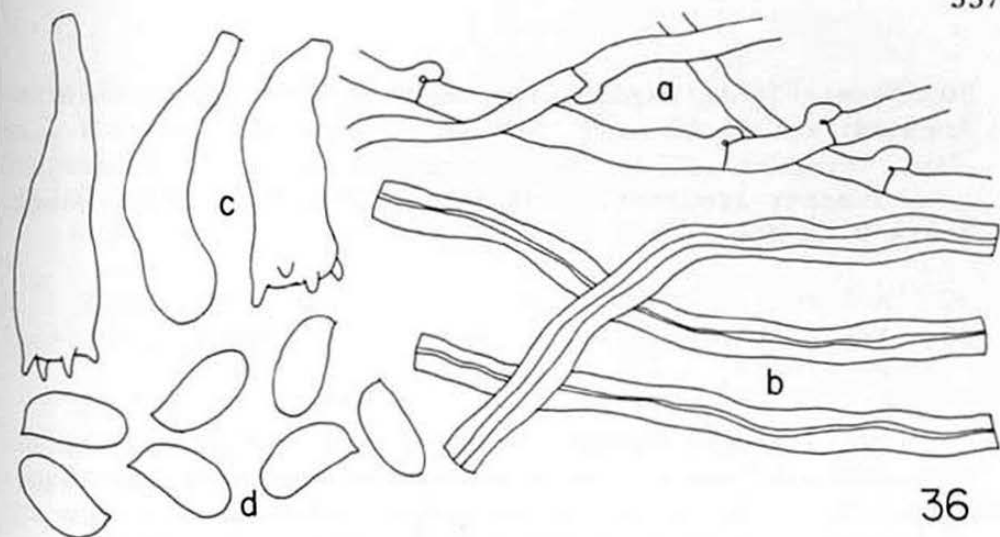
*Antrodia heteromorpha* is associated with a brown cubical rot of fallen and standing dead stems and branches.

Voucher specimens: RLG 10213 and 10216, Santa Rita Expt. Range, Santa Rita Mts., Pima County; ERC 71-79, Redington-Benson Rd., San Pedro Valley, Cochise County; ERC 71-255, Aravaipa Canyon, Pinal County; ERC 71-356, Camp Grant Wash, San Pedro Valley, Pinal County; HHB 5955, Redington Rd., Pima County.

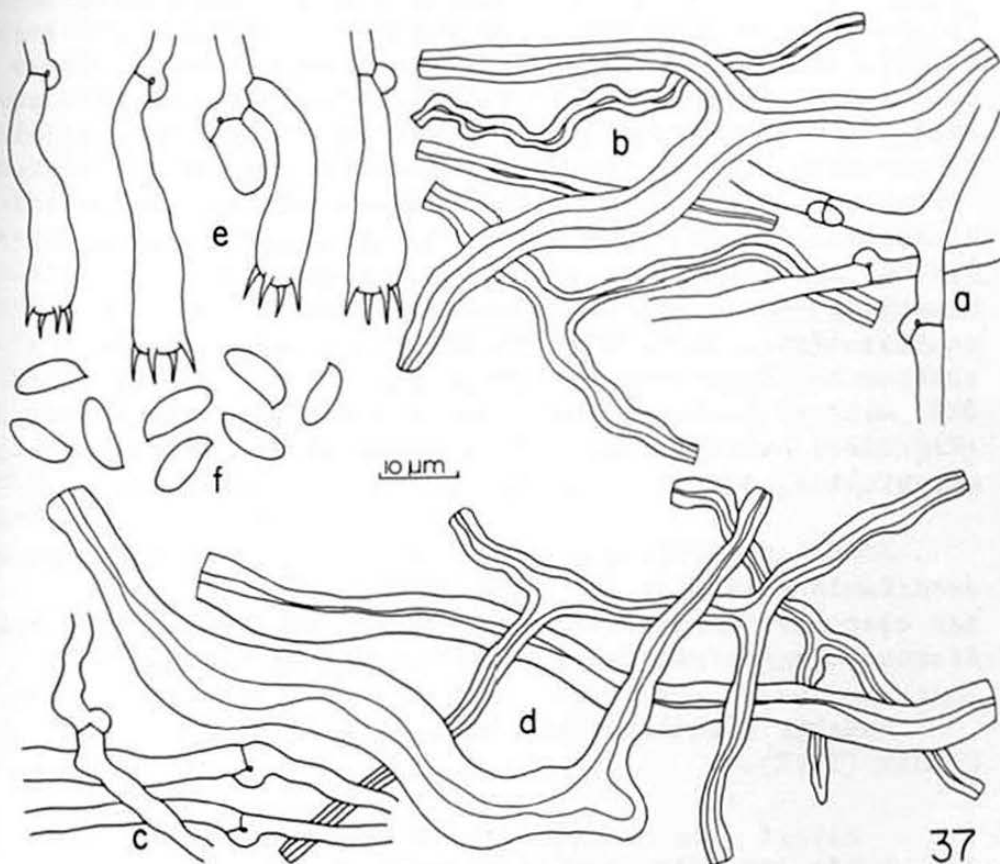
37. POLYPORUS ARCULARIUS Batsch. ex Fr., Syst. Myc. 1: 342. 1821.

Basidiocarps annual, centrally stipitate; pilei circular, solitary, up to 2.5 cm diam and 0.3 cm thick; surface of pileus straw-colored to dark brown, azonate, glabrous, smooth to rugose; margin ciliate, acute, sterile below; stipe central, concolorous with pileus, glabrous, up to 3.5 cm long and 0.4 cm thick; pore surface cream-colored to buff, dull, rough, the pores hexagonal, radially aligned, 1-2 per mm, dissepiments thin, becoming lacerate; context white to buff, azonate, tough, less than 1 mm thick; tube layer concolorous and continuous with context, up to 2 mm thick; hyphal system dimitic; contextual generative hyphae (Fig. 37c) thin-walled, often branched, with abundant clamps, 2.5-5  $\mu\text{m}$  diam; contextual skeletal hyphae (Fig. 37d) thick-walled, aseptate, with occasional branching, 2-11  $\mu\text{m}$  diam; tramal hyphae (Fig. 37a,b) similar, not readily separable; hyphae on pileus surface slender, thin-walled, with clamps, 1-1.5  $\mu\text{m}$  diam; cystidia none; basidia (Fig. 37e) clavate, 4-sterigmate 25-35 x 5-6  $\mu\text{m}$ , with a basal clamp; basidiospores (Fig. 37f) cylindrical, straight or slightly curved, 7-9 x 2.5-3.5  $\mu\text{m}$ , hyaline, smooth, negative in Melzer's reagent.

*Polyporus arcularius* causes a uniform white rot of fallen dead hardwoods and is occasionally found on



36



37

Fig. 36. *Antrodia heteromorpha* (RLG 9952). a, contextual generative hyphae; b, contextual skeletal hyphae; c, basidia; d, basidiospores. Fig. 37. *Polyporus arcularius* (RLG 7903). a, tramal generative hyphae; b, tramal skeletal hyphae; c, contextual generative hyphae; d, contextual skeletal hyphae; e, basidia; f, basidiospores.

junipers. It is especially common on oak in southern Arizona.

Voucher specimen: HHB 8481, Santa Rita Expt. Range, Santa Rita Mts., Pima County.

38. *PORIA APACHERIENSIS* Gilbertson et Canfield.  
Mycologia, 65:1117. 1973.

Basidiocarps annual, effused up to 10 cm, adnate, soft-fibrous; pore surface white to Cream Color or Light Buff, the pores irregular in shape, daedaloid in some areas, up to 1 mm diam but mostly 2-3 per mm; dissepiments thick and finely tomentose at first but becoming thick and deeply lacerate; tube layer soft-fibrous, white to cream colored, up to 2 mm thick; subiculum white, soft, azonate, less than 0.5 mm thick; hyphal system monomitic; subicular hyphae (Fig. 38a) with clamps, thin-walled, with occasional branching, 2-4  $\mu$ m diam; tramal hyphae similar, incrustated at dissepiment edges; cystidia of two types, some acicular to cylindric (Fig. 38b), thin-walled, smooth or lightly incrustated, 3-5  $\mu$ m diam and projecting up to 40  $\mu$ m, others capitata (Fig. 38c), with stalk 3-5  $\mu$ m diam and swollen apex up to 10  $\mu$ m diam, projecting to 45  $\mu$ m; basidia (Fig. 38d) clavate, 4-sterigmate, 18-21 x 6-7  $\mu$ m; basidiospores (Fig. 38e) broadly ellipsoid to subglobose, 5-6.5 x 4-5.5  $\mu$ m, hyaline, smooth, negative in Melzer's reagent.

*Poria apacheriensis* is associated with a white rot of dead fallen mesquite and other desert trees and shrubs. It has also been found associated with a root rot of several of these desert plants (Gilbertson and Canfield, 1973).

Voucher specimen: ERC 180, Patagonia, Santa Cruz County (TYPE).

39. *PORIA BABOQUIVARIENSIS* Gilbertson, sp. nov.

Fructificatio annua, resupinata, aurantiaca; pori angulati, 1-3 per mm; subiculum album, arachnoideum; margo alba, floccosa vel arachnoidea cum rhizomorphis; hyphae fibulatae et septatae, cum ampullae, 3-8  $\mu$ m diam; cystidia tenuitunicata, cylindrica; basidia late clavata, 4-sterigmatibus, 7-9  $\mu$ m diam; basidiosporae globosae vel late ellipsoidae, 5-6 x 4-5  $\mu$ m, tunica echinulatae, hyalina, non-

amyloidea; HOLOTYPUS: in ligno *Prosopis juliflora* (Sw.) DC., Arizona Highway 86 near Kitt Peak Rd., Pima County, Arizona, leg. R. L. Gilbertson No. 10503, in herb. CFMR.

ETYMOLOGY: from Baboquivari Mountains near the type locality.

Basidiocarps annual, effused up to 5 cm; pore surface orange when fresh, drying to orange-brown, the pores rounded to angular, up to 1 mm diam; margin whitish, arachnoid to floccose, with hyphal strands visible near the substratum, these continuing beyond the margin in some places, formed by a large central hypha surrounded by closely interwoven narrow hyphae; tubes soft and fragile when fresh, drying brittle, up to 2 mm long; subiculum white, arachnoid, very thin; hyphal system monomitic; subicular hyphae (Fig. 39a,b) thin-walled, with frequent branching, with clamp connections and simple septa, some ampullate, 3-8  $\mu$ m diam; cystidia (Fig. 39c) thin-walled, often with clamps or simple septa, cylindric, scattered in hymenium and abundant at dissepiment edges, 3-5  $\mu$ m diam, often with a swollen base up to 10  $\mu$ m diam, projecting to 50  $\mu$ m; basidia (Fig. 39d) broadly clavate, with a basal clamp, 7-9  $\mu$ m diam; basidiospores (Fig. 39e) hyaline, negative in Melzer's reagent, subglobose to broadly ellipsoid, distinctly echinulate at maturity, with a large central guttule, 5-6 x 4-5  $\mu$ m.

*Poria baboquivariensis* is associated with a white rot of dead, fallen mesquite. The distinctive characters are the orange color of the basidiocarp, the echinulate spores, and the ampullate hyphae. The latter two characters suggest a relationship to the genus *Trechispora* of the Corticiaceae.

Voucher specimen: holotype previously listed.

40. *PORIA LATEMARGINATA* (Dur. et Mont.) Cke., *Grevillea* 14:112. 1886.

*Poria ambigua* Bres., *Accad. Rover. Agiati Atti ser.* 3, 3:84. 1897.

Basidiocarps annual or rarely perennial, becoming

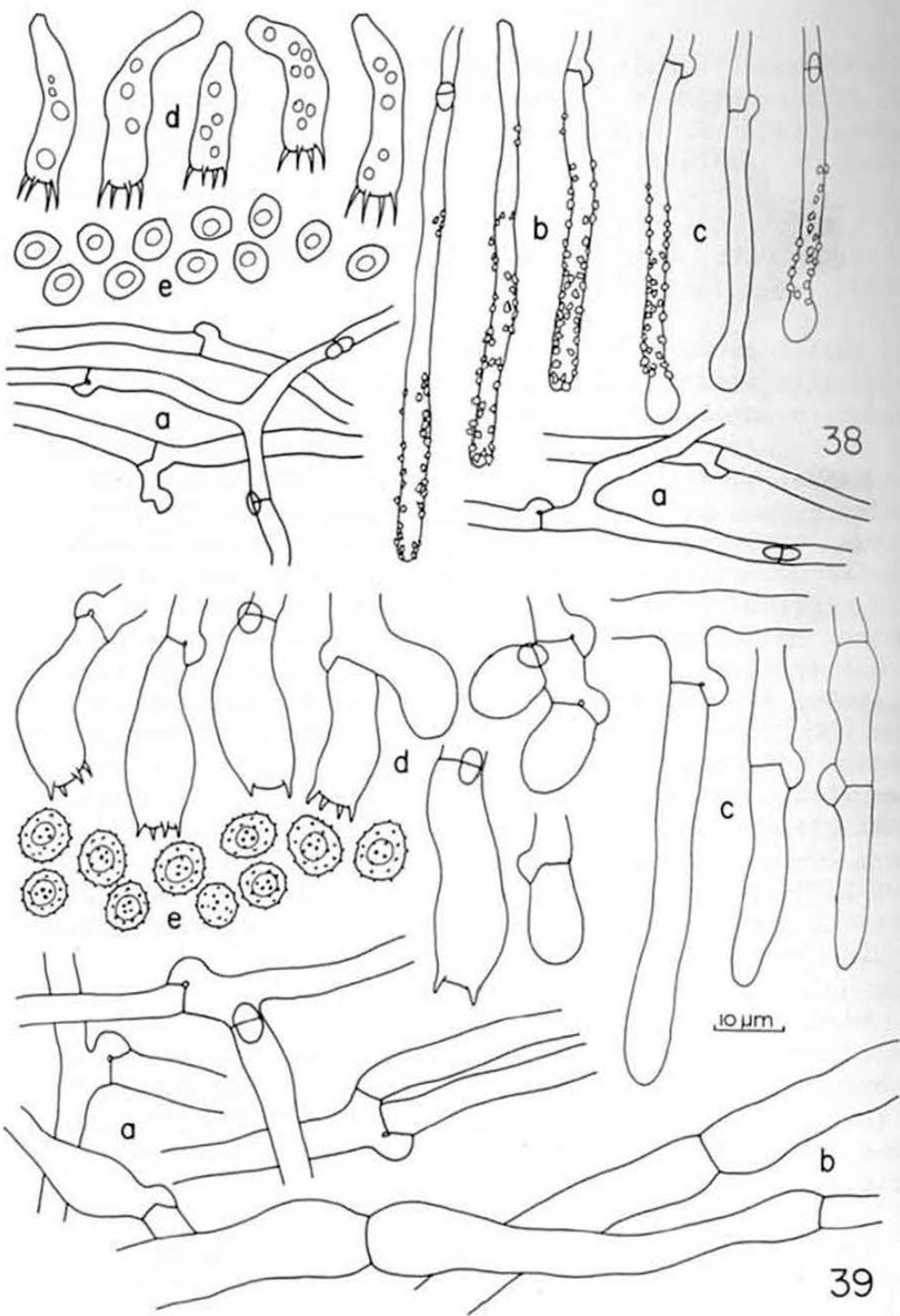


Fig. 38. *Poria apacheriensis* (ERC 180). a, subicular hyphae; b, cylindric cystidia; c, capitate cystidia; d, basidia; e, basidiospores. Fig. 39. *Poria baboquivariensis* (RLG 10503). a, nodose-septate subicular hyphae; b, simple-septate subicular hyphae; c, cystidia; d, basidia; e, basidiospores.



widely effused, adnate; pore surface cream-colored to pale tan, the pores angular, 1-3 per mm; subiculum ivory, soft-fibrous; hyphal system monomitic; subicular hyphae (Fig. 40a) hyaline, single septate, thin-walled to relatively thick-walled, often partially incrustated, 3-10  $\mu\text{m}$  diam; cystidia frequent or rare, to absent, cylindrical to clavate, entirely or capitately incrustated, 17-25 x 5-7  $\mu\text{m}$ ; basidia (Fig. 40b) clavate, 4-sterigmate, 20-25 x 6-7  $\mu\text{m}$ , with a basal septum; basidiospores (Fig. 40c) broadly ellipsoid to ovoid, 5-8 x 3-5  $\mu\text{m}$ , hyaline, smooth, negative in Melzer's reagent.

*Poria latemarginata* is associated with a white rot of dead hardwoods. Collection RLG 10843 was from the base of a recently killed standing mesquite and was associated with a root and butt rot.

Voucher specimens: RLG 10843, Vail Road near Pantano Wash, Pima County; RLG 10843, Aravaipa Canyon, Galluiro Mts., Pinal County.

41. PORIA MEDULLA-PANIS (Jacq. sensu Pers.) Bres., Accad. Rover. Agiati Atti ser. 3, 3:84.

Basidiocarps annual or perennial, usually effused but sometimes narrowly reflexed on vertical surfaces, tough-corky; pore surface cream-colored to yellow, drying pale buff on some specimens, the pores circular, 5-7 per mm; dissepiments thick, entire; hyphal system trimitic; subicular generative hyphae (Fig. 41a) with clamps, thin-walled, with occasional branching, 3-4  $\mu\text{m}$  diam; subicular skeletal hyphae (Fig. 41b) thick-walled, aseptate, rarely branched, 3-4  $\mu\text{m}$  diam; binding hyphae (Fig. 41c) thick-walled, often dextrinoid in Melzer's reagent, aseptate, mostly with abundant branching, tips of branches tapering down to a very slender tip, (0.5-)1-2  $\mu\text{m}$  diam; tramal hyphae similar; hyphal pegs present; fusoid cystidioles (Fig. 41d) 15-20 x 6-8  $\mu\text{m}$ , with a basal clamp; basidia (Fig. 41e) broadly clavate, 4-sterigmate, 20-27 x 9-10  $\mu\text{m}$ , with a basal clamp; basidiospores (Fig. 41f) 6-8 x 4.5-6  $\mu\text{m}$ , ovoid to ellipsoid, becoming truncate and thick-walled at maturity, with a germ pore at the truncate end, hyaline, weakly to strongly dextrinoid in Melzer's reagent.

*Poria medulla-panis* is associated with a white rot of hardwood logs and stumps and is a common fungus from the

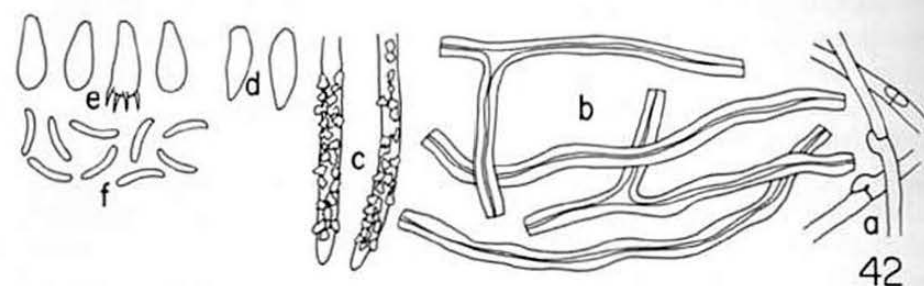
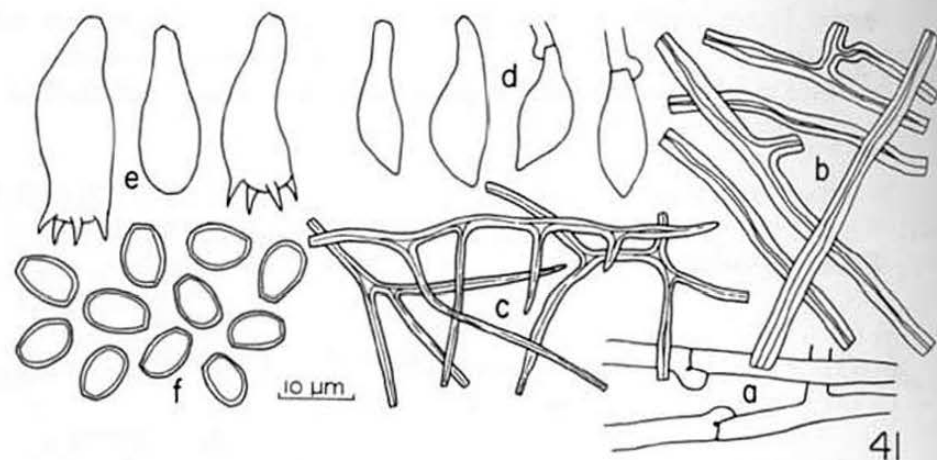
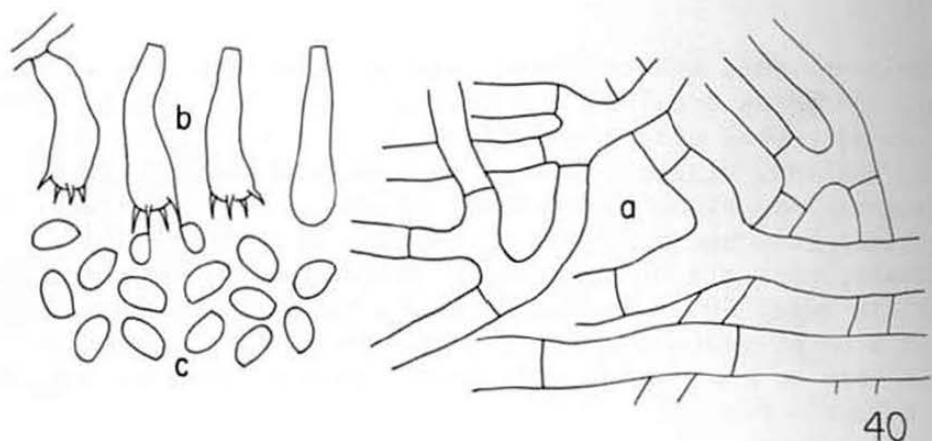


Fig. 40. *Poria latemarginata* (RLG 10843). a, subicular hyphae; b, basidia; c, basidiospores. Fig. 41. *Poria medulla-panis* (RLG 8459). a, subicular generative hyphae; b, subicular skeletal hyphae; c, slender binding hyphae; d, fusoid cystidioles; e, basidia; f, basidiospores. Fig. 42. *Poria subincarnata* (KJM 310). a, subicular generative hyphae; b, subicular skeletal hyphae; c, incrusted hyphal ends at dissepiment edges; d, fusoid cystidioles; e, basidia; f, basidiospores.

desert up through the oak-woodland zone in southern Arizona.

Voucher specimens: RLG 7782, Saguaro Nat. Monument, East Unit, Pima County; RLG 8459, Buenos Aires, Papago Indian Res., Baboquivari Mts., Pima County; RLG 10495, Rest area near Kitt Peak Rd., Highway 86, Pima County.

42. *PORIA SUBINCARNATA* (Pk.) Murr., Mycologia 13:86. 1921.

Basidiocarps annual, becoming broadly effused, separable or somewhat adnate, often cracking upon drying; taste mild; margin narrow, white, tomentose to fimbriate; pore surface creamy-white or with a pink tint when fresh, drying cream to buff, tubes soft-waxy to coriaceous, to 4 mm in length, the pores 4-7 per mm; subiculum soft, thin, white; hyphal system dimitic; subicular skeletal hyphae (Fig. 42b) thick-walled, aseptate, 2-3.5  $\mu\text{m}$  diam; subicular generative hyphae (Fig. 42a) with clamps, 2-3  $\mu\text{m}$  diam; tramal hyphae (Fig. 42c) similar, heavily incrustated at the dissepiment edges; conspicuous hyphal pegs present; fusoid cystidioles (Fig. 42d) 9-11 x 3-4  $\mu\text{m}$ ; basidia (Fig. 42e) clavate, 4-sterigmate, 9-11 x 4-5  $\mu\text{m}$ , with a basal clamp; basidiospores (Fig. 42f) allantoid, 4-5 x 1-1.5  $\mu\text{m}$ , hyaline, smooth, negative in Melzer's reagent.

*Poria subincarnata* is associated with a white rot of conifer, and rarely hardwood logs and slash. White rhizomorphs are sometimes present in bark and between bark and wood under basidiocarps.

Voucher specimen: RLG 7041, Madera Canyon, Santa Rita Mts., Pima County.

43. *PORIA TARDA* (Berk.) Cke., Grevillea 14:109. 1886.

Basidiocarps becoming broadly effused, annual, usually adnate, up to 1 mm thick; pore surface rose-pink to cream, usually drying cream to pale buff, tubes originating as isolated cupules; pores 3-5 per mm; 0.5-1 mm long; sterile margin usually rather wide, thinning out, white to cream; context white to cream, soft, very thin; tube layer concolorous with subiculum, 0.5-1 mm thick; hyphal system monomitic; subicular hyphae (Fig. 43a) hyaline, thin-

walled, simple-septate, lacking clamps or with rare clamps, often slightly ampullate at the septa, frequently branched at right-angles, frequently lightly incrustated, 3.5  $\mu\text{m}$  diam; tramal hyphae similar; cystidia none; basidia (Fig. 43b) clavate, 4-sterigmate, 16-18 x 4-5  $\mu\text{m}$ , simple-septate at base; basidiospores (Fig. 43c) 4-5 x 2-2.5  $\mu\text{m}$ , cylindric, ellipsoid, hyaline, thin-walled, smooth, negative in Melzer's reagent.

*Poria tarda* is associated with a white rot of fallen conifer and hardwood branches and stems.

Voucher specimen: HHB 5970, Redington, San Pedro River Valley, Pima County.

44. FUNALIA GALLICA (Fr.) Bond. et Sing., Ann. Mycol. 39: 62. 1941.

*Trametes hispida* Bagl., Erb. Crittog. Ital., no. 1356. 1866.

Basidiocarps annual, effused-reflexed to sessile, occasionally completely effused; pilei dimidiate, up to 10 cm wide; upper surface hispid, pale brown, azonate or faintly zonate; pore surface pale purplish (Drab to Light Drab); pores angular, over 1 mm diam in some specimens; dissepiments thick at first, tomentose, becoming thin and lacerate; hyphal system trimitic; contextual generative hyphae (Fig. 44c) inconspicuous, thin-walled, hyaline to pale yellow, septate and with clamps, rarely branched, 2-2.5  $\mu\text{m}$  diam; contextual skeletal hyphae (Fig. 44a) conspicuous, slightly to strongly thick-walled, pale greenish-brown, aseptate, rarely branched, 2-3  $\mu\text{m}$  diam; cystidia none; basidia (Fig. 44d) clavate, 4-sterigmate, 24-30 x 8-10  $\mu\text{m}$ ; basidiospores (Fig. 44e) 11-16 x 4-5  $\mu\text{m}$ , cylindric, hyaline, thin-walled, negative in Melzer's reagent.

*Funalia gallica* is associated with a uniform white rot of dead standing or fallen hardwoods. It is common on several hardwoods, including Fremont cottonwood (*Populus fremontii* S. Wats) and Arizona sycamore (*Platanus wrightii* S. Wats.), but rare on mesquite in southern Arizona.

Voucher specimen: RLG 10396, Aravaipa Canyon, Pinal County.

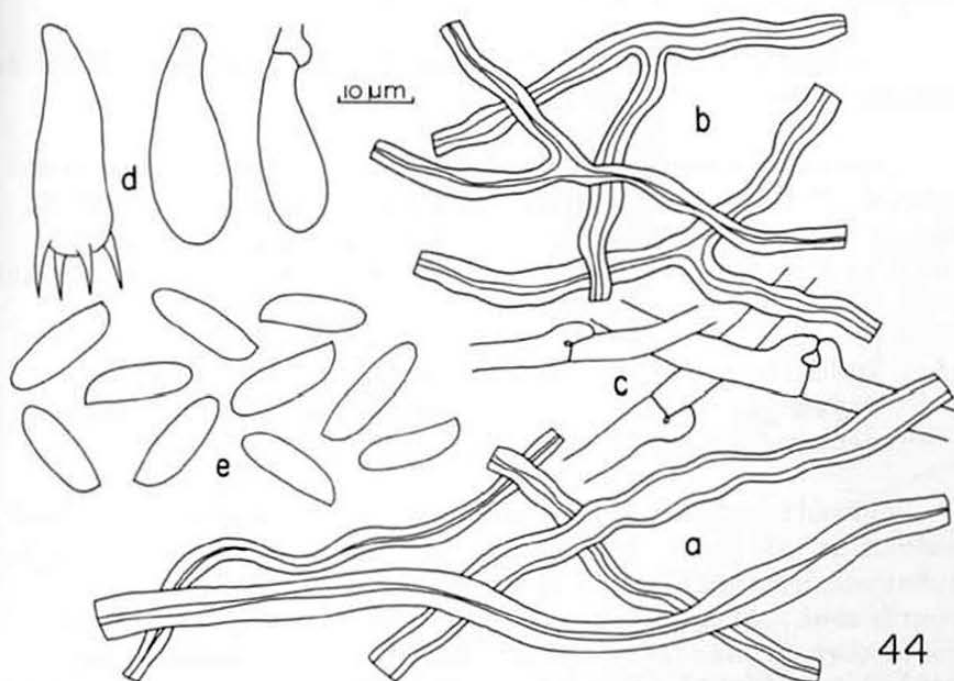
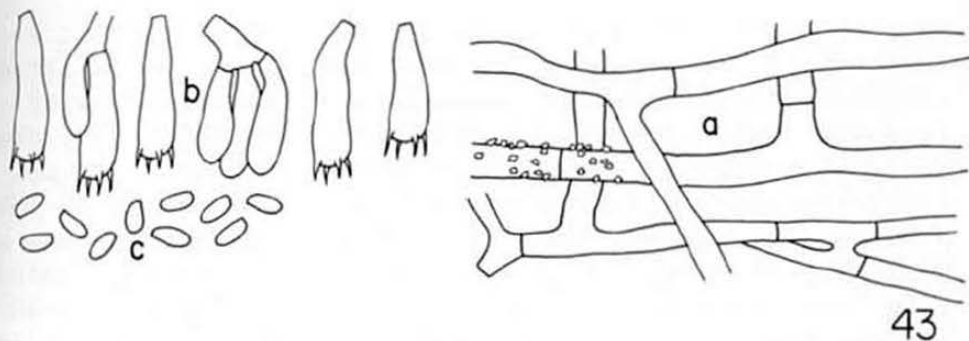


Fig. 43. *Poria tarda* (RLG 10135). a, subicular hyphae; b, basidia; c, basidiospores. Fig. 44. *Funalia gallica* (RLG 10396). a, contextual skeletal hyphae; b, contextual binding hyphae; c, contextual generative hyphae; d, basidia; e, basidiospores.

45. *LOPHARIA CRASSA* (Lév.) Boidin, Bull. Soc. Mycol. France 74:479. 1958.

Basidiocarp effused up to 20 cm, annular, adnate, hymenial surface smooth, bright purple at maturity, drying near Taupe Brown or Anthracene Purple, eventually becoming brown and rimose with age, hymenial layer cracking to ex-

pose the pale buff subiculum; hyphal system monomitic; subicular hyphae (Fig. 45a) oriented parallel to substrate, simple-septate, thin- to moderately thick-walled, with frequent branching, 3-5  $\mu\text{m}$  diam; cystidia (Fig. 45b) abundant, thick-walled, imbedded or projecting up to 45  $\mu\text{m}$ , fusiform, usually incrustated over the apical half, 60-180 x 8-12  $\mu\text{m}$ , originating from horizontally oriented hyphae of subiculum, curving out parallel with the basidia; basidia (Fig. 45c) narrowly clavate, with a basal septum, 28-40 x 5-6  $\mu\text{m}$ ; basidiospores (Fig. 45d) cylindrical, 7-9 x 3-4  $\mu\text{m}$ , hyaline, thin-walled, negative in Melzer's reagent.

*Lopharia crassa* is associated with a white rot of dead fallen stems of desert plants.

Voucher specimens: RLG 10493 and 10502, Rest Area near Kitt Peak Rd., Highway 86, Pima County; RLG 10537, ERC 71-357, Camp Grant Wash, San Pedro Valley, Pinal County; HHB 5968, Redington, San Pedro Valley, Pima County.

46. TOMENTELLA COERULEA (Bres.) Hoehn. et Litsch.,  
Sitzungs. kaiserl. Akad. Wissensch. Wien, Math.-  
naturw. Klasse 116:831. 1907.

Basidiocarps effused up to 2 cm, fragile, arachnoid, smooth or slightly granulose, easily separated from substratum; hymenial surface Cinnamon-Buff to Chamois, discontinuous; margin with slender white mycelial strands; subicular hyphae (Fig. 46a) mostly with clamps, thin-walled to slightly thick-walled, yellow-brown, with crystalline material dissolving, becoming green in KOH, 3-6  $\mu\text{m}$  diam; cystidia none; basidia (Fig. 46b) cylindrical to clavate, 4-sterigmate, sometimes with transverse septa, contents often red in H<sub>2</sub>O, walls yellow-brown in KOH, surface granular materials dissolving and becoming green in KOH, 50-60 x 6.5-7  $\mu\text{m}$ ; basidiospores (Fig. 46c) subglobose to globose, 5.5-7  $\mu\text{m}$  in diam, echinulate, pale brown, negative in Melzer's reagent.

The associated rot is unknown but probably of little importance in the decay of mesquite.

Voucher specimen: RLG 10515, Rest area near Kitt Peak Rd., Highway 86, Pima County.



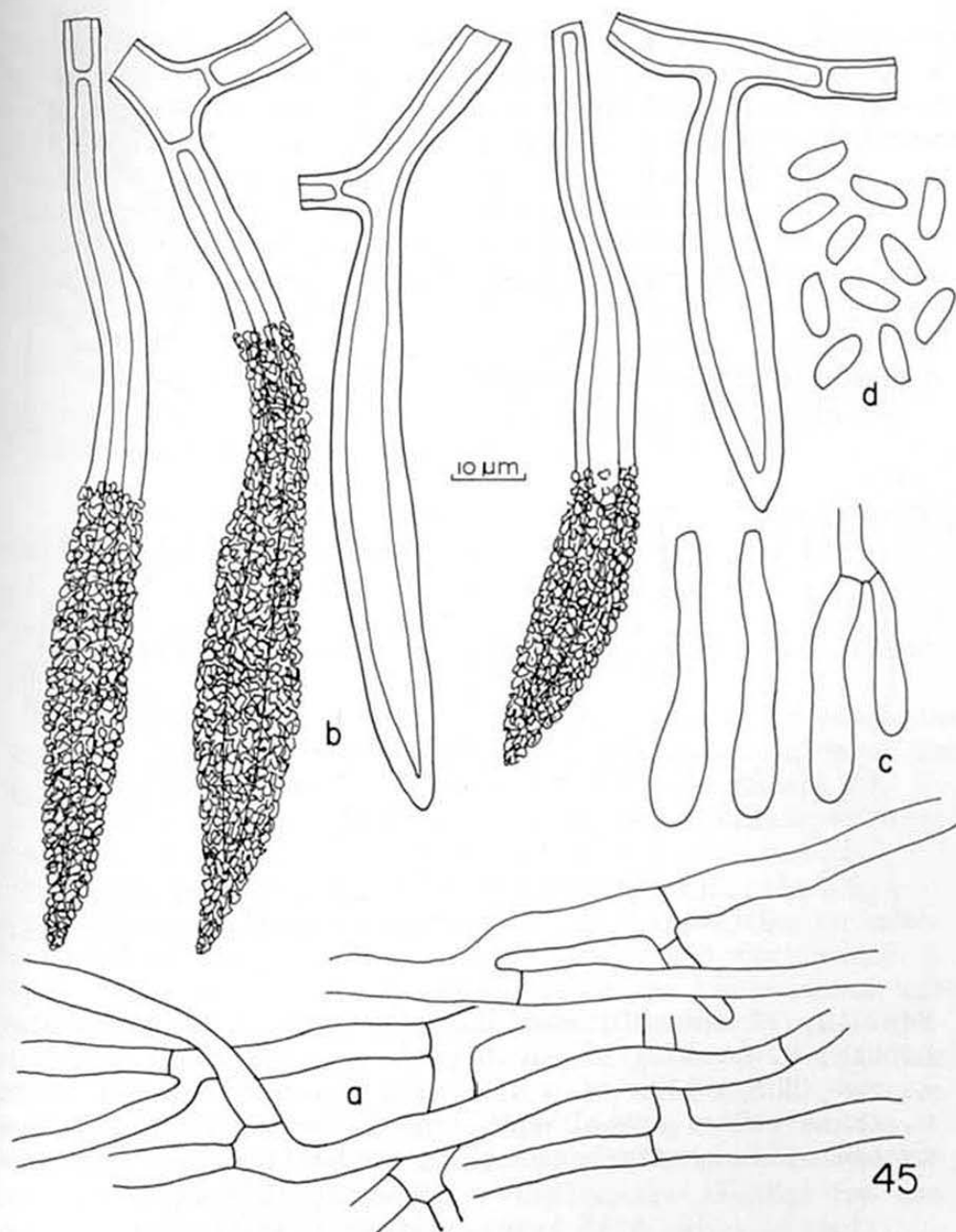
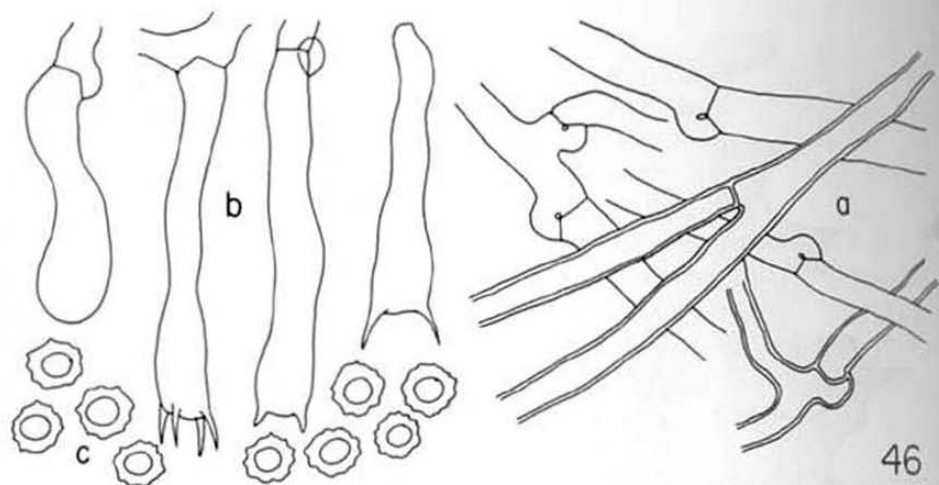


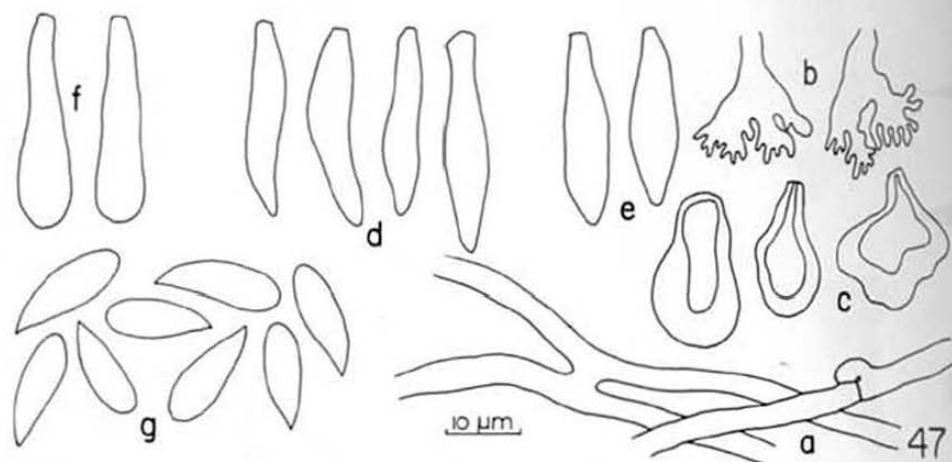
Fig. 45. *Lopharia crassa* (RLG 10502). a, subicular hyphae; b, cystidia; c, basidia; d, basidiospores.

47. *MARASMIUS SICCUS* (Schw.) Fr., *Epicr. Syst. Mycol.* p. 382. 1836.

Basidiocarps centrally stipitate, reviving; pileus hemispherical, up to 4 mm diam, thin, fragile; upper surface reddish-brown, plicate-striate; gills cream-colored,



46



47

Fig. 46. *Tomentella coerulea* (RLG 10515). a, subicular hyphae; b, basidia; c, basidiospores. Fig. 47. *Marasmius siccus* (HHB 8483). a, contextual hyphae; b, broom cells; c, thick-walled hyphal ends from upper surface; d, pleurocystidia; e, cheilocystidia; f, basidia; g, basidiospores.

adnate, dry, subdistant; stipe 10-15 mm long and 0.5 mm diam, tough-cartilaginous, brown, with appressed darker fibrils, shiny; pileus cuticle composed of dark reddish-brown, variously-shaped, irregularly thick-walled broom cells up to 13  $\mu\text{m}$  diam (Fig. 47b), with few to numerous pale yellow to hyaline finger-like projections; thick-walled, brown swollen hyphal ends also present on upper surface (Fig. 47c); contextual hyphae (Fig. 47a) hyaline, thin-walled, tightly interwoven, 2.5-5  $\mu\text{m}$ , with clamp

connections; gill trama similar; pleurocystidia (Fig. 47d) cylindrical, tapered to apex, hyaline, thin-walled, 24-28 x 4.5-6  $\mu$ m, with basal clamp; cheilocystidia (Fig. 47e) cylindrical, slightly tapered at apex, 22-25 x 5-6  $\mu$ m; broom cells also present on gill edges; basidia (Fig. 47f) clavate, 26-27 x 7-7.5  $\mu$ m, hyaline, with a basal clamp; basidiospores (Fig. 47g) narrowly lacrymiform, adaxially flattened, 13-16 x 4-5  $\mu$ m, hyaline, thin-walled, negative in Melzer's reagent.

*Marasmius siccus* was found on fallen mesquite twigs. It has not been reported on other Sonoran Desert plants and the associated rot is unknown.

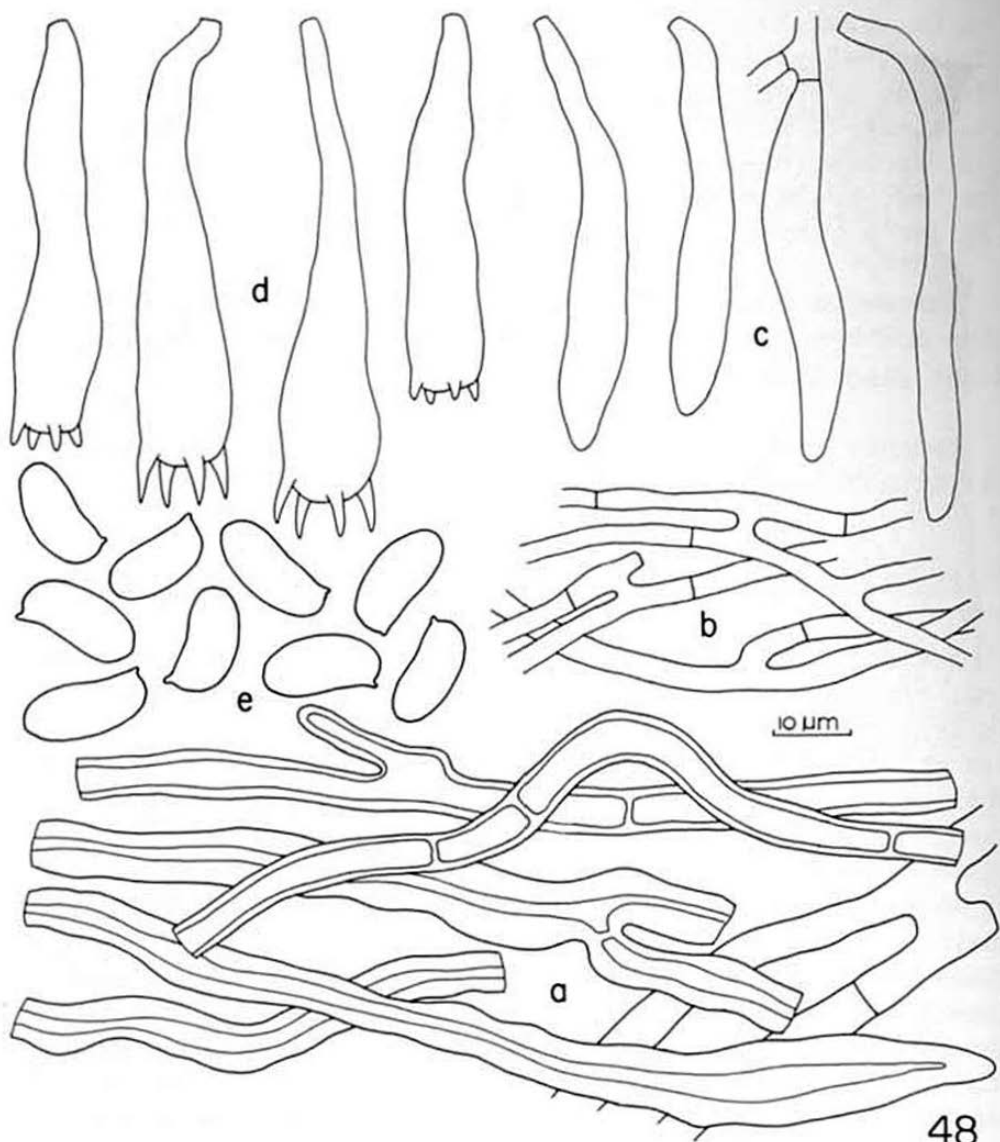
Voucher specimen: HHB 8483, Santa Rita Expt. Range, Santa Rita Mts., Pima County.

48. PANUS FULVIDUS Bres., Fungi Trid. II, p. 56. 1900.

Basidiocarps centrally stipitate, single to gregarious; pileus circular to hemispherical, 0.5-3 cm diam; upper surface dry, pale brown (Cinnamon-Buff to Clay Color) or cream colored with scattered pale brown, radially arranged fibrillar scales; stipe equal, 10-20 x 1-2 mm, cream colored to pale brown, usually darker at the base, glabrous to minutely pubescent; gills pinkish-cream to pale buff when dried, distant, edges sinuous and distinctly granulose under 30 X lens, free to adnate, continuous with striations on upper stipe; contextual hyphae (Fig. 48a) filamentous, simple-septate, thin- to thick-walled, 3-5  $\mu$ m diam; hyphae of gill trama (Fig. 48b) thin-walled, simple-septate, 2-4  $\mu$ m diam; pleurocystidia (Fig. 48c) fusoid, barely projecting, 45-50 x 5-6  $\mu$ m; cheilocystidia similar; basidia (Fig. 48d) clavate, 4-sterigmate, 38-42 x 7-8  $\mu$ m; with a basal septum; basidiospores (Fig. 48e) broadly cylindrical, 12-15 x 6-6.5  $\mu$ m, hyaline, smooth, negative in Melzer's reagent.

*Panus fulvidus* is associated with a brown cubical rot of dead hardwood trees and shrubs and is commonly found on junipers and juniper fence posts in southern Arizona.

Voucher specimen: ERC 71-158, Redington, San Pedro Valley, Pima County.



48

Fig. 48. *Panus fulvidus* (ERC 71-132). a, contextual hyphae; b, tramal hyphae; c, pleurocystidia; d, basidia; e, basidiospores.

## LITERATURE CITED

- Benson, Lyman. 1941. The mesquites and screw-beans of the United States. *Amer. J. Bot.* 28:748-754.
- Gilbertson, R. L., and H. H. Burdsall, Jr. 1975. *Peniophora tamaricicola* in North America. *Mycotaxon* 2:143-150.
- Gilbertson, R. L., and E. R. Canfield. 1973. A new *Poria* from southern Arizona. *Mycologia* 65:1117-1124.
- Gilbertson, R. L., K. J. Martin, and J. P. Lindsey. 1974. Annotated check list and host index for Arizona wood-rotting fungi. *Univ. Ariz. Agr. Expt. Sta. Tech. Bul.* 209. 48 p.
- Jülich, Walter. 1974. The genera of the Hyphodermoideae (Corticaceae). *Persoonia* 8:59-97.
- Ridgway, Robert. 1912. Color standards and color nomenclature. Washington, D. C. Published by the author.

## BOOK REVIEWS (continued from page 486)

A CONTRIBUTION TO THE TAXONOMY OF THE GENUS *TOMENTELLA* par Michael J. LARSEN, 6 + 145 p., 173 figs. fotogr. bl.-n. Mycologia Memoirs, No. 4, 1974. The Mycological Society of America, c/o The New York Botanical Garden, Bronx, NY 10458. \$9.- (USA), 10.- (Foreign).

L'auteur, dont les travaux sur les *Tomentella* d'Amérique du Nord sont bien connus, présente maintenant un travail de synthèse où il classe les 72 espèces nord-américaines dans les 14 sections, dont 9 nouvelles, du genre *Tomentella*. Deux espèces et seize combinaisons aussi sont nouvelles.

Ce travail résulte de l'examen de près de 1200 échantillons en provenance du monde entier.

En plus de la qualité de la taxonomie des espèces, on remarquera l'attention de l'auteur à rechercher les affinités de *Tomentella* avec les autres genres de Thelephoraceae, en particulier *Pseudotomentella*, *Tomentellina*, *Tomentellastrum* et *Thelephora*.

Un longue liste de Nomina excludenda, avec commentaires de l'auteur, vaut la peine d'être consultée.

Un travail qui, espérons-le, contribuera beaucoup à une monographie générale des *Tomentella*.

RAMARIA SUBGENUS LENTORAMARIA WITH EMPHASIS ON NORTH AMERICAN TAXA, par Ronald H. PETERSEN, 161 p., 18 figs., 15 pl. fotogr. coul. et bl.-n., 14 × 22 cm, broché. Bibliotheca Mycologia 43, 1975, ed. J. Cramer, FL-9490 Vaduz, Liechtenstein. DM 50.-

Eclairer d'une lumière nouvelle ce groupe d'espèces qui si souvent dans le passé ont été confondues, n'est pas une tâche facile. L'auteur cependant y excelle, grâce à une très grand souci de précision et de clarté dans l'observation des caractères et leur usage pour la taxonomie.

L'auteur a voulu se cantonner aux espèces nord-américaines, mais la référence aux espèces voisines et aux synonymes l'amène, par l'étude des types, à fournir une documentation importante sur de nombreuses espèces extra-nord-américaines, ce qui donne à son livre une portée générale appréciable.

CHEMISCHE FARBREAKTIONEN VON PILZE, par A. MEIXNER, 286 p., 16 × 22 cm., 1975, ed. J. Cramer, FL-9490 Vaduz, Liechtenstein. DM 29.50.

The author offers a compilation of the color reactions to chemicals and to the air, as observed in the field and under the microscope, of the larger Ascomycetes and the Basidiomycetes. Thirty-six reactives are considered. The response of the fungi up to seven of these reactives is arranged in taxonomic tables. A special chapter concerns the oxydative reaction of the fungi to the air.

(continued on page 558)



PUCIOLA SPINOSA, A NEW DEMATIACEOUS HYPHOMYCETE  
FROM SOIL

M. de Bertoldi

*Istituto di Microbiologia Agraria, Università di Pisa, Centro  
di Studio per la Microbiologia del Suolo, CNR, Pisa, Italia.*

## ABSTRACT

*Puciola spinosa* n. gen. n. sp., a new dematiaceous hyphomycete, originating from sandy soil in Italy is described. Its most distinctive features are the needle-shaped erect conidiophores and its peculiar conidiogenous cells which on aging become conidiophores supporting conidia only on new lateral conidiogenous cells.

This new dematiaceous hyphomycete has been isolated, in one sample, from soil originating from sandy bank of the river Arno near Pisa, Italy, by plating soil suspension on Mycological agar (Difco) and keeping the plates for two weeks at 26° C.

This fungus appears to be unusual in its features and particularly in its conidiophores and conidiogenous cells. None of the dematiaceous hyphomycetes seem to have similar characters.

## DESCRIPTION

*Puciola* gen. nov.

Hyphomycetes, dematiaceae. Hyphae hyalinae, septatae, ramosae. Conidiophora macronemata, brunnea, dichotoma, aliquando cum medio ramo, recta, erecta, acicularia. Cellulae conidiogenae breves, cylindricae, sub-inflatae, brunnae, gignentes acropleurogena conidia. Post maturitatem, conidia excidunt et conidiogenae cellulae longior et aciculariae fiunt sicut conidiophora sunt. Conidia iam non producuntur directe ex eo, sed ex novis lateralibus conidiogenis cellulis. Conidia holoblastica, singula, acropleurogena, unicellularia, ovoidea, pallide brunnea.

Species typica: *P. spinosa* spec. nov.

*Puciola spinosa* spec. nov. (Fig. 1 & 2)

Colonies lente crescentes, 2.1 cm diam. quattuordecim diebus, 26° C., fuscobrunnae vel nigrescentes, copiose sporulantes. Hyphae hyalinae, septatae, 1.0-1.5  $\mu$  in diam., tenuitunicatae. Conidiophora macronemata, brunnea, dichotoma, saepe cum medio ramo, recta, erecta, acicularia. Cellulae conidiogenae breves, cylindricae, sub-inflatae, brunnae, gignentis acropleurogena conidia. Post maturitatem conidia excidunt et conidiogenae cellulae longior et aciculariae fiunt sicut conidiophora sunt. Conidia iam non producuntur directe ex eis sed ex novis lateralibus conidiogenis cellulis. Conidia holoblastica, singula, unicellularia, ovoidea, pallide brunnea, attenuata ad basile septum, levia, 3.0-3.3x4.5-6.0  $\mu$ . Chlamydospora in substrata non formata. Habitat in arenoso humo.

Colonies slow growing, 2.1 cm diam. in 14 days at 26° C. on 2% malt agar, dark brown to black with a whitish margin, flattened, partially immersed. Hyphae hyaline, septate, regular, thin walled, narrow, 1.0-1.5  $\mu$  diam. Conidiophores macronematous, up to 150  $\mu$  long, 2.2-3.0  $\mu$  diam., brown, septate, laterally beared by vegetative hyphae, emergent, dicotomously branched and often with a central elongation, straight, needle-shaped, bearing lateral conidiogenous cells. Conidiogenous cells cylindrical, short and slightly swollen in the middle, brown, bearing apically and laterally conidia. At maturity conidia fall and then the conidiogenous cell elongates becoming needle-shaped like conidiophores; conidia are no longer produced directly on it but on new lateral conidiogenous cells. Conidia holoblastic, numerous, borne singly and acropleurogenously, unicellular, light-brown, smooth, dry, caducous, oval with a little basal denticle and truncate at the attachment point, 3.0-3.3x4.5-6.0  $\mu$ . No chlamydospores or perfect state observed.

Habitat in sandy soil, Pisa, Italy. Culture in Istituto di Microbiologia Agraria, Pisa, Italy (n°555) and in CBS, Baarn.

## DISCUSSION

The new genus *Puciola* is distinguished from other genera by the following features: (1) needle-shaped brown conidiophores dicotomously branched, often presenting a central elongation; (2) lateral cylindrical conidiogenous cells bearing acropleurogenously light brown conidia; (3) elongation of conidiogenous cells when conidia are fallen, becoming new conidiophores; (4) conidiogenous cells are never geniculate or with zig-zag form and do not present denticles but only small

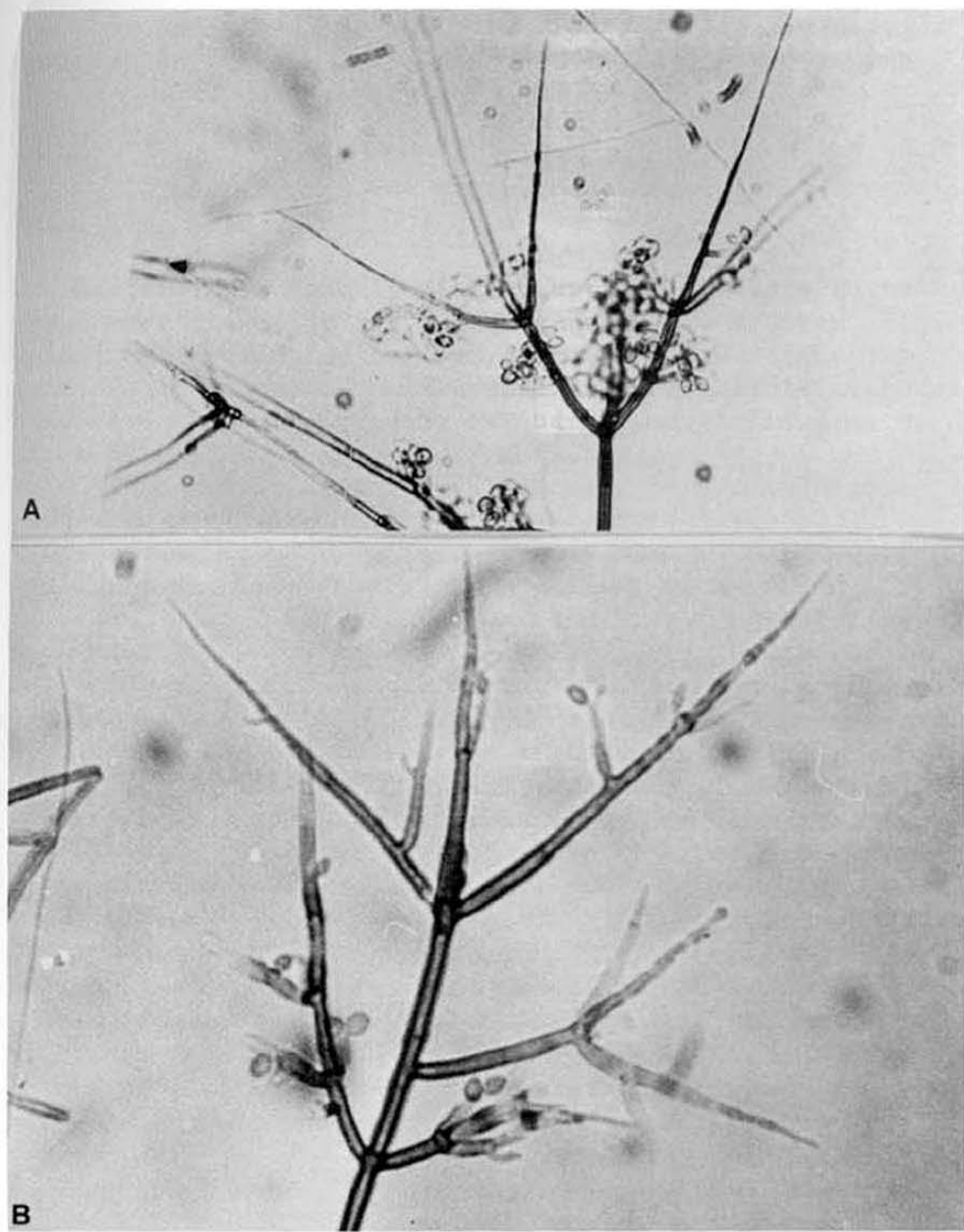


Fig. 1. *Puciola spinosa*. Conidiophores, conidiogenous cells and conidia in a young (A) and older culture (B); A x900, B x1400.

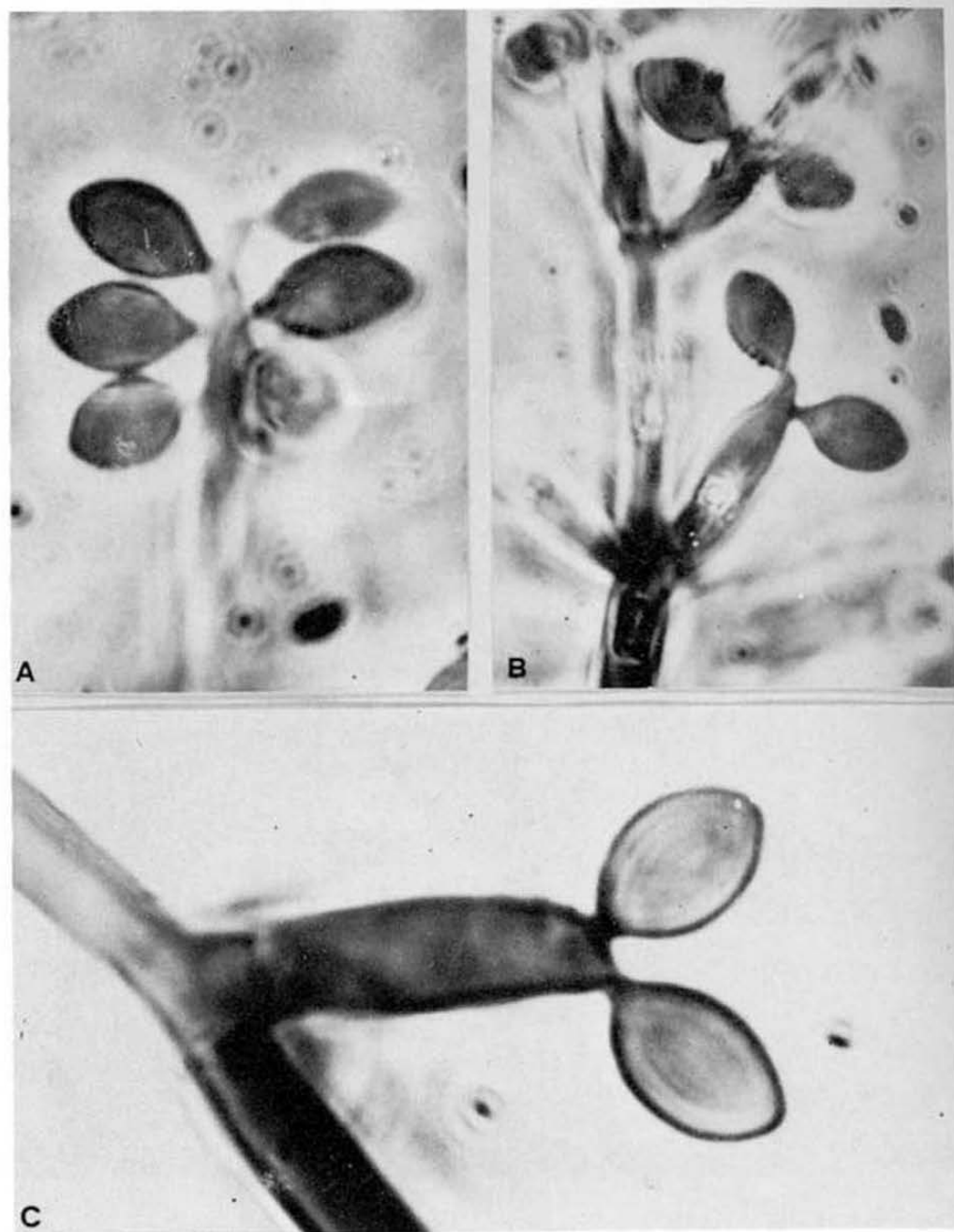


Fig. 2. *Puciola spinosa*. Conidiogenous cells and conidial development; A x3500, B x2500, C x4500.

scars; (5) the caducity of conidia.

Considering the above reported features this new genus is clearly different from the following similar genera: *Tritirachium* Limber, *Acrodontium* de Hoog, *Beauveria* Vuill (de Hoog, 1972), *Heimiadora* Nicot & Parguey (Nicot & Parguey, 1960; Benjamin, 1963), *Rhinochadiella* Nann. (Schol-Schwarz, 1968), *Geniculisporium* Chesters & Greenhalgh (Barron, 1968) and *Lomentospora* Hennebert & Desai (Hennebert & Desai, 1974).

The species here described recalls the conidial state of *Ascotricha erinacea* Zambett. The author who described that species referred its conidial state to *Myxotrichella* Sacc. (Zambettakis, 1955) a genus in which conidiogenesis is not well defined and, in any case, different from *Puciola*.

In a revision of the genus *Ascotricha* Hawksworth (1971) reports that the conidial state of *A. erinacea*, like that of *A. chartarum*, has to be referred to the genus *Dicyma* Boul.

We think that the genus *Puciola* has to be considered different from the two genera above mentioned.

#### BIBLIOGRAPHY

- Barron, G.L. (1968). The genera of Hyphomycetes from soil. *The Williams & Wilkins Co., Baltimore.*
- Benjamin, R.K. (1963). Addenda to "The Merosporangiferous Mucorales" II. *Aliso* 5, 273-288.
- De Hoog, G.S. (1972). The genera *Beauveria*, *Isaria*, *Tritirachium* and *Acrodontium* Gen. Nov. *Studies in Mycology, Baarn*, 1, 41 p.
- Hawksworth, D.L. (1971). A revision of the genus *Ascotricha* Berk. *Commonwealth Mycological Institute, Kew, Mycological Papers No. 126.*
- Hennebert, G.L. & Desai, B.G. (1974). *Lomentospora prolificans*, a new hyphomycete from greenhouse soil. *Mycotaxon*, 1, 45-50.
- Nicot, J. & Parguey, A. (1960). Une moisissure nouvelle du sol en Extrême-orient: *Heimiadora verticillata* nov. gen., nov. sp. *Ann. Sci. Nat. Botan. Sér. 12*, 1, 365-385.
- Schol-Schwarz, M.B. (1968). *Rhinochadiella*, its synonym *Fonsecaea* and its relation to *Phialophora*. *Ant. van Leeuwenhoek*, 34, 119-152.
- Zambettakis, C. (1955). Un nouveau Champignon papyricole. *Bull. Soc. Bot. Fr.*, 102, 219-225.

## BOOK REVIEWS (continued from page 552)

The author's wishes are to provide the amateur with what is hopefully to become a reliable tool (but still now to use with caution) for a rapid identification of the mushrooms, and to point out the need of more comparative and extended studies of these color reactions to serve field taxonomy. Certainly this interesting book will fulfill the author's wishes.

THE ENDOGONACEAE IN THE PACIFIC NORTHWEST, par J. W. GERDEMANN et James M. TRAPPE, 4 + 76 p., 28 figs. photo-gr. bl.-n. Mycologia Memoirs, No. 5, Juillet 1974. The Mycological Society of America, c/o The New York Botanical Garden, Bronx, NY 10458. \$4.50 (USA), 5.50 (Foreign).

Après vingt années de recherche sur les Endogonacées, les auteurs nous présentent ce livre comme une synthèse des connaissances actuelles qu'ils ont acquises. Ils y distinguent sept genres. *Endogone* est le seul sexuellement différencié. *Gigaspora* et *Acaulospora*, deux nouveaux genres, produisent des "azygospores," cellules ressemblant aux zygospores, mais dont les suspenseurs, s'il en est, n'ont pas les caractères de gamétanges. S'ajoutent encore trois autres genres imparfaits, *Modicella* produisant des sporanges, *Glomus* des sclérocystes et *Glaziella* des chlamydo-spores. En revêtant aussi bon nombre d'espèces de ces genres, observées ailleurs que dans le Nord-Ouest-Pacifique, les auteurs ont largement contribué à la monographie de cette famille des Mucorales. Onze espèces et vingt combinaisons sont nouvelles.

CBS COURSE OF MYCOLOGY, par W. GAMS, H. A. VAN DER AA, A. S. VAN DER PLAATS-NITERINK, R. A. SAMSON et J. A. STALPERS, 105 p., 73 fig., 16 x 24 cm. broché. Centraalbureau voor Schimmelcultures, Baarn, Pays-Bas, 1975. [In English.] Hfl. 15.- (NL), 20.- (Foreign).

Ce texte du cours introductif de mycologie systématique donné annuellement au C.B.S., Baarn, est constitué de 2 parties. La première est un résumé des principales méthodes d'isolement et de culture des champignons. La seconde, un exposé taxonomique des classes, ordres et familles des champignons, avec référence aux genres faisant l'objet de démonstration. Cette partie est introduite par un bref résumé des principes de nomenclature et se termine par une longue liste de références bibliographiques groupées par matière.

Notons deux points intéressants: la présentation de la Classe des Endomycètes, telle que la conçoit actuellement le Prof. J. A. von Arx, avec entre autres l'ordre des Endomycetales groupant les familles des Endomycetaceae (*Endomyces*,

(continued on page 564)



# MYCOTAXON

Vol. III, No. 3, pp. 559-563

April-June 1976

## NOTES ON HYPHOMYCETES. IX. A NEW SPECIES OF *CURVULARIA*.

G. Morgan-Jones and G. W. Karr, Jr.

Department of Botany and Microbiology  
Auburn University Agricultural Experiment Station  
Auburn, Alabama 36830, U.S.A.

### ABSTRACT

*Curvularia gudauskasii* Morgan-Jones and Karr, a new species, is described and illustrated. It is compared with *C. trifolii* (Kauffm.) Boedijn.

### INTRODUCTION

A survey of microfungi occurring on varieties of corn grown for virus resistance testing at a substation of the Auburn University Agricultural Experiment Station System yielded a hitherto undescribed species of *Curvularia* Boedijn. Examinations of many collections of the morphologically similar *Curvularia trifolii* housed at the Commonwealth Mycological Institute, Kew, England, resulted in the discovery of another specimen of the organism found growing on leaves of *Cyanostrum johnstoni* in Tanzania. It can easily be distinguished from related species by conidium shape and dimensions, relative size of conidial cells and by hilum characteristics. It most closely resembles *C. trifolii*.

### TAXONOMIC PART

*Curvularia gudauskasii* sp. nov (Figs. 1 and 3 E-K).

Coloniae effusae, grisea-brunneae, pilosae. Mycelium in substrato immersum, ex hyphis ramosis, septatis, pallide brunneis, levibus, 2.5-6µm crassis compositum. Conidiophora solitaria vel fasciculata, recta vel flexuosa, septata, brunnea, laevia, 62-98µm longa, 5-6µm crassa. Conidia acropleurogena, solitaria, elliptica, curvata, laevia vel verruculosa, 4-septata, brunnea, cellulis extimis pallidoribus, 27-29µm longa, 15-19µm crassa, hilo protudenti praedita.

In foliis vivis *Zea mays* L., Camp Hill, Tallapoosa Co., Alabama VII 1975, G. W. Karr, Jr., BPI, holotypus.

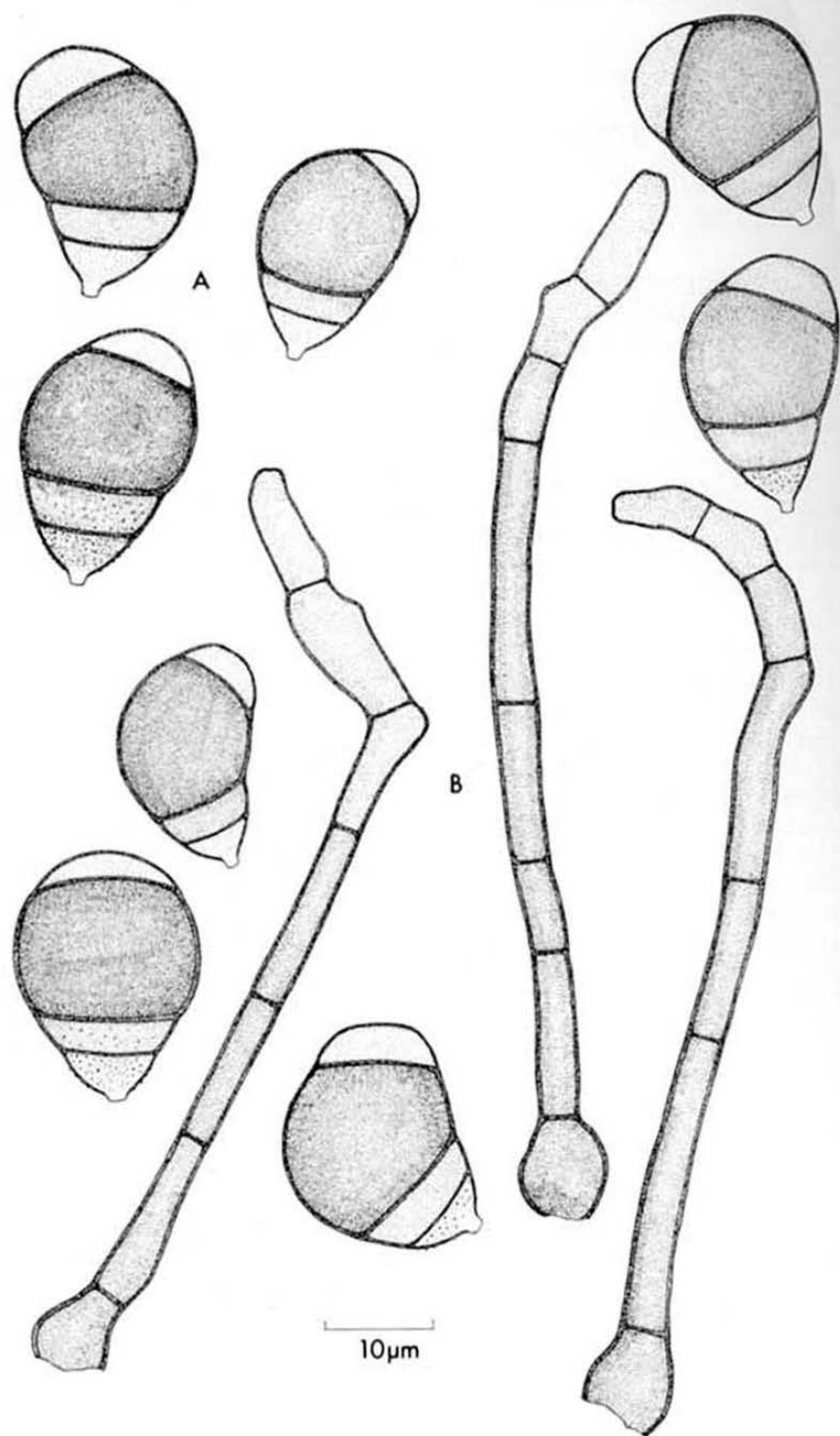


FIGURE 1. *Curvularia gudauskasii*. A, Conidia; B, conidiophores.

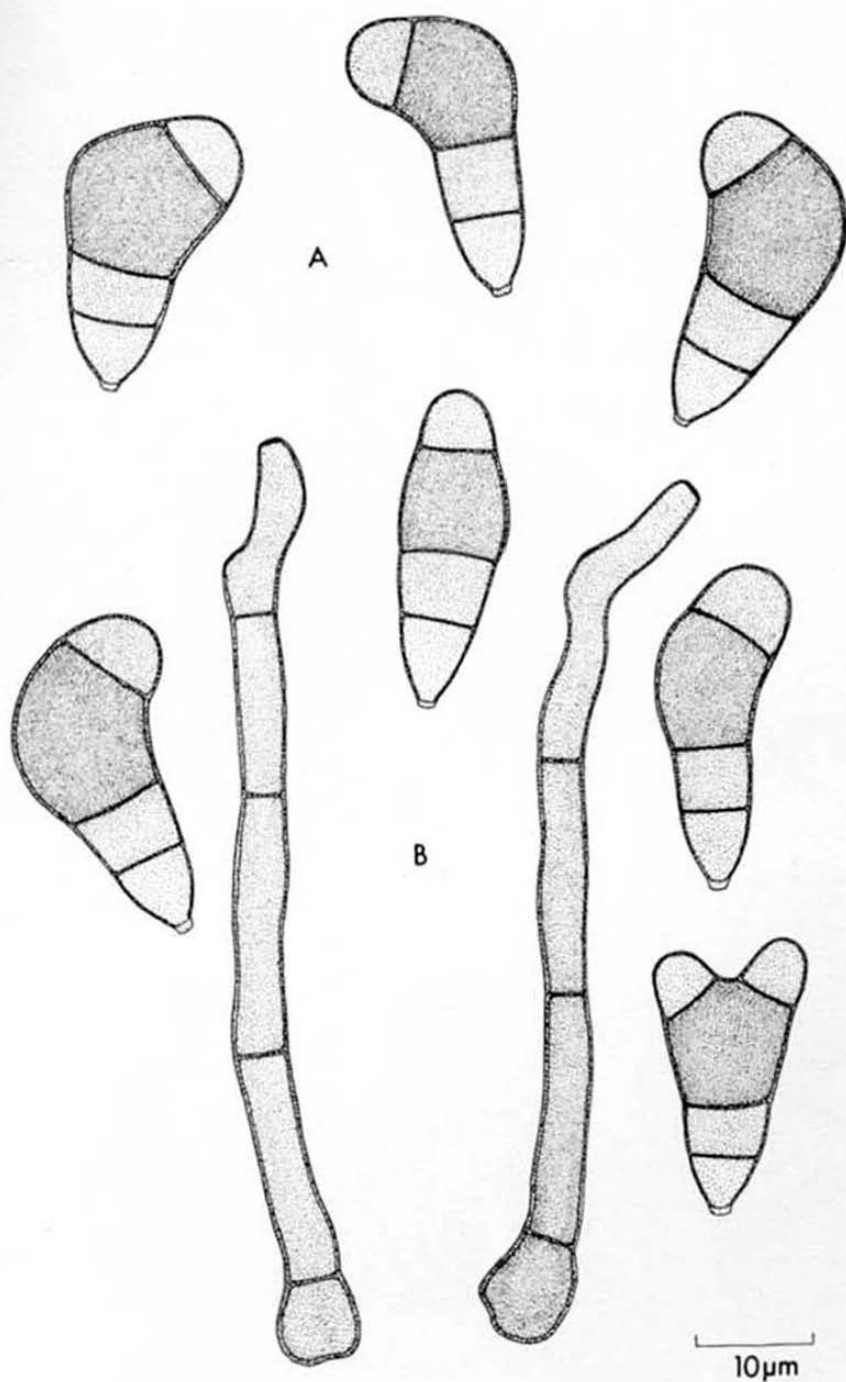


FIGURE 2. *Curvularia trifolii*. A, Conidia; B, conidiophores.

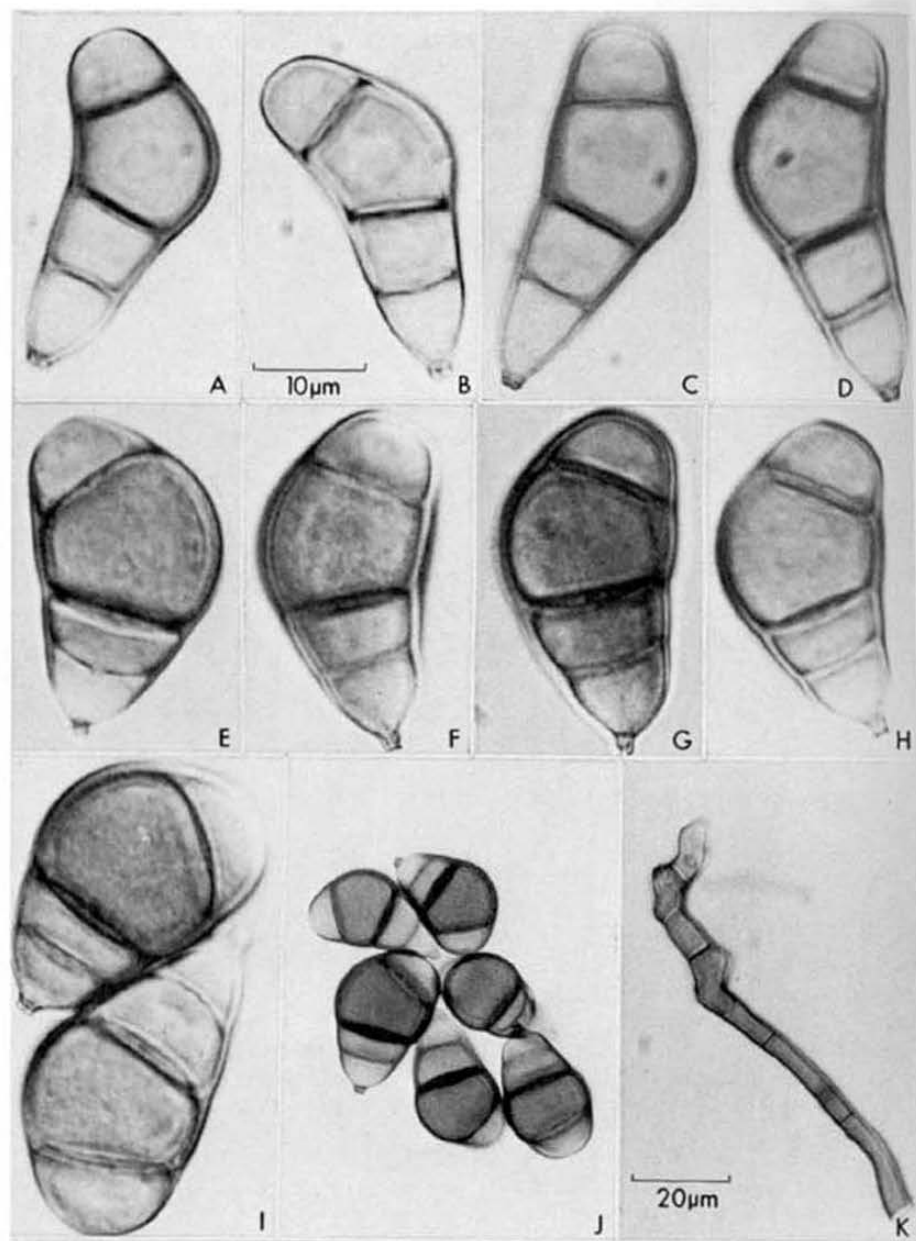


FIGURE 3. *Curvularia trifolii*. A-D, conidia; *Curvularia gudauskasii*. E-J, conidia; K, conidiophore.

The new taxon is named in honour of our colleague, plant pathologist Dr. Robert T. Gudauskas, whose work on corn diseases led to its discovery.

Colonies effuse, grayish-brown, hairy. Mycelium immersed in the substratum, composed of branched, septate, smooth, pale brown hyphae, 2.5-6 $\mu$ m wide. Conidiophores macronematous, mononematous, sometimes somewhat fasciculate, erect, simple, straight or flexuous, cylindrical, slightly nodose distally, septate, brown, paler towards the apex, smooth, 62-98 X 5-6 $\mu$ m, up to 9 $\mu$ m wide at a bulbous base. Conidiogenous cells monotretic or polytretic, integrated, terminal and intercalary, sympodial, cylindrical. Conidia acropleurogenous, solitary, simple, broadly ellipsoidal to obovoid, curved, 4-septate, smooth-walled or with the walls of the lower two cells, especially the basal, minutely verruculose, brown, central cell darker and much larger than the end cells, apical cell frequently distinctly flattened at the top, basal hilum protuberant, up to 2 $\mu$ m long, 27-29 X 15-19 $\mu$ m.

On leaves of *Cyanastrum johnstoni* Baker and *Zea mays*; Africa and North America.

Specimens examined: (1) on *Zea mays*, Auburn University Agricultural Experiment Station, Piedmont Substation, Camp Hill, Tallapoosa County, Alabama, July 1975, G. W. Karr, Jr., BPI, AUA, type; (2) on *Cyanastrum johnstoni*, Mkenke, Kigoma, Tanzania, December 3, 1964, K. A. Pirozynski, IMI 107045, AUA.

#### DISCUSSION

A number of features serve to distinguish *C. gudauskasii* from *C. trifolii*. The conidia of the former are substantially broader and have, therefore, a significantly different shape, their central cell is much longer relative to the four end cells and the basal hilum is somewhat more prominent. We have examined the type collection of *C. trifolii* (Figs. 2 and 3 A-D); on *Trifolium repens*, Takoma Park, Montgomery County, Maryland, June-July 1919, C. H. Kauffman, MICH. The conidia of this species measure 23-30 X 8.5-14 $\mu$ m. Additional distinguishing features of *C. gudauskasii* are the flattened conidium apex and the verruculose nature of part of the conidium wall particularly that surrounding the basal cell.

#### ACKNOWLEDGEMENT

We thank Dr. M. B. Ellis, Commonwealth Mycological Institute, Kew, England, for allowing one of us (G.M-J) free access to the *Curvularia* collections housed in that institution.

## BOOK REVIEWS (continued from page 558)

*Dipodascus*), Ascoideaceae (*Ascoidea*), Saccharomycodaceae (*Saccharomycodes*, *Hanseniaspora*) et Saccharomycetaceae (*Saccharomyces*, *Hansenula*) (von Arx, 1976, Pilzkunde, 2d ed.). Aussi une intéressante comparaison des concepts de conidio-genèse de Kendrick (1971) et de von Arx (1974).



# MYCOTAXON

Vol. III, No. 3, pp. 565-569

April-June 1976

## ACAULOSPORA TRAPPEI SP. NOV.

ROBERT N. AMES

Department of Botany and Plant Pathology  
Oregon State University, Corvallis, Oregon 97331

AND

ROBERT G. LINDERMAN

USDA/ARS, Ornamental Plants Research Laboratory,  
Oregon State University, Corvallis, Oregon 97331

*Acaulospora trappei* is a new species of vesicular-arbuscular (VA) mycorrhizal fungus isolated from Easter lily fields in the Pacific Northwest. The epithet honors James M. Trappe for his contributions to mycorrhiza research.

The genus *Acaulospora*, as erected by Gerdemann and Trappe (1974), is distinguished from other Endogonaceae by the production of sessile azygospores budded below a terminal vesicle, which empties as the spore matures. The two species *A. elegans* Trappe & Gerd. and *A. laevis* Gerd. & Trappe have pigmented spores and produce lobed vesicles as part of the mycorrhizal association. *A. trappei*, as described herein, differs from those two species by having smaller, nonpigmented spores; by lacking, fine, emergent, branched hyphae below the spore attachment; and by forming round to irregular but not lobed vesicles within host cells of VA roots. Trappe (personal communication) has stated that still other *Acaulospora* spp. have been found and will soon be described.

Spores were collected by mixing 100 cc of soil in 1000 ml water, allowing one minute settling time, and decanting the solution through a series of screens. Contents of the lowest mesh screen (45-63  $\mu$ m) were washed and suspended in water, and individual spores were collected with a pipetting device under a dissecting microscope (32X). Spores

were mounted in distilled water for observation under a compound light microscope.

Mycorrhizae were examined by a modification of the technique of Phillips and Hayman (1970). Roots were cleared in 10% KOH at 55° C for 12 to 15 hours, washed twice in distilled water, acidified in dilute HCl (5.6 ml conc. HCl in 100 ml distilled water) for one hour, stained in 0.05% trypan blue in lactophenol at 55° C for 15 minutes, destained in clear lactophenol, and mounted in clear lactophenol for microscopic examination. This modification prevented air-bubble formation in the roots.

ACAULOSPORA TRAPPEI Ames & Linderman sp. nov. (see Figs. 1 and 2).

DESCRIPTION: Sporocarpia ignota. Sporae singulae in solo aut radicibus efformatae, sessiles, gestae lateraliter in cellula inramosa hyphali in vesiculo 50-82 X 42-72  $\mu$ m prope terminatae. Sporae minute scabridae, 42-99 X 42-70  $\mu$ m, globosae, ellipsoideae vel obovoideae, incolores; tunica ut vedetur singula, 1.2-2.3  $\mu$ m crassa vel 3-4  $\mu$ m crassa prope colligationem. Vesiculae intra mycorrhizas vesiculares-arbusculares inlobatae.

Sporocarps unknown. Spores formed singly in soil or occasionally within roots, sessile, borne laterally on a smooth, unbranched hyphal cell that terminates nearby in a subglobose to ellipsoid or obovoid vesicle 50-82 X 42-72  $\mu$ m diam.; vesicles develop to full size before spore formation, with colorless oily contents that are transferred to the budding spore; the emptied vesicle often does not collapse. Spores are minutely roughened, 42-99 X 42-70  $\mu$ m globose to ellipsoid or obovoid, colorless, containing rounded to polyhedral oil globules; wall apparently single, 1.2-2.3  $\mu$ m thick, except sometimes thickened to 3-4  $\mu$ m near attachment. Vesicles within VA mycorrhizae are not lobed.

DISTRIBUTION, HABITAT, AND SEASON: To date, *A. trappei* is known only from Easter lily fields along southern Oregon and northern California coastal areas. Spores can be sieved from soil throughout the year. Spores are formed abundantly in potted plant cultures after 4 months.

MYCORRHIZAL ASSOCIATIONS: *A. trappei* forms VA mycorrhizae with very finely branched arbuscules and unlobed vesicles. It is associated in field collections with roots

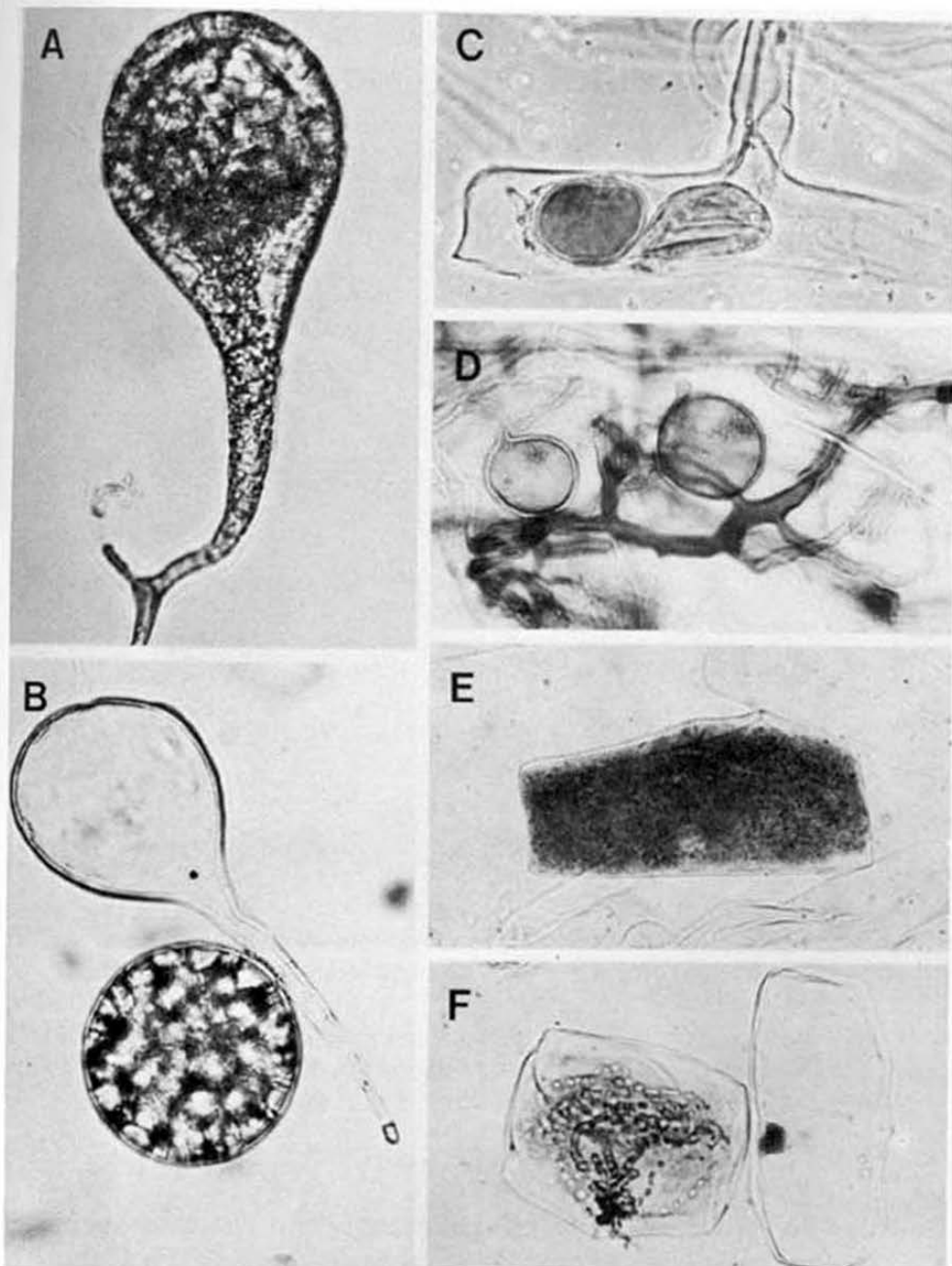


Fig. 1. (A-B) Fresh specimens mounted in water, X 500. (A) Immature vesicle before spore formation. (B) Mature spore with attached empty vesicle. (C-F) Squashed preparation of cleared and stained Easter lily roots in clear lactophenol, X 250. (C) Mature spore with attached vesicle in root-hair cell. (D) Vesicles. (E) Young arbuscule. (F) Partially digested arbuscule.

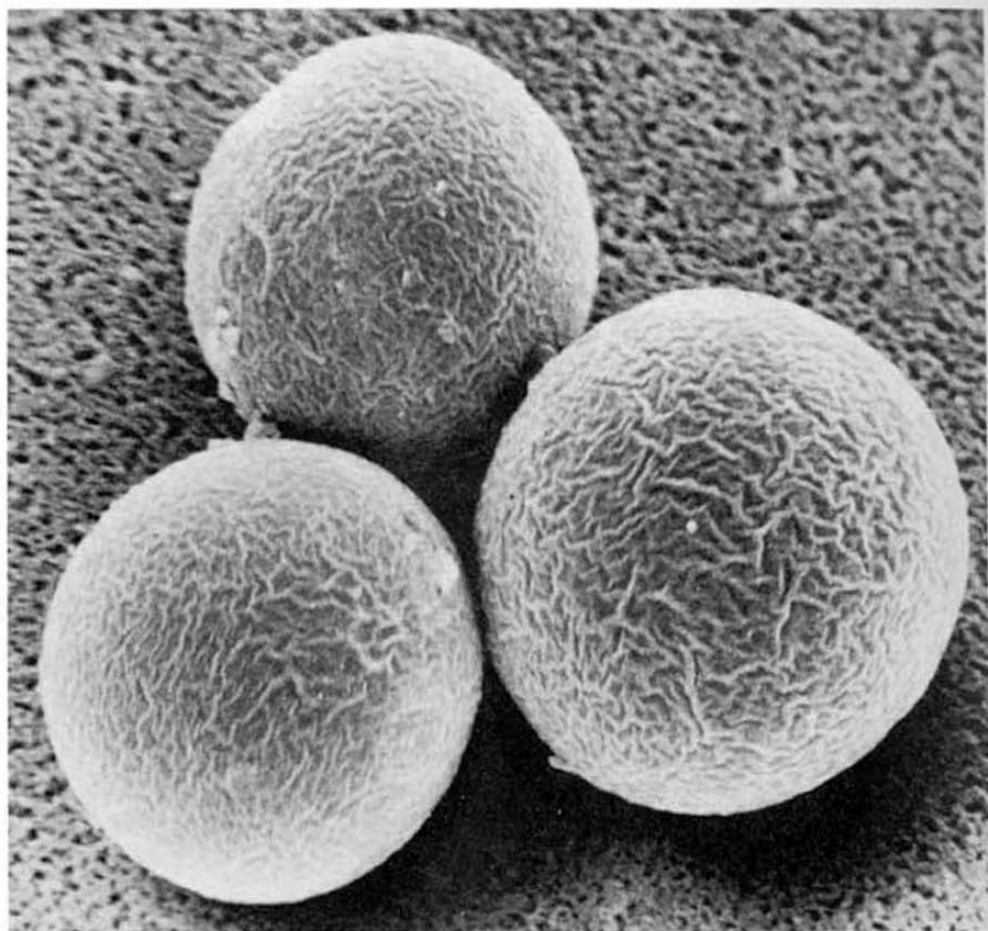


Fig. 2. Scan electron micrograph of *A. trappei* spores (X 700).

of Easter lily (*Lilium longiflorum* Thunb.) and it forms VA mycorrhizae in pot culture with Easter lily, red clover (*Trifolium pratense* L.), and onion (*Allium cepa* L.).

COLLECTIONS: Sieved soil, collected in April, 1975 from fields of *Lilium longiflorum*, was added to autoclaved sand in which seeds of *Trifolium pratense* were then planted. In September, 1975, newly formed spores were collected from the *T. pratense* pot cultures and used for the type and paratype specimens.

TYPE: OREGON, Curry Co., 4-8 km north of the Oregon-California boundary, at the Oregon Agricultural Experiment Field Station on U.S. Highway 101, near Harbor, Oregon; April, 1975, Ames #01 (OSC). PARATYPE: CALIFORNIA, Del Norte Co., 7.5 km south of the Oregon-California boundary on U.S. Highway 101, near Smith River, California; April, 1975, Ames #02 (OSC).

This study was supported in part by the Fred C. Gloeckner Foundation Inc.

The authors wish to thank Dr. James Trappe for the Latin description.

#### LITERATURE CITED

- Gerdemann, J. W. and Trappe, J. M. 1974. The Endogonaceae in the Pacific Northwest. *Mycologia Memoir* 5:1-76.
- Phillips, J. M. and Hayman, D. S. 1970. Improved procedures for clearing roots and staining parasitic and vesicular-arbuscular mycorrhizal fungi for rapid assessment of infection. *Trans. Brit. Mycol. Soc.* 55:158-161.

## INDEX TO FUNGOUS AND LICHEN TAXA

This index includes genera, infrageneric taxa, species, and infraspecific taxa. New taxa are in CAPITALS, and the pages where they are published are in *italics*; new suprageneric taxa are in *ITALIC CAPITALS*. The list of epithets on pp. 244-260 is not indexed here.

- Absidia 60; californica 61; cylindrospora 61, 71; spinosa 61, 341  
 Acaulospora 565; elegans 565; laevis 565; TRAPPEI 565, 566, 568  
 ACICULOCONIDIUM 401, 407; ACULEATUM 401, 404, 407  
 Acremonium 65, 342; alabamensis 65, 71; curvulum 65, 70, 71; strictum 65, 69  
 Acrodontium 557  
 Acrothecium robustum 341  
 Actinomucor elegans 341; repens 341, 343  
 Aecidium nitens 139, 140  
 [Agrotelium hyptidis, *lapsus*, 154]  
 Albugo 30  
 Aleurodiscus 489  
 Allescheria boydii 64  
 Alternaria 341; alternata 342; tenuis 342  
 Ampullifera 132  
 Angiopoma 377-379; campanulatum 377-379  
 Angiopsora 157  
 Anthostoma 328; grandineum 326  
 Antrodia heteromorpha 489, 491, 493, 535-537  
 Arcyria 305; cinerea 299, 304, 305; denudata 299; insignis 304; leiocarpa 304; nutans 305  
 Argomyces 154; parilis 154  
 Argotelium 153, 154; hyptidis 154  
 Arnium 387, 388; absimile 389  
 Arthrimum 73; arundinis 342; phaeospermum 65, 70  
 Arthrotrichys 162, 163; dactyloides 162; entomopaga 162, 163  
 Ascobolus 69; epimyces 64  
 Ascodesmis 69, 73, 391, 392, 395; CANINUS 391, 392-395; nigricans 64, 391; sphaerosporus 64  
 Ascotricha 557; chartarum 557; erinacea 557  
 Ascoidea 2  
 Aspergillus 72, 342, 420; alternatus 433; candidus 342; clavatus 342, 419; flavipes 65; flavus 342, 419; fumigatus 55, 65, 69, 71, 72, 342, 419; giganteus 419; glaucus 342; minutus 342; nidulans 419; niger 342, 414, 419, 465; ochraceus 342; quadrilineatus 342; sydowii 65; terreus 65, 342; ustus 342; wentii 342  
 Athelia coprophila 490, 495, 503  
 Auerswaldiella 325  
 Aureobasidium 397; pullulans 65, 343, 397  
 Auriscalpium 358; vulgare 358, 359  
 Bacidia marginalis 323  
 Badhamia affinis 300; gracilis 310; utricularis 310  
 Basidiobolus 46  
 Beauveria 557; bassiana 68, 69, 71, 342  
 Bispora 132  
 Boedijnopeziza 229  
 Boletus 261; sect Boletus 264; subsect Boleti 264; aereus 264; affinis 262, 272; amylosporus 273; BARROWSII 261, 262, 264, 272; bicolor 272; calopus 272; chrysen-teron 272; edulis 264, 272; erythropus 272; fragrans 272; luridus 262, 272; piperatus 272; porosporus 272; pulverulentus 272; rubripes 272; subglabripes 272; subtomentosus 272; subvelutipes 272; truncatus 272; vermiculosus 272  
 BOTRYANDROMYCES 193, 195, 198, 202; HETEROCERATIS 193, 195, 198, 200, 203; HETEROCERI 193, 196-198, 200, 203  
 Botryosphaeria 325  
 Bovista ochrotricha 275  
 Brevicegna declina 60, 61  
 BURENIA 1, 9, 10, 11, 30, 46, 47; CICUTA 11, 12, 47; INUNDATA 11, 12, 47  
 Byssochlamys 73; nivea 62, 70  
 Byssomerulius corium 488, 490, 494, 504, 505; sulphureus 490, 494, 504, 505  
 Caecoma callianthum 138, 139; divinum 138, 139; indicum 138, 139; interstitialis 139; nitens 139



- Calonema luteolum* 305, 306  
*Camarops grandinea* 326  
*Candelabrella* 163  
*Candida* 65, 401, 407  
*Carpophoromyces* 206  
*Catenulospora* 133, 134; *flacourtiiae* 133  
*Caularca* 170; *montana* 170, 171  
*Cephalosporiopsis* 65, 73  
*Cephalosporium* 342; *crotocinigenum* 416; *curtipes* 342  
*Ceratiomyxa fruticulosa* 299  
*Cercospora* 119, 120, 125; *apii* 120; ECUADORIANA 119, 120, 122, 125; *europaea* 119; *latens f europaea* 119, 120; *NODOSA* 119, 120, 122, 124, 125; *psoraleae* 119, 120, 122; *psoraleae-bituminosae* 119, 120, 122, 125  
*Cerotelium* 133, 134  
*Chaconia* 137, 138; *coaetanea* 137  
*Chaetomium* 60, 69; *cochlioides* 63; *funicolum* 63; *seminudum* 63; *spirale* 63; *subspirale* 63; *torulosum* 63  
*Chloridium chlamydosporis* 65  
*Chloroscypha* 165, 168, 171, 229, 230; *sabinae* 167, 169  
*Chroodiscus* 175  
*Chrysocelis* 137, 138; *coaetaneum* 138  
*Chrysomyxa* 134, 136; *simplex* 134  
*Chrysosporium keratinophilum* 64, 70, 71, 75; *pruinum* 343  
*Ciboria acerina* 223  
*Circinella* 60, 61  
*Cladochytrium helocharidis* 30; *menyanthis* 31  
*Cladosporium* 342; *cladosporioides* 65, 70, 71, 342; *herbarum* 65, 70  
*Clavaria farinosa* 240  
*Clavicornia* 358; *dryophila* 358; *pyxidata* 358  
*Cleistothelobolus* 388  
*Clitocybe illudens* 363, 368, 369  
*Cochliobolus sativus* 342  
*Coccospora aurantiaca* 33  
*Coelopuccinia* 134, 136; *simplex* 134; *sinensis* 136  
*Coelopucciniella* 134, 136; *idei* 134, 136; *simplex* 134-136  
*Coleosporium* 154, 155; *campanulae* 136, 137, 154; *melampyri* 137; *rhinanthacearum* 137  
*Colloderma* 297, 298, 307, 316; *oculatum* 307; *robustum* 307, 308, 316  
*Colus schellenbergiae* 373, 374  
*Comatricha* 309, 315; *elegans* 308; *longa* 300; *pulchella* 300; *subcaespitosa* 309; *tenerrima* 309; *typhoides* 300  
*Coniochaeta* 63, 69, 74; *eremophila* 489, 490, 494, 501, 502  
*Coniothyrium* 68, 342; *fuckelii* 68, 70  
*Conoplea olivacea* 189  
*Conotrema* 234; *harmandii* 236; *urceolatum* 236  
*Cookeina* 229  
*Coprotus* 69, 73; *niveus* 64, 70  
*Cordana* 73; *pauciseptata* 68  
*Corticium bombycinum* 510; *coprophilum* 503; *tuberculatum* 521  
*Cortinarius* 95; *sect Dermocybe* 95-97; *cinnamomeus* 97; *clelandii* 95-100; *huronensis* 97; *incognitus* 97; *subcinnamomeus* 95, 96; *tubarius* 95, 97  
*Costantinella terrestris* 343  
*Craterium aureum* 310; *leucocephalum* 300  
*Cribraria argillacea* 303; *violacea* 304  
*Cunninghamella* 60, 72; *elegans* 61; *verticillata* 342  
*Curvularia* 559, 563; *GUDAUSKASII* 559, 560, 562, 563; *trifolii* 559, 561, 563  
*Cyathicula* 324  
*Cylindrocarpon* 65; *destructans* 65  
*Cylindrosporium* 120  
*Cyttaria* 229, 230  
  
*Dacrymyces minor* 490, 491, 496, 497, 499, 501  
*Dactylaria* 68  
*Dermatea laricicola* 168  
*Dermea* 165, 168, 171; *cerasi* 189  
*Desmotelium* 137, 138  
*Diatrype grandinea* 326, 328  
*Dichotomyces* 73; *cejpii* 62, 70  
*Dicoccum asperum* 342  
*Dictydium cancellatum* 299  
*Dicyma* 557  
*Didyma crustaceum* 315; *effusum* 300; *hemisphaericum* 300; *niveum* 315; *spumarioides* 315; *testaceum* 315  
*Didymium anellus* 315; *clavus* 300; *difforme* 316; *iridis* 316; *minus* 316; *nigripes* 300; *squamulosum* 300  
*Didymosphaeria* 328, 329; *igniaria* 65  
*Diheterospora chlamydosporia* 64, 69, 71, 75  
*Diplodia* 342

- Diplogelasinospora 69, 73, 74; princeps 63  
 Discosia 342  
 Ditiola radicata 188  
 Doassansia alismatis 31; comari 29, 31; limosellae 31; martianoffiana 31; sagittariae 28, 33  
 Doratomyces microsporus 64  
 Dothidea asteroma 189, 190; vaccini 190  
 Drechslera 342, 377-379; CAMPANULATA 379; verticillata 378  
 Echinostelium 297, 298, 304; minutum 304, 307  
 Ecteinomyces pusillimus 204, 205; trichopterophilus 205  
 Elateraecium 138, 139; divinum 138, 139; salicicola 138, 139  
 Eleutherascus 73, 395; lectardii 63, 70, 71  
 Endogone 31  
 Entyloma australe 32; calendulae 28; chrysosplenii 28; eryngii 29; fergussonii 30; ficariae 30; microsporus 31; ranunculi 31  
 Eoterfezia 387, 388; parasitica 387, 389, 390; PERLUCIDA 387, 388, 389  
 Eriosphaeria raripila 414, 422  
 Eupenicillium 62, 69; levitum 62  
 Euphoriomyces 206  
 Eurotium 69; chevalieri 62; var intermedium 62, 70, 71; rubrum 62  
 Eustegia ilici 189; robertiani 189  
 Eusynaptomyces 194  
 Evernia 346; americana 347  
 EVERNIASTRUM 345-347; AFRICANUM 345, 346, 351; AMERICANUM 347, 351; ARSENEI 347, 350; CATAWBIENSE 347, 350; CIRRHATUM 345-347, 349, 351; COLUMBIENSE 347, 350; ECUADORIENSE 347, 350; FISTULATUM 347, 350; IMITATUM 348, 351; LI-MAEFORME 347, 350; LIPIDIFERUM 348, 351; MORELIENSE 348, 351; NEOCIRRHATUM 348, 350; NEPALENSE 346, 348-350; NIGROCILIATUM 348, 351; PACHYDERMUM 348, 351; PERUVIANUM 345, 348, 350, 351; PSEUDONEPALENSE 349, 350; SOROCHAILUM 346, 349, 350; SUBNEPALENSE 345, 349-351; VEXANS 346, 347, 350  
 Excipula punctiformis 189  
 Exidiopsis calcea 490, 492, 496-498; leucophaea 489, 490, 492, 497, 498  
 Fomes badius 531  
 Frommea 155; obtusa 155-157  
 Fuckelia grandinea 326  
 Fuckelina 414; albipes 423, 425; socia 414, 422, 423, 425  
 Fuligo cinerea 310; septica 300  
 Funalia gallica 491, 493, 544, 545  
 Fusarium 70, 73, 342; caudatum 342; concolor 416; equiseti 342, 416; moniliforme 65, 70, 342; nivale 342, 416; oxysporum 55, 66, 69, 71, 342; roseum 342; scirpi 416; solani 66, 71, 73, 342; tricinctum 342, 416  
 Fuscoboletinus 262; aeruginascens 272  
 Ganoderma lucidum 490, 492, 525, 526  
 Gelasinospora 69, 74; cerealis 63, 70  
 GELATINODISCACEAE 231  
 Gelatinodiscus 210-214, 219, 229-231; flavidus 209, 210, 213, 214, 216, 219, 220, 222, 224, 226  
 Geniculisporium 73, 557; serpens 55, 68, 69, 71  
 Geotrichum 406, 407  
 Gibberella zeae 416  
 Gliobotrys 414; albiviridis 342, 414, 423, 425  
 Glioccephalotrichum ohioense 66  
 Gliocladium deliquescens 66, 70; roseum 66, 69-71, 73, 342; virens 66  
 Gliomastix murorum var felina 66, 70  
 Gloiodon 358; strigosum 358, 360, 361  
 Gloniella 87; curtisii 86  
 Glonium 87; chlorinum 86; curtisii 82, 83, 86; cyrillae 86, 87; gigasporum 86; macrosporium 86  
 Gnomonia 63  
 Gongronella 60; butleri 61  
 Gonytrichum macrocladium 66  
 Guignardia 325  
 Gymnoconia 139, 140; hyptidis 154; interstitialis 139, 140; nitens 139; peckiana 139  
 Gymnosporangium 136, 140; biseptatum 135, 136; ellisii 135, 136; fuscum 140, 141, juniperi 140, 141; sabinae 140, 141  
 Gyroporus 262; castaneus 272  
 Hamigera 62, 73; avellanea 62  
 Hapalophragmiopsis 141, 142  
 Hapalophragmium 141; derridis 141;

- millettiae 141, 142; mysorense 141; ornatum 141; ponderosum 141; pulchrum 142; setulosum 141  
 Haplographium 465; echinatum 464; musae 471  
 Heimiodora 557  
 Helminthosporium 342; anomalum 342; sativum 342  
 Helotiopsis 319, 323, 324; ANONYMA 319, 321-323; apicalis 319, 321-323; JENKINSII 319-321-323; marginalis 323  
 Hemitrichia 305; calyculata 306; karstenii 305, 306; serpula 299  
 Henningsomyces candidus 490, 493, 523, 524  
 Hericium 358; erinaceum 358  
 Heteroconium 130, 132; citharexii 132  
 Hiratsukamyces 139  
 Hormiscium 342  
 Hormodendrum cladosporioides 342; pallidum 342  
 Humicola 109, 111, 113-117; allopassonella 111, 112, 117; brunnea 111, 112, 117; var africana 111, 112, 117; fuscoatra 111, 112, 117; grisea 111; var thermoidea 64, 71; parvispora 111, 112, 115, 117  
 Hyalopora polypodii 30  
 [Hyalospora polypodii, lapsus, 30]  
 Hyalostachybotrys 414, 431, 433; bisbyi 430, 431; sacchari 430, 431  
 Hydnum chrysorhizon 521; erinaceum 358  
 Hymenochaete arida 491, 494, 525, 527; rubiginosa 491, 494, 528, 529  
 Hyphoderma 490, 496, 507, 508, 514; amoenum 490, 496, 506, 507  
 Hyphodontia quercina 490, 494, 508, 509  
 Hypochnicium 513; analogum 513; bombycinum 490, 495, 510-513; geogenium 513; PROSOPIDIS 487, 490, 496, 511, 512, 513; punctulatum 513; sphaerosporum 513  
 Hypotrachyna 346  
 Hypoxylon 325; grandineum 325, 326, 328; serpens 167, 169  
 Hysterium 187; chlorinum 86, 87; curtisii 86, 87; cyrillae 86, 87; flexuosum 87; lineolatum 87; nova-caesariense 82, 84; pulicare 81  
 Hysteroglonium curtisii 86  
 Hysterographium 82; flexuosum 82; nova-caesariense 84; viticolum 87  
 Idriella lunata 342  
 Inonotus texanus 487, 488, 491, 492, 529, 530  
 Iodophanus 166; carneus 171  
 Kernkampella 142, 144, 146, 157; AP-PENDICULATA 142, 143; BREVISPORA 142; breyniae 142-144; breyniae-patensis 144, 157; COMBATORICA 143, 144; EMBLICAE 144, 145; KIRGANELLAE 144; PHYLLANTHI 145, 146  
 Kuehnia 133, 134, 136; malvicola 134  
 Kunkelia 139, 140; nitens 139  
 Laboulbenia 194; heteroceratis 193-195, 206, 208; partita 202  
 Lactarius 336; sect Plinthogali 331, 334, 336; gerardii 336; LOUISII 331, 332, 334, 336; xanthorheus 331, 336  
 Laeticorticium 489  
 Lambertella 166  
 Lamproderma acryrionema 309; echinulatum 309  
 Lasiobolidium 388  
 Leccinum 261; atrostipitatum 272; aurantiacum 272; brunneum 272; cinnamomeum 272; discolor 272; fallax 266, 272; incarnatum 272; insigne var brunneum 272; var insigne 272; f ochraceum 273; SUBALPINUM 261, 264, 266, 273; vulpinum 272  
 Lentiniella 358; cochleatus 358  
 Leocarpus fragilis 312  
 Lepiota 381; cupressea 381, 383; marginata 381, 384, 385  
 Leptostroma spiraeae var rubi 189, 190  
 Licea 316; minima 303, 307; pedicellata 299  
 Lichenopsis 233, 236; sphaeroboloides 233, 236  
 LOCULOHYPOXYLON 326, 328, 329; GRANDINEUM 326-328  
 Lomentospora 557  
 Lopharia crassa 491, 495, 545-547  
 Lophium 187; aggregatum 189, 190; sassafras 82, 83  
 Lycogala epidendrum 299

- Lycoperdon* 275, 282, 284, 286, 288, 290, 292, 293; *americanum* 290, 293, 294; *ashantiense* 291, 295; *atropurpureum* 284, 286, 293; *atrum* 276-278, 280, 282, 291-293, 295; *bispinosum* 291, 293, 295; *calvescens* 294; *candidum* 294; *cruciatum* 294; *decipiens* 293; *delicatum* 284, 286, 293; *echinatum* 290-294; *floccosum* 293; *foetidum* 290; *juvruense* 276, 278, 280, 282, 295; *mammiforme* 293; *marginatum* 290, 294; *mauryanum* 284, 286, 293; *MELANESICUM* 277, 278, 284, 287, 288, 292, 293, 295; *molle* 280, 290-293; *perlatus* 290; *pulcherrimum* 293; *pyriforme* 287, 288, 292, 293, 295; *SETIFERUM* 277, 278, 282, 284, 292, 293, 295; *umbrinoides* 291, 293, 295  
*LYLEA* 129, 130, 132; *CATENULATA* 129, 130, 131
- Macbrideola cornea* 309  
*Macrosporium* 342  
*Magnusiella umbelliferarum* 41  
*Malbranchea pulchella* var *sulfurea* 65, 71  
*Marasmius siccus* 491, 493, 547-549  
*Meionomyces* 206  
*Melanopsamma pomiformis* 414, 422, 423, 427, 429  
*Melanotaenium ari* 28; *endogenum* 29, 30  
*Melittosporium* 233, 236  
*Memnoniella* 409, 413-415, 419, 421-423, 468, 469, 472; *aterrima* 464, 468; *echinata* 409-411, 414, 415, 417, 418, 420, 423, 464, 466-469, 472-474; *levispora* 469; *subsimplis* 410, 411, 423, 468, 470-473; *zingiberis* 469  
*Memnonium sphaerospermum* 434  
*Merulius corium* 504; *sulphureus* 504  
*Metarrhizium anisopliae* 66, 69, 71, 420  
*Metatrichia vesparium* 299  
*Microeurotium* 388  
*Microsporion brachytomum* 398  
*Microstoma* 229  
*Misgomyces* 193-195, 202; *annae* 193, 194, 204; *clivinae* 194; *dyschirii* 194, 197, 202; *flexus* 193, 194, 204; *heteroceri* 193, 196; *perpendicularis* 194; *ptenidii* 193, 194, 204  
*Mixia* 8, 46; *osmundae* 46
- Mollisiella anonyma* 323; *apicalis* 322  
*Monadelphus subilludens* 363, 368  
*Monosporium apiospermum* 64  
*Morganella* 280, 287; *samoensis* 287; *velutina* 275  
*Mortierella* 55, 60, 70, 73, 342; *alpina* 61, 70; *isabellina* 61; *marburgensis* 61, 71; *minutissima* 61; *mutabilis* 61; *nana* 55, 60, 61, 71; *parvispora* 61; *ramanniana* 61; *vinacea* 61, 71; *zonata* 61, 70  
*Mucilago crustacea* 316  
*Mucor* 51, 59, 60; *circinelloides* 342; *corticulus* 61; *fragilis* 62, 70; *glomerula* 342; *griseo-cyanus* 62; *hiemalis* 55, 60, 62; *lausannensis* 342; *mucedo* 62; *racemosus* 62, 342  
*Mycoacia AUSTRAL-OCIDENTALE* 487, 490, 494, 513  
*Mycogone* 64, 70, 73  
*Mycothyridium* 329  
*Myrothecium* 209, 228; *roridum* 416; *verrucaria* 416  
*Mytilidion* 81, 82; *nova-caesariense* 84; *sassafras* 83  
*Mytilinidion* 81, 82  
*Myxotrichiella* 557
- Nectria* 73; *episphaeria* 63, 70  
*Neurospora crassa* 420  
*Nigredo fallens* 149, 150  
*Nodulisporium* 55, 68, 69, 73  
*Nothoravenelia* 146; *commiphorae* 146
- Ocellularia* 175, 233, 234, 236; *CARNEODISCA* 173, 174, 179; *chonestoma* 174; *dilatata* 177; *exanthismocarpa* 176; *GROENHARTII* 173, 174, 179; *LOPEZII* 173, 174, 179; *nylanderiana* 174; *MAGNIFICA* 234, 236; *MAURETIANA* 175, 179  
*Odontia pruni* 490, 494, 514, 515  
*Oidiodendron flavum* 65  
*Oidium chartarum* 433  
*Omphalotus* 363, 367-369, 371; *illudens* 368, 371; *olearius* 363, 367-371; *OLIVASCENS* 363-365, 367-369, 371; *subilludens* 368  
*Oospora chartarum* 433  
*Orbicula* 388  
*Ostrechnion* 81-83, 88; *americanum* 81, 83; *CURTISII* 81, 83, 84, 86-88; *europaeum* 81; *NOVA-CAESARIENSE* 81, 83, 84; *SASSAFRAS* 81-83, 84  
*Ostreion* 81; *americanum* 81-83

- Ostreola* 82; *consociata* 82  
*Pachyella* 105, 107, 166, 170, 171;  
*adnata* 105, 107; *babingtonii* 107;  
*clypeata* 107; *megalosperma* 107;  
*punctispora* 105, 107; *violaceoni-*  
*gra* 105, 107  
*Paecilomyces* 60, 420; *bacillisporus*  
 66; *carneus* 66; *elegans* 66; *fumo-*  
*so-roseus* 66, 70; *marquandii* 66,  
 69, 71, 73; *variotti* 66  
*Panus fulvidus* 489, 491, 493, 549,  
 550  
*Papulospora* 342  
*Paradiacheopsis cribrata* 309  
*Parmelia* subg *Everniiformes* 345;  
 sect *Everniiformes* 345; *americana*  
 347; *arsenei* 347; *camtschadalis*  
 347; *cirrhatta* 345, 347; *columbi-*  
*ensis* 347; *ecuadoriensis* 347;  
*fistulata* 347; *imitata* 348; *li-*  
*maeformis* 348; *lipidifera* 348;  
*moreliensis* 348; *neocirrhatta* 348;  
*nepalensis* 348; *nigrociliata* 348;  
*pachyderma* 348; *pseudonepalensis*  
 349; *sorocheila* 349; var *catawbi-*  
*ensis* 347  
*Passariniella* 329  
*Patellaria livida* 168; *rubi* 168  
*Penicillium* 55, 60, 67, 69, 72,  
 342, 465; *adametzii* 342; *brevi-*  
*compactum* 66, 70; *chrysogenum*  
 342; *citrinum* 66, 342; *claviforme*  
 420; *clavigerum* 420; *commune* 66,  
 70, 342; *corymbiferum* 66, 420;  
*cyclopodium* 66; *daleae* 66; *decum-*  
*bens* 342; *digitatum* 342; *de-*  
*clauxii* 342; *echinatum* 342, 464,  
 465, 468; *expansum* 342; *frequen-*  
*tans* 66, 67; *funiculosum* 67, 342;  
*godlewskii* 342; *granulatum* 67;  
*humicola* 342; *intricatum* 342;  
*janthinellum* 67, 342; *lilacinum*  
 342; *nigricans* 67, 69, 342; *nota-*  
*tum* 67; *piceum* 342; *purpurogenum*  
 67, 342; *raistrickii* 67; *restric-*  
*tum* 342; *roquefortii* 67; *roseum*  
 342; *rubrum* 67; *rugulosum* 67;  
*simplicissimum* 343; *steckii* 67;  
*stoloniferum* 67, 342; *thomii* 67,  
 69-71; *velutinum* 67; *viridicatum*  
 342; *waksmanii* 67  
*Peniophora* 499; *albobadia* 488, 490,  
 495, 514-516; *amoena* 506; *nuda*  
 489, 490, 495, 516, 517; *sambuci*  
 510; *tamaricicola* 488, 490, 495,  
 499, 517, 518  
*Perichaena* 305; *chrysosperma* 300;  
*depressa* 305, 306; *liceoides* 306;  
*microspora* 305; *quadrata* 305,  
 306  
*Periconia igniaria* 65; *papyrogena*  
 464  
*Peronospora alsineriarum* 33  
*Pestalotia* 73; *lespedezae* 68; *man-*  
*gifolia* 68  
*Petriella* 69, 73; *guttulata* 63  
*Peyronellaea* 342  
*Peziza* 165, 168, 171; *acericola*  
 169, 170  
*Peziza* 105, 166, 170, 171; *apicalis*  
 322; *flammea* 189, [*languinea*, *lap-*  
*sus*, 191]; *repanda* 170; *resinae*  
 189; *sanguinea* 189, 191  
*Pezizella anonyma* 319, 323  
*Pezoloma iodocyaneascens* 166  
*Phacidium patella* 189; *rugosum*  $\beta$   
 189, 190; *shizoxylon* 189  
*Phaeotrema* 175; *FOLIICOLA* 175, 179;  
*STICTICUM* 176, 179  
*Phakopsora* 134; *vitis* 157  
*Phanerochaete allantospora* 489, 490,  
 495, 518-520; *arizonica* 489, 490,  
 495, 519, 520; *chrysorhizon* 490,  
 494, 521, 522; *tuberculata* 489,  
 490, 495, 521, 522  
*Phaulomyces* 206  
*Phellinus badius* 487, 488, 491, 492,  
 530, 531; *ferruginosus* 489, 491,  
 492, 531-533; *gilvus* 491, 492,  
 532, 533  
*Phialocephala* 126; *dimorphospora*  
 420; *gabalongii* 126, 127; *humicola*  
 126, 127  
*Phialomyces* 420  
*Phialophora* 67, 70; *richardsiae* 420  
*Phlebia ochraceofulva* 490, 495, 523,  
 524  
*Phoma* 68, 70, 342; *betae* 342; *pruni-*  
*cola* 68  
*Phomopsis* 69, 70  
*Phragmidium* 155, 156; *obtusum* 156,  
 157; *potentillae* 155-157; *tormen-*  
*tillae* 155, 156  
*Phragmotrichum acerinum* 189  
*Physarella oblonga* 300  
*Physarina echinospora* 300  
*Physarum bogoriense* 310-313; *cinere-*  
*um* 313; *citrinum* 313; *compressum*  
 300; *globuliferum* 300; *melleum*  
 314; *mutabile* 314; *nicaraguense*  
 300; *oblatum* 300; *penetrabile* 314;  
*pusillum* 314; *stellatum* 300; *sul-*  
*phurinum* 300; *tenerum* 300; *vernum*



- 300; virescens 315  
 Physcia 102; DUPLICORTICATA 102-104;  
 millegrana 104; tribacia 104  
 Physoderma gibbosum 23  
 Physopella 134, 157; vitis 157  
 Phytophthora 343  
 Platygloea mycophila 490, 492, 499,  
 500; peniophorae 490, 492, 496,  
 499-501  
 Platygrapha magnifica 233, 234  
 Platysticta 233, 234, 236; magnifica  
 233, 234; simulans 233, 234, 236  
 Podospora 387, 388; communis 389  
 Polychidium 355; STIPITATUM 355-357  
 Polyporus arcularius 491, 493, 536,  
 537; gilvus 532  
 Poria ambigua 539; apacheriensis  
 491, 493, 538, 540; BABOQUIVARI-  
 ENSIS 487, 491, 493, 538-540;  
 ferruginosa 531; latemarginata  
 491, 493, 539, 541, 542; medulla-  
 panis 491, 493, 541, 542; subin-  
 carnata 491, 493, 542, 543; tarda  
 489, 491, 493, 543-545'  
 Protomyces 1-4, 6-12, 14, 19, 21,  
 24, 27-32, 44, 46, 47; andinus  
 15, 16, 18, 19, 27; ari 28; bel-  
 ledis 34; bidentis 18, 27; bizzo-  
 zerianus 28; burenianus 15, 16,  
 18, 28; calendulae 28; calthae  
 28; cari 23; carpogenus 28; cen-  
 taurea 24; centelli 28; chryso-  
 splenii 28; cocae 28; comari 29;  
 concomitans 29; conglomeratus 29;  
 corticola 29; crepidicola 24;  
 crepidis 24, 25; crepidis-paludo-  
 sae 24; crisi-oleracei 24; cyre-  
 naicus 29; endogenus 29; eryngii  
 29; erythronii 29; fallax 29; var  
 albellenensis 30; fergussonii 30;  
 ficariae 30; filicinus 30; fuscus  
 30; giganteus 16, 18; gaillardiae  
 30; galii 30; graminicola 30;  
 GRANDISPORUS 14, 18, 19; gravidus  
 14, 19, 27; helminthae 25, 27;  
 heleocharidis 30; helosciadii 10,  
 12; hispanicus 30; inouyei 6, 8,  
 14, 15, 19, 21, 47; inundatus 3,  
 4, 6, 8, 10, 12; ixeridis-oldhami  
 21, 27; kemneri 30; kreuthensis  
 24; kriegerianus 24; lactucae 21,  
 27; lactucae-debilis 15, 21, 27;  
 leniariis 31; limnanthemii 31; li-  
 mosellae 31; macrosporus 1, 3, 4,  
 6-8, 10, 12, 14, 21, 23, 28; ma-  
 cularis 31; martianoffianus 31;  
 martindalei 31; matricariae 16,  
 23, 25; melanodes 31; menyanthis  
 31; microsporus 31; muscorum 31;  
 najadis 32; pachydermus 4, 14,  
 15, 23-25, 27; paridis 32; persi-  
 cifilus 32; physalidis 32; picri-  
 dis 24; pithiophilus 32; polyspo-  
 rus 32; punctiformis 32; purpure-  
 o-tinges 32; radicolica 32; reti-  
 culatus 32; rhizobius 33; sagit-  
 tariae 33; sonchi 16, 25, 35;  
 stellariae 33; theae 33; tuberum-  
 solani 33; vagabundus 33; viola-  
 ceus 33; wodzickoi 18, 28; xylo-  
 genus 33  
 Protomyces 2, 4, 6-9, 21, 33, 34,  
 38, 39, 46, 47; ajmeriensis 39;  
 arnoldii 34, 38; belledis 4, 34,  
 35; chrysanthemii 38; crepidis 24;  
 crotonariae 39; hyoseridii 34, 35;  
 leontodontis 34, 35; leucanthemii  
 34, 38, 41; patelli 39; pharenis  
 39; phaseoli 39; pulicariae 39;  
 thirumalacharii 39, 40  
 Prototheca filamenta 89-93, 398, 399  
 Pseudevernia 346  
 Pseudocolus 373; javanicus 373, 374  
 Pseudoeurotium 73; punctatum 63; zo-  
 natum 63, 70  
 Pseudohelotium apicalis 322  
 Psilogonium cyrillae 86  
 Puccinia 154; discolor 148, 149; gi-  
 bertii 154; hyptidis 154; institi-  
 tia 148; juniperi 140; NEOHYPTIDIS  
 154; nerviphila 150; parilis 154;  
 potentillae 155, 156; pruni-spino-  
 sae 148; f discolor 148, 149; pru-  
 norum 148; trifolii 151, 152  
 Pucciniola nerviphila 150  
 PUCIOLA 553, 554, 557; SPINOSA 553,  
 554-556  
 Pullularia pullulans 343  
 Pyrenochaeta 69, 70, 343; decipiens  
 69; terrestre 343  
 Pyrenophora 379; semeniperda 378,  
 379  
 Pythium 343  
 Radulum quercinum 508  
 Ravenelia 136, 142, 146; appendicu-  
 lata 142; brevispora 142; breyniae  
 144; breyniae-patensis 144, 157;  
 coimbatorensis 144; epiphylla 146,  
 147; glandulosa 146; kirganellae  
 144, 157; ornata 146, 147; phyl-  
 lanthi 146; pygmaea 145, 146  
 Reticularia intermedia 303  
 Rhabdocline 168, 229, 230; pseudo-



- tsugae 167, 168; weirii 168  
 Rhinocladia 557; mansonii 68., 70  
 Rhizoctonia solani 69, 343  
 Rhizopus 60; arrhizus 62, 343; elegans 343; nigricans 343; stolonifer 343  
 Saccobolus 69, 73; globuliferellus 64  
 Sarcinomyces 397, 398; albus 397; crustaceus 397; inkin 89, 93, 398  
 SARCINOSPORON 89, 92, 397, 398; INKIN 89, 93, 398  
 Sarcotrochila balsamea 167  
 Sartorya 69; fumigata 62, 70  
 Sclerospora graminicola 30  
 Scopulariopsis candida 64  
 Sebacina calcea 496  
 Semidelitschia 325; agasmatica 325  
 Sepedonium chrysospermum 343  
 Septonema 130, 132  
 Setchellia punctiformis 32  
 SIEMASZKOA 193, 202, 205, 206; ANNAE 193, 204-206; FLEXA 193, 204-206; PTENIDII 193, 204-206  
 Solenia candida 523  
 Sordaria 69, 74, 387; fimicola 63  
 Sorosporium paridis 32  
 Spermophthora 44  
 Sphaeria 187; abducens 188; [rank?] minor 188; alligata 189; ambiens 187; applanata 189; arbuticola 189, 190; brevirostris 189; bulbata 189; calvescens 189, 190; caulium 189, 190; cerasorum  $\alpha$  189;  $\beta$  189, 190; cirrhosa 189; clypeata 189; complanata 191;  $\beta$  minor 189; corni [rank?] suecicae 189; corticis 189; craterium 189, 191; deplanata 189, 190; diminuens 189, 191; disciformis 187; doliolum 189; dothidea 189; eutypa 191; var [undecipherable] 189, 191; excipuliformis 187; favacea 189; fibrosa 189; filicina 187; fimbriata 188; galii 189; inquinans 189; lanciformis 187; lata 188; lejoplaca 188;  $\beta$  189, 191; lirella 189; loniceræ 189, 190; macrostoma 189; mammaeformis 189; mammillana [rank?] minor 189; me-logramma 189; mutila  $\beta$  189; mutillaria 188; nucula ... platystoma 188; ocellata  $\beta$  188; omalogramma 189, 190; oppilata 189; pertusa 189; pomiformis 422; prorumpens  $\beta$  189; prunastri 188; pupula  $\beta$  philadelphia 189; rigida 189; salicina 189, 191; semitecta 189, 190; spiculosa 189; stellulata 189, 191; stricta var [unnamed] 190; strobilina 189; suffusa 188; tessella 188; thelebola 189; tristis 189; tubaeformis 187; tubeformis 187; uberiformis 189; uda 189; vibratilis 188-190; xanthostroma 189  
 Sphaeronema hemisphaerica 187; subulatum 189  
 Sphaeropsis 343  
 Sphaerosporium lignatile 33  
 Spicaria simplicissima 343  
 Spongospora scabies 33  
 Sporocybe albipes 422, 423, 425, 427; lobulata 434  
 [Sporomiella leporina, *Lapsus*, 64]  
 Sporormiella 73; leporina 64, 70, 71  
 Sporotrichum pruinatum 343; thermophile 64, 71  
 Stachybotrys 409, 413-415, 419-423, 431, 432, 435, 461, 465, 468, 469, 472, 473; ALBIPES 410, 411, 424, 425-427, 429, 430; alternans 415, 434, 439; asperula 434; atra 413-415, 417, 419, 420, 433, 435, 438, 439, 442, 443, 472; var brevicaulis 438; var cylindrospora 440; var genuina 438; var lobulata 438; var microspora 439, 448, 449, 451, 474; atrogrisea 434; aurantia 418, 430-432; bambusicola 433; bisbyi 410, 411, 418, 423, 428-430, 432, 433; chartarum 409-411, 415-420, 424, 433, 435-438, 442, 443, 449, 451, 472, 474; crassa 464; cylindrospora 67, 343, 410, 411, 424, 440-442; dakotensis 434; dichroa 410, 411, 424, 430, 442-445; e-chinata 464; elasticae 434; gracilis 434; kampalensis 410, 411, 424, 446-448, 474; lobulata 434, 438; MICROSPORA 410, 411, 424, 448, 450, 451; nephrospora 410, 411, 424, 452-455, 474; nilagirica 464; oenantes 410, 411, 424, 455-457; palmijunci 433; papyrogena 464; parvispora 410, 411, 424, 458-460; pulchra 434; reniformis 410, 453-455; sacchari 410, 430, 432, 433; scabra 434; sinuatospora 410, 453-455; socia 414, 422, 423, 425, 427; subsimplex 342, 413, 414, 468, 471, 472; theobromae 410, 411, 423, 424, 460, 462-464,

- 474; verrucosa 434; voglinii 434  
 Staphylotrichum 73; coccosporum 64, 70  
 Stemonitis axifera 310; fusca 310; pallida 300; smithii 300; splendens 300; trechispora 300; virginensis 310  
 Stemphylium 343  
 Stereum albobadium 514  
 Sterigmatobotrys papyrogena 464  
 Stictis 234, 236, 238; parallela 187; populea 234  
 Stilbospora chartarum 414, 433  
 Stilbothamnium nudipes 420  
 Strattonia 63, 69, 73, 74; minor 63  
 Strossmayeria 166  
 Suillus 261, 270; sect Suillus 268, 270; albidipes 268, 272, 273; americanus 271, 273; brevipes 270, 273; brunnescens 273; flavogranulatus 273; flavoluteus 272; glandulosipes 273; granulatus 268, 272, 273; hirtellus 272; KAIBABENSIS 261, 266, 268, 273; lakei 273; luteus 273; OCCIDENTALIS 261, 268, 273; pseudobrevipes 273; sibericus 271, 273; subaureus 262, 270, 273; tomentosus 273; umbonatus 273; WASATCHICUS 261, 268, 270, 272, 273  
 Syncephalastrum 51; racemosum 51, 54, 343; VERRUCULOSUM 51, 52, 54  
 Synchytrium phaseoli 39  
 Synsporium 414; biguttatum 434  
 Taeniolella 132  
 Talaromyces 55, 60, 69; flavus var flavus 62; helicus 70; var helicus 62; luteus 55, 60, 62; trachyspermus 55, 60, 62; ucrainicus 62, 70; udagawae 62; wortmannii 62  
 Taphridium 2, 4, 6-8, 10, 11, 40, 43, 46, 47; algeriense 40, 41; cicutae 4, 6, 11; crepidis 43; inundatae 12; umbelliferarum 40, 41, 44  
 Taphrina 3, 7, 43, 44, 46, 47; oreoselini 41; rhaetica 43; umbelliferarum 41  
 Thelebolus 2  
 Thelotrema 236; colobolicum 177; CONFERENDUM 176, 179; decorticans 178; EITENII 176, 179; EMINENS 177, 179; INDICUM 177, 179; insigne 178; ISIDIATUM 178, 179; leprocarpum 177; MERIDENSE 179; tuberculiferum 177, 178  
 Thermoascus 73; aurantiacus 63, 70, 71  
 Thyridium 329  
 Tomentella coerulea 491, 494, 546, 548  
 Torula 342; thermophila 68, 70, 71  
 Trametes heteromorpha 535; hispida 544  
 Tranzschelia discolor 147, 149; pruni-spinosae 148; var discolor 148, 149; var pruni-spinosae 148, 149; f discolor 149  
 Tremella sabinæ 140; simplex 490, 492, 496, 500, 501  
 Triactella 142  
 Triangularia 69, 73, 74; backusii 63  
 Trichia decipiens 300; favoginea 300; varia 306; verrucosa 300  
 Trichobasis 157, 158  
 Trichocladium asperum 342; canadense 64  
 Trichoderma 55, 60, 69, 70, 72, 337-341, 343; album 343; aureoviride 67, 337-341; glaucum 338, 343; hamatum 55, 67, 69, 71, 338-340; harzianum 67, 69, 337-341; koningii 55, 67, 69, 70, 337-341; lignorum 338, 343; longibrachiatum 67, 70, 341; piluliferum 341; polysporum 55, 68, 69, 338-341, 343; pseudokoningii 68, 338-341; saturnisporum 341, 420; viride 338-340, 343, 416  
 Trichophaea 69; abundans 64  
 Trichophyton terrestre 64, 75; tonsurans 89  
 Trichosporon 89, 90, 398, 401, 406, 407; aculeatum 401, 406, 407; inkin 89-91, 93, 398, 399  
 Trichosporum effusum subsp binucleatum 434  
 Trichothecium roseum 434, 416  
 Tritirachium 557  
 Trochila craterium 191  
 Trypethelium 174  
 Tubercinia paridis 32  
 Tubifera ferruginosa 303; microsperma 303  
 Tylopilus 261; alboater 262, 273; ferrugineus 273; porphyrosporus 273  
 Tympanis frangulae 187  
 Uredo 155; campanulae 137; fabae 157, 158; fallens 149, 150; hyptidis 153, 154; melampyri 138; obtu-

- sa 155-157; potentillae 155; rhi-  
nanthacearum 138, 154; tremellosa  
var campanulae 137, 154, 155; tri-  
folii 151, 152; vitis 157
- Uromyces 150; affinis 151; anthylli-  
dis 152; fallens 149, 150, 152;  
flectens 150, 151; iresines 151;  
minor 152; nerviphilus 150-152;  
striatus 152; trifolii 150-152;  
var fallens 149; trifolii-repentis  
150-152
- Urophlyctis hemisphaerica 33
- Usnea 349
- Ustilago haesendonckii 33
- Valsaria 323, 329; crenata 323; in-  
sitiva 329
- Vararia tropica 491, 494, 534, 535
- Verticillium 68; albo-atrum 420;  
cephalosporium 68; nigrescens  
420; psalliotae 68; terrestre 343
- Vibrissea 166
- Volkartia 2, 4, 6-8, 10, 43, 46,  
47; rhaetica 4, 43, 44; umbelli-  
ferarum 41
- Volutella ciliata 68, 70, 73
- Xanthoparmelia camtschadalis 347;  
chlorochroa 580; wyomingca 580
- Xeromyces 388
- Xylohypha 132
- Zygorhynchus 60; moelleri 62

## REVIEWERS

The Co-Editors express their appreciation to the following individuals who have reviewed one or more of the papers in this volume prior to their submission.

C. J. ALEXOPOULOS	R. D. GOOS	A. F. RAINBOW
G. L. BARRON	R. T. HANLIN	A. RAMBELLI
L. R. BATRA	D. L. HAWKSWORTH	C. T. ROGERSON
C. R. BENJAMIN	C. L. HESSELTINE	G. SAYRE
R. K. BENJAMIN	J. W. KIMBROUGH	M. A. SHERWOOD
T. E. BROOKS	D. S. KING	R. A. SHOEMAKER
J. VAN BRUMMELEN	D. T. KOWALSKI	E. G. SIMMONS
H. H. BURDSALL, JR.	M. J. LARSEN	A. H. SMITH
S. E. CARPENTER	P. L. LENTZ	E. A. D. SNELL
W. B. COOKE	J. P. LINDSEY	W. H. SNELL
J. L. CRANE	T. H. NASH	H. D. THIERS
E. E. DAVIS	J. T. PALMER	J. W. THOMSON
R. DONOVICK	R. H. PETERSEN	J. M. TRAPPE
D. M. DRING	D. H. PFISTER	J. WALKER
M. L. FARR	K. A. PIROZYNSKI	F. A. WECKER
J. W. GERDEMANN		M. WIRTH

## ERRATA TO VOLUME TWO

Page 219, Fig. 1 is *Xanthoparmelia chlorochroa* and Fig. 2 is *X. wyomingea*.

## ERRATA TO VOLUME THREE

- Page 30, line 15:       for: *Hyalospora*  
                          read: *Hyalospora*
- Page 64, line 3:       for: \**Sporomiella*  
                          read: \**Sporormiella*
- Page 154, line 33:     for: *Agrotelium*  
                          read: *Argotelium*
- Page 191, line 28:    for: *languinea*  
                          read: *sanguinea*
- Page 216, line 2:     for: CE  
                          read: C-E
- Page 282, line 33     for: Grave  
                          read: Grove
- Page 286, line 4:     for: 10-16  
                          read: 7-9
- Page 287, line 6:     for: 10  $\mu$ , paries 2,6  $\mu$ )  
                          read: 20  $\mu$ , paries 7  $\mu$ )
- Page 295, line 26:    for: 2,6  $\mu$ )  
                          read: 7  $\mu$ )
- Page 296, line 7:     for: höherer  
                          read: Höherer
- Page 298, line 37:    for: Alexopoulos (1968)  
                          read: Alexopoulos and Blackwell (1968)
- Page 317, line 2:     for: Alexopoulos, C. J. 1968.  
                          read: Alexopoulos, C. J. and M. Blackwell. 1968.
- Page 319, line 25:    for: (Obrien  
                          read: (O'Brien



# CO-EDITORS OF MYCOTAXON

G. L. HENNEBERT  
FRENCH LANGUAGE EDITOR  
& BOOK REVIEW EDITOR

Huttelaan 36  
B-3030 Heverlee, Belgium

RICHARD P. KORF  
ENGLISH LANGUAGE EDITOR  
& MANAGING EDITOR

P.O. Box 264  
Ithaca, NY 14850, USA

MYCOTAXON is a quarterly journal devoted to all phases of mycological and lichenological taxonomy and nomenclature. It seeks to publish all papers within 4 months of acceptance, using photo-offset lithography. All articles are reviewed by specialists prior to acceptance. Publication is open to all persons, and papers may be in French or in English.

## SUBSCRIPTION INFORMATION

Each issue of MYCOTAXON may vary in number of pages. Each volume, beginning with volume 3, consists of at least 512 pages, and may consist of as few as 2 or as many as 8 quarterly issues depending upon the amount of copy received from authors. Subscriptions are on a per volume basis, *not* on an annual basis. If only one bill during each year is a requirement, please pay for two volumes, which will cover at least one year's issues. Personal subscriptions are available at a substantially reduced subscription rate for individuals who agree not to deposit their copies in another library than their private one within three years after publication. Subscription prices for each volume, beginning with volume 3, are:

	U.S. & CANADA	OTHER FOREIGN
Regular (multi-user)	\$30.00	\$32.00
Personal (individuals only)	\$12.00	\$14.00

(Vols. 1 & 2 are available at half the above rates per volume.)

MYCOTAXON may also be obtained on a journal-exchange basis. This may be arranged with journals, institutions, or individuals who have difficulty in obtaining foreign currencies. For details and exchange subscription forms write to a Co-Editor.

## EDITORIAL SERVICES AND INFORMATION FOR PROSPECTIVE AUTHORS

Authors prepare their own camera-ready copy after having received comments from pre-submission reviewers. Detailed Instructions to Authors appeared in MYCOTAXON 1(1): 3-12, 1974. A copy of these instructions will be sent upon request to one of the Co-Editors.

We are able to provide prospective authors with two aids to publication. Both are sold at no profit, and are shipped postpaid from MYCOTAXON, Ltd., P.O. Box 264, Ithaca, NY 14850 USA:

SPECIAL MANUSCRIPT PAPER is available in packages of 50 sheets, and is ruled in blue, non-photoreproducing ink for each of the two sizes of typeface called for in the instructions to authors (elite and pica). It is a convenience to typists, but certainly not an essential, since the appropriate sized rectangles can be prepared on any paper using a non-photoreproducing blue pencil. Each package of 50 sheets is available at \$1.25, *postpaid*.

BIOPLATE is a special sheet of transfer letters for the use of authors in the preparation of plates and graphs for publication. It is manufactured specifically for us, and is available in both black and white. Each sheet is approximately 30 x 39 cm, and has a wide assortment of numbers, letters, Greek letters, symbols, and arrows in various sizes. Our cost is \$3.00 per sheet, and we will mail these to prospective authors *postpaid* (black will be sent unless white is specified).