MYCOTAXON

Vol. XXII, pp. 1-12 January-March 1985

ON DISTINGUISHING STEREUM GAUSAPATUM FROM THE "S. HIRSUTUM-COMPLEX"

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ABSTRACT

A new character is proposed that can be used to help distinguish Stereum gausapatum from members of the S. hirsutum-complex, sensu Welden (S. hirsutum, S. complicatum and S. versicolor). An analysis of pseudocystidial wall thickness indicates that, on average, S. gausapatum possesses walls less than 1.5 µm while the other species possess an average wall thickness greater than 1.5 µm.

Welden (1971) suggested the combination of numerous well-established species of Stereum (sensu stricto) into a few "species complexes", based primarily on the existence of gross morphological continua and an apparent lack of reliable microscopic and cultural characters. Within one of these, the S. hirsutum-complex, he included S. hirsutum (Willd.:Fr.) S.F. Gray, S. complicatum (Fr.:Fr.) Fr. (= S. rameale (Schw.) Burt), S. styracifluum (Schw.:Fr.) Fr., S. subtomentosum Pouzar, S. versicolor (Sw.:Fr.) Fr., and S. gausapatum (Fr.:Fr.) Fr.

The hypothesis put forth in the present paper is simple: S. gausapatum can be distinguished reliably from the remainder of the aforementioned species and therefore should not be included in the S. hirsutum-complex. In

addition to S. gausapatum, the principal New World species of the complex were studied: S. hirsutum, S. complicatum and S. versicolor.

Interfertility studies are not useful in Stereum s.s. because members of the genus have holocoenocytic nuclear behavior and are assumed to be homothallic (Boidin, 1958a, 1958b, 1971). However, recent evidence suggests that at least some Stereum species exhibit heterokaryon formation when monosporous isolates are confronted (Boddy and Rayner, 1982; Chamuris, unpublished; Coates et al., 1981; Rayner and Turton, 1982). These mycelial interactions may reflect true sexuality, but likely indicate a type of somatic incompatibility. Either way, the practicing mycologist who wishes to identify a specimen in hand must rely upon a morphological species concept. What then are the characters that can be used to separate S. gausapatum from S. hirsutum?

Traditional morphological descriptions of species in this group carry "usually" type qualifiers. The basidiomata of S. gausapatum vary from effused, effuso-reflexed to pileate, and are "usually" radially plicate. The hymenial surface of fresh specimens "usually" bruises or bleeds red, while dried specimens show dark violet or blackish stains. In well-developed specimens the hymenial surface is somewhat folded radially, reflecting the plicate tendency. Eriksson et al. (1984) state that ". . . the colour of the hymenium . . . is buff to clay coloured in S. gausapatum, yellow to pale orange in S. hirsutum." Although this is "often" true, it is frequently difficult to demonstrate reliably, especially in older herbarium specimens. Conducting hyphae and pseudocystidia with brownish contents are "usually" evident in radial section.

Many exceptions plague the above mentioned characters. For example, specimens of S. gausapatum can be found which are not radially plicate (young) and show little evidence of bleeding or bruising. S. complicatum may bruise red, but microscopic examination of radial sections reveals that the conducting hyphae do not possess the brownish contents typical of S. gausapatum. S. versicolor is a neotropical expression of S. hirsutum, and may possess brownish conducting hyphal contents. This situation parallels that seen in S. australe, a tropical expression of S. fasciatum (S. fasciatum-complex).

It would seem that the darkness of the conducting hyphal and pseudocystidial contents is due at least in part to environmental factors, and therefore is not a dependable character in tropical areas. The presence of conducting hyphae and pseudocystidia with dark contents is, however, a fairly reliable character for separating S. gausapatum from the S. hirsutum-complex in temperate areas.

S. gausapatum "almost always" produces basidiomata on stumps or limbs of oak species. This association with Quercus species seems to be a reliable character in Europe as well as in North America. Eriksson et al. (1984) report that S. gausapatum follows the distribution of Quercus in Europe. S. complicatum and S. hirsutum may be associated with oaks (see Table 2, Chamuris 1503); however when the substrate can be identified as oak wood, the stereum most likely to be present is S. gausapatum (see Tables 1-4).

In addition to substrate, a reliable character for separating S. gausapatum from members of the S. hirsutum-complex is the degree to which the wall of the hymenial pseudocystidia becomes thickened. In Stereum, conducting hyphae (also called vascular or sanguinolentous hyphae) run radially through the context, curve downwards into the hymenium, and end as embedded or slightly protruding pseudocystidia (Fig. 1). S. hirsutum, S. complicatum and S. versicolor have thick-walled pseudocystidia (Fig. 1a) while S. gausapatum has relatively thin-walled pseudocystidia (Fig. 1b). This paper is concerned with an analysis of this character.

Although this difference in wall thickness is striking in radial sections, one can find only brief and suggestive mention of it in the literature. Pouzar (1959) apparently noticed the difference when he erected the genus Haematostereum (a rejected genus that included S. gausapatum). Jülich and Stalpers (1980) used relative pseudocystidial wall thickness as a character in their key to North Temperate sterea. The wall thickness character was mentioned neither by Welden (1971) nor by Lentz (1955, 1960), however Lentz (1955, Pl. 15D) and Rattan (1977, p. 165, Fig. A) presented line drawings of S. gausapatum depicting thin-walled pseudocystidia. Eriksson et al. (1984) mention the character, but do not call special attention to it. In addition, their excellent line

drawings of S. gausapatum (Fig. 746, p. 1418) and S. hirsutum (especially Fig. 750, p. 1424 and Fig. 751, p. 1425) clearly illustrate the wall thickness difference.

In an attempt to quantify the expressions "thick-walled" and "relatively thin-walled", as well as to determine if the thickness difference was clear and dependable, the average pseudocystidial wall thickness for each of 62 specimens was determined. The specimens were grouped initially according to aspect, gross mophology, color of conducting hyphal contents and substratum. Seventeen were grouped as S. hirsutum, 13 as S. complicatum, 6 as S. versicolor and 26 as S. gausapatum. Species concepts were developed previously both by a study of the historical literature and by examination of specimens and exsiccati determined by a variety of authorities. Specimens were chosen for their broad geographical representation of 17 countries and 19 states. All specimens are held in the Cryptogamic Herbarium at the New York Botanical Garden.

METHODS AND MATERIALS

Radial sections cut by hand with a razor blade (from several basidiomata per collection when possible) were mounted in a drop of 3% KOH. Sections were taken from several points along the radial distance of each pileus. Mounts were examined under 1500x magnification (oil immersion), and the color of conducting hyphae and pseudocystidia were noted. The mount was then squashed gently to isolate the hymenial elements sufficiently for measurement of wall thickness.

Using an eyepiece micrometer the wall thickness of each of ten randomly selected pseudocystidia from at least two sections was measured. Measurements were made to the nearest 0.5 µm when the walls were at least 1.0 µm thick. Walls less than 1.0 µm thick were judged to have a thickness between 0.5 and 1.0 µm (estimated as 0.75 µm) or between 0 and 0.5 µm (estimated as 0.25 µm).

Walls were measured at the base of the pseudocystidia (Fig. 1a and 1b). This is where they bend into the hymenium, and is the most convenient area for making

measurements. It should be pointed out that in S. gausapatum, thick-walled contextual hyphae become increasingly abundant toward the adhymenial side; and as in other sterea, become the dominant type in the cutis and tomentum.

Two pitfalls in wall measurement should be mentioned. First, care must be taken to distinguish the pseudocystidial wall from the walls of adjacent hyphae. This is of special concern when the pseudocystidia have

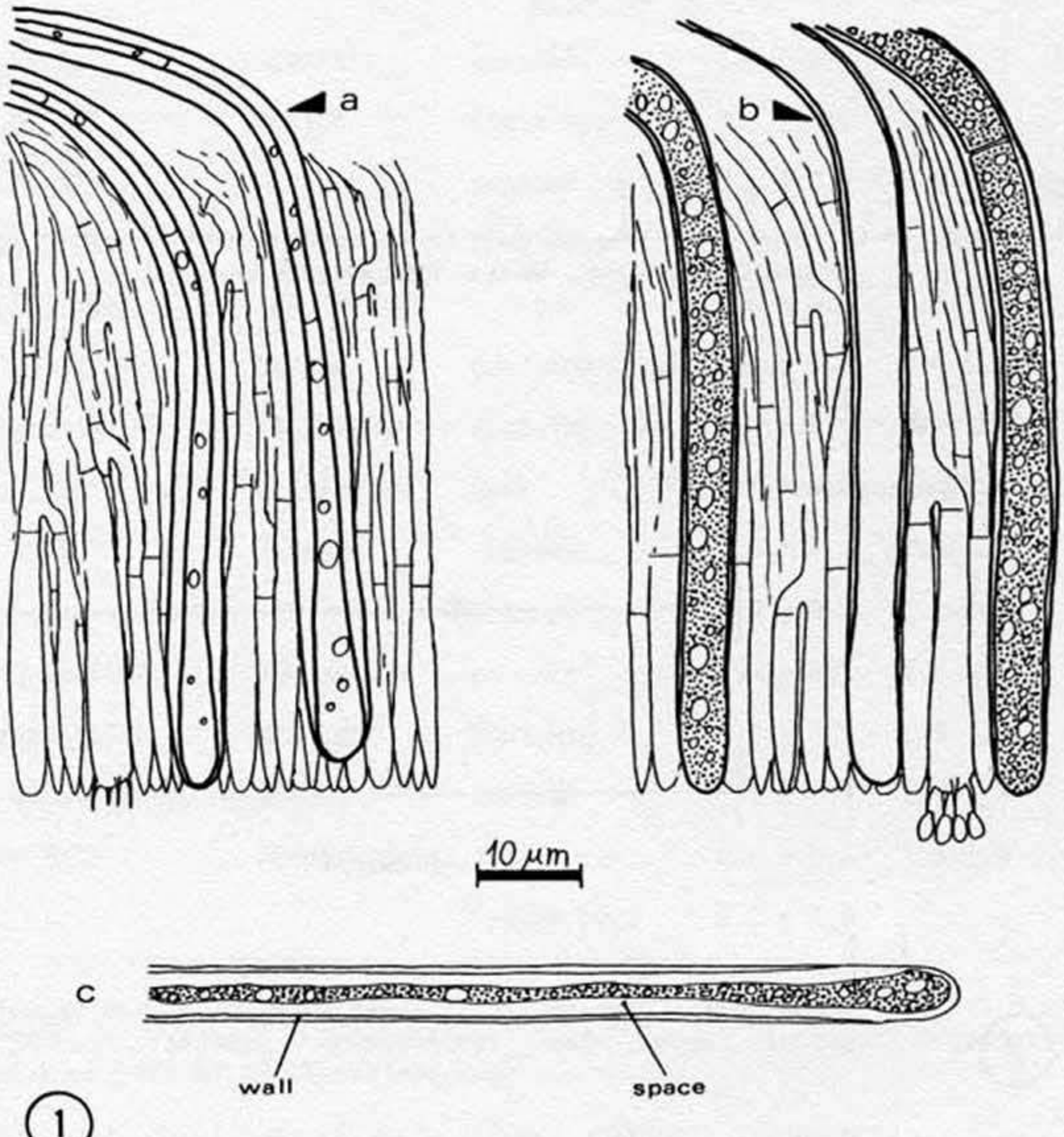

Fig. 1. Measuring pseudocystidial wall thickness. Walls are measured at the base of the hymenium in S. hirsutum, a; and S. gausapatum, b. When the contents retract, care must be taken to measure the wall, not the space, c.

lost their content, and the lumen gives the impression of a "space" in the section. The second pitfall concerns the shrinkage of the pseudocystidial contents. The surface tension of the contents creates the illusion of a surrounding membrane. The space between this boundary and the inner face of the wall should not be mistaken for the wall itself (Fig. 1c).

The wall thickness data are presented in Tables 1-4. Mean wall thicknesses were compared using the Student's t-distribution (Sokal and Rohlf, 1981).

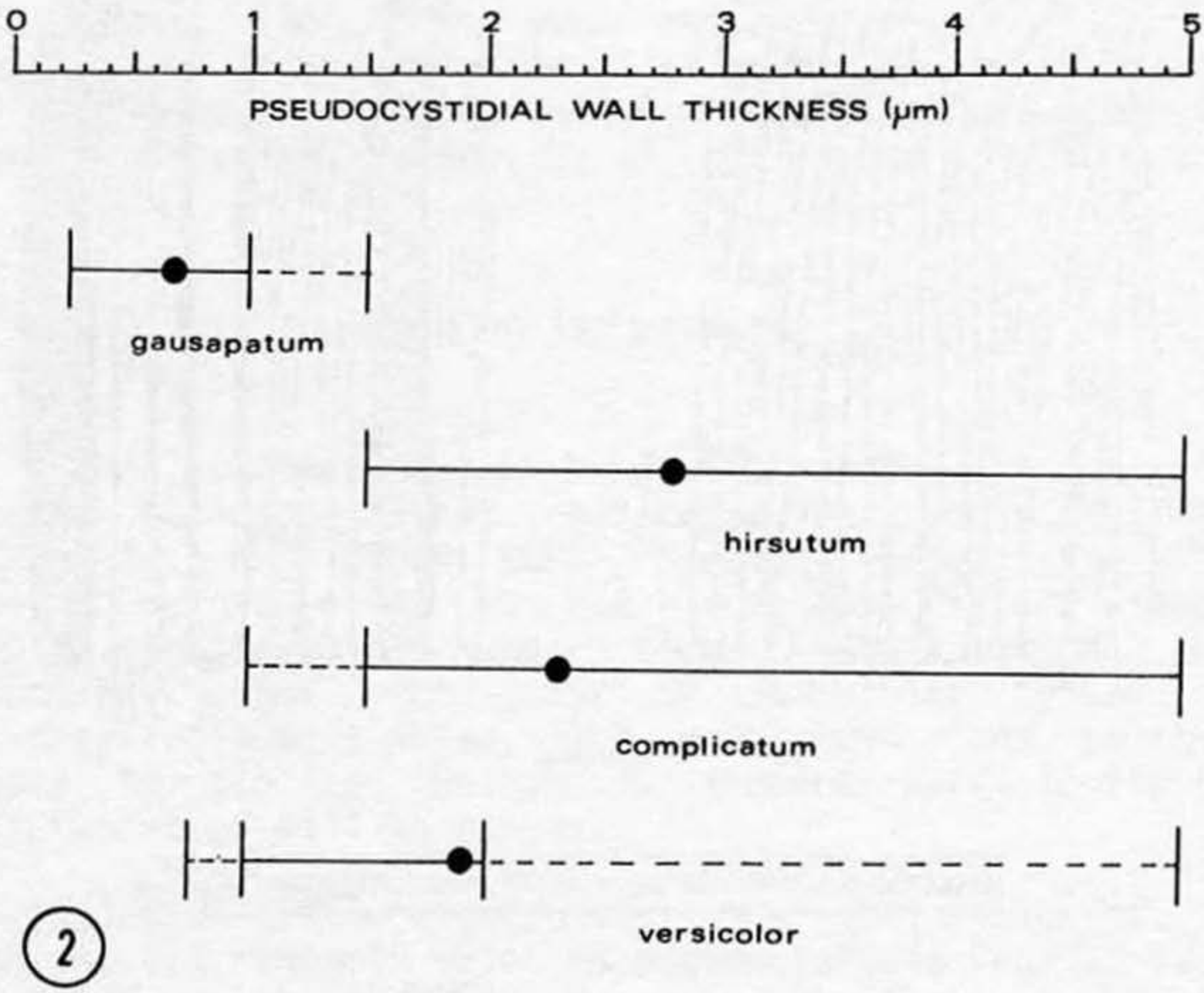

Fig. 2. Comparison of pseudocystidial wall thickness data. Dots indicate the mean wall thickness; the lines indicate the range of values. Dotted lines indicate that less than 5% of the walls fell within this range.

Table 1. Mean pseudocystidial wall thickness data (μm) ± s.d. for *S. hirsutum*.

SPECIMEN	LOCATION	SUBSTRATE	PSEUDOCYSTIDIA WALL THICKNESS MEAN	PSEUDOCYSTIDIA WALL THICKNESS RANGE	PSEUDOCYSTIDIA CONTENT COLOR
Buck 9943	ECUADOR	unknown	2.7 ± 0.6	2.0-4.0	PYB
Luteyn 8973	ECUADOR	dead tree	2.0 ± 0.4	1.5-3.0	PY
Bresadola, 1897	ITALY	*Eucalyptus globulus*	3.1 ± 0.5	1.5-4.0	PY
Anonymous	GERMANY	unknown	2.5 ± 0.3	1.5-3.0	PY-PYB
CUP-ME 157	MEXICO	*Pinus* sp.	3.3 ± 1.2	2.0-4.0	PY
CUP-ME 313	MEXICO	unknown	2.8 ± 0.4	1.5-4.0	H
Brass 17266	MALAWI	dead wood	2.9 ± 0.4	2.0-3.5	H
Merrill 6895	PHILIPPINES	unknown	3.4 ± 0.9	2.0-5.0	PY
EAAFRO 317	UGANDA	hardwood slash	4.0 ± 0.9	2.0-5.0	H
McClatchie 145	CALIFORNIA	decaying wood	3.7 ± 1.0	2.0-5.0	PYB
Morse 330	CALIFORNIA	bark	2.6 ± 0.4	2.0-3.0	H
EEK 6096	FLORIDA	unknown	4.0 ± 0.9	2.5-5.0	H
Rogerson, ix.1970	NEW YORK	unknown	1.9 ± 0.3	1.5-2.5	H
Chamuris 1192	NEW YORK	hardwood	2.4 ± 0.5	2.0-3.5	H-PY
Chamuris 1237	NEW YORK	hardwood	2.0 ± 0.2	1.5-2.0	H
Lloyd, x.1897	OREGON	unknown	2.6 ± 0.5	2.0-3.5	H-Y
Henry 5213	PENNSYLVANIA	log	2.5 ± 0.8	1.5-4.0	H-PY
		Pooled mean	2.8 ± 0.6		

Abbreviations: CUP-ME=Cornell University, Specimens from Mexico; EAAFRO=East African Agricultural and Forest Research Organization; EEK=Exploration of the Everglade Keys

Color code: H=hyaline; PY=pale yellow; PYB=pale yellow-brown.

Table 2. Mean pseudocystidial wall thickness data (µm) ± s.d. for S. complicatum.

SPECIMEN	LOCATION	SUBSTRATE	PSEUDOCYSTIDIA WALL THICKNESS MEAN	PSEUDOCYSTIDIA WALL THICKNESS RANGE	PSEUDOCYSTIDIA CONTENT COLOR
Prance et al.	BRAZIL	unknown	1.8 ± 0.4	1.0-2.5	YB
Welden 2986	COSTA RICA	unknown	2.8 ± 0.6	2.0-4.0	H-PYB
Escobar 5088	EL SALVADOR	unknown	2.5 ± 0.3	2.0-3.0	H-PY
Isotype? S. rameale	ALABAMA	unknown	2.3 ± 0.5	1.5-3.0	Y
Doutt, CM 20307	GEORGIA	unknown	2.4 ± 0.3	2.0-3.0	PY
Earle, viii.1908	LOUISIANA	unknown	2.2 ± 0.6	1.5-3.0	H-PYB
Chamuris 1503	NEW YORK	Quercus rubra	2.4 ± 0.5	1.5-3.0	PY
Chamuris 1584	NEW YORK	hardwood	2.0 ± 0.3	1.5-2.5	H-PY
Jennings, CM 8059	PENNSYLVANIA	hardwood	1.8 ± 0.4	1.5-2.5	PY
Sumstine, CM 14270	PENNSYLVANIA	unknown	2.4 ± 0.4	1.5-3.0	PYB
Henry 4393	PENNSYLVANIA	Fagus sp.	3.2 ± 1.0	1.5-5.0	Y
Chamuris 1276	PENNSYLVANIA	hardwood	2.3 ± 0.3	2.0-3.0	PY
Richmond, CM 14290	VIRGINIA	unknown	2.0 ± 0.4	1.5-2.5	Y
		Pooled mean	2.3 + 0.4		

Abbreviation: CM=Carnegie Museum.

Color code: H=hyaline; PY=pale yellow; PYB=pale yellow brown; Y=yellow; YB=yellow-brown.

RESULTS

Wall thickness comparisons are illustrated graphically in Fig. 2. The mean pseudocystidial wall thickness for S. gausapatum is significantly less ($p = 0.02$) than that for S. hirsutum, S. complicatum and S. versicolor. There was no significant difference ($p = 0.02$) between S. hirsutum and S. complicatum.

In S. gausapatum, 7 of the 260 walls (3%) measured 1.5 µm, but most of the walls (97%) were between 0.25 and 1.0 µm in thickness. In S. complicatum, 1 of the 130 walls (0.8%) measured 1.0 µm. Most of the remainder fell between 1.5 and 3.0 µm, with some between 3.0 and 5.0 µm. The walls in S. hirsutum ranged from 1.5 to 5.0 µm in thickness.

S. versicolor is somewhat intermediate. Although its mean wall thickness (1.9 µm) did not differ from that of S. hirsutum and S. complicatum at p = 0.001, there is a difference at p = 0.01. S. versicolor shows 13 of the 60 walls (22%) being less than or equal to 1.0 µm in thickness, but 78% are up to 5.0 µm in thickness. These data may be explained by one or more of the following: 1) small sample size for S. versicolor (N = 6), 2) greater variation in wall thickness, 3) S. versicolor has walls thinner than S. hirsutum and S. complicatum (but thicker than S. gausapatum). Items 1 and 2 provide the most reasonable explanation.

Table 3. Mean pseudocystidial wall thickness data (µm) ± s.d. for S. versicolor.

SPECIMEN	LOCATION	SUBSTRATE	PSEUDOCYSTIDIA WALL THICKNESS MEAN	PSEUDOCYSTIDIA WALL THICKNESS RANGE	PSEUDOCYSTIDIA CONTENT COLOR
CUP-BO 57	BOLIVIA	log	2.2 ± 0.5	1.5-3.0	YB-B
CUP-BR 47	BRAZIL	log	2.3 ± 0.5	1.5-2.5	B
Welden 952	JAMAICA	frondose wood	1.0 ± 0.2	0.75-1.5	B
Shafer 3692	PUERTO RICO	unknown	1.5 ± 0.4	1.0-2.0	B
Small, EEK 7089	FLORIDA	unknown	2.7 ± 1.1	1.5-5.0	PY
Underwood 1377	FLORIDA	unknown	1.9 ± 0.4	1.0-2.5	H-PY
		Pooled mean	1.9 + 0.5		

Abbreviations: CUP-BO=Cornell University, specimens from Boliva; CUP-BR=Cornell University, specimens from Brazil; EEK=Exploration of the Everglade Keys.

Color Code: B=brownish; H=hyaline; PY=pale yellow; YB=yellow brown.

Table 4. Mean pseudocystidial wall thickness data (μm) ± s.d. for *S. gausapatum*.

SPECIMEN	LOCATION	SUBSTRATE	PSEUDOCYSTIDIA WALL THICKNESS MEAN	PSEUDOCYSTIDIA WALL THICKNESS RANGE	PSEUDOCYSTIDIA CONTENT COLOR
Cain 2697	CANADA (ONT.)	*Quercus* sp.	0.6 ± 0.3	0.25-1.0	B
Teng 3528	CHINA	*Quercus* sp.	0.7 ± 0.2	0.25-1.0	B
Cooke, FBE 107	ENGLAND	unknown	0.5 ± 0.3	0.25-1.0	B
Sharp 4865	GUATEMALA	*Quercus* sp.	0.9 ± 0.1	0.75-1.0	B
Bresadola, x.1900	ITALY	*Quercus* sp.	0.75 ± 0	0.75	B
Sharp 16816	MEXICO	*Quercus* sp.	1.0 ± 0.2	0.75-1.5	B
Sharp 16817	MEXICO	*Quercus* sp.	0.4 ± 0.3	0.25-1.0	B
Romell, FEPS 28	SWEDEN	*Quercus* sp.	0.6 ± 0.3	0.25-1.0	B
Bartholomew, FC 2883	ARKANSAS	*Quercus* sp.	0.75 ± 0	0.75	B
Commons, CM 13788	DELAWARE	unknown	0.9 ± 0.5	0.25-2.0	B
Tulane 408	FLORIDA	unknown	0.9 ± 0.3	0.25-1.5	B
Doutt, CM 20307	GEORGIA	dead log	0.75 ± 0	0.75	B
Garrett KF 86	KANSAS	*Quercus* sp.	1.1 ± 0.7	0.75-1.0	B
Henry, viii.1960	LOUISIANA	unknown	0.75 ± 0	0.75	B
Ellis and Everh., FC 218	NEW JERSEY	*Quercus* sp.	0.6 ± 0.2	0.25-0.75	B
Smith 29415	NEW YORK	*Q. alba*	0.7 ± 0.3	0.25-1.0	B
Rogerson, x.1966	NEW YORK	*Q. alba*	0.25 ± 0	0.25	B
Rogerson, x.1966	NEW YORK	*Q. velutina*	0.5 ± 0.3	0.25-1.0	B
Henry, viii.1931	NEW YORK	unknown	0.6 ± 0.2	0.25-0.75	B
Rhoads, 1915	NEW YORK	*Quercus nigra*	0.7 ± 0.2	0.25-1.0	B
Brenckle, FD 522	N. DAKOTA	*Q. macrocarpa*	0.8 ± 0.1	0.75-1.0	B
Welden, Tulane 7416	OHIO	*Quercus* sp.	0.8 ± 0.3	0.25-1.5	B
Sumstine, CM 4752	OHIO	unknown	1.1 ± 0.2	0.75-1.5	B
Grover 14297	OHIO	*Quercus* sp.	0.6 ± 0.4	0.25-1.0	B
Henry 5624	PENNSYLVANIA	log	0.9 ± 0.2	0.75-1.5	B
Weir, x.1921	WASH., D.C.	*Q. marylandica*	0.9 ± 0.4	0.25-1.5	B
		Pooled mean	0.7 + 0.2		

Table 4 continued.

Abbreviations: CM=Carnegie Museum; FBE=Fungi Brittanica Exsiccati; FC=Fungi Columbiani; FEPS=Fungi Exsiccati Praesertim Scandinavici; FD=Fungi Dakatotenses; KF=Kansas Fungi.

Color code: B=brownish

DISCUSSION

The results presented in this paper suggest that the thickness of the pseudocystidial walls can be used to distinguish S. gausapatum from the other members of the S. hirsutum-complex, sensu Welden (1971). The accepted members of the complex, then, are S. hirsutum (= S. styracifluum, = S. subtomentosum), S. complicatum, and S. versicolor.

The wall thickness character can be used to confirm judgments made on the basis of field and gross morphological observations. For a S. gausapatum candidate, these include habitation of oak wood, the bleeding or bruising red of the fresh hymenial surface (or dark stains on dry hymenia), and radially plicate pilei.

In the Temperate Zone, a microscopic clue would be the presence of brownish pseudocystidial and conducting hyphal contents. Finally, after measuring 5-10 pseudocystidial walls at the base of the hymenium, an average thickness of less than 1.5 µm should solidify the decision to place the specimen in S. gausapatum.

ACKNOWLEDGMENTS

This work was carried out at the Cryptogamic Herbarium of the New York Botanical Garden, under the tenure of a Gertrude S. Burlingham Fellowship in Mycology. Many thanks to the staff for their help and support. Also, thanks to Drs. J.L. Lowe and C.-J. K. Wang for reviewing the manuscript.

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MYCOTAXON

Vol. XXII, pp. 13-32 January-March 1985

FOUR NEW SPECIES OF NECTRIA AND THEIR CHAETOPSINA ANAMORPHS

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SUMMARY

Four new species of Nectria Fries are described: N. chaetopsinae, N. chaetopsinae-polyblastiae, N. chaetopsinae-penicillatae, and N. chaetopsinae-catenulatae. Their anamorphs are, respectively, Chaetopsina cf. fulva Rambelli, C. polyblastia sp. nov., C. penicillata sp. nov., and C. catenulata sp. nov. The relationship of Chaetopsina Rambelli to other anamorph fungi having setiform conidiophores is discussed. It is suggested that Chaetopsina be restricted to species with setae that become yellow in 100% lactic acid and that are anamorphs of Nectria species.

Chaetopsina Rambelli anamorphs were found in close proximity to perithecia of four species of Nectria Fries collected in the American tropics and/or New Zealand. Colonies derived from single ascospores of these species of Nectria produced Chaetopsina conidiophores in pure culture that were morphologically similar to those found in nature.

The Chaetopsina teleomorphs are closely related species of Nectria. The smooth, red, superficial, perithecia are anatomically and morphologically strongly reminiscent of Nectria episphaeria (Tode : Fries) Fries and its relatives (Booth 1959), hypersaprobes with Fusarium Link : Fries and Verticillium Nees anamorphs usually occurring on stromatic ascomycetes; and of N. consors (Ellis & Everhart) Seaver, which has a Volutella Fries anamorph (Samuels 1977). The Chaetopsina teleomorphs are apparently not hypersaprobic; like N. consors, they occur on decaying herbaceous debris or wood.

The perithecial wall of the Chaetopsina teleomorphs is typical of the perithecial wall found in the Nectria episphaeria group. The wall comprises intertwined hyphae, the cells of which appear more or less elliptical in section. Cells of the wall seen in surface view are textura epidermoidea and their walls are unevenly thickened and adjacent cells are connected by pores.

Eight species of Chaetopsina have previously been described (Table 1), all of which inhabit herbaceous debris and wood and are generally found in geographical areas having a warm climate (Africa, Papua New Guinea, Taiwan, Brazil, Japan, southern U.S.A.); the collection reported by Ellis (1971) from Canada is an exception. Until now, none has been reported to have a teleomorph. The anamorph of Nectria chaetopsinae sp. nov. is morphologically similar to the type species of Chaetopsina, C. fulva Rambelli (1956), and may be that species. None of the other Chaetopsina anamorphs of Nectria could be identified with any of the previously described species of Chaetopsina and are proposed as new species.

Chaetopsina fulva, as originally described from decaying leaves in northern Italy (Rambelli 1956), has cylindrical conidia, 7.5-10.8 x 1.0-1.5 µm. Subsequent collections have been reported from decaying leaves, pine needles and soil by Barron (1968), Ellis (1971), Matsushima (1971, 1975, 1980) and Pirozynski & Hodges (1973) from the U.S.A. (South Carolina), Canada, Taiwan, Japan (Hyogo, Sendai, Tokyo) and Papua New Guinea. Conidia in these collections were described as cylindrical; conidia in most ranged from (8-)10-13 x (1.0-)1.2-1.5 µm Conidia from the two collections associated with N. chaetopsinae were oblong and measured (in vivo) (5.0-)5.6-7.2(-8.5) x 1.0-1.3 (-1.7) µm and are thus shorter than is reported for C. fulva; conidia formed in culture measured (6.5-)9.3-17.3(-22.0) x 2.0-2.5(-3.0) µm. In other morphological details the Nectria anamorph is identical to C. fulva.

Chaetopsina was originally described (Rambelli 1956) for hyphomycetes having a pigmented, setose conidiophore with a sterile apex and laterally produced, thin-walled, non-pigmented branches bearing monoblastic phialides. Conidia were unicellular and held in slime heads. The original species was C. fulva. With the eight species that have been added since 1956, and with the three that are added herewith, the circumscription of Chaetopsina has gradually been expanded and now includes species that have a thick-walled, pigmented, setose conidiophore with a sterile or fertile apex and with or without sterile, setose branches; phialides are either monoblastic or polyblastic and conidia are either unicellular or bicellular and held singly or in slimy heads or chains (Table 1).

Chaetopsina most closely resembles Chaetopsis Grev., Gonytrichum Nees & Nees, Phaeostalagmus Gams, and Acrophialophora Edwards (see illustrations in Ellis 1971, Carmichael et al. 1980). Chaetopsina and Chaetopsis have been distinguished primarily on the basis of the presence of polyblastic phialides in Chaetopsis (Rambelli & Lunghini 1976) but polyblastic phialides are also found in Chaetopsina ivoriensis Rambelli & Lunghini (Rambelli & Lunghini 1976), C. romantica Rambelli & Lunghini [Morgan-Jones 1982; = Chaetopsis romantica (Rambelli & Lunghini) DiCosmo, Berch & Kendrick, 1983], and in the Chaetopsina anamorph of Nectria chaetopsinae-polyblastiae sp. nov. In one of the specimens of C. fulva cited by Matsushima (1980) from Taiwan (PDD 44253 ex MFC 8266) some conidiophores had only monoblastic phialides while on other conidiophores monoblastic and polyblastic phialides were present. Morgan-Jones (1982) questioned whether Chaetopsina and Chaetopsis could be maintained as distinct genera but he concluded that the primary differences between the two

genera lie in the orientation and morphology of the phialide bearing branches: acutely divergent, thick-walled and robust toward the point of origin in Chaetopsis as opposed to branches that are usually oriented more or less parallel to the seta and are generally flexuous and thin-walled in Chaetopsina. To these differences, it can be added that the reddish-brown seta in the anamorphs of Nectria becomes yellow in 100% lactic acid, a reaction paralleling the reaction in the perithecial wall of species of Nectria having red perithecia and apparently known only in the Hypocreales. The conidiophores of the Taiwanese collection of C. fulva cited above were reddish-brown and exhibited the same reaction. The conidiophores of one specimen of Chaetopsis grisea (Ehrenb.) Sacc. (PDD 15026 ex IMI 13928 c), the type species of Chaetopsis, were dark brown and remained brown in 100% lactic acid.

In Phaeostalagmus phialides either arise directly from the setose conidiophore or are arranged in ill-defined verticils. However, colonies of Phaeostalagmus are grey to black (Gams & Holubová-Jechová 1976), not brown as in Chaetopsina (Rambelli & Lunghini 1976 and data published herewith), and the phialides are Phialophora- or Chloridium-like, possessing a widely flaring collarette, whereas phialides of Chaetopsina have only a narrow opening which is not flared. Phaeostalagmus is differentiated from Gonytrichum through the method of attachment of the phialide-bearing branches to the seta. In Phaeostalagmus the phialophorous branches subtend a much larger angle relative to the seta above than do those of Gonytrichum, which may be appressed to the seta. In Cryptophiale Pirozynski the fertile branches arise from a dark brown seta and are densely compacted in the form of a shield (Pirozynski 1968, Sutton & Hodges 1976). Are these differences, in themselves, sufficient for generic delimitation? The phialophorous branches of C. fulva are closely appressed to the seta while among the other Chaetopsina anamorphs of Nectria two possibilities occur; conidiophorous branches of N. chaetopsinae-polyblastiae sp. nov. lie almost parallel to the seta while the phialophorous branches of N. chaetopsinae-catenulatae sp. nov. are more widely divergent. The only known teleomorph of Gonytrichum is the sphaeriaceous ascomycete Melanopsamella inaequalis (Grove) Höhnel; although teleomorphs are not known for Phaeostalagmus and Cryptophiale, the phialides suggest anamorphs of such sphaeriaceous ascomycetes as Lasiosphaeria Ces. & de Not. (Gams & Holubová-Jechová 1976) or Chaetosphaeria Tul. (Gams & Holubová-Jechová 1976). It is reasonable to ask whether Phaeostalagmus, Gonytrichum, and Cryptophiale are extremes within the same pattern of development that is found in Chaetopsina.

Acrophialophora is distinguished from Chaetopsina in that its conidia are dry and are borne end to end in chains; colonies are dark brown to black in reverse (Samson & Mahood 1970). Conidia of N. chaetopsinae-catenulatae sp. nov. are held in chains in nature but chains that form in culture slime down.

The examples given above indicate that the setiform conidiophore has arisen many times in the phialidic anamorph fungi; it is also a normal type of development in other ontogenetic series of anamorph fungi [e.g. Spondylocladiopsis M.B. Ellis and Circinotrichum fertile Pirozynski & Hodges in the denticulate series; Verticicladium Preuss,

Table 1. Summary of Chaetopsina species.

	CONIDIA size (µm)	septa	PHIALIDES	color	FERTILE SETAE apex	sterile branches
C. ivoriensis Rambelli & Lunghini (1976)	3-5 x 1.2-2.5	0	globose-ampulliform, mono- polyblastic	dark brown	sterile	-
C. auburnensis Morgan-Jones (1979)	4-8 x 0.5-0.75	0	globose, monoblastic	brown	sterile	-
C. romantica Rambelli (1979)	7-11.5 x 1.5-2.5	0	cylindrical, monoblastic	'Mars brown'	sterile or fertile	-
C. fulva Rambelli (1956)	7-14 x 1.6-2	0	ampulliform-cylindrical, mono- polyblastic	brown	sterile	-
C. polyblastia sp. nov.	7-9 x 2.5-3	0	cylindrical, mono- polyblastic	red-brown	fertile	-
C. ramifera Matsushima (1971)	8-12 x 1-1.5	0	cylindrical, monoblastic	dark brown	sterile	+
C. ludoviciana Crane & Schoknecht (1982)	9-11 x 1.3-1.5	0-1	cylindrical, monoblastic	brown	sterile	+
C. splendida Sutton & Hodges (1976)	9.5-12 x 1.5	0	cylindrical, monoblastic	red-brown	sterile	+
C. penicillata sp. nov.	9.4-22.3 x 5.9-10.3	0	cylindrical, monoblastic	red-brown	sterile or fertile	-
C. catenulata sp. nov.	12-16 x 2.5-2.5	0-1	cylindrical, monoblastic	red-brown	fertile	-
C. virtuosa Rambelli & Lunghini (1979)	20.5-34.5 x 2.0-2.5	0-1	cylindrical, mono- polyblastic	'Yellow ochre'	sterile	-

Verticicladiella Hughes in the holoblastic-sympodially proliferating series, and Haplographium Berkeley & Broome in the holoblastic-percurrently proliferating series].

It is doubtful that all the species currently disposed in Chaetopsina are actually congeneric with C. fulva. The red-brown conidiophore that turns yellow in lactic acid is a striking feature of Chaetopsina fulva and the other Chaetopsina anamorphs of Nectria. Because of their association with similar species of Nectria, it seems reasonable to limit Chaetopsina to species having a red-brown conidiophore that turns yellow in lactic acid. It is unlikely that the conidiophores of species having dark brown to black setae fit into this series of Nectria anamorphs; for example C. auburnensis Morgan-Jones (Morgan-Jones 1979), a species that is morphologically close to C. fulva but which is described as having dark brown or black colonies and brown conidiophores and phialides, C. ludoviciana Crane & Schoknecht (Crane & Schoknecht 1982), or C. ramifera Matsushima (Matsushima 1971). Other species should also be regarded with circumspection.

In a discussion of the setose genera Cylindrotrichum and Chaetopsis, DiCosmo et al. (1983) quantified the "intuitive process" of taxonomy of anamorph fungi by giving characters numerical values on the basis of their frequency of occurrence among anamorph genera. The features given greatest weight were considered to have the greatest taxonomic utility. Conidial shape and the presence of polyphialides were accorded the greatest significance; the formation of setose conidiophores was given lesser importance. As a result of this analysis they synonymized Cylindrotrichum with the older Chaetopsis and the definition of Chaetopsis was modified to include polyphialidic, sympodially proliferating conidiogenous cells and 0-1-septate, cylindrical conidia. They described two new genera, Kylindria DiCosmo, Berch & Kendrick and Xenokylindria DiCosmo, Berch & Kendrick, for species formerly included in Cylindrotrichum. These two genera were distinguished from Chaetopsis because their conidiogenous cells are monophialidic and their conidia are oblong-elliptic. Kylindria was distinguished from Xenokylindria through the non-proliferating phialides in the former and the percurrently proliferating phialides in the latter.

Although I do not disagree with their taxonomic conclusions, the present work demonstrates that their numerical analysis could be misleading. If the circumscription of Chaetopsina proposed in the present paper, and based on relationship to closely related species of Nectria, is accepted then none of the characters given great--or even moderate--weight by DiCosmo et al. (1983) are highly significant. The four Chaetopsina anamorphs are held together by the rather subtle feature of pigmentation of the setose conidiophore. Using traditional concepts of anamorph taxonomy or the more sophisticated numerical analysis of DiCosmo et al. these anamorphs would have been classified in two or more genera.

MATERIALS & METHODS

Single ascospores were isolated on cornmeal dextrose agar (CMD Difco) with the aid of a micromanipulator. Colonies were studied on

CMD, potato dextrose agar (PDA Difco) and oatmeal agar (OA Difco). Except where noted, colonies were grown for 10 days at 20°C, 12 h darkness alternating with 12 h cool white fluorescent + near-ultraviolet light. Dried specimens were rehydrated in 3% KOH. All measurements were made from material mounted in 100% lactic acid. Selected cultures are maintained in the American Type Culture Collection (ATCC).

DESCRIPTIONS OF THE SPECIES

1. Nectria chaetopsinae Samuels, sp. nov. Fig. 1.

Perithecia solitaria, superficialia, pyriformia, (128-)139-190(-205) x (115-)122-180(-185) µm, sicca rubra; in aqua vel potassii hydroxidi solutione humectata rubra, in acidis lactico lutescens; apice acuto. Asci clavati, (35-)38-43(-45) x 4.5-6.0(-8.0) µm, unitunicati, octospori, apice ab annulo refractili cincto. Ascosporae biseriatae, ellipticae, (7.0-)7.8-9.3(-10.0) x 1.9-2.7(-3.0) µm, aequaliter bicellulares, leves, hyalinae.

In folibus Collospermi hastati crescens.

Holotypus: PDD 44237, Isotypus: NY.

Status anamorphosus: Chaetopsina cf. fulva Rambelli, Atti Accad. Sci. Bologna 15: 5. 1956.

Conidiophores mononematous, scattered, setiform, erect, unbranched, red-brown, becoming yellow in 100% lactic acid, 200-230 µm long, tapering from 8-10 µm wide just above the swollen, 10-15 µm wide base to 4-5 µm wide at tip; wall ca. 2 µm wide at base, thinning to ≤0.5 µm wide at tip; apex sterile; bearing a few short lateral branches at or below the middle; branches formed of many small, ≤5 µm wide, thin-walled, non-pigmented cells, each cell producing one or more phialides; phialides densely clustered, subglobose to ampulliform, (10-)15-20(-22) µm long x 2.5-3.0 µm wide at base, monoblastic, tip 0.5-1.0 µm wide, lacking obvious periclinal thickening, not flared. Conidia oblong, (5.0-) 5.6-7.2(-8.5) x 1.0-1.3(-1.7) µm, lacking an obvious basal abscission scar, unicellular, hyaline, held in colorless slime. Sterile setae abundant, similar to conidiophores but lacking phialides and conidia.

Perithecia scattered, solitary, superficial, non-stromatic, mycelium not evident; pyriform, apex acute, not collapsing when dry, smooth, red; remaining red in 3% KOH, becoming yellow in 100% lactic acid, (128-)139-190(-205) µm high x (115-)122-180(-185) µm wide.

Cells at surface of perithecial wall textura epidermoidea, walls unevenly thickened, adjacent cells connected by pores or very thin regions of the wall. Perithecial wall ca. 10 µm wide, formed of a single region of intertwined hyphae; cells in section elliptical to fusiform, lumens 5-8 µm long x 1-2 µm wide; wall ca. 2 µm thick, pigmented; cells of inner ca. 5 µm elongated to fusiform, wall <0.5 µm thick, non-pigmented. Perithecial apex comprising ± elliptical cells at the surface; cells within arranged in a palisade of hyphae with rounded, 1-2 µm wide tips; hyphal elements merging with periphyses within. Perithecia anchored to substrate by hyphae arising from surface of lower perithecial wall.

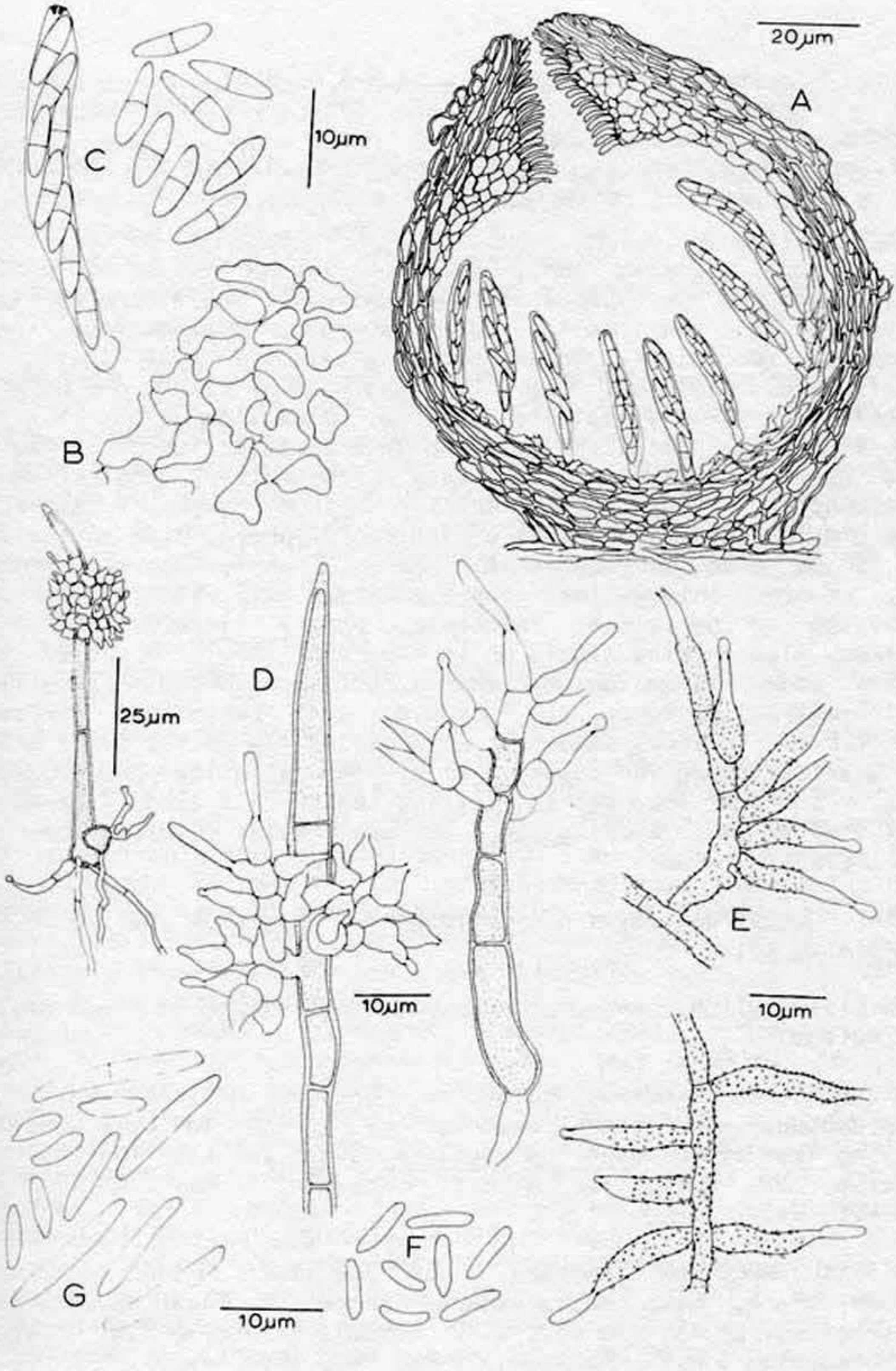


Fig. 1. Nectria chaetopsinae. A. Median longitudinal section of mature perithecium (GJS 83-105). B. Surface of perithecial wall (GJS 83-105). C. Asci and ascospores (GJS 83-105. D. Setose conidiophores from culture (conidiophore on right from GJS 83-105, otherwise from GJS 161). E. Micronematous conidiophores from culture (GJS 83-161). F. Conidia from nature (GJS 83-105). G. Conidia from culture (GJS 83-105).

Asci clavate, (35-)38-43(-45) x 4.5-6.0(-8.0) µm, apex with a ring; 8-spored, ascospores 2-seriate, entirely filling each ascus or up to 10 µm of ascal base empty.

Ascospores elliptical, (7.0-)7.8-9.3(-10.0) x 1.9-2.7(-3.0) µm, equally 2-celled, not constricted at the septum, smooth, hyaline.

CHARACTERISTICS IN CULTURE. CMD, PDA, OA: ca. 1 cm diam, flat, waxy, opaque, lacking aerial mycelium, Sienna (Rayner 8) in center, margin white (on PDA, entire colony white). Conidiophores forming profusely on all media, macronematous, mononematous, setose, unbranched, smooth; red-brown, becoming yellow in 100% lactic acid, (107-)125-165(-175) µm long x 10-12 µm wide at base x 4-5 µm wide at subacute tip, (1-)6-9-septate; wall ca. 3 µm wide at base x < 0.5 µm wide at apex. Phialides arising in a compact cluster in the upper third of the conidiophore, less frequently terminating the conidiophore. Phialides arising from short, thin-walled, non-pigmented lateral branches of the conidiophore, with an enlarged, ca. 3 µm wide, subglobose base and an abruptly narrowed, 1 µm wide neck, smooth, thin-walled, non-pigmented, tip lacking periclinal thickening or periclinal thickening barely visible, not flared. Phialides also arising singly or in ± verticillately branched whorls of 2-3 from hyphae on surface of agar, subglobose to ampulliform, (10-)15-20(-22) µm long; tip 1 µm wide, with periclinal thickening; base 1.5-2.0 µm wide, smooth or with yellow (in lactic acid) granular incrustations along the lower 2/3 of the phialide and subtending hypha. Conidia oblong to cylindrical, (6.5-)9.3-17.3(-22.0) x 2.0-2.5(-3.0) µm, lacking an obvious basal abscission scar, unicellular, hyaline.

HABITAT. Decaying leaves of Collospermum hastatum (Col.) Skottsb. and Astelia sp.

KNOWN DISTRIBUTION. Anamorph cosmopolitan, teleomorph known only from New Zealand.

HOLOTYPE. NEW ZEALAND: Gisborne, Urewera National Park, Lake Waikaremoana, vic. park headquarters, track to Lake Ruapani, on decaying leaf of Collospermum hastatum, G.J. Samuels (83-105), P.R. Johnston, T. Matsushima & A.Y. Rossman, 31 May 1983 (PDD 44237; ISOTYPE: NY).

ADDITIONAL SPECIMEN EXAMINED. NEW ZEALAND: Gisborne, Urewera National Park, Lake Waikaremoana, track to Lake Waikare-iti, on decaying leaf of Astelia sp., G.J. Samuels (83-161), P.R. Johnston, T. Matsushima & A.Y. Rossman, 29 May 1983 (PDD 44236).

NOTES. Conidiophores formed in culture paralleled those found in nature except that in nature phialides were strictly terminal whereas in culture they were either terminal or intercalary. Cultures were made from ascospores isolated from both of the collections cited above; unfortunately these cultures have been lost. Dried cultures are deposited with the specimens deposited in PDD.

2. Nectria chaetopsinae-polyblastiae Samuels, sp. nov. Figs. 2,3.

Nectria chaetopsinae similis, sed perithecia 145-160 x 115-145 um; asci (41-)43-56(-60) x 10-13 um; ascosporae angustae ellipticae vel oblonges, (7.5-)11.2-14.8(-16.0) x 3.0-3.5 um.

In corticibus ignotis crescens.

Holotypus. Samuels 1891: VEN; Isotypus: NY.

Status anamorphosus: Chaetopsina polyblastia Samuels, sp. nov.

Setae singularitim dispersae, erectae, rectae, septatae, laeves, crasse tunicatae; rubro brunneae, in acidis lactico lutescens, 145-160 um longae, 4-5 um crassae, basi 10-15 um crassae. Rami conidiophori e apice gerentes, exiles, hyalini. Phialides monoblasticae vel polyblasticae, 12-20 um longae, superne 1.5-2.0 um, inferne 2.5-3.0 um. Conidia oblonga vel elliptica, (5.5-)7.0-9.0 x 2.5-3.0 um (in vivo), (11.0-)17.6-25.4(-27.0) x 4.0-5.3(-6.0) um (in vitro) unicellularia, hyalina.

In corticibus.

Holotypus. Dumont-VE 6914: NY.

Status teleomorphosus. Nectria chaetopsinae-polyblastiae Samuels

Conidiophores red-brown, yellow in 100% lactic acid, erect, setose, septate, 145-160 um long with base bulbous, 10-15 um wide x 4-5 um wide at tip, wall 1.5-2.0 um thick; apically branched; branches thin-walled, non-pigmented, ca. 100 um long, each bearing several lateral phialides. Phialides 12-20 um long, tapering from 2.5-3.0 um wide at base to 1.5-2.0 um wide at tip, polyblastic with both terminal and lateral conidiogenous loci, or monoblastic, apex with periclinal thickening, collarette flared or not. Conidia oblong to elliptical, lacking an obvious basal abscission scar, (5.5-)7.0-9.0 x 2.5-3.0 um, unicellular, hyaline.

Ascomata solitary, scattered, superficial, non-stromatic, difficult to remove from substrate with base sometimes partially immersed in substrate; red above, orange to red below, uniformly red in 3% KOH, yellow in 100% lactic acid; pyriform with an acute apex, not collapsing when dry, 145-160 um high x 115-145 um wide, smooth.

Ascomatal wall ca. 10 um wide. Cells at surface of wall textura epidermoidea, walls unevenly thickened, < 3 um wide. Ascomatal wall in longitudinal section comprising a single region of ± intertwined hyphae appearing as elliptical or flattened cells 8-10 um long with lumens < 5 um wide, or narrow, 1 um wide; walls 1.0-1.5 um thick, cells becoming progressively more flattened toward the interior of the wall. Ostiolar area composed of ± vertically oriented cells; cells becoming progressively more hyphal, merging with periphyses at ostiolar canal. Ascomata anchored to substrate by a minute basal stroma comprising thin-walled textura epidermoidea.

Asci clavate, (41-)43-56(-60) x 10-13 um, apex with a ring; 8-spored, ascospores 2-seriate above, 1-seriate below, completely filling each ascus.

Ascospores narrowly ellipsoidal to oblong, (7.5-)11.2-14.8(-16.0) x 3.0-3.5 um, equally 2-celled, not constricted at the septum, smooth, hyaline.

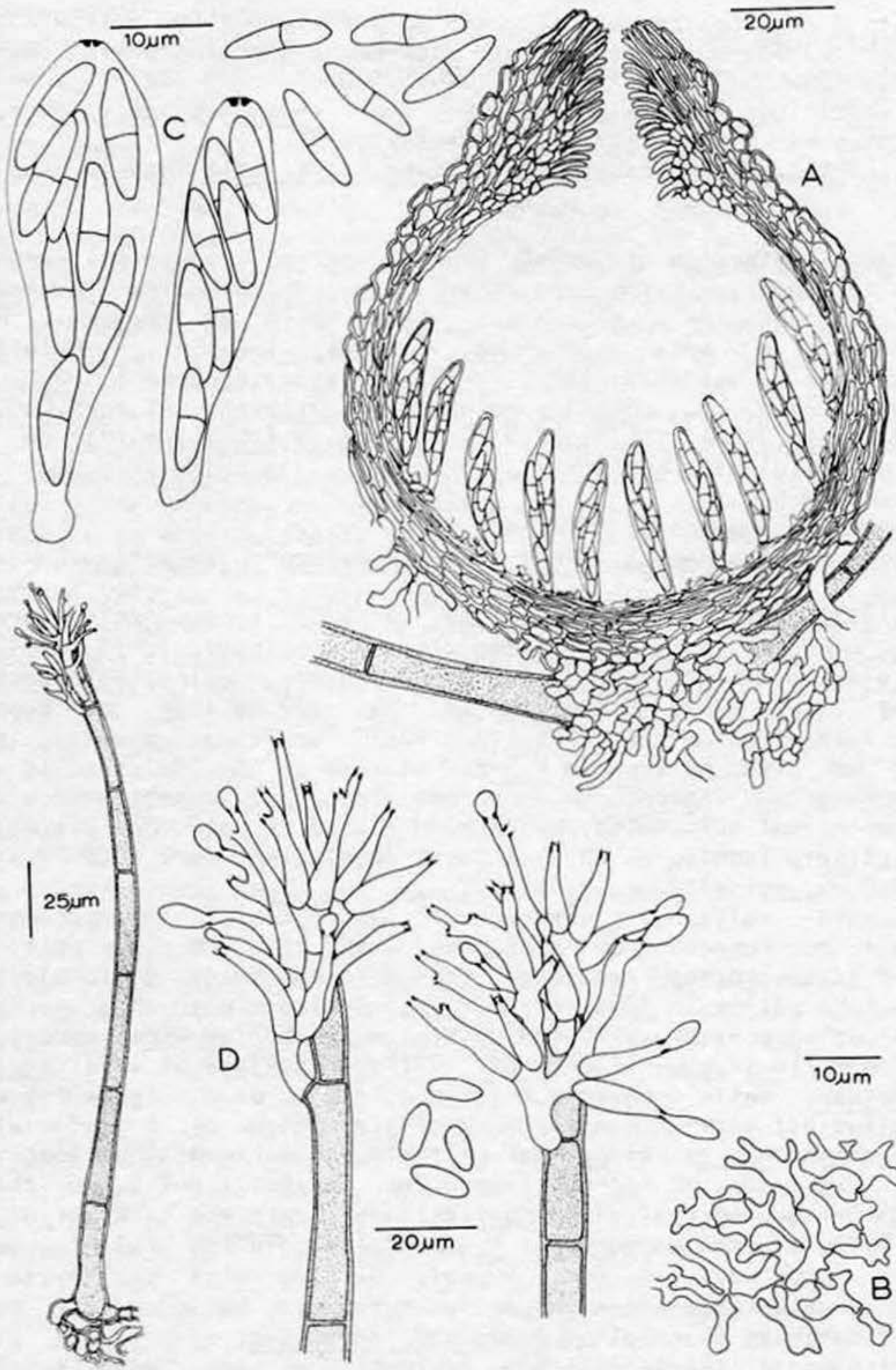


Fig. 2. Nectria chaetopsinae-polyblastiae. A. Median longitudinal section of mature perithecium (Dumont-EC 886). B. Surface of perithecial wall (Dumont-EC 886). C. Asci and ascospores (Dumont-VE 6914 a). D. Conidiophores and conidia (Dumont-VE 6914 a).

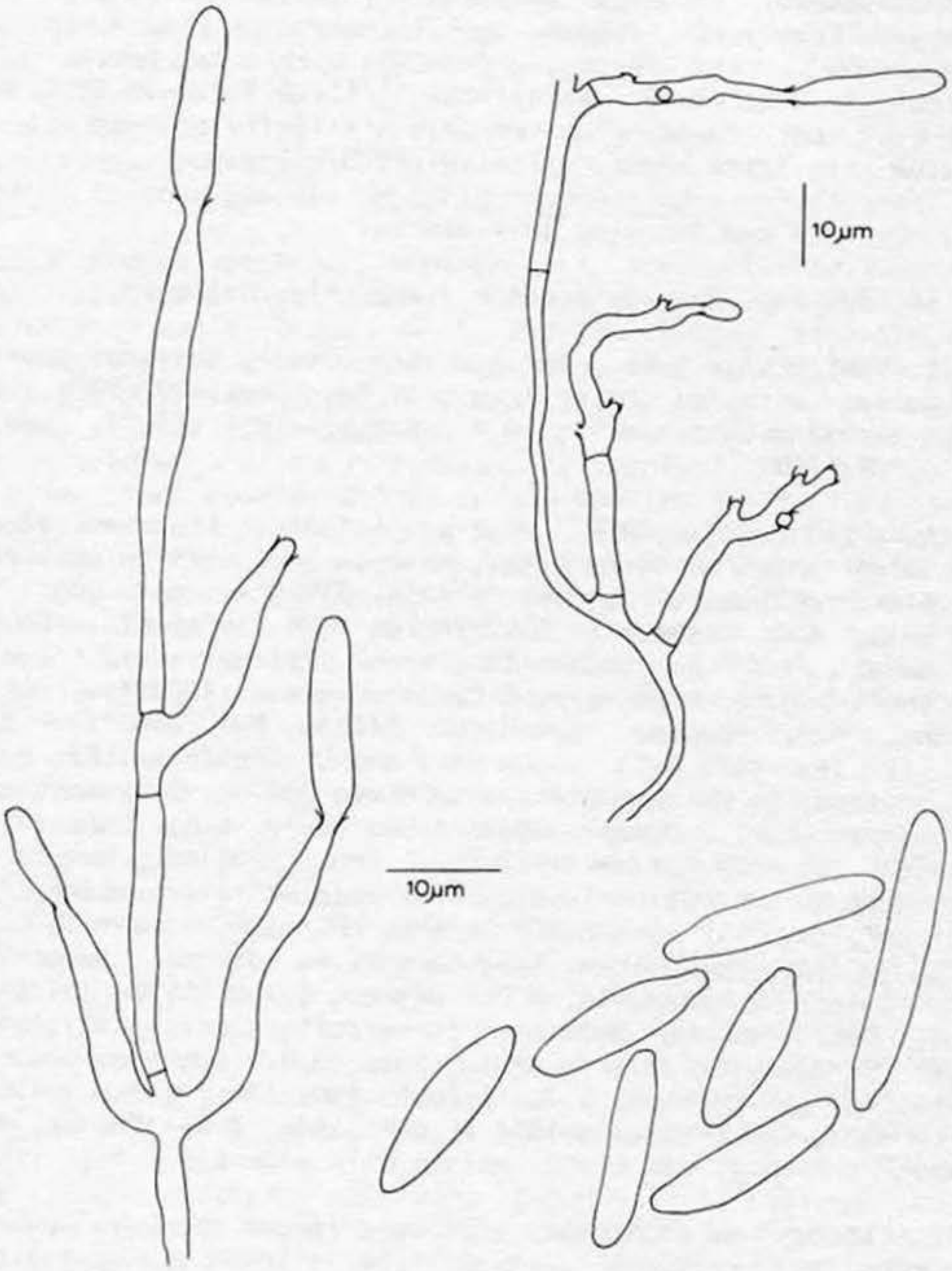


Fig. 3. Nectria chaetopsinae-polyblastiae. Conidia and conidiophores in culture. (Samuels 1891).

CHARACTERISTICS IN CULTURE. CMD: 1 cm, flat, opaque; reddish (approximately Rayner 42: Apricot) in the center, white elsewhere; aerial mycelium scant, hyphae short. PDA: 1.5 cm, flat, opaque, Rust (Rayner 39) in the center, white elsewhere; colony surface velvety, aerial hyphae short; Amber pigment (approximately Rayner 47) diffusing. OA: 1.5 cm, flat, white; aerial hyphae scant, short. Conidiophores forming profusely on all media, arising from aerial hyphae and from surface of agar; micronematous, mononematous, smooth, colorless, 12-45 µm long x 1.5 µm at tip x 2-4 µm wide at base, septate or not at base and comprising a single phialide, less frequently once branched and each branch a phialide; phialides at

first monoblastic, becoming polyblastic, tip with slight periclinal thickening. Scattered, setose conidiophores as found in nature forming on OA within 10 days and on PDA within one month. Conidia cylindrical to narrowly elliptical, (11.0-)17.6-25.4(-27.0) x 4.0-5.3(-6.0) µm; base round or with a slightly protuberant, flat, 1.5 µm wide abscission scar; unicellular, hyaline.

HABITAT. On bark and decaying palm debris.

KNOWN DISTRIBUTION. Brazil, Ecuador, Venezuela, Colombia.

HOLOTYPE. VENEZUELA: T.F. Amazonas, Cerro de la Neblina, along Rio Mawarinuma at a point ca. 3 km E of Base Camp (00° 50'N, 66° 10'W), on decaying palm midribs, G.J. Samuels 1891 (84-4), 5 May 1984 (VEN, ISOTYPE: NY).

ADDITIONAL SPECIMENS EXAMINED. BRAZIL: Estado do Amazonas, base of W facing talus slope of Serra Araca, near central portion of serra ca. 45 min walk from lower air strip; 0°45'N, 63°19'W; alt. ca. 60 m, on palm, G.J. Samuels 569, 28 Feb 1984 (INPA, NY). COLOMBIA: Dpto. Meta, vic. km post 18 from Villavicencio, on the Villavicencio-Bogota Road via. Caqueta, elev. 4200 ft., on indet. palm frond, K.P. Dumont (Dumont-CO 2405), P. Buritica & J.L. Luteyn, 11 Jan 1976 (NY). ECUADOR: Prov. Pichincha, Rio Palenque Biology Station, 56 km from Quevedo on Santo Domingo-Quevedo Road, on indet. bark, K.P. Dumont (Dumont-EC 886), S.E. Carpenter & P. Buritica, 21 Jul 1975 (NY). VENEZUELA: Edo. Bolivar, trail up N facing slope of Uei Tepui, from old military camp "Ciento Veinticinco", ca. 118 km S of El Dorado, on road between El Dorado and Sta. Elena, on unidentified bark, K.P. Dumont (Dumont-VE 6914 a), R.F. Cain, G.J. Samuels, & C. Blanco, 5 Aug 1972 (NY); T.F. Amazonas, Cerro de La Neblina, three collections with location as holotype: on decaying palm sheathing base, G.J. Samuels 1888 A, 5 May 1984 (NY); on bark, G.J. Samuels 1902 (84-3), 5 May 1984 (NY, VEN); on wood, G.J. Samuels 1754 A, B. Stein, & W. Thomas, 1,2 May 1984 (NY).

NOTE. Ascospores of Samuels 1902 were larger than is usual for the species but cultures derived from single ascospores of this collection were identical to those produced by Samuels 1891, the holotype.

3. Nectria chaetopsinae-penicillatae Samuels sp. nov. Fig. 4.

Nectria chaetopsinae similis, sed perithecia (266-)288-345 x (220-)228-260 µm; asci (80-)93-114(-120) x (14-)18-22(-23) µm, apice simplices; ascosporae fusiformes, (19-)24.8-41.9(-48.0) x (5.5-)5.8-9.8(-11.0) µm, crasse striatae.

In corticibus Beilschmiedia tawa.

Holotypus. PDD 44235.

Status anamorphosis. Chaetopsina penicillata Samuels sp. nov.

Setae singularitim dispersae, erectae, rectae, septatae, laeves, crasse tunicatae; rubro brunneae, in acidis lactico lutescens, 350-370 um longae, superne ca. 10 µm crassae, basi 15-25 µm crassi. Phialides e apice gerentes, in penicilli ordinati. Penicilli

biverticillati, 1° metulae 10-15 x ca. 4 µm, 2° metulae 8-10 x ca. 4 µm; phialides cylindricae vel ampulliformes, 10-15 x 3-4 µm. Conidia ellipticae vel subfusiformes, (8.0-)9.4-22.9(-26.0) x (5.0-)5.9-10.3(-11.0) µm.

In ramunculo.

Holotypus. Dumont-EC 609: NY.

Status teleomorphosus. Nectria chaetopsinae-penicillatae Samuels

Conidiophores scattered, mononematous, erect, setose, unbranched, septate and appearing segmented; red-brown, becoming yellow in 100% lactic acid; walls 2-3 µm thick, 350-370 µm long, tapering from 15-25 µm wide base to ca. 10 µm wide at tip, bearing a single, terminal, colorless, slimy head of conidia on a ca. 25 µm wide penicillus of phialides. Penicillus biseriate, 2-4 primary metulae arising from tip of conidiophore; primary metulae, cylindrical, 10-15 µm long x ca. 4 µm wide, each bearing 2-5 secondary metulae at its tip; secondary metulae cylindrical, 8-10 µm long x ca. 4 µm wide, each bearing ca. 4 phialides. Phialides cylindrical to ampulliform, 10-15 x 3-4 µm wide, with pronounced periclinal thickening at the tip and a flared collarette. Metulae and phialides thin-walled and non-pigmented. Conidia elliptic to subfusoid, tips rounded to subacute, base rounded or with a flat, protuberant abscission scar, (8.0-)9.4-22.9(-26.0) x (5.0-)5.9-10.3(-11.0) µm, unicellular, hyaline. Sterile setae present, similar to conidiophores.

Perithecia solitary, scattered, superficial, seated on an inconspicuous, non-erumpent basal stroma; red or red above and yellow below, becoming uniformly red in 3% KOH and yellow in 100% lactic acid, pyriform with an acute apex, smooth, not collapsing when dry, (260-)288-345 µm high x (220-)228-260 µm wide.

Cells at surface of perithecial wall textura epidermoidea, adjacent cells joined by a pore, walls 1.5-2.0 µm thick. Perithecial wall ca. 15 µm wide, cells at surface, when seen in section, with flat to circular, 2-5 µm wide lumens, walls 1.5-2.0 µm thick, cells becoming progressively more flattened and thin-walled toward the perithecial locule; perithecial apex comprising a palisade of parallel, hyphal elements with narrow lumens and rounded tips, walls 1-2 µm thick, elements becoming progressively thinner and more thin-walled toward the ostiolar canal, merging with periphyses.

Asci clavate, (80-)93-114(-120) x (14-)18-22(-23) µm, apex simple, 3-8-spored, sometimes with 4 normal spores and 4 aborted spores, ascospores biseriate, completely filling each ascus.

Ascospores fusiform, (19.0-)24.8-41.9(-48.0) x (5.5-)5.8-9.8(-11.0) µm, equally 2-celled, not constricted at the septum, with ridge-like striations, hyaline.

CHARACTERISTICS IN CULTURE. CMD: 1.5 cm diam., flat, transparent, scant, aerial mycelium white, colony white to pale Sienna (Rayner 8), reverse concolorous, some brown pigment spreading into the medium. PDA: 1 cm diam, flat; scant, aerial mycelium scant, white, surface of colony Sienna (Rayner 8), reverse concolorous, Sienna pigment spreading into the medium. OA: 1 cm diam, as PDA but pigmentation less intense, pale red-brown pigment spreading through the medium.

Conidial production abundant on all media. Conidiophores scattered, mononematous, unbranched, stiff, erect, red-brown, 150-230 µm long with base ca. 10 µm wide, wall ca. 2 µm thick; a single, compact penicillus formed at the tip of each conidiophore. Penicillus biseriate, ca. 4 primary metulae arising from the tip of each conidiophore; primary metulae cylindrical, 10-15 µm long x ca. 5 µm wide, each bearing 2-3 secondary metulae or 2-4 phialides; secondary metulae cylindrical, 10-15 long x ca. 5 µm wide, each bearing 2-4 phialides. Phialides cylindrical, 12-16 x 4-5 µm, with periclinal thickening at the tip and a flared, sometimes funnel-shaped, collarette. Phialides also arising from vegetative hyphae, 12-30 µm long x 2-4 µm wide, slight periclinal thickening at tip; collarette flared, often cupulate. Conidia ± elliptical with apex round or acute and papillate, base round or with a protuberant, flat basal abscission scar, (13.0-)17.6-22.3(-25.0) x (6.0-)6.8-8.2 µm, unicellular, smooth, hyaline, produced in basipetal succession and held in a colorless drop of slime at the tip of each conidiophore and forming a continuous layer of white slime on surface of colony.

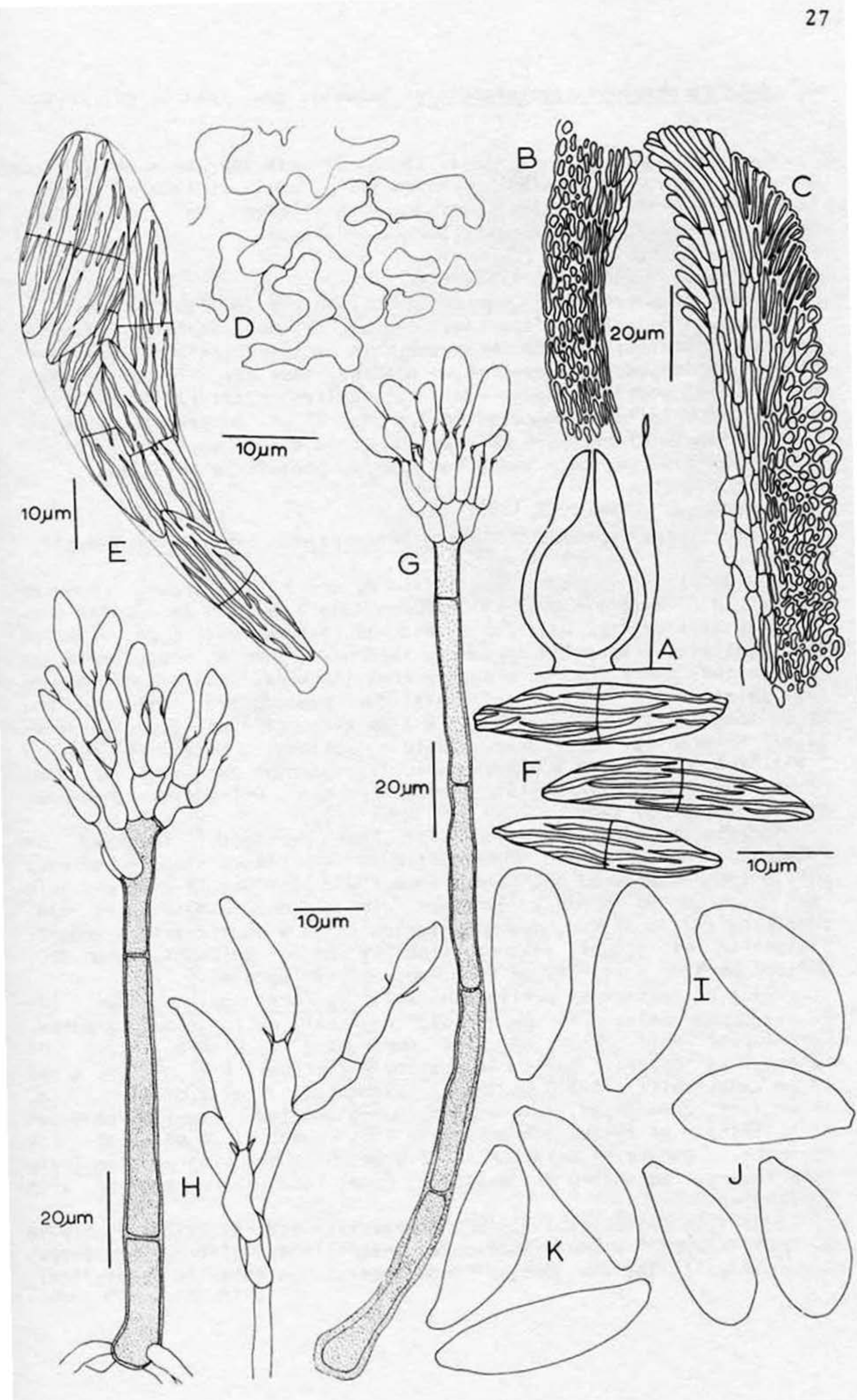
HABITAT. Bark of Beilschmiedia tawa (A. Cunn.) Kirk and sheathing base of palm frond (Rhopalostylis sapida Wendl. & Drude).

KNOWN DISTRIBUTION. Ecuador, Jamaica, New Zealand.

HOLOTYPE. NEW ZEALAND: Auckland, Waitemata City, Waitakere Ranges, Piha Rd., Marguerite Track, on bark of Beilschmiedia tawa, G.J. Samuels (77-21), 21 Mar 1977 (PDD 44235, PDD Culture Collection 7801, ATCC 56205).

ADDITIONAL SPECIMENS EXAMINED. ECUADOR: Prov. Pichincha, 24 km above Toachi on the Toachi-Palo Quemado Rd., elev. ca. 3400 ft., on twig, K.P. Dumont (Dumont-EC 609), S.E. Carpenter, P. Buritica, 19 Jul 1975 (NY, PDD 44233). JAMAICA: St. Andrew's Parish along Wag Water River, near source, Holywell Recreation area, elev. 2800-3000', on bark, R.P. Korf, J.R. Dixon, K.P. Dumont, R.W. Erb, D.H. Pfister, D.R. Reynolds, A.Y. Rossman & G.J. Samuels, 11 Jan 1971 (NY: CUP-MJ 797). NEW ZEALAND: Waitemata City, Waitakere Ranges, Piha Rd., Marguerite Track, on sheathing base of Rhopalostylis sapida, G.J. Samuels (80-54) & B. Kendrick, 14 Mar 1980 (PDD 44234, PDD Culture Collection 7802).

Fig. 4. Nectria chaetopsinae-penicillatae. A. Diagram of perithecium with adjacent conidiophore (GJS 77-21). B. Portion of lateral wall of perithecium (GJS 77-21). C. Portion of ostiolar region of perithecium (GJS 77-21). D. Surface of perithecial wall (GJS 77-21). E. Ascus (GJS 77-21. F. Ascospores (GJS 77-21). G. Conidiophore from nature (Dumont-EC 609). H. Setiform and micronematous conidiophores formed in culture (GJS 80-54). I. Conidia from nature (Ecuador, Dumont-EC 609). J. Conidia from nature (New Zealand, GJS 80-54). K. Conidia from culture (New Zealand, GJS 80-54).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4. Nectria chaetopsinae-catenulatae Samuels, sp. nov. Figs. 5,6.

Nectria chaetopsinae similis, sed perithecia 250-280 x 145-280 µm et cum disco osteolari instructi; asci (44-)53-73(-90) x (5.0-)6.5-9.0(-10.0) µm; ascosporae fusiformes vel ellipticae, (10.0-)10.6-13.2(-15.0) x (3.0-)3.3-4.3(-5.0) µm.

In corticibus.

Holotypus. Dumont-VE 1256: NY.

Status anamorphosus. Chaetopsina catenulata Samuels sp. nov.

Setae singularitim dispersae, erectae, rectae, septatae, laeves, crassa tunicatae; rubro brunneae, in acidis lactico lutescens, 350-450 µm longae, supernae 7-8 µm crassae, basi ca. 15 µm crassi. Rami conidiophori e apice gerentes, exiles, hyalini, in verticilli ordinati. Phialides monoblasticae, ca. 25 µm longae, superne ca. 2 µm crassae, infernae 4-5 µm crassae. Conidia oblonga, (8-)12-16(-21) x 2.5-3.5(-5.0) µm, uni- vel bicellularia, portata in catenis.

In corticibus.

Holotypus. Dumont-VE 1256: NY.

Status teleomorphosus. Nectria chaetopsinae-catenulatae Samuels.

Conidiophores mononematous, setiform, erect, red-brown, becoming yellow in 100% lactic acid, 350-450 µm long x ca. 15 µm wide at base x 7-8 µm wide at tip, wall 2-3 µm wide at base and ca. 1 µm wide at tip, septate, frequently appearing segmented, smooth, producing a few thin-walled, non-pigmented branches from the apex, each branch bearing 1-5 phialides in verticils; phialides monoblastic, subulate, ca. 25 µm long x 4-5 µm wide at base x 2 µm wide at tip; tip with periclinal thickening, not flared. Conidia oblong, (8-)12-16(-21) x 2.5-3.5(-5.0) µm, with a protuberant, flat scar at each end or apex round and base with a flat, protuberant scar, 0-1-septate, hyaline. Sterile setae not seen.

Perithecia superficial or with base partially immersed in substrate, non-stromatic but difficult to remove from substrate, solitary and scattered or, less frequently, cespitose in clusters of a few, globose to broadly pyriform with a broad, obtuse apex; red, remaining red in 3% KOH, becoming yellow in 100% lactic acid, smooth, collapsing by slight lateral pinching or not collapsing when dry, 250-280 µm high x 145-280 µm wide, apex 80-125 µm diam.

Cells at surface of perithecial wall textura epidermoidea, 10-20 µm across, walls 2-3 µm thick; adjacent cells joined by pores. Perithecial wall 30-35 µm wide comprising a single region of intertwined hyphae, cells in section elliptical, 8-25 µm long x ca. 10 µm wide, walls 1.5-2.0 µm thick, pigmented; cells of inner ca. 10 µm flat, compressed, thin-walled, non-pigmented. Papillum composed of a palisade of hyphal elements with tips round, ca. 6 µm wide; walls of hyphal elements at exterior 1.5-2.0 µm thick becoming progressively more thin-walled toward the ostiolar canal and there merging with periphyses.

Asci clavate, (44-)53-73(-90) x (5.0-)6.5-9.0(-10.0) µm, apex with a small ring; 8-spored, ascospores 2-seriate above, 1-seriate below, completely filling the ascus. Ascospores fusiform to elliptical,

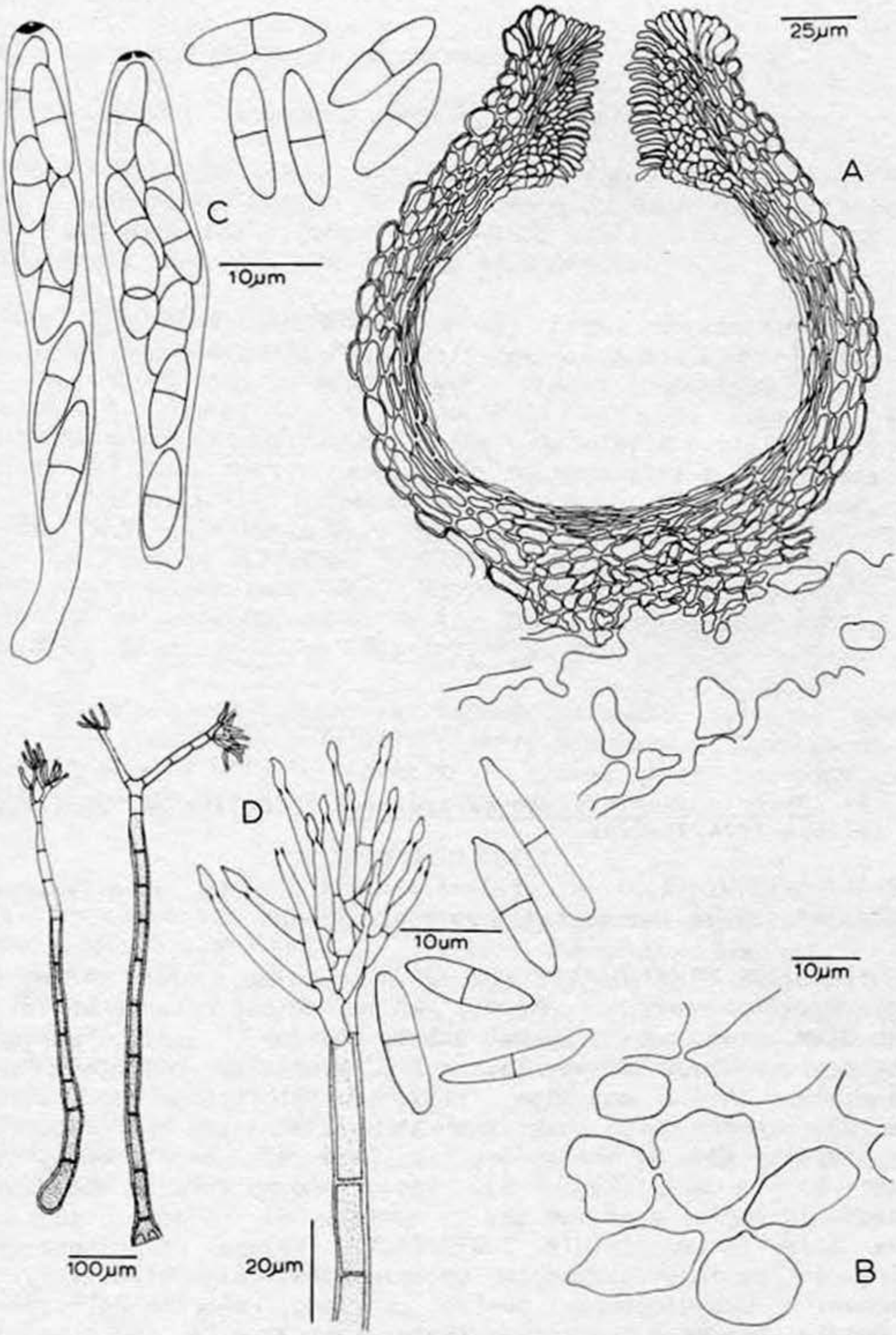

Fig. 5. Nectria chaetopsinae-catenulatae. A. Median, longitudinal section of mature perithecium. B. Surface of perithecial wall. C. Asci and ascospores. D. Conidiophores from nature. (all figures from Dumont-VE 1256).

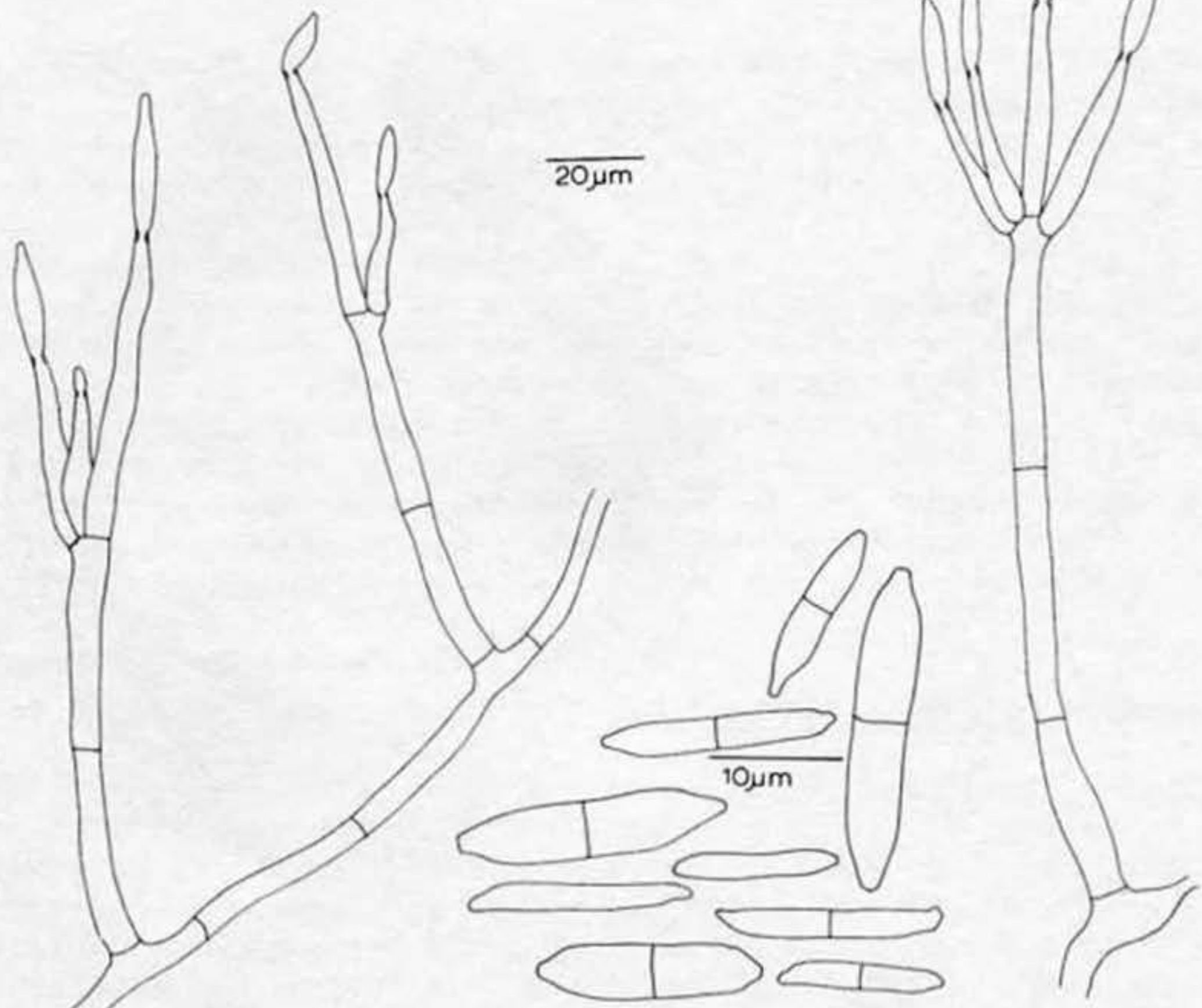

Fig. 6. Nectria chaetopsinae-catenulatae. Conidia and conidiophores from culture (CTR 71-245).

(10.0-)10.6-13.2(-15.0) x (3.0-)3.3- 4.3(-5.0) µm, equally 2-celled, not constricted at the septum, hyaline, smooth.

CHARACTERISTICS IN CULTURE. CMD: 2-3 cm diam, flat, translucent, aerial mycelium short, cottony, white, colony reverse white. PDA: 2-3 cm diam, flat, aerial hyphae short, cottony, white, surface of colony approximately Sienna (Rayner 8), reverse approximately Ochreous (Rayner 44). OA: 3 cm diam, flat, aerial hyphae consisting of barraging, dendroidal, rope-like strands arranged in 1-2 concentric rings near the edge of the colony, surface of colony dark, Sienna (Rayner 8) to Umber (Rayner 9). Conidiophores forming abundantly on all media in aerial mycelium and on surface of colony; surface of colony slimy from conidia. Distinctly setose conidiophores not forming in culture but many conidiophores pigmented very pale red-brown. Conidiophores 50-180 µm long, unbranched, sparingly branched, each branch bearing a single phialide or a verticillate or penicillate whorl of up to 6 phialides. Phialides 12-50 µm long, often with a long phialide in the middle of a whorl of phialides, 1.5-2.0 µm at tip x 2.0-3.5 µm wide at base, straight, smooth, tip with periclinal thickening, not flared. Conidia oblong to fusiform,

(6.5-)10.2-19.5(-23.0) x (1.5-)1.9-3.5(-4.5) µm, with a flat protuberance at each end, 0-1-septate, hyaline, smooth, held in chains that slime down.

HABITAT. Bark and ascomycetous stromata.

KNOWN DISTRIBUTION. Ecuador, Jamaica, Venezuela.

HOLOTYPE. VENEZUELA: Edo. Aragua, 2-3 km along trail behind hotel, up Mt. Guacamaya, Rancho Grande, Parque Nac. Henry Pittier, on unidentified wood, K.P. Dumont (Dumont-VE 1256), J.H. Haines & G.J. Samuels, 4 Jul 1971 (NY, CTR 71-245, ATCC 56204).

ADDITIONAL SPECIMENS EXAMINED. ECUADOR: Prov. Morona Santiago, ca. 5 km from Limon (General Plaza Guiterrez), on the Limon-Mendez road, elev. ca. 4,000 ft., on branch, K.P. Dumont (Dumont-EC 2043), S.E. Carpenter & P. Buritica, 3 Aug 1975 (NY). JAMAICA: Boundary between St. Andrew and Portland Parish, along Lady's Mile trail to just S of Woodcutter's Gap, vic. Newcastle, on stromatic pyrenomycete, R.P. Korf, J.R. Dixon, K.P. Dumont, R.W. Erb, D.H. Pfister, D.R. Reynolds, A.Y. Rossman & G.J. Samuels, 9 Jan 1971 (NY: CUP-MJ 745, CTR 71-23; Rossman 373, ATCC 56203). VENEZUELA: Edo. Miranda, road between Agua Blanco and Parq. Nac. Guatopo at Oficina, Parq. Nac. Guatopo, on unidentified bark, K.P. Dumont (Dumont-VE 942), J.H. Haines & C. Blanco, 29 Jun 1971 (NY, VEN, NYS).

NOTE. Few setose conidiophores formed in pure cultures of this species and these were only very lightly pigmented. Conidia on these conidiophores were held in chains that slimed down to form heads. Conidia in nature are also held in chains.

ACKNOWLEDGMENTS

This research was supported in part by grants from the American Philosophical Society and U.S. National Geographic Society (2736-83) to the author and in part by NSF grants 28593 ff to Dr. K.P. Dumont, The New York Botanical Garden, whose assistance is gratefully acknowledged. Dr. T. Matsushima (Matsushima Fungus Collection, Kobe) kindly provided me with living and dried material of Chaetopsina fulva and a living culture of C. ramifera. Dr. G. Kuschel, Entomology Division, DSIR, corrected the Latin diagnoses. This manuscript was reviewed by Drs. C.T. Rogerson, G. Morgan-Jones and B. Kendrick.

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MYCOTAXON

Vol. XXII, pp. 33-38 January-March 1985

THE NEMATODE PARASITE MERIA CONIOSPORA DRECHSLER IN PURE CULTURE AND ITS CLASSIFICATION

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Meria coniospora was accurately described by Drechsler (1941) as an endoparasite of *Rhabditis* spp. and other nematodes, but not studied in pure culture. This fungus is unique because of its conical conidia which tend to stick with their pointed end to the oral and in some cases the tail region of Rhabditidae and other free-living nematodes (Drechsler, 1941; Barron, 1977; Dürschner, 1983; Jansson and Nordbring-Hertz, 1983). This specific attachment may be due to a lectin-carbohydrate (sialic acid) interaction (Jansson and Nordbring-Hertz, 1983, 1984). *M. coniospora* shows a high ability to infect and kill nematodes, and the strong attraction of nematodes to conidia might play an important role in this respect (Jansson, 1982a, b). In addition, the fungus exudes a mycostatic antibiotic (Barron, 1977). After the original description from the U.S.A., the fungus has been recorded from the British Isles (Duddington, 1946, 1954; Wyborn et al., 1969; Gray, 1983a, b), Canada (Barron, 1977, 1978), Denmark (Jansson, 1982a), Germany and the Netherlands (Dürschner, 1983), Japan (Saikawa, 1982 a and b) and the Antarctic South Orkney and Argentine Islands (Gray, 1982; Gray et al., 1982). It has been recorded from agricultural soils, moss cushions, compost and coniferous litter. A few authors (Barron, Jansson, Dürschner, and Saikawa, l.c.) have had pure cultures available obtained with the method described by Barron (1969) and other methods (Wyborn et al., 1969; Barron, 1977, 1978), but they did not provide a description of the fungus at the macroscopic and light-microscopic level. SEM and TEM illustrations of conidiogenous structures formed in pure culture were, however, published by Saikawa (1982a and b) and Jansson et al. (1984).

For a reassessment of the generic classification of this fascinating fungus, a description of pure cultures and the comparison with *Meria laricis* Vuill., the type species of the genus, are required. These are the aims of the present communication.

Material examined:
Meria coniospora Drechsler, CBS 615.82, isolated by S. Olsson and H.-B. Jansson, from agricultural soils in Denmark in 1978 by means of the differential centrifugation technique (Barron, 1977).
Meria laricis Vuill., CBS 216.31, isolated by T. R. Peace, 1931; CBS 298.52, isolated by E. Müller, Horgenberg, Kt. Zürich, Switzerland, May 1952; CBS 281.59–284.59, isolated by P. Biggs in Scotland and Wales, 1955-56; all from *Larix* spp. (mainly *L. europaea*).

Description of *Meria coniospora* – Fig. 1.

Colonies on MEA, OA and other media growing extremely slowly, reaching 2-3 mm diam in 10 days, 10 mm in 35 days at c. 20 °C, at first white, later becoming cream-coloured, slightly raised, powdery due to erect fertile hyphae. Colony reverse pale ochraceous. Odour very strong, fetid, suggesting dirty socks or a Mexican maize product "taco". Vegetative hyphae of regular width, 1.5–2.5 µm. Sporulation mostly by means of erect fertile hyphae, partly also submerged. Fertile hyphae not distinct from vegetative hyphae, except for the presence of lateral conidiiferous pegs in the uppermost 3-8 cells. The conidiogenous cells are thus one terminal and a number of intercalary phialides, 5–13 x 2.0–2.5 µm, with conidiiferous pegs of 1–4 x 0.6–1.0 µm, with a minute, slightly widening collarette; periclinal wall thickening inconspicuous under the light microscope (but distinct under TEM, Saikawa, 1982a). Conidia initially appearing to be formed singly on each conidiiferous peg of the conidiophore, but after a few weeks forming radiating clusters on each peg; conical, with broadly rounded base and almost pointed tip, one-celled, hyaline, smooth-walled, 1–2-guttulate, 4.5–7 x 1.5–2.0 µm in the broadest part. Aged conidia often show a slight apical swelling which appears to contain the adhesive material for attachment to nematodes. Temperature minimum for growth near 10 °C, for conidial germination near 15 °C, maximum near 27 °C (30 °C is survived for 5 days).
As there is no type specimen prepared by Drechsler accessible, we designate a dried culture of CBS 615.82 as neotype.

In contrast with *Verticillium balanoides* (Drechsler) Dowsett, Reid & Hopkin (Dowsett et al., 1982), the microscopic features of *M. coniospora* are quite constant in pure culture and on eelworms (as observed on cultures of *Panagrellus redivivus* on water agar). Our observations generally confirm Drechsler's (1941) observations from xenic cultures. The very restricted growth and the abundant sporulation in pure culture are remarkable features among the nematode parasites. Jansson (1982 b) found that the fungal biomass of nematode parasites is roughly inversely proportional to their preda-

cious ability. This organism is thus a very typical representative of the R strategy of high stress–high disturbance survivors (Pugh, 1980).

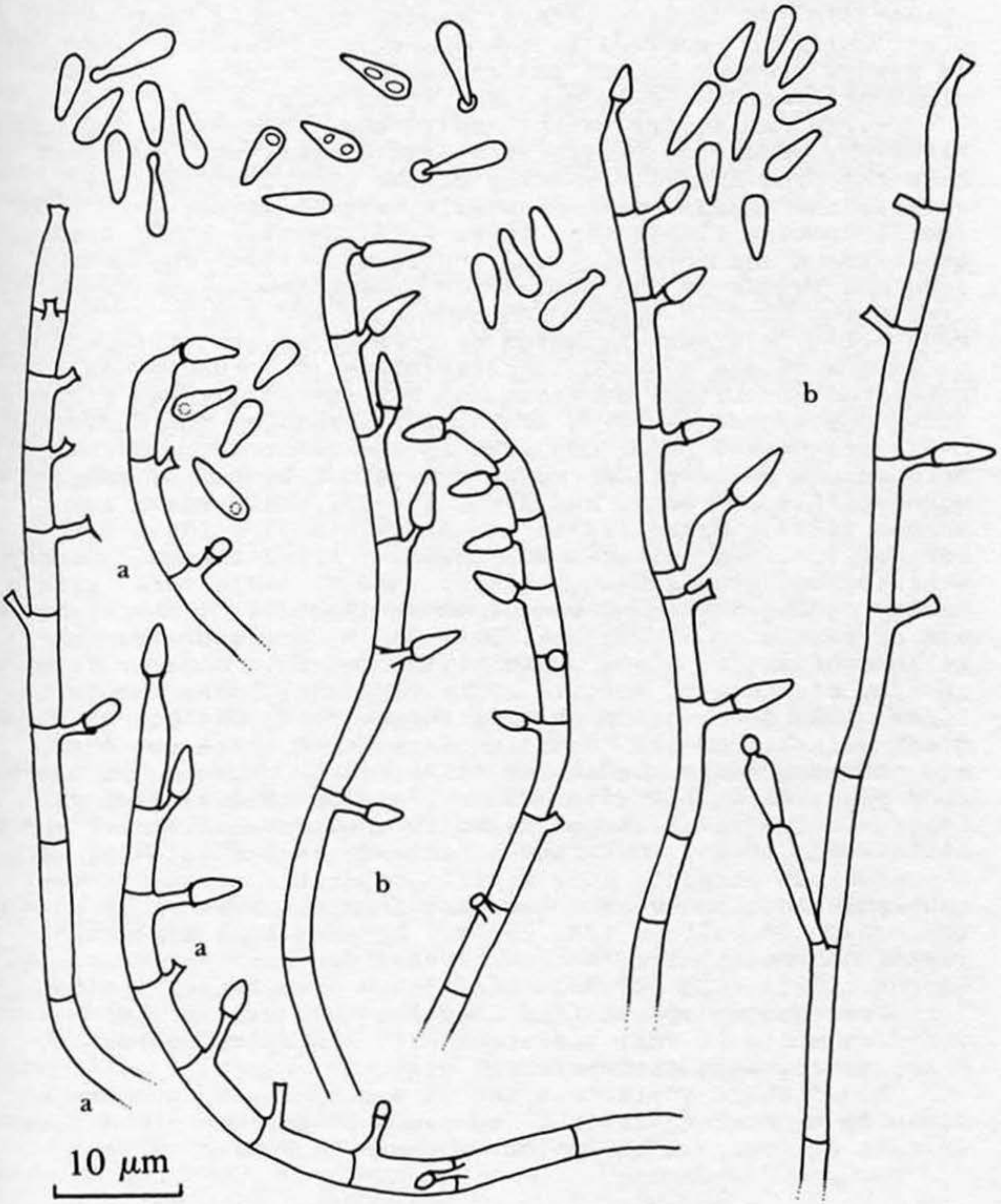

Fig. 1. — *Drechmeria coniospora*, CBS 615.82. a. from 11-day-old culture on MEA, b. from *Panagrellus redivivus* on water agar.

A swelling of the pointed apical end, the adhesive cushion, is not equally visible on all conidia, but apparently formed during maturation (as observed already by Drechsler). In 2-week-old cultures these cushions are still virtually absent. In TEM Saikawa (1982a) showed that this "maturation bud", which is involved in the adhesion to the nematodes and is always present before the attachment to the prey, consists of a mucous layer with radiating fibrils.

Meria coniospora was placed in the genus *Meria* Vuillemin (1896) by Drechsler (1941) with some hesitation. Drechsler knew the type and only species of the genus, *M. laricis* Vuill., the causal agent of needle cast of larch, only from the literature (Vuillemin, 1896, 1905; Hartig, 1899; Lindau, 1900; Peace and Holmes, 1933). Vuillemin (1896) characterized his fungus by the possession of substomatal cushions, from which fertile hyphae protrude with up to four sporiferous cells, a structure which he considered as intermediate between asci and cysts of Ustilaginales. The fungus was described in culture by Peace and Holmes (1933), who recognized the spores as being conidia. In fact the conidiogenous cells are serial phialides like in the nematode parasite. More recent descriptions are given, e.g., by Butler and Jones (1961) and Butin and Zycha (1973), while Peace and Holmes (1933), Batko (1956) and Biggs (1957) studied its variability. The cultures available at present remain mostly sterile, but grow somewhat faster than *M. coniospora* with a weekly radial increment of 4–7 mm at about 20°C. The hyphae are of very unequal width (1.5–4(–7) m) and rather thick-walled. After two weeks sporulation occurs in some isolates in tiny clusters of fertile hyphae on mostly discrete phialides. This observation in addition to the behaviour of this plant parasite on its host, indicates that these two fungi are not congeneric. Drechsler (1941) also compared his nematode parasite with *Dixidium dixae* Poisson (1932) which may belong to *Smittium* (Harpellales, Trichomycetes) (Manier and Lichtwardt, 1968). This fungus has even less similarity with the nematode parasite than *Meria*. Comparable acropleurogenous phialidic sporulation is also found in *Zakatoshia* Sutton, which in culture (CBS 235.82) behaves like a black yeast, not at all like *M. coniospora*. *Pseudomeria mucosa* Barron (1980) (CBS 487.83) resembles *M. coniospora* in its acropleurogenous sporulation, but the sympodial blastic conidiogenesis is very different with conidiogenous cells bearing very long conidiiferous pegs.

As no other suitable genus is available, we propose to classify *M. coniospora* in a new genus of Hyphomycetes, which we call *Drechmeria*, short for Drechsler's *Meria*.

Drechmeria gen. nov.

Genus hyphomycetum phialosporicum. Mycelium hyalinum extensione valde restrictum. Hyphis fertilibus erectis, 2-7 phialides intercalares sub una terminali ferentes; intercalares in collulum acropleurogenum angustum exeuntes; conidia successione basipetali formata, radiatim conglomerata, conica, basi rotundata, sursum quasi acutata, unicellularia, hyalina, levia.

Species typica *Drechmeria coniospora* (Drechsler) W. Gams & Jansson, comb. nov. (basionym *Meria coniospora* Drechsler, Phytopathology 31: 792. 1941).

A genus of phialidic hyphomycetes. Mycelium hyaline, with very restricted growth. Fertile hyphae erect, bearing one terminal and 2-7 intercalary phialides, the intercalary ones bearing acropleurogenous conidiiferous pegs below the upper septum, forming several conidia in basipetal succession, which form stellate clusters. Conidia conical, with rounded base and almost pointed tip, one-celled, hyaline, smooth-walled.

Second species:
Drechmeria harposporioides (Barron & Szijarto) W. Gams & Jansson, comb. nov. (basionym *Meria harposporioides* Barron & Szijarto, Can. J. Bot. 60: 1031. 1982). Although we have not seen this fungus, we trust the adequate original description and are convinced that this parasite of ciliated protozoans, which deviates from *D. coniospora* by falcate conidia, is very close to this species.

We are grateful to Dr D. W. Minter for critically reviewing our text.

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MYCOTAXON

Vol. XXII, pp. 39-42 January-March 1985

TWO PREVIOUSLY UNDESCRIBED *OIDIUM* SPECIES FROM SOUTH AFRICA

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The occurrence of *Oidium* species on *Bauhinia galpinii* N.E.Br. and *Buddleja salviifolia* (L.) Lam. has been reported before in South Africa (Doidge, 1950), but this is the first time that these fungi are described in detail. Their teleomorphic stages have never been found. Both hosts are endemic to southern and tropical Africa.

Oidium bauhiniae Gorter & Eicker sp. nov.

Mycelium amphigenum, griseolo-albidum, effusum vel densum. Hyphae plus minusve rectae, aliquando geniculatae, 3,7-7,5 µm latae, plerumque rectangulariter ramificatae. Cellulae hypharum indistinctae, circa 50-85 µm longae. Appressoria multilobata. Conidiophora hyalina, numerosa, 1-2 septata, recta, aliquando curvata, flexuosa vel prope basim geniculata 40-80 x 6-10 µm, saepe a basi ad apicem leniter crassescentia. Septa ima cellularum basalium 5-12 µm distantia a mycelio. Cellulae basales 20-50 x 6,2-7,5 µm, dimidio ad quadruplo sed plerumque circiter duplo longiores quam cellulae sequentes. Conidia ovoidea ad ellipsoidea, (25-)30-32,5(-45) x (13,7-)17,5(-21,2) µm, solitaria, interdum duo vel tria concatenata remanentia, structura superficialis reticulata-corrugata. Corpuscula fibrosina conspicua desunt, interdum autem granula fibrosina observantur. Ratio longitudinis/latitudinis conidiorum circa 1,75. Tubi germinativi prope apicem oriundi, alii perbreves ac terminantes in appressorium ramosum multilobatum, alii perlongi (170-)200-250(-340) µm. Haustoria globosa habentes granula vel tubercula brevia, 7,5-10 µm diam. Habitat in foliis vivis, pedicellis et fructibus *Bauhiniae galpinii* N.E.Br., Arcadia, Pretoria, mense Martio 1983, PREM No. 47466 (holotypus).

Mycelium amphigenous, grayish white, effuse to dense. Hyphae more or less straight, occasionally geniculate 3,7-7,5 µm wide, branching mostly at right angles. Hyphal cells indistinct, about 50-85 µm long. Appressoria multilobed (Fig. 1). Conidiophores hyalin, numerous, 1-2 septate, straight, occasionally bent, flexuous or geniculate near their base, 40-80 x 6-10 µm, often slightly widening from base to top (Fig. 2). Foot cells sometimes with their basal septum 5-12 µm away from the mycelium, 1,5 to 4 times the length of the following cells, mostly about twice their length,

20-50 x 6,2-7,5 µm. Conidia ovoid to ellipsoid, produced singly but under suitable conditions 2 or 3 successively produced conidia can remain together in a short chain. Surface structure shows network of ridges (Fig. 3). No well developed fibrosin bodies are present but sometimes inclusions of granular fibrosin are observed. Conidia (25-)30-32,5(-45) x (13,7-)17,5(-21,2) µm. Their length/width ratio is circa 1,75. Germ tubes subapical near end of conidia, more seldom apical, either very short and ending in a branched multi-lobed appressorium, or very long (170-)200-250(-340) µm. Haustoria globose with granula or short protuberances 7,5-10 µm in diameter.

On leaves, flower stalks and fruit of *Bauhinia galpinii* N.E.Br. Arcadia, Pretoria, March 1983, PREM No. 47466 (holotype).

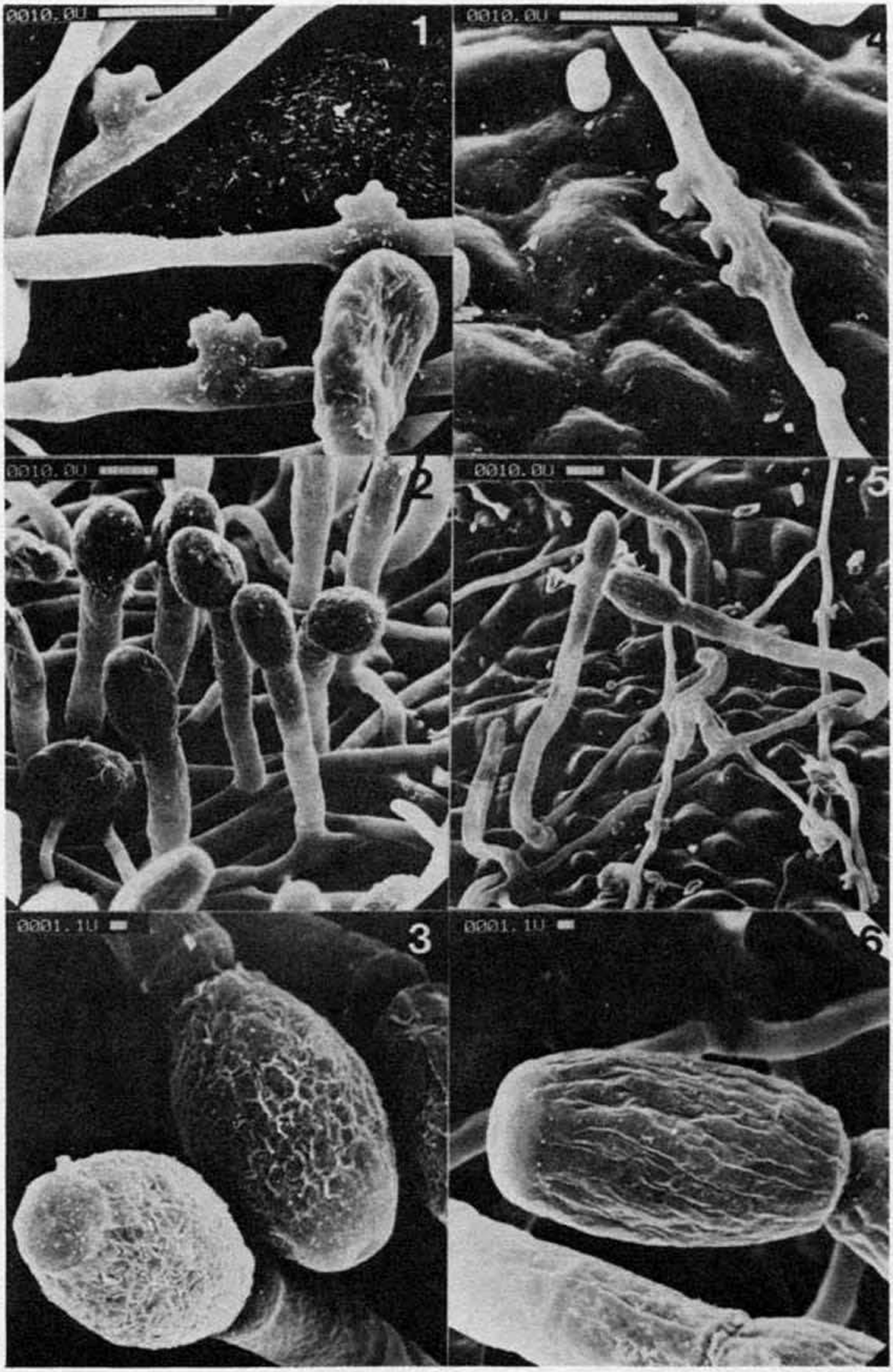
Oidium buddlejae Gorter & Eicker sp. nov.

Mycelium superficiale, albidum. Hyphae hyalinae, flexuosae et geniculatae, 3,7-5 µm latae, habentes appressoria multilobata, plerumque binatim opposita et saepe aggregata. Cellulae hypharum breves, 20-45 µm. Conidiophora abundantia, 1-2 septata, geniculata, interdum curvata, raro recta, a basi ad apicem leniter crassescentia, 62-162 x 8,5-11,5 µm. Cellulae basales 45-85 x 8,5-10 µm, cellulae sequentes breviores. Conidia ovoidea ad ellipsoidea, (25-)27,5-32,5(-36) x (13,7)16,2-18,7 (-21,2) µm, structura superficialis praebens strias subheli= coideas. Tubi germinativi apicales vel subapicales, recti vel subflexuosi, plerumque non ramosi, 25-65 x 2,5-3,7 µm, saepe terminantes in apicem incrassatum appressorio similem (6,2-10 x 5-6,2). Conidia interdum germinantia ad utrumque extremum. Haustoria globosa vel depresse globosa, 7-10 x 7,5-12,5 µm. Habitat in foliis vivis *Buddlejae salviifoliae* (L.) Lam., Arcadia, Pretoria, mense Martio 1982. PREM No. 4726 (holotypus).

Mycelium white, on axial surface. Hyphae hyaline, flexuous and geniculate, 3,7-5 µm wide with numerous multilobed appressoria, usually opposite and grouped together (Fig. 4). Hyphae cells short, 20-40 µm. Conidiophores abundant, 1-2 septate, geniculate, less commonly curved or seldomly straight, slightly widening from bottom to top, 62-162 x 8,5-11,5 µm (Fig. 5). Footcells, 45-85 x 8,5-10 µm followed by one or two shorter cells. Conidia ovoid to ellipsoid, (25-)27,5-32,5(-36) x (13,7-)16,2-18,7(-21,2) µm, surface structure slightly helicoid grooves (Fig. 6). Germ tubes apical or subapical, straight or slightly flexuous, simple or occasionally branched, 25-65 x 2,5-3,7 µm, often ending in a thickened appressorium-like hyphal point (6,2-10 x 5-6,2 µm). Conidia germinate occasionally from opposite ends. Haustoria globose to flattened-globose, 7-10 x 7,5-12,5 µm.

The characteristic geniculate foot cells of *Oidium buddlejae* resemble those of *Oidium indigoferae* described and illustrated by Yen (1966) but differs in longer conidiophores and foot cells and in wider conidia.

On leaves of *Buddleja salviifolia* (L.) Lam., Arcadia, Pretoria, March 1982, PREM No. 47216 (holotype).



Figures 1-3: *Oidium bauhiniae*, 1. appressoria, 2. conidiophores, 3. primary (right) and secondary condidium.
Figures 4-6: *Oidium buddlejae*, 1. appressoria, 2. conidiophores, 3. conidium.

ACKNOWLEDGEMENTS

Financial support for this research was provided by the University of Pretoria, the Department of Agriculture and the South African C.S.I.R. Mr. H.J. van Tonder is thanked for help with the scanning electron micrographs and Mr. P. Hasse for revising the Latin descriptions.

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MYCOTAXON

Vol. XXII, pp. 43-51 January-March 1985

REDISPOSALS AND REDESCRIPTIONS IN THE **MONOCHAETIA-SEIRIDIUM, PESTALOTIA-PESTALOTIOPSIS** COMPLEXES. I. THE CORRECT NAME FOR THE TYPE SPECIES OF PESTALOTIOPSIS.

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Pestalotia maculans (Cda.) Hughes is redescribed and redisposed in Pestalotiopsis. P. guepinii, the type species of Pestalotiopsis), is considered a synonym.

A review of extant mycological literature reveals a plethora of infra-generic taxa in Monochaetia (Sacc.) Allesch. (106 spp.), Seiridium Nees ex Fr. (20 spp.), and Pestalotia deNot. (600 spp.). Of these three anamorph-genera, both Monochaetia and Pestalotia have been studied extensively by Steyaert (1949, 1953 a, 1953 b, 1954, 1955, 1961), and Guba (1961). Both the authors adopted Saccardoan criteria to delimit generic and infra-generic taxa accepted by them.

Guba (1961) recognized 41 species of Monochaetia in three sections based on conidium septation. According to Sutton (1980), only the species included by Guba in the section Quinqueloculatae are probably the true Monochaetia,

while species included in the section Quadriloculatae are probably referable to Truncatella Stey. or Seimatosporium Cda., and those in the section Sexloculatae to Seiridium.

The genus Seiridium, long misinterpreted, has not been revised satisfactorily. The generic synonymy has been discussed in detail by Guba (1961), Shoemaker et al. (1966), and Sutton (1969, 1975).

Steyaert (1949) restricted Pestalotia to a single species and reassigned several species formerly disposed in Pestalotia to the new anamorph-genera Pestalotiopsis Stey., and Truncatella, but a majority of the species remained unassessed. Guba (1961) preferred to adopt a broader generic concept. He reduced Pestalotiopsis, Truncatella and Labridella to synonymy with Pestalotia and accepted 220 species in that genus. Sutton (1969) has fully discussed the arguments opposing or supporting either approach and gave evidence favouring the rearrangement proposed by Steyaert (1949).

The distinctions between the genera in the Monochaetia-Seiridium and Pestalotia-Pestalotiopsis complexes have been discussed by Sutton (1969). The value of differences in conidial wall structure between Pestalotia and Pestalotiopsis, and between Monochaetia and Seiridium has been established by ultrastructural studies (Griffiths & Swart 1974 a, 1974 b, Roberts & Swart 1980). The following generic key highlights these distinctions:

KEY TO GENERA

A. Conidial appendages lacking.....SPOROCADUS
A. Appendages apical/ apical and basal/ basal....B

B. Conidia lacking basal appendage; apical

appendage branched; conidia euseptate; median cells concolorous.....TRUNCATELLA

B. Basal appendage, when present, exogenous and excentric; conidia usually a mixture: some with basal appendage alone some with both apical and basal appendages and some without any.....SEIMATOSPORIUM

B. Basal appendage, when present, not exogenous but centric.....C

C. Conidia euseptate.....D

C. Conidia distoseptate.....E

D. Apical appendage single and unbranched; median cells concolourous.....MONOCHAETIA

D. Apical appendages several in an apical crest or in several tiers on the wall of apical cell; median cells predominantly versicoloured.....PESTALOTIOPSIS

E. Conidia usually 5-septate; basal and apical appendages single, unbranched...SEIRIDIUM

E. Conidia 5-septate; basal and apical appendages much branched.....PESTALOTIA

Despite wide acceptance that there is only a single species in Pestalotia, new species names are still being added to this anamorph genus, although these species appear to belong in Pestalotiopsis, Truncatella or Seiridium (Von Arx 1981; T.-Z. Huang 1982). Though several species of Pestalotia have recently been redisposed in Pestalotiopsis, many of these taxonomic decisions have been based, not on study of type specimens, but on recent collections or original published descriptions or illustrations. But even after these transfers, far too many erroneous names still remain in Pestalotia.

My studies of type specimens of several species in this group have led me to endorse Sutton's view (1980) that many of the taxa still remaining in

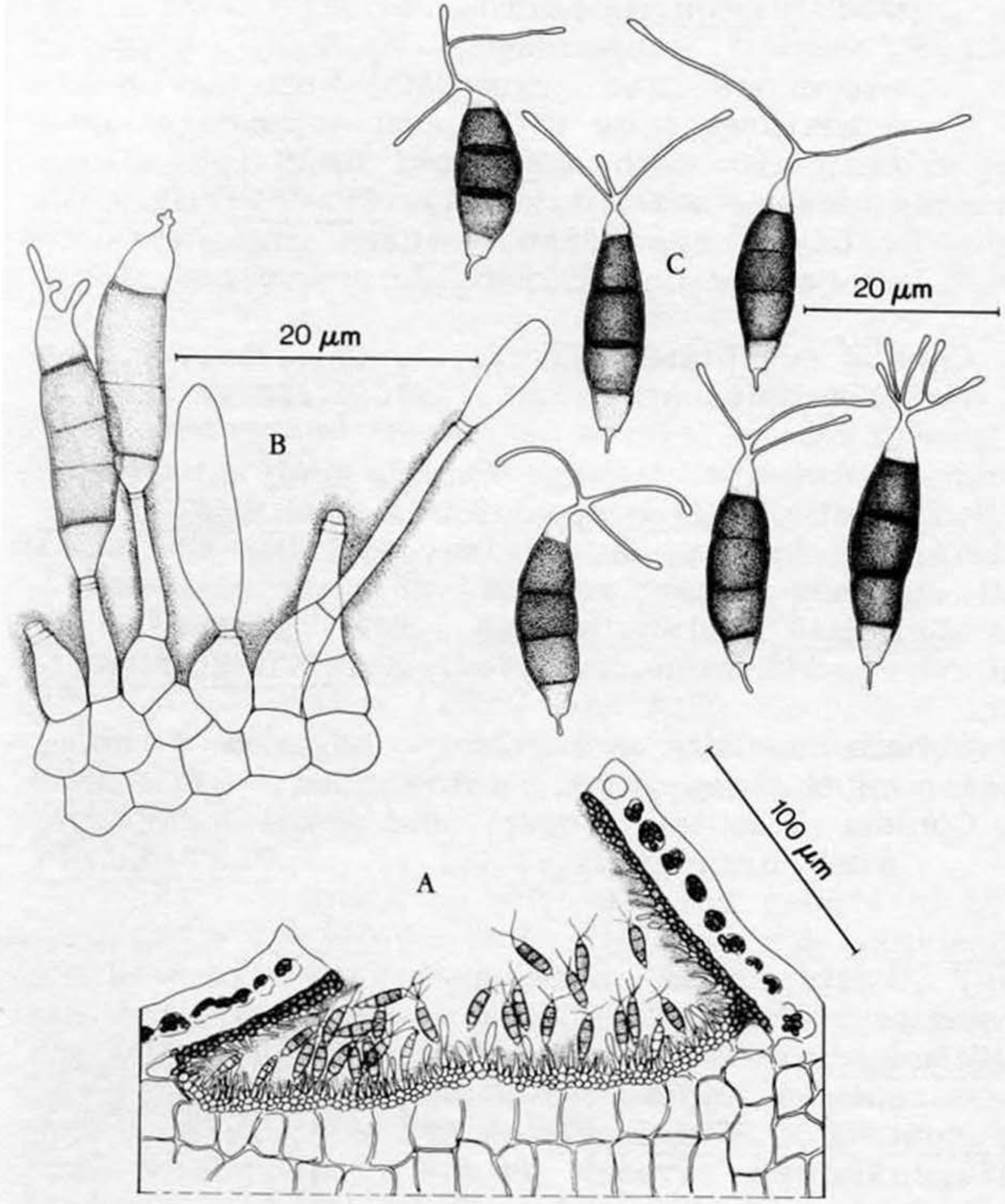

Figure 1. **Pestalotiopsis maculans** ex holotype in PR 155665. A. Vertical section of a conidioma. B. Conidiophores. C. Mature conidia.

Monochaetia and Pestalotia need to be redisposed in other genera. The current series of papers is designed to serve this need.

1. Pestalotia maculans (Cda.) Hughes
Can. J. Bot. 36: 810, 1958.

Hughes (1958) determined that the fungus, originally described by Corda (1839) as Sporocadus maculans, was a Pestalotia and published the appropriate combination for it, listing a few synonyms, but without a detailed description of the fungus. There is no reference to this binomial in the monographic account of Pestalotia by Guba (1961), although he lists a collection of Sporocadus maculans in B under Pestalotia guepinii. It is not clear from Guba's account whether this collection was part of Corda's original collection of S. maculans.

The description and the accompanying illustration (Fig. 1) presented below are based on a study of the holotype specimen in PR 155665. Clearly, the features of the fungus fit the modern generic concept of Pestalotiopsis, type sp.: P. guepinii (Desm.) Stey. Pestalotiopsis aeruginea (Stey.) Stey., P. theae (Sawada) Stey., and P. guepinii are the three species known to occur commonly on Camellia. Of these, only P. guepinii is similar to Corda's material, while the conidia of the other two species have concolourous median cells and differ in their size as well. The isotype specimen, in BPI, of P. guepinii in the exsiccati distributed by Desmazières (Pl. Crypt. Fr. 22: 1084, 1840) has been compared with the above and the two were found to be identical in all essential features. Hence, the following nomenclator is proposed:

Pestalotiopsis maculans (Cda.) **comb. nov.**
≡ Sporocadus maculans Cda., Icones Fungorum 3: 24, 1839.
≡ Hendersonia maculans (Cda.)

Lév., in Sacc., Syll. Fung. 3: 427, 1894.

≡ Pestalotia maculans (Cda.) Hughes, Can. J. Bot. 36: 810, 1958.

= Pestalotiopsis guepinii (Desm.) Stey., Bull. Jard. bot. Brux. 19: 300, 1949.

≡ Pestalotia guepinii Desm., Ann. Sci. nat., ser. 2, 13: 181, 1840.

Foliicolous. Conidiomata stromatic, acervuloid, amphigenous, scattered to gregarious and occasionally confluent, subepidermal in origin, erumpent, orbicular to oval in outline, 200-550 µm diam, 70-130 µm deep, glabrous, black, appearing pulvinate after dehiscence by rupture of the overlying host tissue; basal stroma 10-15 µm thick, of 'textura angularis', cells thick-walled and subhyaline; lateral walls 2-4 cells thick, with thick-walled, pale brown to brown, encrusted cells. Conidiophores formed in the concavity of the conidioma, often extending along the lateral walls, septate, unbranched, up to 30 µm long, often reduced to conidiogenous cells, hyaline, smooth-walled, invested in mucus. Conidiogenous cells phialides, ampulliform to lageniform or cylindrical to subcylindrical, hyaline, thin- and smooth-walled, 6-15 X 2-3.5 ($\bar{x}$ = 11 X 2.7) µm, with up to 3 percurrent proliferations. Conidia blastic-phialidic, fusiform, straight or slightly bent, 4-septate, versicoloured, smooth, 19-27.5 X 6-8.5 ($\bar{x}$ = 23 X 7) µm, bearing appendages (conidium length does not include appendage lengths); basal cell obconic with a truncate base, subhyaline, 3-4.5 ($\bar{x}$ = 3.7) µm long; median cells 3, each subcylindrical or doliiform, together 13-19 ($\bar{x}$ = 16) µm long (supra-basal cell subhyaline to pale brown, central cell dark brown, subapical cell brown); apical cell conic, hyaline, (2.5-) 3-4 ($\bar{x}$ = 3.5) µm long, extending into an irregularly branched, tubular, apical appendage; appendage branches usually 2 or 3, occasionally 5, irregularly spaced, in

an apical crest, often with slightly spathulate tips, flexuous, 10-22 ($\bar{x}$ = 15.5) µm long; basal appendage lacking, or when present single, unbranched, centric, 1.5-3 ($\bar{x}$= 2.2) µm long; mean conidium length/width ratio = 3.7:1.

On living leaves of Camellia japonica, Graft, Salms Gdns., Prague, Winter 1838, Corda (Holotype in PR 155665).

The type specimen comprises four leaves bearing leaf spots 1.5-2 cm diam, oval to irregular in shape, ash gray on the upper surface with narrow, dark or reddish brown margins.

Guba (1961) included many other binomials in the synonymy of P. guepinii. I cannot at present judge whether such synonymy is justifiable or not. Nevertheless, in view of the synonymy proposed above, the binomial P. maculans now is the correct name for P. guepinii, the type species of the anamorph-genus Pestalotiopsis.

Acknowledgments

I thank the curators at BPI and PR for the loan of the specimens in their keeping study. I am deeply indebted to Prof. B. Kendrick, Department of Biology, University of Waterloo, and Dr. Amy Rossman, Mycology Laboratory, Beltsville, Md., U.S.A. for critical reviews of this manuscript. The Natural Sciences and Engineering Research Council of Canada gave financial support for this research in the form of an operating grant to Prof. Kendrick.

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MYCOTAXON

Vol. XXII, pp. 52-63 January-March 1985

REDISPOSALS AND REDESCRIPTIONS IN THE MONOCHAETIA-SEIRIDIUM, PESTALOTIA-PESTALOTIOPSIS COMPLEXES. II. PESTALOTIOPSIS BESSEYII (GUBA) COMB. NOV. AND PESTALOSPHAERIA VARIA SP. NOV.

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A new combination in Pestalotiopsis is proposed for Pestalotia besseyii Guba. An associated teleomorph is described as a new species of Pestalosphaeria.

Supporting Steyaert's (1949) decision to limit Pestalotia to a single species and to redispose most of the other species in Pestalotiopsis and Truncatella, Sutton (1969) stated: "The tendency in recent taxonomic studies is to treat the number of septa as a character subordinate in importance to developmental features of conidia and conidiophores... Variability in number of conidium septa is an accepted feature of most of the Fungi Imperfecti but a few genera do display constancy in septation and it is in the latter group that Pestalotia and its segregates belong. In P. pezizoides, Labridella and Seiridium the conidia are constantly 5-septate. In contrast, the conidia of Pestalotiopsis, Truncatella and Monochaetia are constantly 4-, 3- and 4-septate respectively."

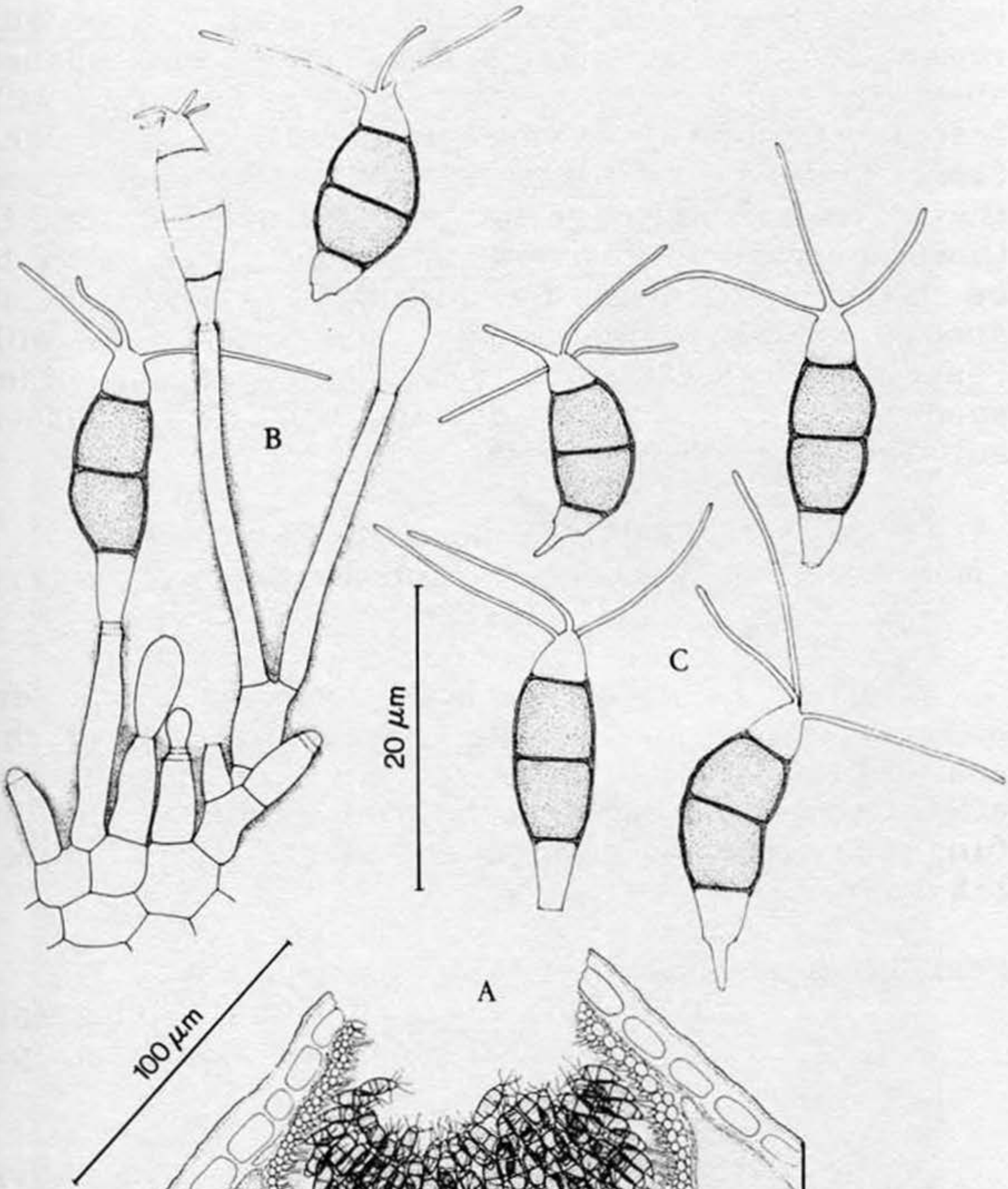


Figure 1. **Pestalotiopsis besseyii** ex type in BPI. A. Vertical section of conidioma. B. Conidiophores. C. Mature conidia.

While I concur with the intent of this statement for the most part, I cannot agree that the number of conidial septa in species of Pestalotiopsis and Monochaetia remain constant at four. I know of an unpublished species of Monochaetia and a species of Seiridium with 3-septate conidia. In several species disposed by Guba (1961) under Pestalotia in the section Quadriloculatae, the anatomical and developmental features conform to those observed in Pestalotiopsis spp. There seems to be little justification for limiting Pestalotiopsis to species with 4-septate conidia. This paper deals with Pestalotia besseyii Guba. Accounts of the other species with 3-septate conidia will be published subsequently in this series.

2. Pestalotia besseyii Guba
Monograph of Monochaetia and Pestalotia, p. 77, 1961.

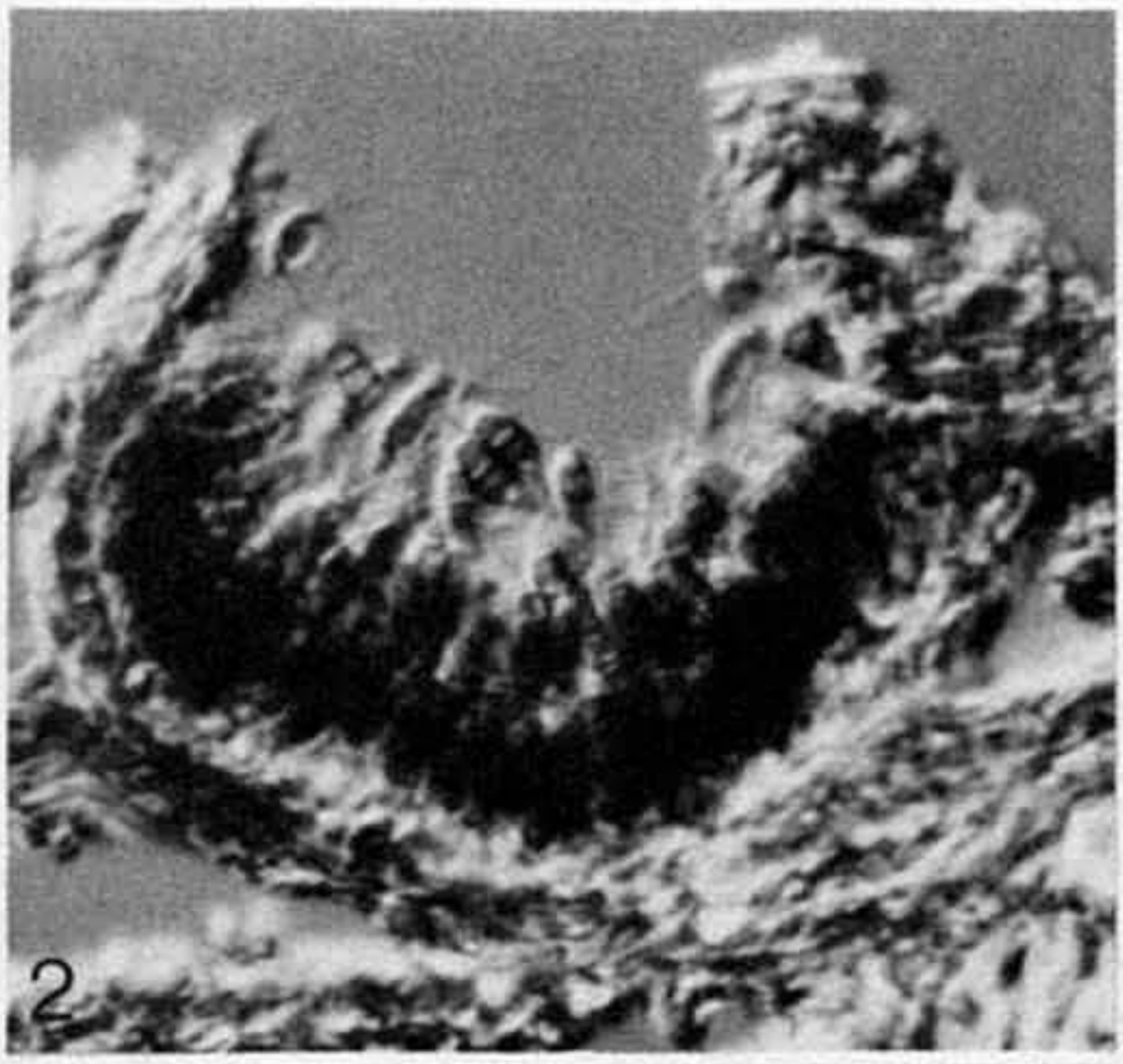
The holotype specimen consists of a few pods of Acacia koa bearing scanty material of the anamorph. Although most of the conidiomata are effete, some have remained in good condition, and the fungus is described in detail and illustrated in Figures 1-8 below.

Pestalotiopsis besseyii (Guba) **comb. nov.**
≡ Pestalotia besseyii Guba, Monograph of Monochaetia and Pestalotia, p. 77, 1961.

Fructicolous. Conidiomata stromatic, pycnidioid, scattered to gregarious, erumpent, subperidermal in origin, globose to depressed globose or hemispherical in sectional view, 100-250 µm diam, 70-200 µm deep, unilocular, glabrous, dark brown to

---

Figures 2-8. **Pestalotiopsis besseyii** ex type in BPI (All with Nomarski interference phase contrast). Fig. 2. Vertical section of conidioma. ca X 230. Figs. 3-7. Conidiophores and conidiogenous cells (arrows in Figs. 5-7 show percurrently proliferating phialides). ca X 1450. Fig. 8. Mature conidia. ca X 1450.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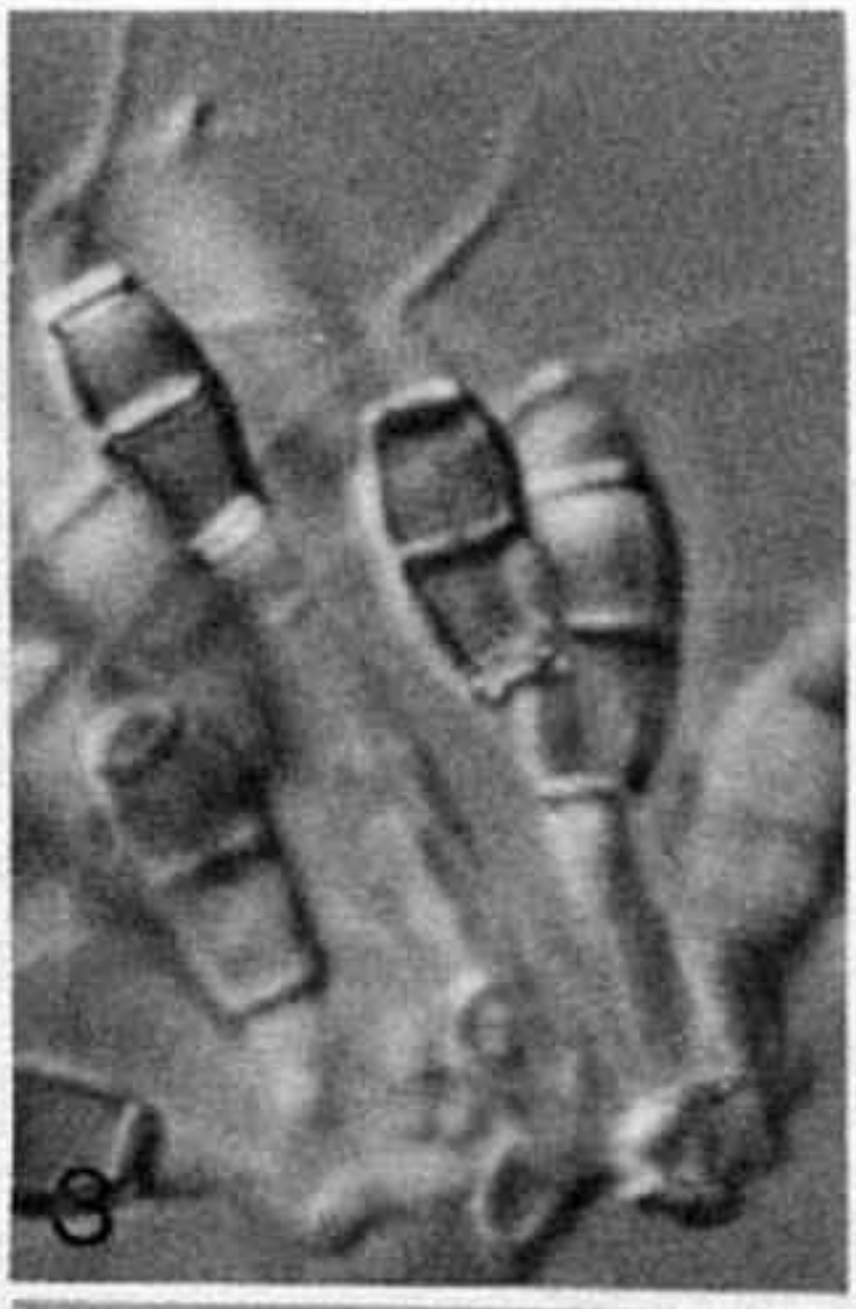
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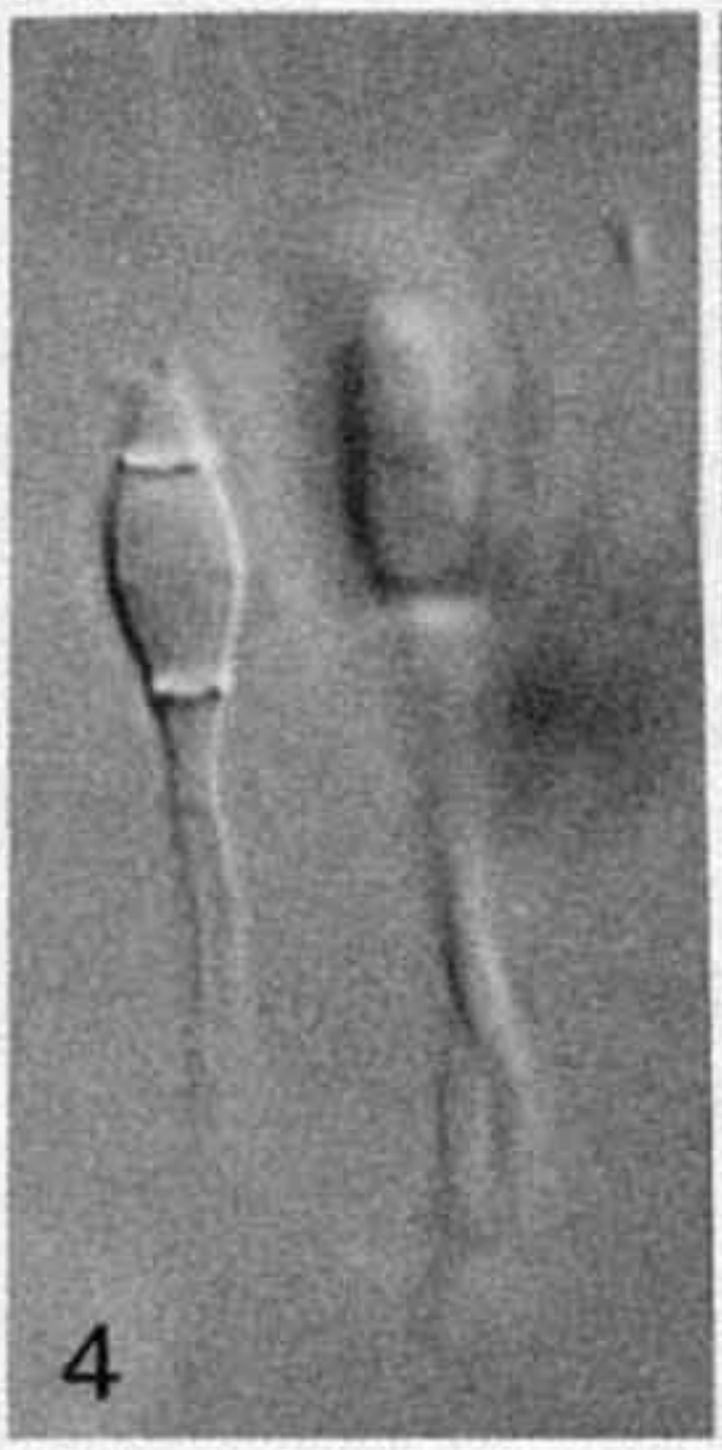
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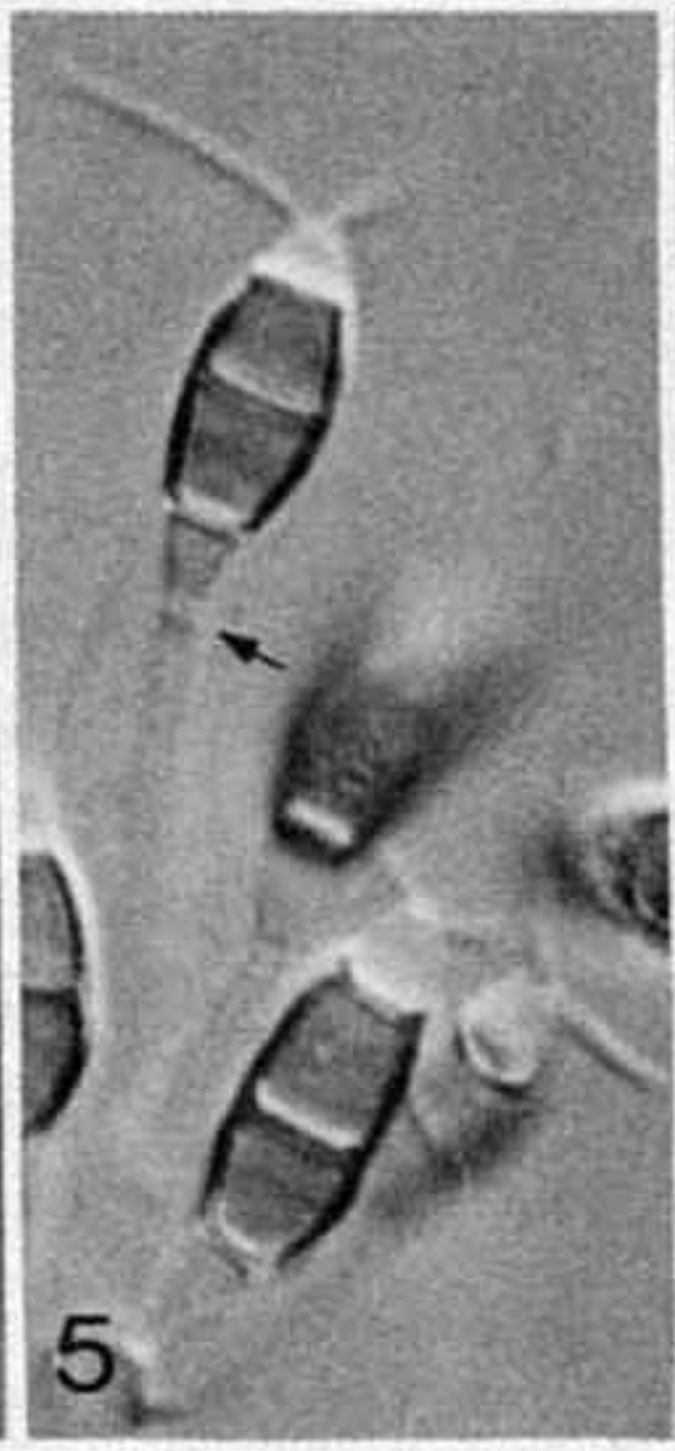
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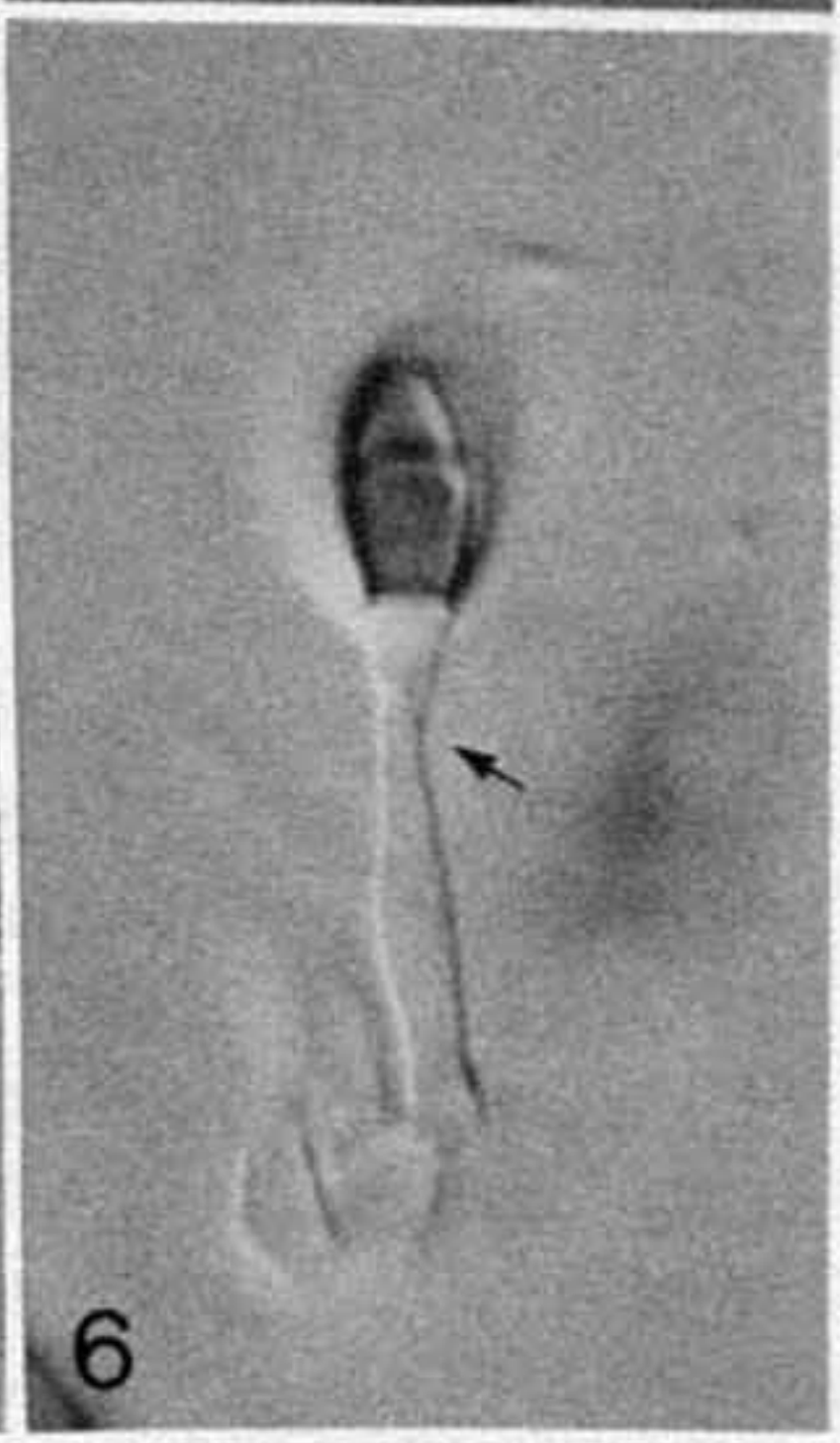
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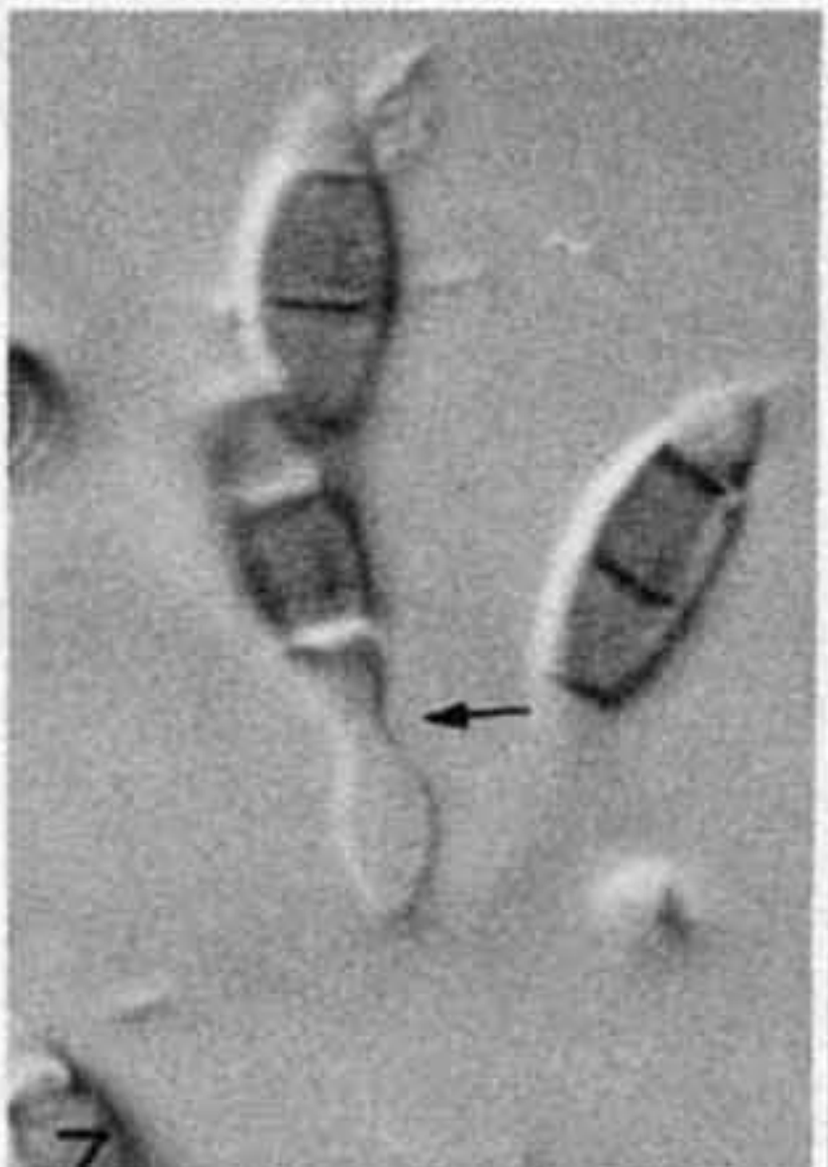
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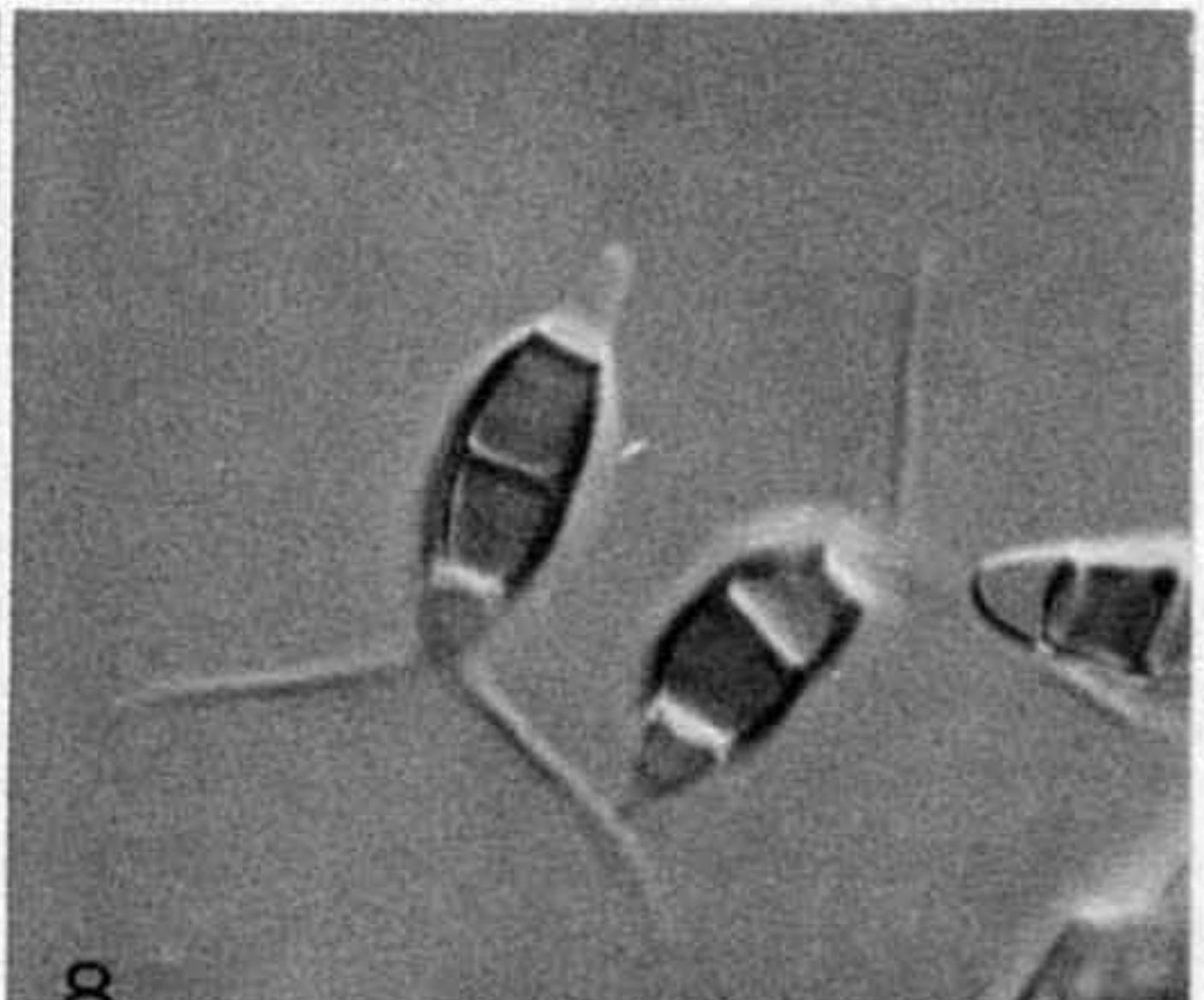
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black, dehiscing by a split in the apical wall; basal stroma and lateral wall 10-15 µm thick, of hyaline 'textura globulosa', 2-3 cells thick. Conidiophores arising from the innermost layer of cells of the wall and basal stroma, lining the cavity of the conidioma, sparsely septate and branched only at the base, often reduced to conidiogenous cells, hyaline, smooth, up to 40 um long, invested in mucus. Conidiogenous cells phialides with minute periclinal thickenings in the collarette zone, lageniform (5-7 X 2-3 µm) or terete to cylindrical (10-23 X 1.5-2.5 µm), hyaline, smooth, proliferating percurrently up to 3 times. Conidia blastic-phialidic, fusiform, 3-septate, 15-19 X 5-6(-6.5) ($\bar{x}$ = 17.3 X 5.5) µm, bearing appendages; basal cell narrowly obconic with a truncate base bearing minute marginal frills, hyaline, smooth, 3-5 ($\bar{x}$ = 4) µm long; median cells 2, doliiform, wall thick, minutely verruculose and with or without slight constrictions at the septa, concolourous and pale brown, together 9-11 ($\bar{x}$ = 10.3) µm long (suprabasal cell 4-5.5 ($\bar{x}$ = 5) µm long; subapical cell 4.5-5.5 ($\bar{x}$ = 5) µm long); apical cell conic with a broad, rounded apex, hyaline, smooth, 3-3.5(-4) ($\bar{x}$ = 3.2) µm long; appendages tubular, unbranched; apical appendages 3, occasionally 2 or 4, inserted at different loci but in a crest at the apex of the apical cell, flexuous, 10-15 (-17) ($\bar{x}$ = 12.3) µm long; basal appendage often lacking, but when present centric, coarse, attenuated, up to 3 µm long; mean conidium body length/width ratio = 3.1:1.

On dry pods of Acacia koa, Kolekola Pass, Oahu, Hawaii, 1.IV.1940, E.A.Bessey (Holotype in BPI).

The type specimen of P. besseyii also bears ascomata of a teleomorph that belongs in the Amphisphaeriaceae. Some of the ascomata are effete, but the description given below and the illustration in Figs. 9-14 have been derived from a study of other ascomata that are in relatively good condition. The morphology of the teleomorph indicates that it belongs in the genus Pestalosphaeria Barr (1975). It appears

to be distinct from all four species currently accepted in Pestalosphaeria (see Table 1).

Key to species of Pestalosphaeria

(Note: In some instances, this key emphasizes the features of the anamorph).

1. Ascospores smooth.....2
1. Ascospores verruculose.....4

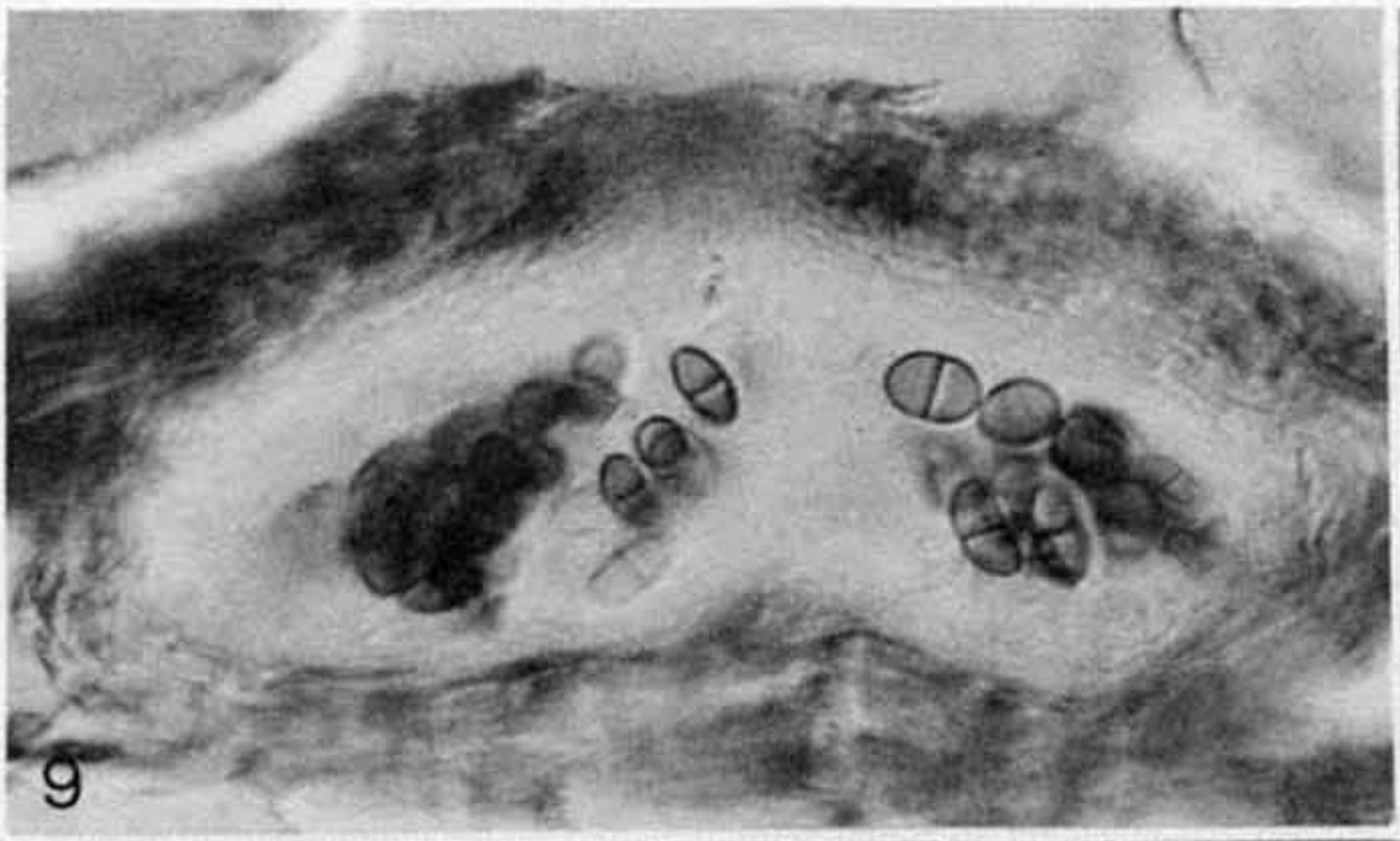
2. Ascospores 7-10 µm wide; six conspicuous wall ridges present; central cell heavily pigmented compared to end cells.....P. concentrica
2. Ascospores 4.5-6 µm wide.....3

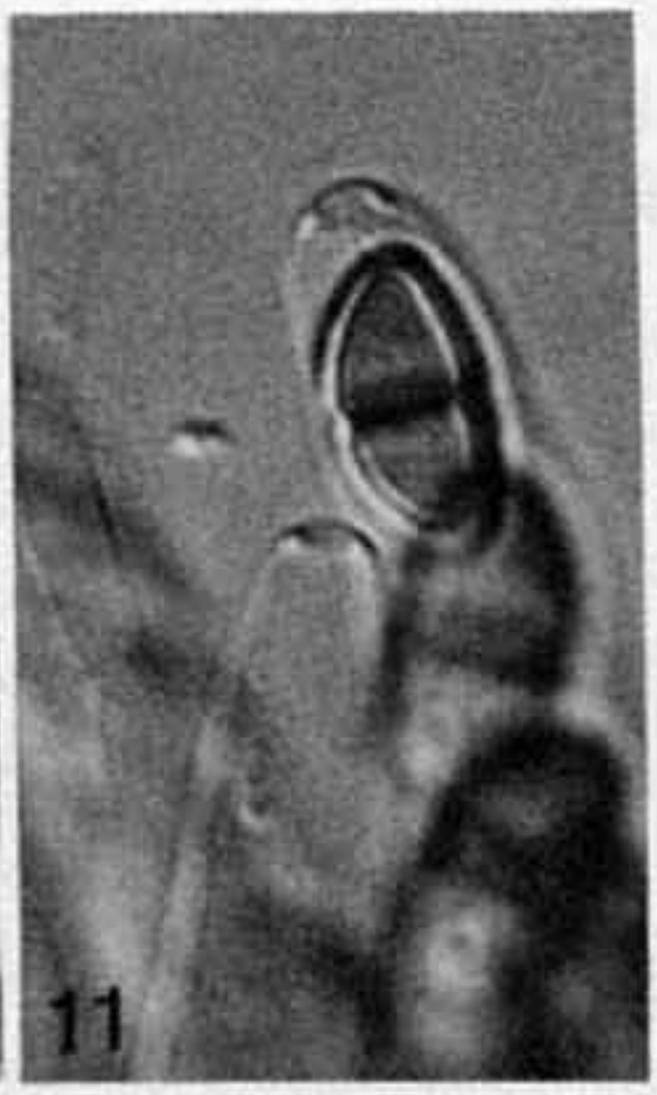
3. Ascospores lacking wall ridges, 13-14.5 µm long; versicoloured conidia 21.5-27.5(-30) X 4.5-6 µm, central cell dark brown, adjoining cells brown, apical appendages 2-4, filiform, 9-17 µm long.....P. hansenii
3. Ascospores 12-21 µm long; conidia (23-)27-34 X 6-7(-10) µm, 3 median cells concolourous, olivaceous brown, apical appendages 2-3, with spathulate tips, 19-24 µm long.....P. elaeidis

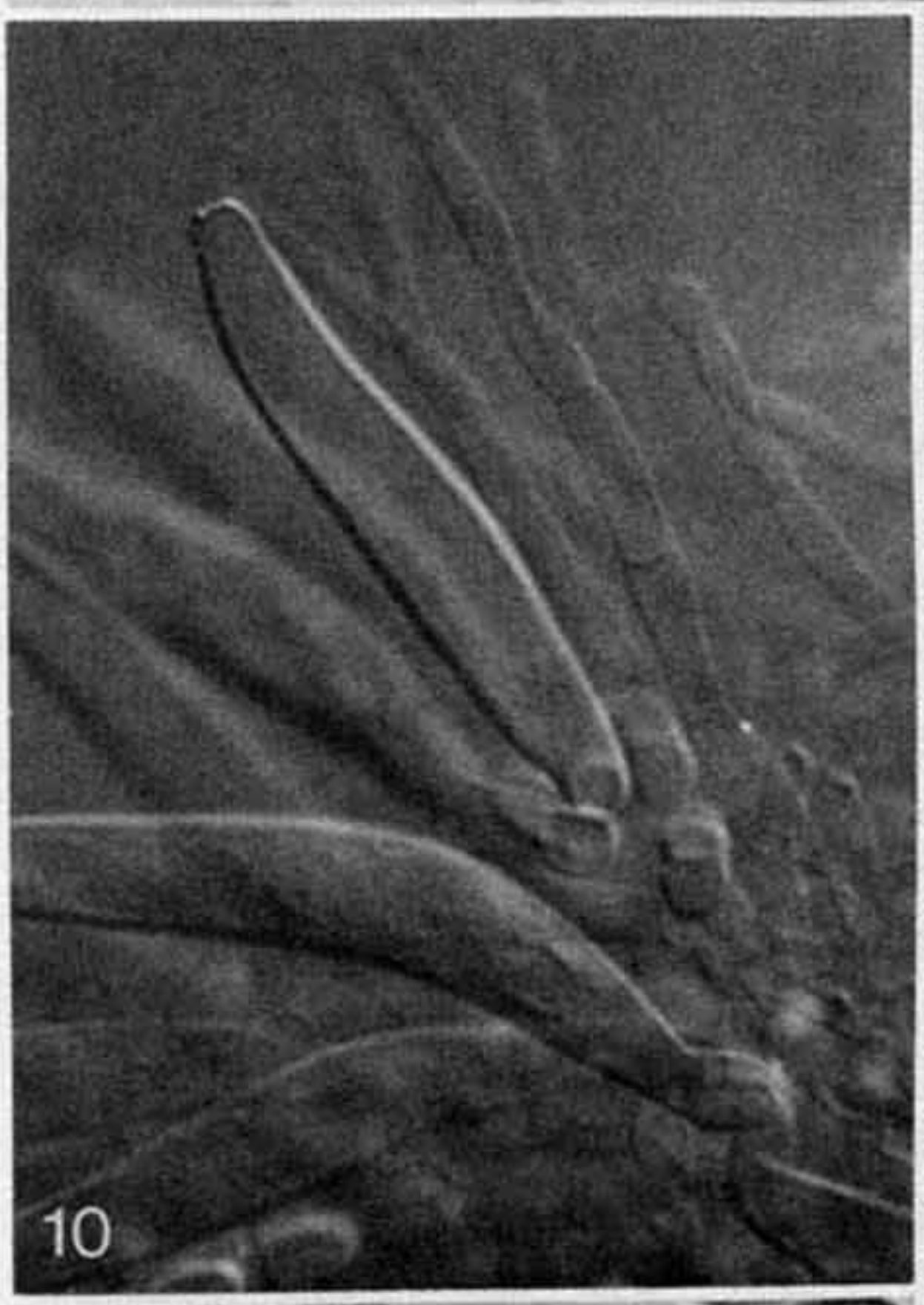
4. Ascospores versicoloured, 20-23 X 8.5-10 µm, central cell amber brown, end cells grayish brown.....P. austroamericana
4. Ascospores 10-17 X 6-8 µm, concolourous and pale brown to brown.....P. varia

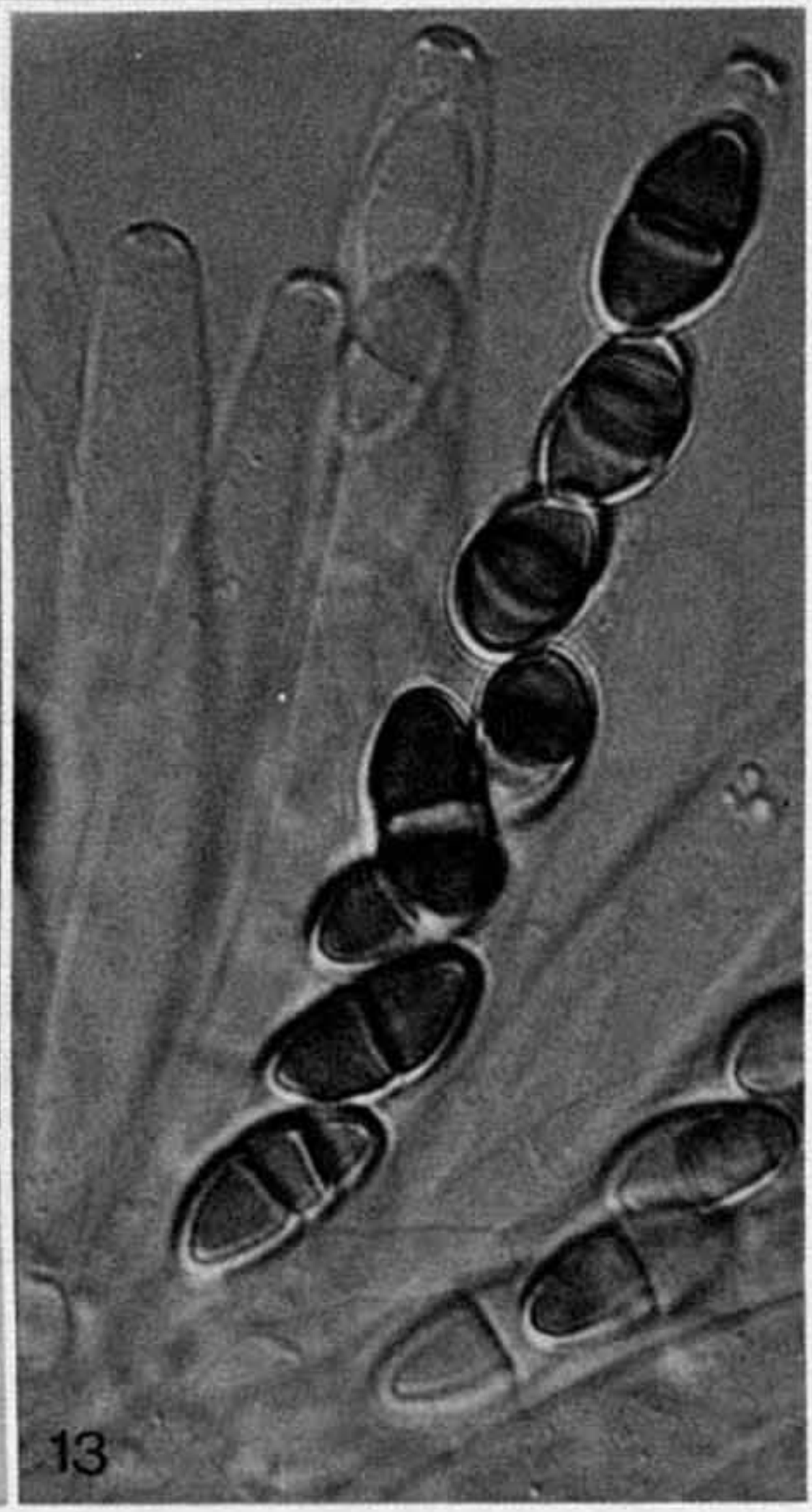
Pestalosphaeria varia sp. nov.

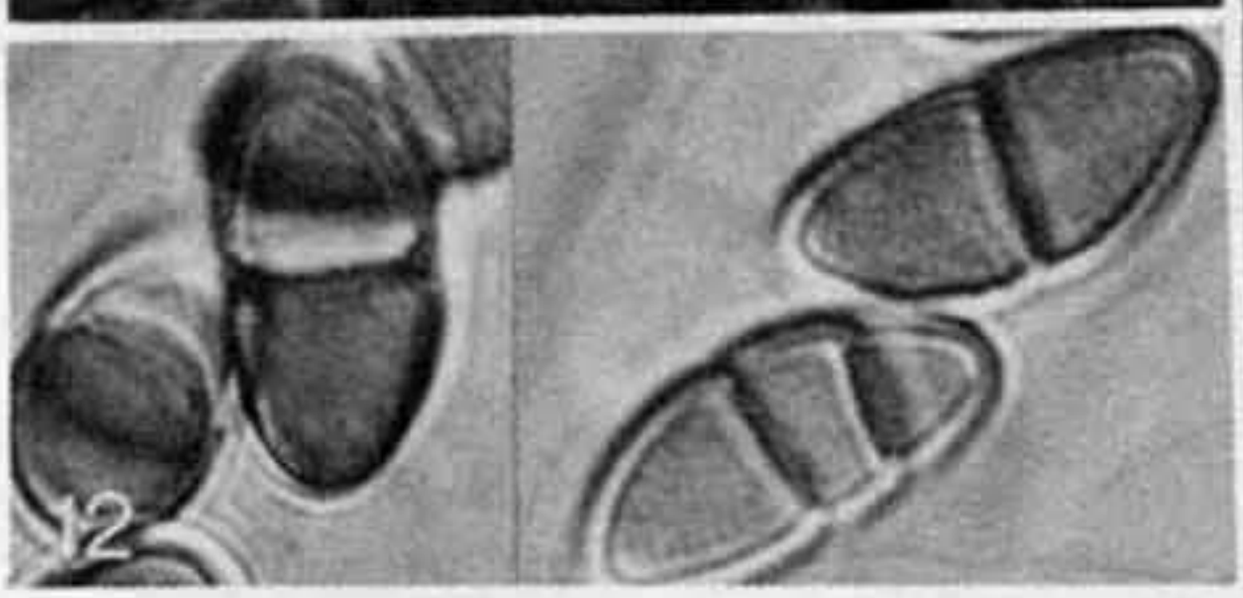
Fructicola. Ascomata dissita ad gregaria, immersa, depresse globosa cum una leniter papillato collulis, 150-250 µm diam, 70-130 µm alt, unilocularia, glabra, ostiolata, pallide brunnea, in aream ostiolum











Figures 9-13. **Pestalosphaeria varia** ex type in BPI (All with Nomarski interference phase contrast). Fig. 9. Vertical section of an ascoma. ca X 570. Fig. 10. Immature asci and paraphyses. ca X 720. Fig. 11. Ascus tip showing apical apparatus. ca X 720. Fig. 12. Mature ascospores with 1 to 2 septa (verrucosities on the wall can be seen in some ascospores). ca X 1450. Fig. 13. Asci. ca X 1130.

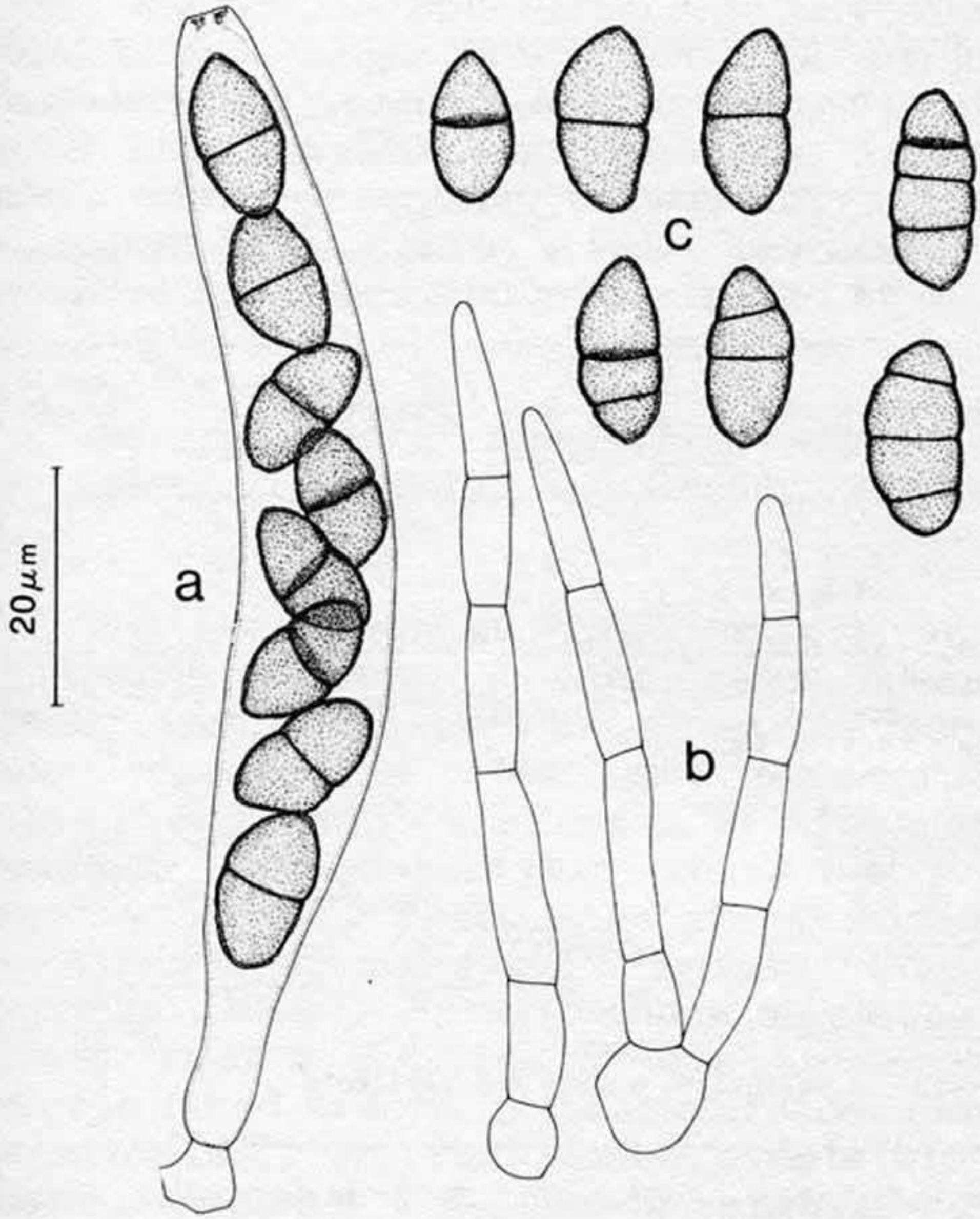


Figure 14. **Pestalosphaeria varia** ex type in BPI. a. Ascus. b. Paraphyses. c. Mature ascospores.

brunneam; pariete 20-30 µm cr, externe e 'textura angularis' ex cellulis crassitunicatis et pallide brunneis et interne e 'textura prismatica' ex cellulis tenuitunicatis et hyalinis compositus; canalis apicalis periphysatis; ostiolum circulare vel ovale, 20-25 µm diam. Asci unitunicati, clavati cum uno stipite breve, annulus apicalis amyloideus, octospori, 80-95 X 10-12 ($\bar{x}$ = 87 X 11) µm, paraphysibus simplicibus vel irregulatim ramosis, parce septatis, hyalinis, laevis, 50-67 X 5-6 µm interpositi. Ascosporae uniseriatae, fusiformes vel ellipsoideae, transverse circulares,

Table 1. Comparison of ascospore features of **Pestalosphaeria** spp.

Taxon	Dimensions	Septa	End view	Ridges	Ornamentation
hansenii	13-14.5 X 4.5-6 µm	2	hexagonal	-	smooth
concentrica	13.5-20 X 7-10 µm	2	hexagonal	+	smooth
elaeidis	12-21 X 4.5-6 µm	2	NA	NA	smooth
austro-americana	20-23 X 8.5-10 µm	2(-3)	NA	-	verruculose
varia sp. nov.	10-17 X 6-8 µm	1(-3)	not hexagonal	-	verruculose

Explanation:

+ = present; - = absent; NA = data not available

vulgo uniseptatae, plerumque 2-3-septatae, pallide brunneae ad brunneae, pariete crasso, verruculoso et in septo leniter contracto, 10-17 X 6-8 ($\bar{x}$ = 14 X 7) µm; ratione ascosporii long./lat. = 2:1.

Ascomata scattered to gregarious, immersed in the host periderm, depressed globose with a slightly papillate neck, 150-250 µm diam, 70-130 µm deep, unilocular, glabrous, ostiolate, pale brown, but brown in the ostiolar region; wall 20-30 µm thick, composed of an outer 'textura angularis' several cells deep with the cells thick-walled and pale brown, and an inner 'textura prismatica' with thin-walled, hyaline cells; apical canal periphysate; ostiole circular or oval, 20-25 µm diam. Asci unitunicate, clavate with a short stipe, apical apparatus with an amyloid ring, octosporous,

80-95 X 10-12 ($\bar{x}$ = 87 X 11) µm, intermixed with sparsely septate, simple or irregularly branched, hyaline, smooth-walled paraphyses 50-67 um long and 5-6 um wide. Ascospores uniseriate, fusiform to ellipsoid with somewhat rounded ends, transversely circular, mostly 1-septate, occasionally 2-3-septate, pale brown to brown, wall relatively thick, verruculose and occasionally constricted at the septa, 10-17 X 6-8 ($\bar{x}$ = 14 X 7) µm; mean ascospore length/width ratio = 2:1.

On dry pods of Acacia koa, Kolekola Pass, Oahu, Hawaii, 1.IV.1940, E.A.Bessey (Holotype in BPI).

The association of Pestalosphaeria varia and Pestalotiopsis besseyii on the same specimen is extremely significant in view of earlier reports of genetic connections between teleomorphs in Pestalosphaeria and anamorphs in Pestalotiopsis. Barr (1975) established that there was a genetic connection between Pestalosphaeria concentrica Barr and Pestalotiopsis guepinii (Desm.) Stey. var. macrotricha (Kleb.) Sutton, when single ascospore isolations yielded cultures of the anamorph. The teleomorph failed to form in these cultures. Shoemaker & Simpson (1981) reported similar events with single ascospore isolates of Pestalosphaeria hansenii Shoemaker & Simpson, which produced an undetermined species of Pestalotiopsis. Booth & Robertson (1961) reported that both anamorph and teleomorph developed in single ascospore cultures of Pestalosphaeria elaeidis (Booth & Robertson) Van der Aa (≡ Leptosphaeria elaeidis Booth & Robertson). Nag Raj (1979) reported a presumptive connection between Pestalosphaeria austroamericana Nag Raj & DiCosmo and an unnamed species of Pestalotiopsis by virtue of the close association between the two on the same specimen; cultural studies were not feasible. In view of this overwhelming evidence it is tempting to suggest a genetic connection between Pestalosphaeria varia and Pestalotiopsis besseyii. However, such a suggestion needs to be confirmed by cultural studies from fresh

collections of the teleomorph and anamorph from the type locality. The conidial features of the anamorphs of Pestalosphaeria spp. and Pestalotiopsis besseyii are compared in Table 2.

Table 2. Comparison of conidial features of Pestalotiopsis besseyii and anamorphs of Pestalosphaeria spp.

Features	hansenii	concentrica	elaeidis	austro-americana	besseyii
Dimensions in µm	21.5-27.5 (-30)X 4.5-6	20-32 X 6-8	(23)-27-34 X 6-7(-10)	28-30 X 10-11	15-19 X 5-6 (-6.5)
Number of septa	4	4	4	4	3
median cells	central dk. br., adj.br.	two upper darker br.	conc. oliv. br.	central dk. br., adj. br.	conc. pale br.
apical appendage-					
number	2-4	2-4	2-3	2-5	2-4
form &	filif.	filif.	spath.	filif.	filif.
length in µm.	9-17	(5-)12-38	19-24	12-40	10-15 (-17)
basal appendage length (µm)	5-7	10-18	5-7	4-10	0-3

Explanation:

dk. = dark; br. = brown; adj. = adjacent cells; conc. = concolourous; oliv. = olivaceous; filif. = filiform; spath. = spathulate.

Acknowledgments

I thank the curator at BPI for the loan of the specimen examined in this study. I am deeply indebted to Prof. B. Kendrick, Department of Biology, University of Waterloo, and Dr. Amy

Rossman, Mycology Laboratory, Beltsville, Md., U.S.A. for critical reviews of this manuscript. The Natural Sciences and Engineering Research Council of Canada gave financial support for this research in the form of an operating grant to Prof. Kendrick.

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MYCOTAXON

Vol. XXII, pp. 64-70 January-March 1985

REDISPOSALS AND REDESCRIPTIONS IN THE MONOCHAETIA-SEIRIDIUM, PESTALOTIA-PESTALOTIOPSIS COMPLEXES. III.

MONOCHAETIA ILICINA (SACC.) COMB. NOV.

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A new combination is proposed for Pestalotia ilicina Sacc.

3. Pestalotia ilicina Sacc.
Nuova Gior. Bot. ital. 8: 198, 1876.

Saccardo (1876) published an account of this fungus and distributed exsiccati as Mycotheca Veneta No. 327. The label on the packet of exsiccatum indicates that Saccardo had some suspicion that his fungus was the same as Pestalotia ilicis Westd. (Bull. Ac. Roy. Belg. 7: 90, 1859). Later, Saccardo (1884) redisposed the fungus in Cryptostictis as C. ilicina. Guba (1961), however, included Pestalotia ilicina as a synonym of Monochaetia monochaeta (Desm.) Allesch. Pestalotia ilicis, a binomial accepted by Guba, had earlier been correctly disposed by Steyaert (1949) as Pestalotiopsis ilicis (Westd.) Stey.

A study of the exsiccatum in BPI indicates that the fungus belongs in Monochaetia (Sacc.) Allesch. Guba (1961) was in error when he included

Table 1. Comparison of conidial features of Monochaetia ilicina, M. monochaeta, M. mucronata, and M. saccardiana.

Features	ilicina	monochaeta	mucronata (Sutton 1975)	saccardiana (Guba 1961)
Dimensions in µm	15-22 X 5.5-7.5	15-28 X 4.5-6.5	16-20 X 6.5-7.5	12-16 X 4-5
number of septa	3-4	4	3-4	3
med.cells:-				
tot. length in µm	10-14/ 9-12.5	10-18.5	10-13.5	8-11
wall orn.	smooth	minutely verruc.	smooth	NA
pigmntn.	pale br.	pale oliv.	brown	pale oliv.
appendage length in um				
apical	up to 4.5	6-24	1-2	3-7 (-10)
basal	up to 1	up to 15	1	6-10
l/w ratio	2.8:1	3.5:1	*2.6:1	*3.1:1

Explanation:
med. cells = median cells; tot. length = total length; orn. = ornamentation; verruc. = verruculose; pigmntn. = pigmentation; br. = brown; oliv. = olivaceous; NA = data not available.

* estimated value based on reported conidial dimensions (vide Guba 1961 and Sutton 1975).

Pestalotia ilicina as a synonym of Monochaetia monochaeta (Desm.) Allesch. The features of P. ilicina suggest that the fungus is identical with Monochaetia mucronata (Massal.) Maire. From a study of the holotype specimen of Coryneum mucronatum Massal. (on leaves of Quercus pubescens, Scaveaghe, Verona, Italy, II.1890, C.Massalongo) in VER, Sutton (1975)

concluded that Guba (1961) erred in placing M. mucronata in synonymy with M. saccardiana (Vogl.) Sacc. Guba (1961) attributes to M. saccardiana conidial dimensions that are different from those reported by Sutton for M. mucronatum and from those obtained for P. ilicina in the present study. Nevertheless, Sutton subsequently (1980) accepted the synonyms published by Guba (1961) for M. saccardiana. I disagree. Pestalotia ilicina and M. mucronata are identical. Table 1 clearly shows the differences between M. ilicina, M. monochaeta and M. saccardiana, in conidial length/width ratio, ornamentation of median cell walls, and the length of the apical appendage. The epithet 'ilicina' has priority over the epithet 'mucronatum'. Hence, the correct nomenclator for the fungus under consideration should be:

Monochaetia ilicina (Sacc.) **comb. nov.** Figs. 1-7

≡ Pestalotia ilicina Sacc., Nuova Gior. Bot. ital. 8: 198, 1876.

≡ Cryptostictis ilicina (Sacc.) Sacc., Syll. Fung. 3: 443, 1884; Syll. Fung. 15: 242, 1901.

= Coryneum mucronatum Massal., Malpighia 8: 208, 1894.

≡ Monochaetia mucronata (Massal.) Maire, Bull. Soc. Bot. Fr. 53: 187, 1907.

Foliicolous. Conidiomata stromatic, acervuloid, predominantly eliphyllous, scattered to gregarious, orbicular to oval or irregular in outline, 150-190 µm wide, 80-100 µm deep, intraepidermal in origin, erumpent, unilocular, glabrous, dark brown to black, dehiscing by a stellate split in the overlying host tissue; basal stroma 15-30 µm thick, of 'textura globulosa', cells moderately thick-walled, subhyaline to pale brown. Conidiophores lining the cavity of the conidioma, arising from the upper layer of cells of the

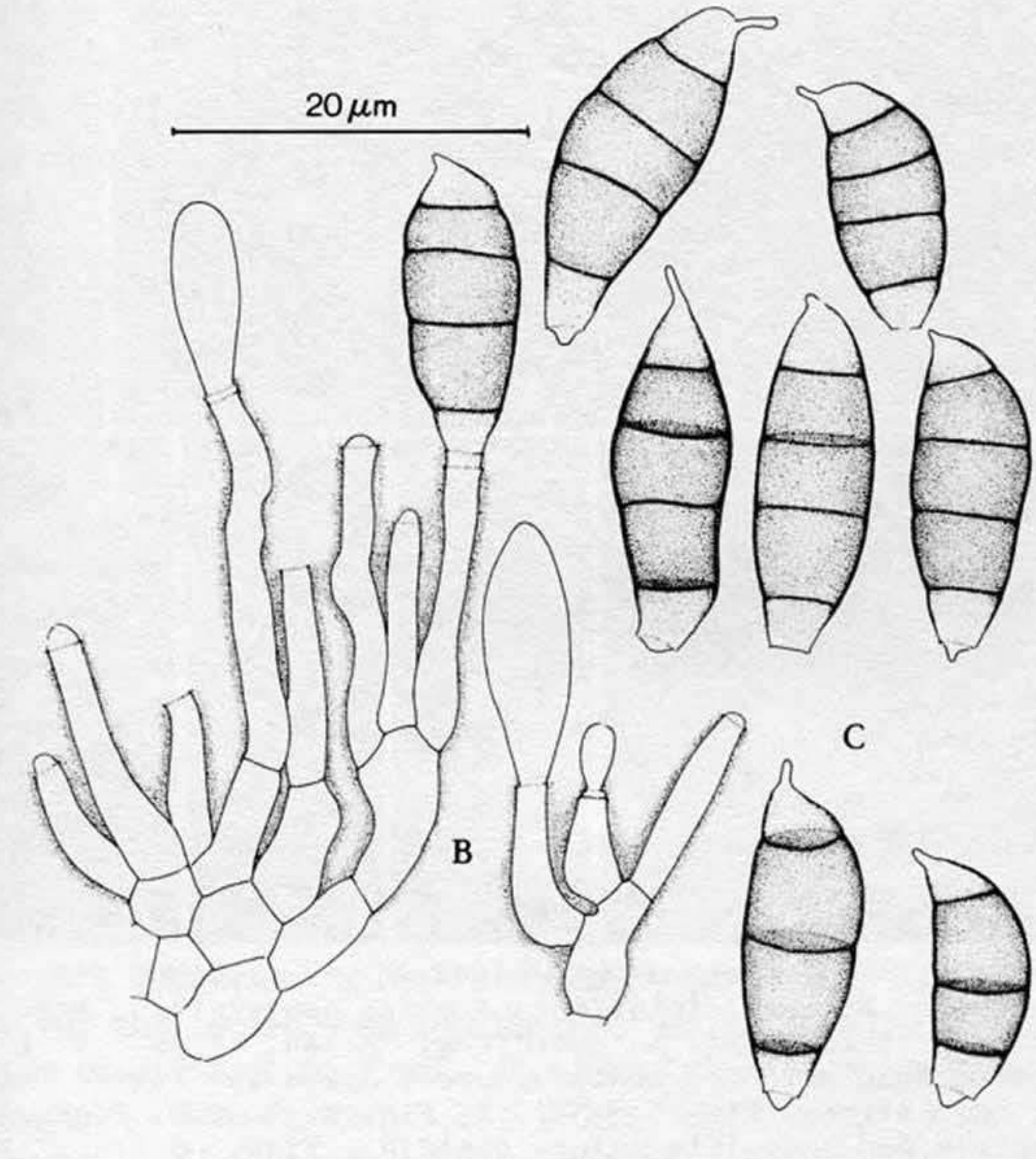

Figure 1. **Monochaetia ilicina** ex isotype in BPI (Saccardo--Mycoth. Ven. No. 327). A. Vertical section of conidioma. B. Conidiophores with conidiogenous cells. C. Mature conidia.

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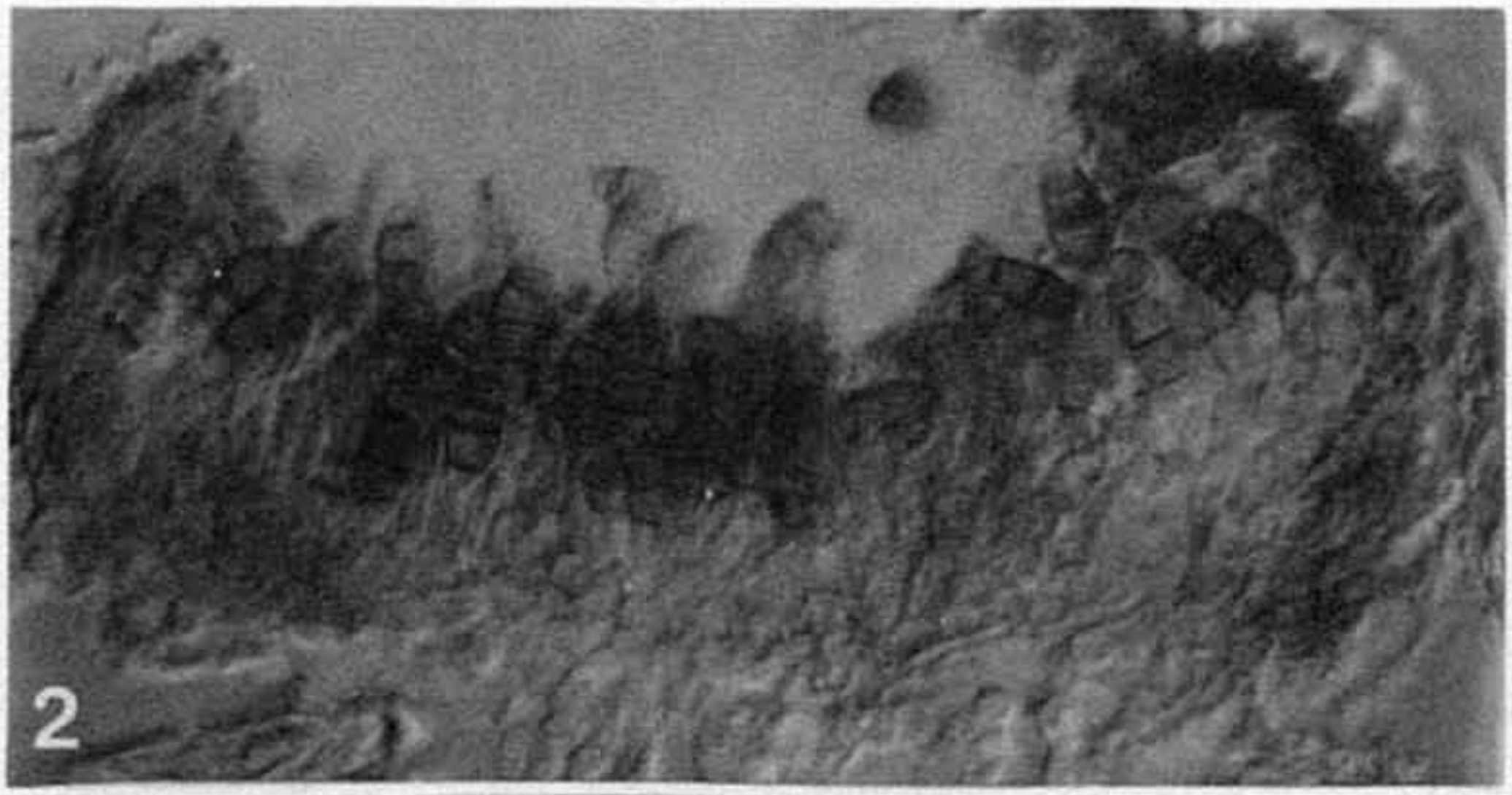
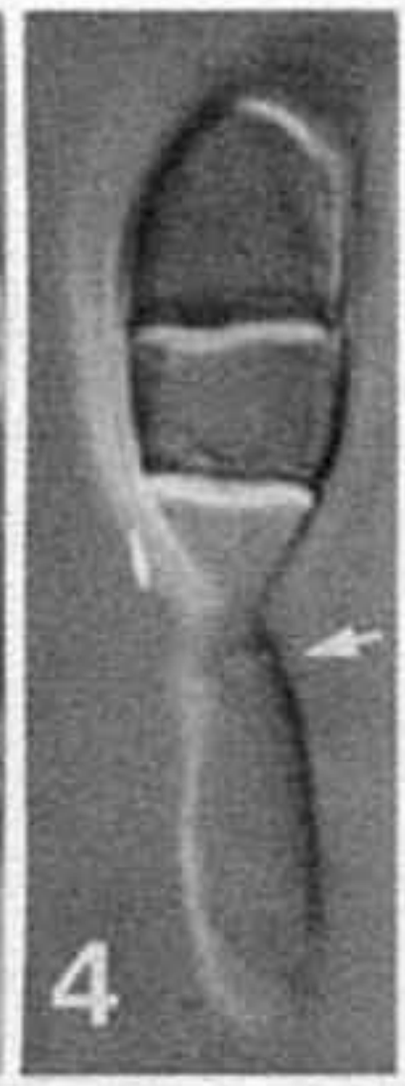
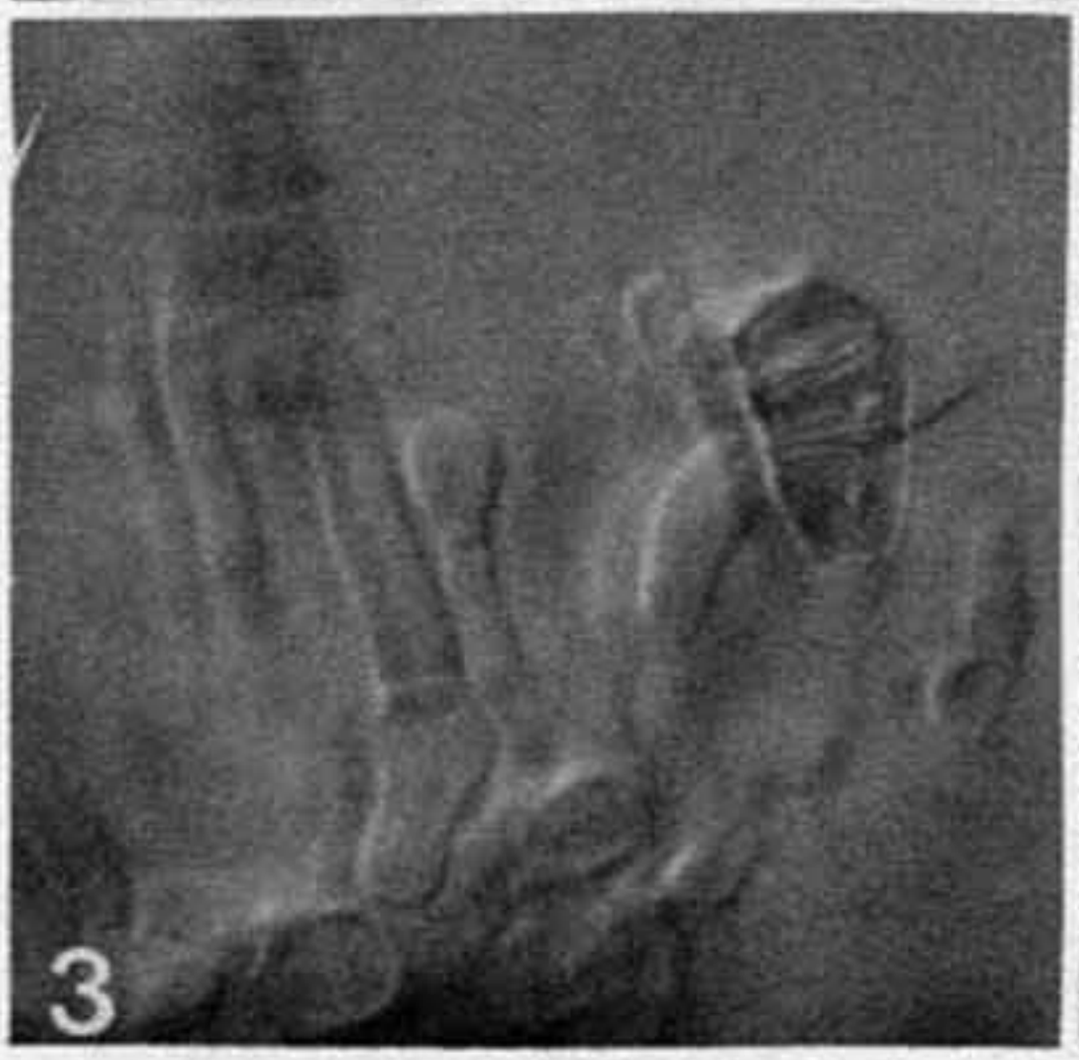
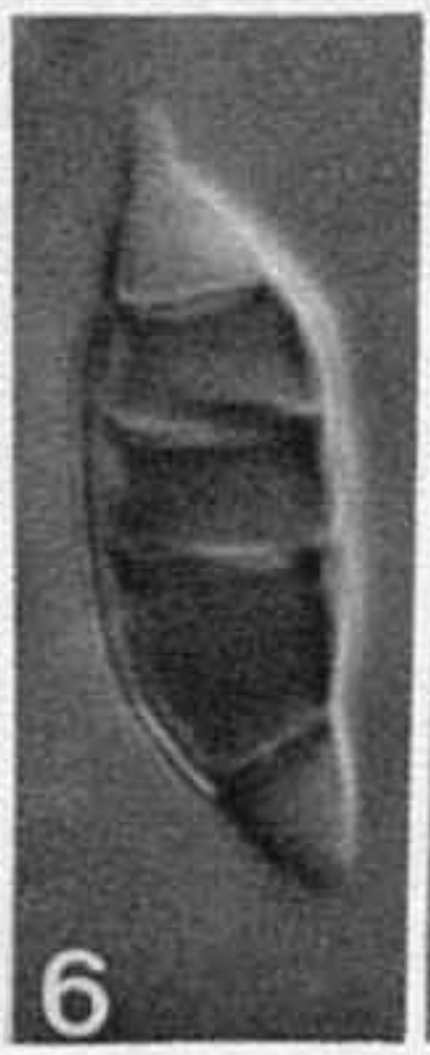
basal stroma, septate and irregularly branched, hyaline, smooth-walled, invested in mucus, up to 40









Figures 2-7. Monochaetia ilicina ex isotype in BPI (All with Nomarski interference phase contrast). Fig. 2. Vertical section of a conidioma. X 480. Figs. 3 & 4. Conidiogenous cell and conidiophores. Arrow in fig. 4 marks the annellations. Fig. 3-- X 1250; Fig. 4. X 2000. Figs. 5-7. 4-septate and 3-septate mature conidia. Figs. 5,6-- X 2000; Fig. 7-- X 1250.

µm long. Conidiogenous cells annellides, terete, lageniform or irregular, hyaline, smooth-walled, 8-23 X 2-3.5 ($\bar{x}$ = 15.5 X 2.7) µm, with up to 3 annellations. Conidia blastic-annellidic, ellipsoid to fusiform, 3-4-septate, 15-22 X 5.5-7.5 ($\bar{x}$ = 18.5 X 6.5) µm, often bearing apical and occasionally basal appendages; basal cell obconic with a truncate base, subhyaline to hyaline, smooth-walled, 2.5-4 ($\bar{x}$ = 3.2) µm long; 3 or 2 median cells doliiform, pale brown, wall smooth and often slightly constricted at the septa, together 10-14 ($\bar{x}$ = 12) µm long in 4-septate forms, but 9-12.5 ($\bar{x}$ = 10.5) µm long in 3-septate forms (suprabasal cell 4-6(-6.5) ($\bar{x}$ = 5) µm long; central and

subapical cells 3-4 ($\bar{x}$ = 3.5) µm long); apical cell conical with a mucronate apex or the apex drawn out into an appendage, subhyaline to hyaline, smooth-walled, 2-4.5 ($\bar{x}$ = 3.2) µm long; apical appendage, when present, tubular, attenuated, oblique, 1-2 ($\bar{x}$ = 1.5) µm long; basal appendage often lacking, but when present centric, tubular, attenuated, up to 1 µm long; mean conidium length/width ratio = 2.8:1.

On leaves of Quercus ilex, Arco, Trentino, N. Italy, IX.1874 (isotype in BPI).

I have not examined the type specimen of Monochaetia saccardiana. If subsequent studies reveal that it is identical with M. ilicina, it will have to be considered a synonym of the latter, since P. ilicina predates Pestalotia saccardiana Vogl. (Atti. Soc. Ven.-Trent. Sci. Nat. Padova 9: 233, 1885).

Acknowledgments

I thank the curator at BPI for the loan of the specimen examined in this study. I am deeply indebted to Prof. B. Kendrick, Department of Biology, University of Waterloo, and Dr. Amy Rossman, Mycology Laboratory, Beltsville, Md., U.S.A. for critical reviews of this manuscript. The Natural Sciences and Engineering Research Council of Canada gave financial support for this research in the form of an operating grant to Prof. Kendrick.

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MYCOTAXON

Vol. XXII, pp. 71-75 January-March 1985

REDISPOSALS AND REDESCRIPTIONS IN THE **MONOCHAETIA-SEIRIDIUM, PESTALOTIA-PESTALOTIOPSIS** COMPLEXES. IV. ON MONOCHAETIA MIERSI

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Monochaetia miersi Speg. is shown to be a species of Pestalotiopsis.

4. Monochaetia miersi Speg. Bol. Acad. Nac. Ci. Cordoba (Argent.) 25:113, 1921.

On rind of fruits of Bellota miersi, in woods near Los Perales, Chile, Spring 1918, C. Spegazzini (type in LPS 12046).

Both Steyaert (1961, see also annotation in Fig. 1c) and Guba (1961) considered Monochaetia miersi an acceptable taxon. Published descriptions characterize the fungus as bearing numerous, somewhat lenticular, brownish black to black, innate-erumpent acervuli 200-350 µm diam.; fusiform or clavate fusiform, 5-celled conidia, 30-35 X 7-10 µm; with 3, pellucid, dark coloured intermediate cells equal in size; basal cell elongate-turbinate, hyaline, tapering; apical cell short conoid, abruptly terminating in a short, somewhat lateral or oblique

UNIVERSIDAD NACIONAL DE LA CIUDAD EVA PERON
MUSEO - INSTITUTO SPEGAZZINI
COLECCIONES MICOLOGICAS

No. 12046. TIPO

Monochaetia miersi Speg.

S/. Bullota miersi

Chile, Los Perales, 1918.
Leg. C. Spegazzini

a

(Inst. Speg. C.M. 12046)

Monochaetia miersii Speg.

25. V. 1960

Determinavit

C

Monochaetia Miersii Speg. (n. form.)

Fungus parasit. Bullotae Miersii Los Perales 1918

b

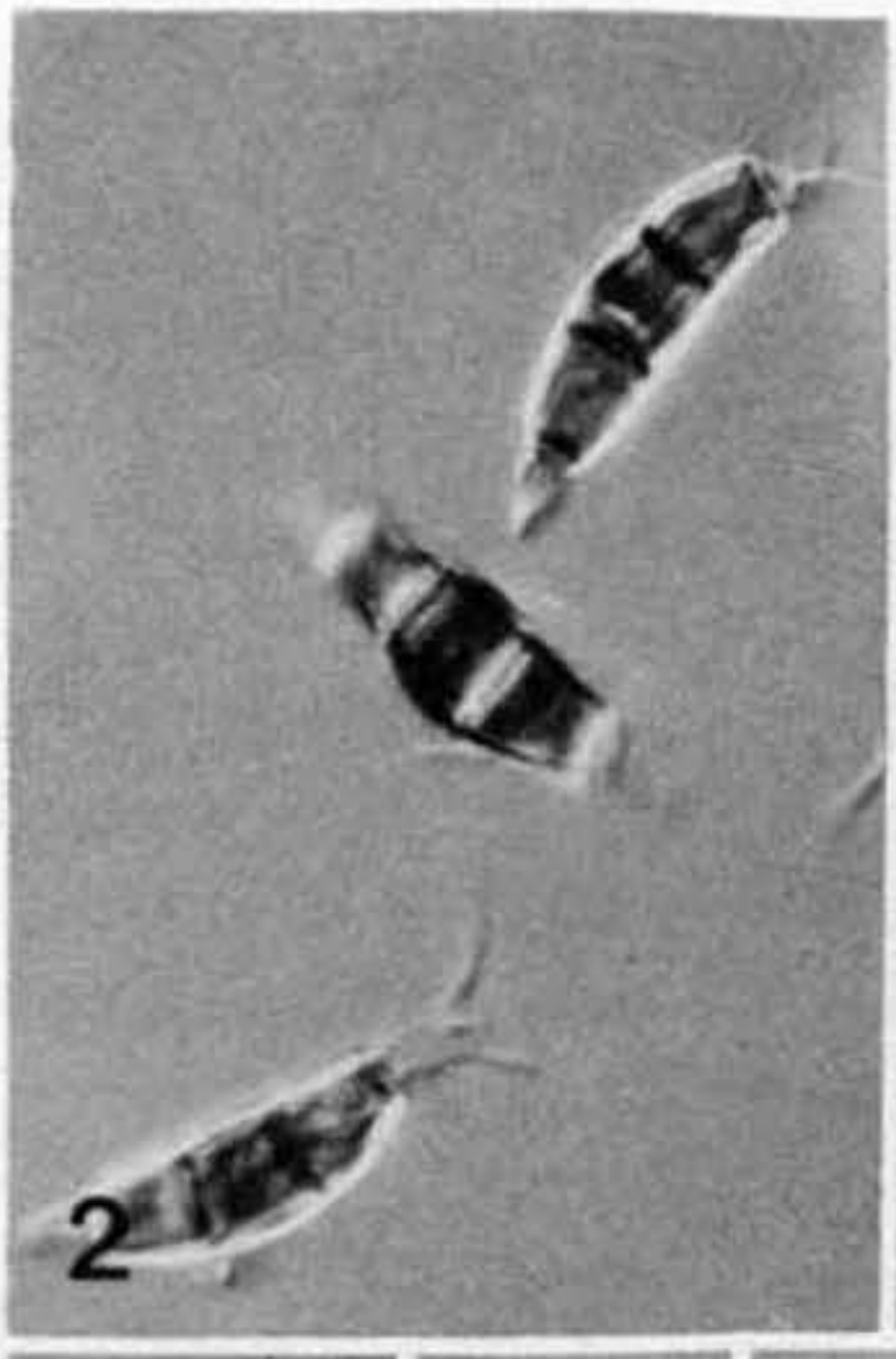
Figure 1. Pestalotiopsis sp. ex type of Monochaetia miersi in LPS. Copy of the label (a), Spegazzini's pencilled notation (b), and Steyaert's annotation concerning the fungus (c).

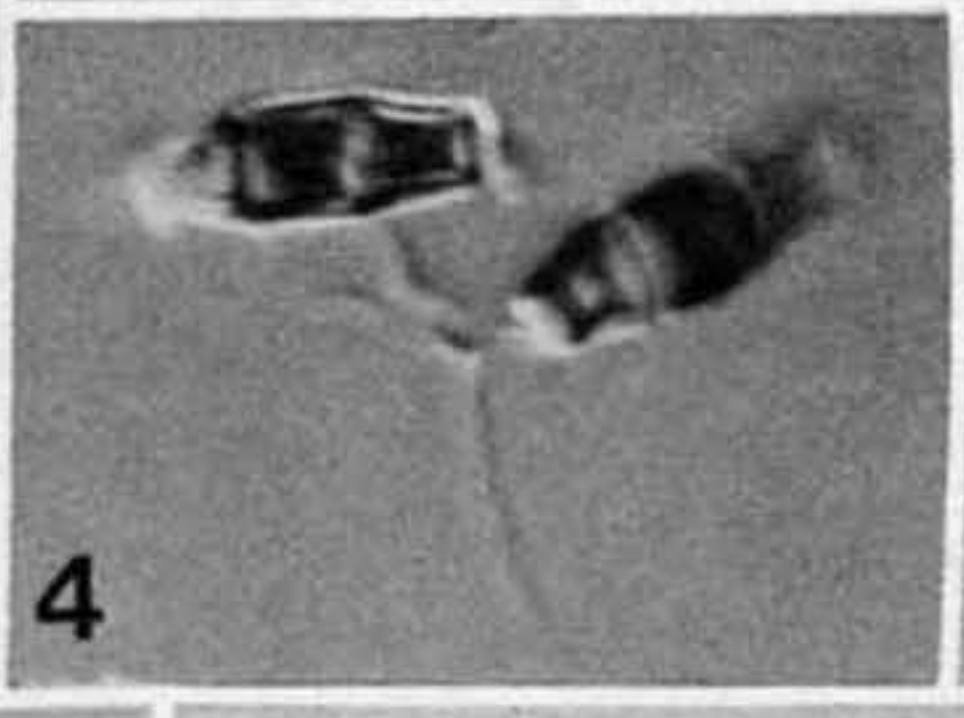
setula, 8-10 X 1 µm, and a short and delicate 'pedicel'.

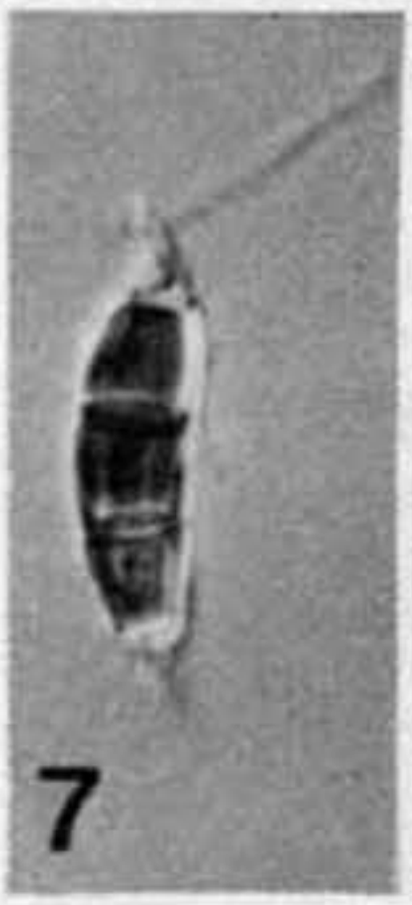
I have examined the type specimen. The label on the herbarium packet along with Spegazzini's pencilled notes and Steyaert's annotation pertaining to the fungus are reproduced in Fig 1a-c. The packet contains numerous fragments of fruit rind of the host bearing abundant conidiomata, which are scattered to gregarious, innate erumpent, appearing initially as minute yellowish brown blisters, ultimately dehiscing to reveal a black mass of agglutinated conidia. Several problems were encountered while studying anatomical details of the fungus. In the numerous sections examined, the conidiomata appear stromatic and pycnidioid, but details of the basal stroma or lateral wall and of the conidial hymenium could not be elucidated since these structures had collapsed and/or disintegrated. Repeated attempts at rehydration of the material in water and 2% KOH, prior to sectioning, did not improve the results. The conidia tend to cohere and can be separated only with great difficulty. Results obtained from several squash mounts are illustrated in Figs. 2-10.

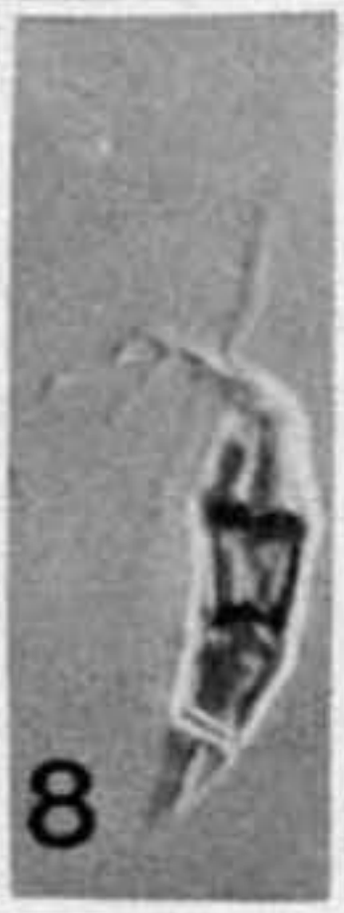
The apical and basal cells in a majority of the conidia have collapsed, and remnants of these present the appearance of conidial appendages. As a result, it was impossible to obtain reliable dimensions for entire conidia. The three median cells are short cylindric to doliiform, brown but versicoloured, with the two upper cells darker than the lower cell; smooth-walled, measuring 17-21 µm long in toto (individual cells 5-6 ($\bar{x}$ = 5.5) µm, 6-7.5 (-8) ($\bar{x}$ = 6.7) µm, and 6.5-7.5 ($\bar{x}$ = 7) µm long), 7.5-9 µm wide. In a few intact conidia the basal cell appears obconic with a truncate base, hyaline, thin- and smooth-walled, 3-5 µm long, often bearing an unbranched, centric, tubular appendage up to 7 µm long; the apical cell is conical, hyaline, thin- and smooth-walled, 4-5 µm long, with 3-4 tubular appendages 3-9(-20) µm long.

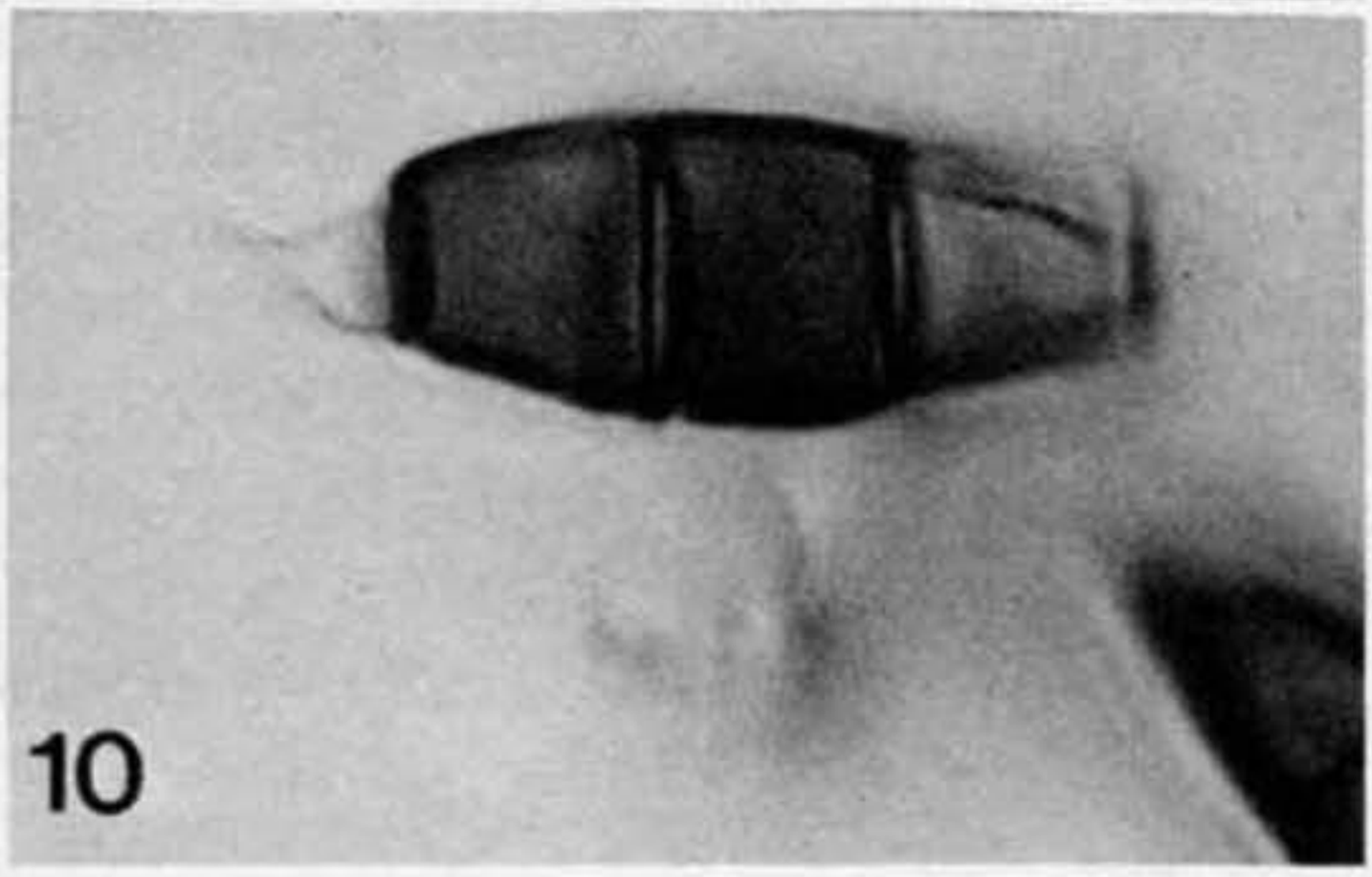
The fact that Spegazzini, astute mycologist











Figures. 2-10. Conidia of Pestalotiopsis sp. ex type of Monochaetia miersi in LPS (All with Nomarski interference phase contrast). Figs. 2-9. X 800. Fig. 10. X 2000.

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that he was, included only 3 conidia and no sectional views of the conidioma in his pencilled notes (although he included sectional views with many other of his coelomycete collections), and the fact that tissues of the wall and conidial hymenium are mostly disintegrated in the collection suggest that the specimen was in all probability not in good condition even at the time of collection. Spegazzini's sketch of one of the conidia with apically knobbed and trifid apical cell (middle conidium in Fig 1b) appears significant in relation to my findings. Although Spegazzini did not record multiple apical appendages on the conidia, these are clearly visible in Figs. 2-9.

The versicoloured median cells, presence of 3-4 tubular appendages at the apex of the apical cell, and the presence of an occasional centric, tubular appendage on the basal cell are not characteristic for species of Monochaetia but are typical of species of Pestalotiopsis. The difficulty in elucidating qualitative and quantitative characters satisfactorily due to the condition of the specimen, presents an obstacle for determination of the species affinities. Hence, M. miersi has to be considered a species of Pestalotiopsis of uncertain status in the genus.

Acknowledgments

I thank the curator at LPS for the loan of the specimen examined in this study. I am deeply indebted to Prof. B. Kendrick, Department of Biology, University of Waterloo, and Dr. Amy Rossman, Mycology Laboratory, Beltsville, Md., U.S.A. for critical reviews of this manuscript. The Natural Sciences and Engineering Research Council of Canada gave financial support for this research in the form of an operating grant to Prof. Kendrick.

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NOTICES

ASPT HERBARIUM TRAVEL AWARDS

The American Society of Plant Taxonomists is pleased to announce the availability of competitive awards for travel by graduate students to the nation's herbaria. Awards will not exceed $500 and will be used to help to pay expenses to and from any herbarium (or herbaria) in the United States and per diem expenses during the visit. The first competition deadline was 1 January 1985, with a second deadline 1 July 1985. The grants program will last a minimum of three years (six competitions). Interested Master's or Ph.D. graduate students should send a curriculum vitae, two letters of recommendation (including one from the major professor), a two or three page outline of the proposed research emphasizing the role that the visit to the herbarium will play, and a letter from the Head Curator, Chairman or Director of the institution(s) to be visited indicating willingness to receive the visitor. Completed applications and additional questions should be directed to Tod F. Stuessy, Chairman, ASPT Committee for Systematics Collections, Department of Botany, Ohio State University, 1735 Neil Avenue, Columbus, OH 43210. (Telephone: (614) 422-5200 or (614) 422-8952.)

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The Biological Research Station of the Edmund Niles Huyck Preserve Inc. offers grants for the support of research in which the natural resources of the Huyck Preserve are utilized. These grants in amounts up to $3500 are available to graduate and post-graduate investigators.

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Inquire for instructions on application and for additional information from Box 188, Rensselaerville, NY 12147. Applications are due in early January, each year.

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Vol. XXII, pp. 77-85 January-March 1985

PHYTOPHTHORA CLANDESTINA SP. NOV. IN ROOTS OF SUBTERRANEAN CLOVER

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INTRODUCTION

In 1982 sporangia of a *Phytophthora* species were observed on rotted roots of subterranean clover(18). The plants were sampled from sites in Victoria where root rot is recognised as a serious problem which reduces the productivity of pastures (18,19). The fungus could not be isolated using standard selective media. It was eventually cultured from aseptically produced clover seedlings infected by zoospores (18). The fungus showed a unique combination of sporangial, gametangial and vegetative characters and we describe it here as a new species, *Phytophthora clandestina*.

METHODS

Detection. Roots of subterranean clover plants from sites affected by root rot were washed free of soil and sections of tap roots with lesions were washed vigorously with tap water. The root pieces were transferred to sterile distilled water in Petri-dishes, incubated at 20°C for 24-48h and examined microscopically for sporangia. These were usually most abundant on slightly discoloured tissue near the margins of root lesions. Cortical tissues adjacent to the stele of infected roots usually contained oogonia similar to those of *Phytophthora*. Small pieces of these roots were mounted on slides for detailed observations of gametangial morphology.

Isolation. Subterranean clover seeds cv. Woogenellup were treated with sodium hypochlorite solution (1% active chlorine) under continuous agitation

for 45 min., rinsed twice in sterile water and germinated at 20°C on moist sterile filter paper. Small pieces of naturally-infected roots bearing abundant sporangia were transferred to sterile distilled water in Petri-dishes. Zoospore production was stimulated by chilling the dishes in a refrigerator at 5°C for approx. 30 min. and returning them to 20°C. A few drops of zoospore suspension were transferred to dishes of sterile water containing 2-3-day-old seedlings of subterranean clover. After 4-7 days at 20°C, abundant sporangia were visible on infected seedling baits. Contamination by other micro-organisms was reduced by repeating the production and transfer of zoospores, or by transfer of single sporangia (using a pasteur pipette drawn to a very fine capillary) to fresh seedlings in Petri-dishes. This procedure eliminated *Pythium spp.*, which were slower to sporulate and release zoospores than the clover-infecting *Phytophthora*. Infected seedlings were washed in sterile water, blotted dry on sterile filter-paper and placed on agar. Bacterial contamination was eliminated by inverting the agar after 3-4 days and subculturing from the reverse side of the colony (14)

Media. Lima bean agar (LBA) was found to be most suitable for isolation and growth of the fungus. Pea-sucrose agar (3) also supported good growth and sporulation but was too opaque for microscopic examination of colonies. Other media used were water agar (distilled water 1L, "Oxoid" agar no.3, 20g), corn meal agar (distilled water 1L, "Oxoid" Cornmeal agar, 20g) and V8-juice agar(11). LBA was prepared as a homogenate of 300g canned lima beans ("Masterfoods" brand) strained through six layers of cheese cloth and made up to one litre with distilled water. The pH was adjusted to 6.0 and 15g of agar ("Oxoid" no.3) was added before the medium was autoclaved at 101 kPa for 20 min.

Observations and Measurements. Hyphal characters and swellings were measured and described from agar culture. Sporangia formed on clover seedlings in distilled water were mounted in lactic acid or lactic acid-trypan blue for observations of morphology and measurements of papilla depth and pedicel length. Measurements of length and breadth were made in water. Zoospores in distilled water were killed with formaldehyde to facilitate observation and measurement. Oogonia and antheridia were observed in roots mounted in distilled water, lactic acid, or lactic acid-trypan blue. Melzer's reagent (16) was used to stain antheridia within host tissues (Pascoe, unpublished data). Measurements of the diameter of oogonia and oospores were made in lactic acid mountants and were taken at right angles to the axis of the oogonial stalk. Antheridial length was determined as the longest visible axis within delimiting septa and the width was taken at right angles to the length. All dimensions are quoted as the range and mean $\pm$ the standard deviation of 100 measurements, except those which showed little variation.

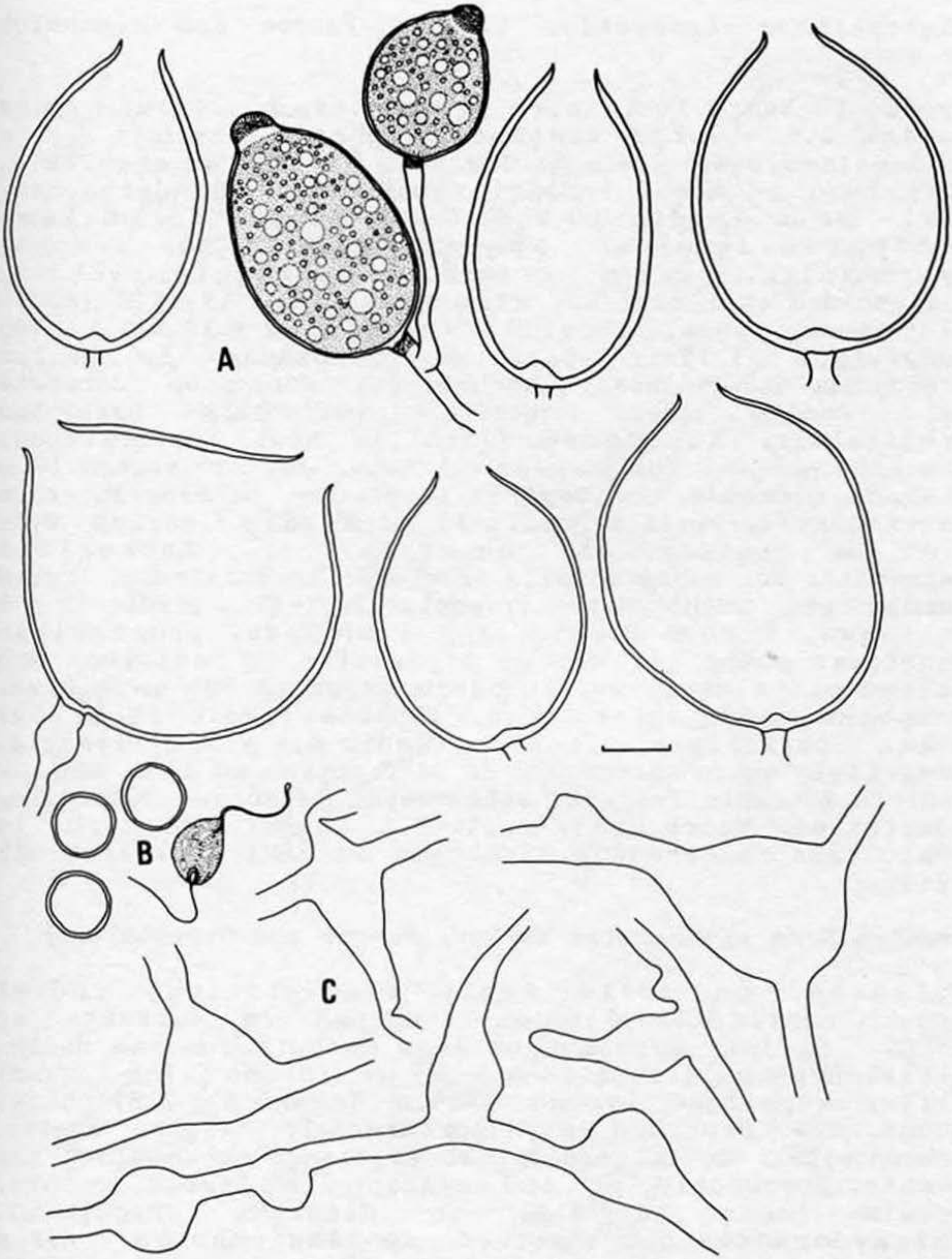

FIG. 1. *Phytophthora clandestina*. A:Sporangia, B:Zoospore and encysted zoospores, C:Hyphal swellings on V8-juice agar. Scale bar represents 10 µm.

DESCRIPTION

Phytophthora clandestina Taylor, Pascoe and Greenhalgh sp.nov.

Hyphae in agaro lentissime crescentes, hyalinae; hyphae aeriae 1.5 - 3.9 µm crassae, hyphae submersae 3.0 - 15.0 µm (medio 6.0 ± 2.0 m) crassae, ramosae ad angulam c. 90°, rami ad nodos inflati subspherici vel deltoidei, 7.5 - 24 µm (medio 18.4 ± 4.0 µm) diametro. **Chlamy-dosporae** ignotae. **Sporangiophora** non ramosa, sympodialia, c.3 µm crassa. **Sporangia** decidua, ellipsoidea vel ovoidea, raro subglobosa, 19-66 µm (medio 41 ± 16 µm) longa, 15-41µm (medio 32 ± 11µm) lata; longi:lati 1.35:1; papillae conspicuae, 5.6 ± 1.2µm profundae, c.7 µm latae; obturamenta conspicua umbonata vel conica septo basali; pedicellis basalibus brevissimis. **Zoosporae** flagellis binis lateralibus, limoniformes vel fusiformes, c.12X8µm, ubi incystatae 10 m diam. globosae. **Oogonia** plerumque terminalia raro intercalaria, 21-36µm (medio 30 ± 3µm) diam.; paries 0.5-1.0 µm crassus, in agaro aureus. **Antheridia** terminalia vel subterminalia interdum intercalaria, quoad formam et magnitudinem irregularia, 9-45µm (medio 18 ± 5 µm) longa, 4-17 µm (medio 11 ± 3 µm) lata, processibus digitatis saepe per septum separatis; in radicibus pro maxime parte paragyna, in agaro usque ad 50% amphigyna. **Oosporae** valde aplerotícae, 19-30 µm (medio 25 ± 2 µm) diam., parietibus 0.3-3.6 µm (medio 1.4 ± 1µm) crassis. **Crescit** in agaro inter 5°C ad 31°C optime ad 25°C. **Hab.** in radicis putridis *Trifolii subterranei*, Kyabram, Victoriae, Australiae, March 1983, coll. P.A. Taylor. Holotypus in VPRI 12234 conservatus, isotypus ad IMI 278933 et DAR 49489 .

Phytophthora clandestina Taylor, Pascoe and Greenhalgh.

Colonies on solid media slow-growing, radial growth rate c.1.5-2.0 mm.day^{-1} on LBA in darkness at 25°C. Aerial mycelium on agar conspicuous and dense. Aerial hyphae slender, 1.5-3.9 µm (mean 2.7 ± 1.5 µm) thick; submerged hyphae 3-15µm (mean 6 ± 2µm) thick, abundantly branched at approximately right angles. Subspherical to deltoid hyphal swellings occur along the hyphae, frequently at or adjacent to branch points, 8-24 µm (mean 18 ± 4 µm) in diameter (Figs.1,3.). **Chlamydospores** not observed. **Sporangiophores** c.3 µm thick, with simple, sympodial branching. Nodal swellings rare. **Sporangia** (Figs.1,3.) are produced most abundantly on infected material submerged in water but also occur frequently on solid media. Sporangia papillate, occasionally with two or three papillae, apical thickening c.4-6 µm deep in lactic acid, exit pore c.6-7µm wide. Sporangia broadly ellipsoid to ovoid, sometimes sub-globose, 19-66µm (mean 41 ± 16µm) long and 15-44µm (mean 32 ± 11 µm) wide, length to breadth ratio

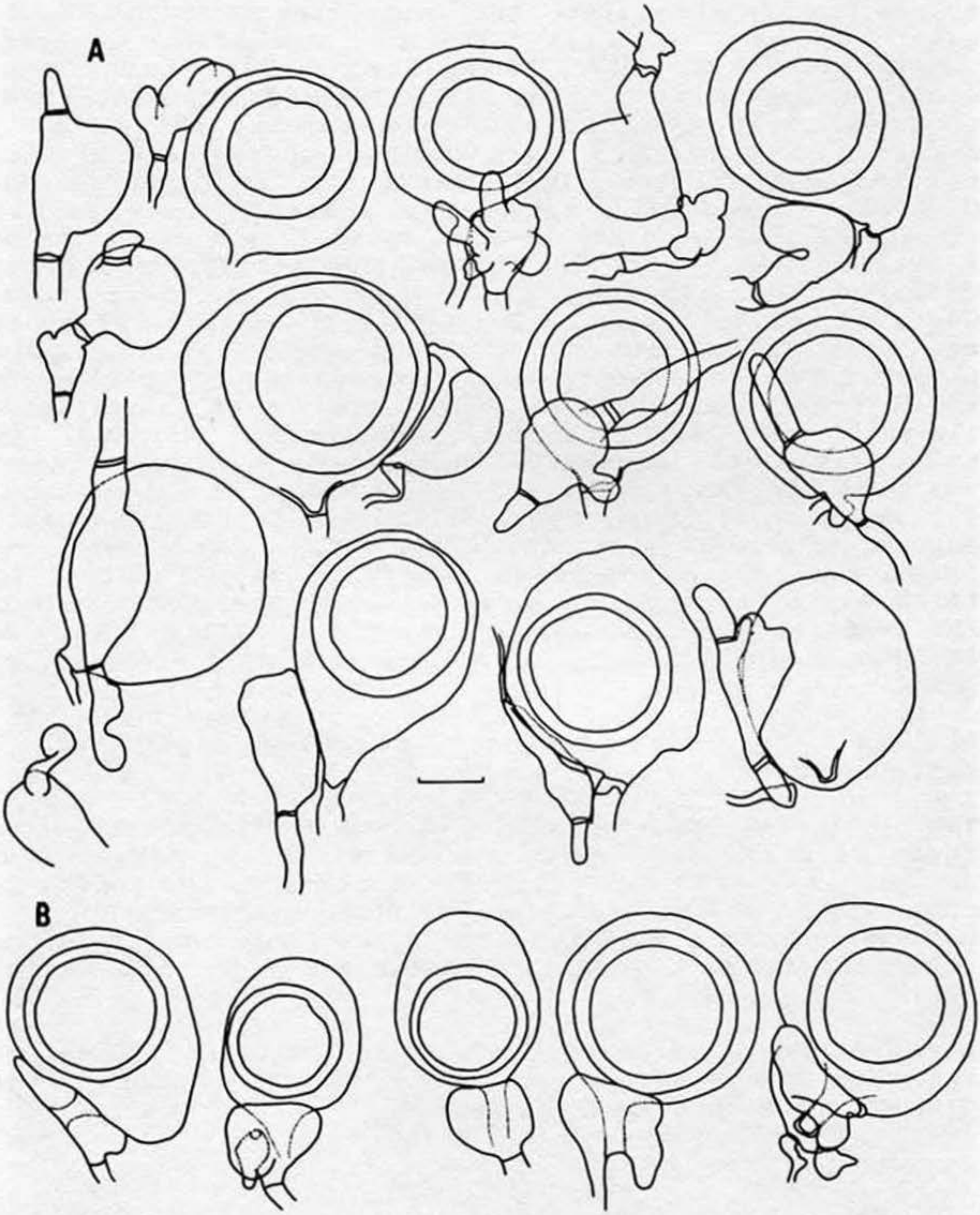

FIG. 2. *Phytophthora clandestina*, gametangia in roots of subterranean clover seedlings. A:Oogonia and paragynous antheridia. B:Oogonia and amphigynous antheridia. Scale bar represents 10 µm.

1.35:1 (range 1.2:1 to 1.4:1). Frequently a conspicuous, dome-shaped or broadly conical basal plug protrudes into the sporangium. Sporangia not readily removed from sporangiophores at first, but empty sporangia deciduous, seceding by a short (1-6 µm) occluded pedicel. **Zoospores** (Fig.1) limoniform to reniform, c.12X8 µm, with two lateral flagellae and, when encysted, globose, c.10 µm diameter. **Gametangia** (Figs 2,3.) abundant in infected host roots, sparse and slow to develop in culture (c.4 weeks at 20°C on LBA). **Oogonia** usually terminal, rarely intercalary (frequency 2%), diameter 21-36 µm (mean 30 ± 3 µm), inter-or intracellular, more or less spherical, sometimes distorted or assuming the shape of the host cell. Oogonial wall smooth, 0.5-1.0 µm thick, golden yellow in culture, colourless in host tissue. **Antheridia** paragynous or amphigynous; predominantly paragynous (70-93%) in host tissues, but frequently amphigynous (50-60%) in agar culture. Antheridia terminal or subterminal, occasionally intercalary (frequency 14%), variable in shape and size, 9-45 µm (mean 18 ± 5µm) long, 4-17µm (mean 11 ± 3µm) wide, delimited by a thick basal septum. Antheridia frequently (35%) complex, often with one or more digitate processes which may be delimited by thick septa. Amphigynous antheridia often eccentric about the oogonial stalk. **Oospores** markedly aplerotic, diameter 19-31µm (mean 25 ± 2 µm), wall 0.3-3.6µm (mean 1.4 ± 1.0 µm) thick.

Optimum temperature for radial growth on agar c.25°C, minimum <5°C, maximum 31°C.

The holotype specimen VPRI 12234 is derived from rotted roots of *Trifolium subterraneum* subsp. *yanninicum* cv. Yarloop from Kyabram, Victoria, Australia. The fungus is preserved in the herbarium of the Plant Research Institute, Burnley, Victoria as microscope slides, dried cultures and infected roots. Isotype specimens are deposited as IMI 278933 and DAR 49489.

Etymology:from Latin, "clandestinus", meaning hidden or secretive, in recognition of the difficulty encountered in detecting and culturing the fungus.

DISCUSSION

Several fungi, in particular *Fusarium spp.* and *Pythium spp.* have been associated with root rot of subterranean clover (1,2,5,8,9,10,15,17), but reports of *Phytophthora spp.* are rare. Stovold (17) isolated a "sterile" *Phytophthora* with non-papillate sporangia (Stovold, personal communication) from rotted roots at one location in New South Wales, Australia (17). In North America, *P.megasperma* Drechs.has been associated with diseased subterranean clover (7,13). Both fungi are clearly distinct from *P.clandestina* (12,20,21).

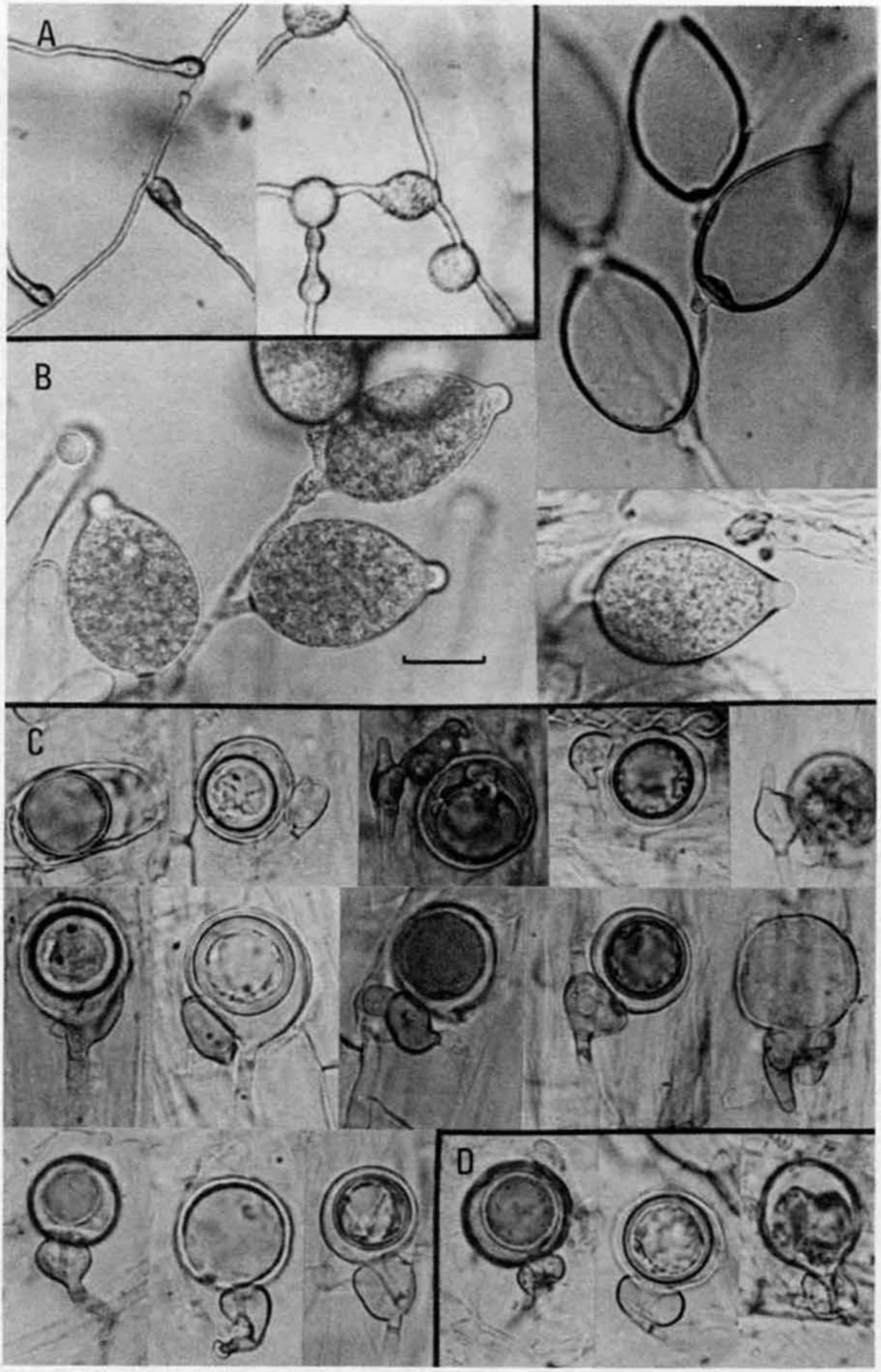

FIG 3. *Phytophthora clandestina*. A:Hyphal swellings. B:Sporangia. C:Gametangia in roots. D:Gametangia in agar. Scale bar represents 20 µm.

P. clandestina has some characters in common with *P. cactorum* (Leb. et Cohn) Schroet., *P. iranica* Ershad(4) and *P. pseudotsugae* Hamm and Hansen(6), but differs from them in its slower growth rate, characteristic hyphal swellings and commonly subterminal or digitate antheridia. The frequent occurrence of a prominent basal plug in the sporangia of *P. clandestina* is also a character not recorded for these other fungi. In addition *P. clandestina* is distinguished from *P. cactorum* by the frequent occurrence of amphigynous antheridia in culture and from both *P. pseudotsugae* and *P. iranica* by its markedly aplerotic oospores. The recent discoveries of *P. iranica*, *P. pseudotsugae* and now *P. clandestina* show that the frequent production of both amphigynous and paragynous antheridia by a *Phytophthora sp.* with papillate sporangia sensu Waterhouse (20,12) is not as unusual as was previously thought(6).

ACKNOWLEDGEMENTS

We thank D.J. Stamps and F.J. Newhook for advice and critical review of the manuscript, G.A.M. Scott of Monash University for correcting the Latin diagnosis and Karen Kuehnapfel and Stephanie Yates for technical assistance. Financial support from the Australian Dairy Research Trust Fund is gratefully acknowledged.

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MYCOTAXON

Vol. XXII, pp. 87-96 January-March 1985

TAXONOMIC NOTES ON SOME POWDERY MILDEWS (V)

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The following descriptions and combinations are included in this paper: Erysiphe magnicellulata U. Braun var. robusta (Zheng & Chen) U. Braun stat. nov., E. glycines Tai var. lespedezae (Zheng & U. Braun) U. Braun & Zheng stat. nov., Microsphaera menispermi Howe var. dahurica U. Braun & Y. Nomura var. nov., M. menispermi var. sinomenii (Yu) U. Braun stat. nov., M. subtrichotoma U. Braun spec. nov., Uncinula togashiana U. Braun var. rigida U. Braun & S. Tanda var. nov., U. wuyiensis (Chen & GAO) U. Braun comb. nov., Uncinuliella simulans (Salm.) Zheng & Chen var. tandae U. Braun stat. & nom. nov., and Sawadaia polyfida (Wei) Zheng & Chen var. japonica U. Braun & S. Tanda var. nov. Furthermore, a short survey of the genus Phyllactinia in North America is given.

1. Erysiphe magnicellulata U. Braun var. robusta (Zheng & Chen) U. Braun stat. nov.

Bas.: Erysiphe robusta Zheng & Chen, Sydowia 34, p. 296 (1981).

I have studied additional material on Polemonium linifolium Vass., collected in the Far East of the USSR. The sample is from the herbarium of the Far East State University, Vladivostok. The Erysiphe on Polemoniaceae (E. magnicellulata) is well characterized by the appearance of the mycelium (dense, persistent patches or covers) and large (10-30 µm diam.), thick-walled, conspicuous peridium cells. This species is widely distributed on Phlox, especially in N. America. Collections on some species of Polemonium in N. America and Europe coincide well with E. magnicellulata, and the samples on Polemonium chinense and linifolium in Asia (China, Far

East of the USSR) are largely agreeing, too. They differ, however, by very broad appendages, (4-) 6-13 (-18) µm, and peridium cells that reach 40 µm in diam. These minor differences are not sufficient to recognize a separate species. Therefore, I prefer a comprehensive Erysiphe on Polemoniaceae, separated into two varieties.

2. Erysiphe glycines Tai var. lespedezae (Zheng & U. Braun) U. Braun & Zheng stat. nov.

Bas.: Erysiphe lespedezae Zheng & U. Braun, Mycotaxon 18(1), p.142 (1983).

E. glycines and lespedezae are two very closely related taxa, well characterized by scattered ascocarps, long, hyaline or only pale yellow, very slender appendages and fairly numerous ascospores (4-8). The number of ascospores provides the only clear difference between E. glycines and the Lespedeza-Erysiphe (4-7-spored in the former and 6-8-spored in the latter species). Recent investigations of additional Japanese collections of E. glycines showed that there are specimens of this species with 6-7-spored asci. The difference between these taxa is too small to warrant a recognition of separate species. The Lespedeza fungus is hardly more than a variety of E. glycines.

3. Microsphaera menispermi Howe s.str. and allied taxa

M. menispermi is distributed in North America on Menispermum canadense. The cleistothecia are (80-) 100-135 (-145) µm in diam., appendages (6-) 8-18 (-20), the apex is rather compact, closely branched (fig. 1). Two geographically isolated taxa on other hosts of the Menispermaceae are very near to M. menispermi; they coincide in most essential features. A powdery mildew on Menispermum dauricum in Japan deviates from the fungus on M. canadense by a different mode of branching. The branchings are looser and characteristically angular. Microsphaera sinomenii Yu, described on Sinomenium acutum from China, differs from both taxa on Menispermum by fairly few appendages (ca. 5-11) and smaller ascocarps (ca. 70-115 µm in diam.). A separation on varietal rank seems to be appropriate.

Microsphaera menispermi Howe var. sinomenii (Yu) U. Braun stat. nov.

Bas.: Microsphaera sinomenii Yu, Acta Microbiol. Sinica 21(1), p.10 (1981).

Microsphaera menispermi Howe var. dahurica U. Braun & Y. Nomura var. nov.

Mycelium amphigenum, subpersistens, conidia non catenulata, ellipsoideae (-doliiformae), ca. 30-40 x 15-20 µm. Cleistothecia sparsa (-subgregaria), 90-120 µm diam.,

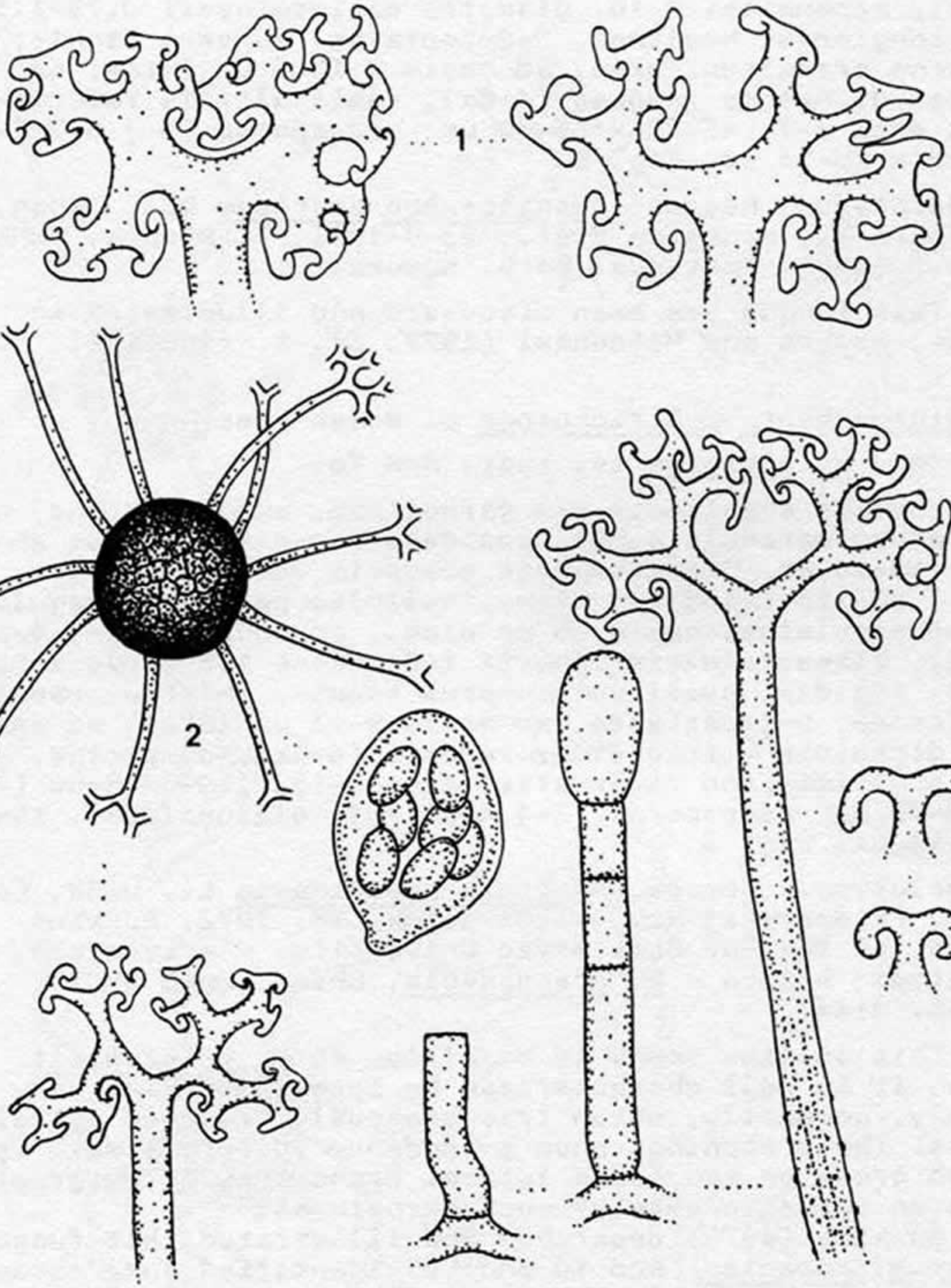

Fig. 1-2. Microsphaera menispermi var. menispermi (1), branchings of the appendages. M. menispermi var. dahurica (2), ascocarp, ascus, appendages, conidiophores. U. Braun del.

cellulae peridii irregulariter angulatae, ca. 10-20 µm diam., appendices 4-18, diametro cleistothecii 0.75-1.5 plo longiores, hyalinae, 0-2-septatae, superne tenui-, inferne crassitunicatae, ad basim 7-10.5 µm latae, ad apicem dichotome ramosae (4-6x), ramis ultimis recurvatis, asci 4-7, 45-70 x 35-50 µm, ascosporae (5-) 6-7 (-8), 16-25 x 10-14 µm. Fig. 2.

Holotypus: hospes - Menispermum dauricum DC., Japan, Oenohara T., Kanagawa Pref., 23-9-1981, Y. Nomura, YNMH 6758-2 (HAL). Isotypus: herb. Nomura.

This fungus has been discussed and illustrated in Tanda, Nomura and Matsunami (1977, pl. X, fig. 1-8).

4. Microsphaera subtrichotoma U. Braun spec. nov.

Syn.: M. robiniae ss. auct. non Tai

Mycelium amphigenum vel carpogenum, subpersistens, conidia non catenulata, ellipsoideae (-ovoideae), ca. 26-38 x 13-18 µm. Cleistothecia gregaria vel subsparsa, (70-) 80-125 (-145) µm diam., cellulae peridii irregulariter angulatae, ca. 8-25 µm diam., appendices (2-) 4-10 (-13), diametro cleistothecii 1-3, saepe 1.5-2 plo longiores, rigidae, hyalinae, superne tenui-, inferne crassitunicatae, 0-1-septatae, ad basim 9-13 µm latae, ad apicem dichotome - trichotome ramosae (4-8x), compactae, ramis ultimis non recurvatis, asci 4-15, (40-) 45-60 (-65) x 25-40 µm, ascosporae (3-) 4-5 (-6), ellipsoideae, 15-23 x 9-13 µm. Fig. 3.

Holotypus: hospes - Robinia pseudacacia L., USSR, Far East, Primosrskij Kr., Vladivostok, IX. 1972, Bunkina (herb. of the Far East State University, Vladivostok). Paratypi: hospes - R. pseudacacia, China, HMAS 39029, 41446, 41447.

This species seems to be allied to M. palczewskii Jacz. It is well characterized by appendages with very richly, compactly, often trichotomously branched apical parts. The branchings show a tendency to form a main axis which grows on and bears lateral branchings or outgrowth or even opposite sets of such structures.

Bunkina (1979) described and illustrated this fungus under M. robiniae, and Yu and Lai identified some agreeing Chinese samples on Robinia as well as two collections on Indigofera spec. (HMAS 41456) and Lespedeza bicolor Turcz. (HMAS 41455) with M. robiniae, too. The collections on Indigofera and Lespedeza pertain clearly to M. diffusa C. & P. They differ from M. subtrichotoma by numerous appendages (ca. 9-25) and a distinct mode of branching. I have revised the type of M. robiniae Tai (HMAS 05523). This species, only known from the type, is not closely related to M. subtrichotoma. It is, however, near to M. hedysari U. Braun, M. thermopsidis U. Braun, and M. alhagi (Golovin) U. Braun. The cleistothecia of M. robiniae

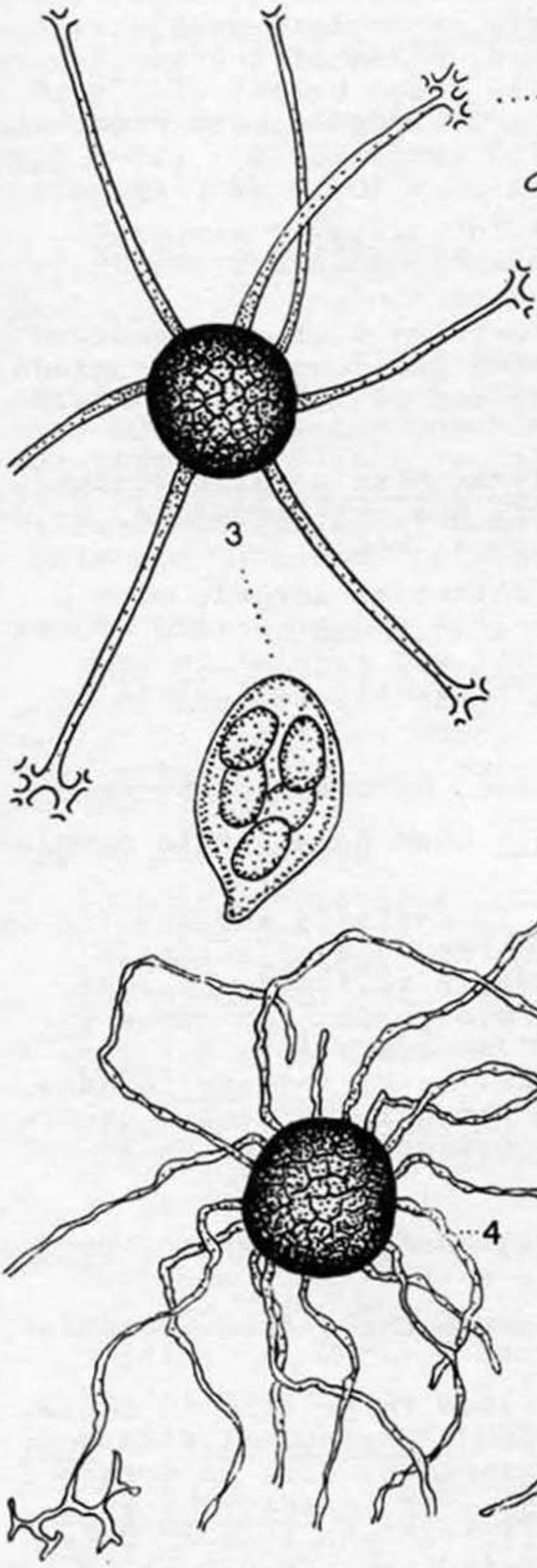

Fig. 3-4. Microsphaera subtrichotoma (3), ascocarp, ascus, apical parts of the appendages, conidia. M. robiniae (4), ascocarp, ascus, apex of an appendage. U. Braun del.

are 85-145 µm in diam., appendages numerous, 6-25, mostly 10-20, 1-3 times as long as the cleist. diam., very irregular, flexuous, lax, strongly geniculate-undulate, hyaline, 0-2-septate, thin-walled, somewhat thicker toward the base, smooth or only faintly rough below, (3-) 4-10 (-12) µm wide, apex simple or 1-5 times loosely branched, diffuse, tips not recurved, 6-13 asci, 50-70 x (25-) 30-45 µm, (4-) 5-6 (-7) spores, 14-20 x 10-15 µm (fig. 4).

5. Uncinula togashiana U. Braun var. rigida U. Braun & S. Tanda var. nov.

Cleistothecia sparsa, ca. 80-90 µm diam., appendices 15-25, diametro cleistothecii 1-2 plo longiores, rigidae, asci 3-7, 40-60 x 30-45 µm, ascosporae 3-5, 15-24 x 9.5-14 µm. Fig. 5.

Holotypus: hospes - Pterostyrax hispida Sieb. & Zucc., Japan, Yamanashi Pref., Masutomi Spa, Kitakoma-gun, 9-10-1983, Tanda (TUAMH 2207). Isotypus: HAL.

The fungus on Pterostyrax coincides largely with U. togashiana. It differs, however, in the structure of the appendages. They are rather stiff and regular in var. rigida and more irregular and frequently geniculate in var. togashiana.

6. Uncinula wuyiensis (Chen & Gao) U. Braun comb. nov.

Bas.: Furcouncinula wuyiensis Chen & Gao, Acta Mycol. Sinica 1(1), p.11 (1982).

The apex of the appendages is uncinate and the tip is very shortly bi- to trifid with recurved or uncinate branchlets. This type of appendages is fairly unusual, but it does not warrant a separate genus. The genus Uncinula possesses numerous "odd" species, e.g. U. paradoxa Simonian, U. nothofagi Thax. or U. forestalis Mena, all with unusual features. The recently separated genera (Uncinuliella, Bulbouncinula) possess differences in the basic characteristics.

7. Uncinuliella simulans (Salm.) Zheng & Chen var. tandae U. Braun stat. et nom. nov.

Bas.: Uncinuliella rosae Zheng & Chen, Acta Microbiol. Sinica 19(3), p.284 (1979).

Zheng and Chen (l.c.) described three taxa in their comprehensive revision of the genus Uncinuliella on Rosa: U. rosae and U. simulans var. simulans, both on Rosa multiflora in Japan, and U. simulans var. rosae-rubi on R. rubus in China. I have reinvestigated the type of U. rosae, which is very close to U. simulans. It agrees in all essential features and differs only by smaller ascocarps (70-110 µm diam.), 3-5 (-6)-spored asci and appendages which are only coloured near the base. U. rosae is hardly more than a variety of U. simulans. It is named after Dr. S. Tanda (Tokyo), the collector of the type specimen.

8. Sawadaia polyfida (Wei) Zheng & Chen var. japonica U. Braun et S. Tanda var. nov.

Cleistothecia similia eis typi; saepe 150-200 µm diam. Fig. 6.

Holotypus: hospes - Acer palmatum Thunb. var. matsumurae Mak., Japan, Tokyo, 9-11-1983, Kawai (TUAMH 2408). Isotypus: HAL.

Japanese Sawadaia collections on Acer palmatum, tenuifolium and sieboldianum are very well agreeing with S. polyfida. The appendages are very numerous (more than 100, reaching 250) and richly branched (2-3 x). The ascocarps of the Japanese collections are, however, constantly smaller (usually about 150-200 µm in diam., average less than 200 µm, rarely reaching 250 µm; ascocarps of var. polyfida generally more than 200 µm, reaching 300 µm). Some collections of var. japonica have been described and illustrated in Tanda, Nomura and Matsunami (1977), Nomura, Tanda and Matsunami (1978) and Tanda and Nomura (1978).

9. The genus Phyllactinia in North America

The morphology of the taxa in Phyllactinia is very uniform and our knowledge about the biological specialization is too poor. Therefore, I prefer a comprehensive Phyllactinia guttata; only few segregate species are recognized.

Key to the species

1. Conidia characteristically angular, often somewhat constricted centrally or ± cylindric (fig. 8), 35-60 (-80) x 16-26 (-30) µm, on Fagaceae (Castanea, Fagus, Quercus and Ulmus ... (a.) Phyllactinia angulata (Salm.) Blumer

1′ Conidia ± clavate, not angular (fig. 7), ca. 40-90 x 10-25 µm 2

2. Cleistothecia agreeing with Ph. guttata, but asci frequently 3-spored, seldom 4-sp., on Oleaceae (Fraxinus) ..... (b.) Ph. fraxini (DC.) Fuss

2′ Asci constantly 2-spored, very rarely 3, on other host families 3

3. Cleist. ca. 140-250 µm in diam., seldom slightly exceeding, on various hosts ..... (c.) Ph. guttata (Wallr.: Fr.) Lév.

3′ Cleist. larger, ca. 220-280 µm in diam., on Eleagnus argentea ..... (d.) Ph. eleagni Linder

3′′ Cleist. fairly small, ca. 140-185 µm in diam., average below 170 µm, on Crataegus (e.) Ph. mali (Duby) Braun

(a.) Phyllactinia angulata (Salm.) Blumer, Beitr. Krypt.-Fl. Schweiz 7(1), p.399 (1933)

Syn.: Ph. corylea var. angulata Salm., Ann. Myc. 3, p.

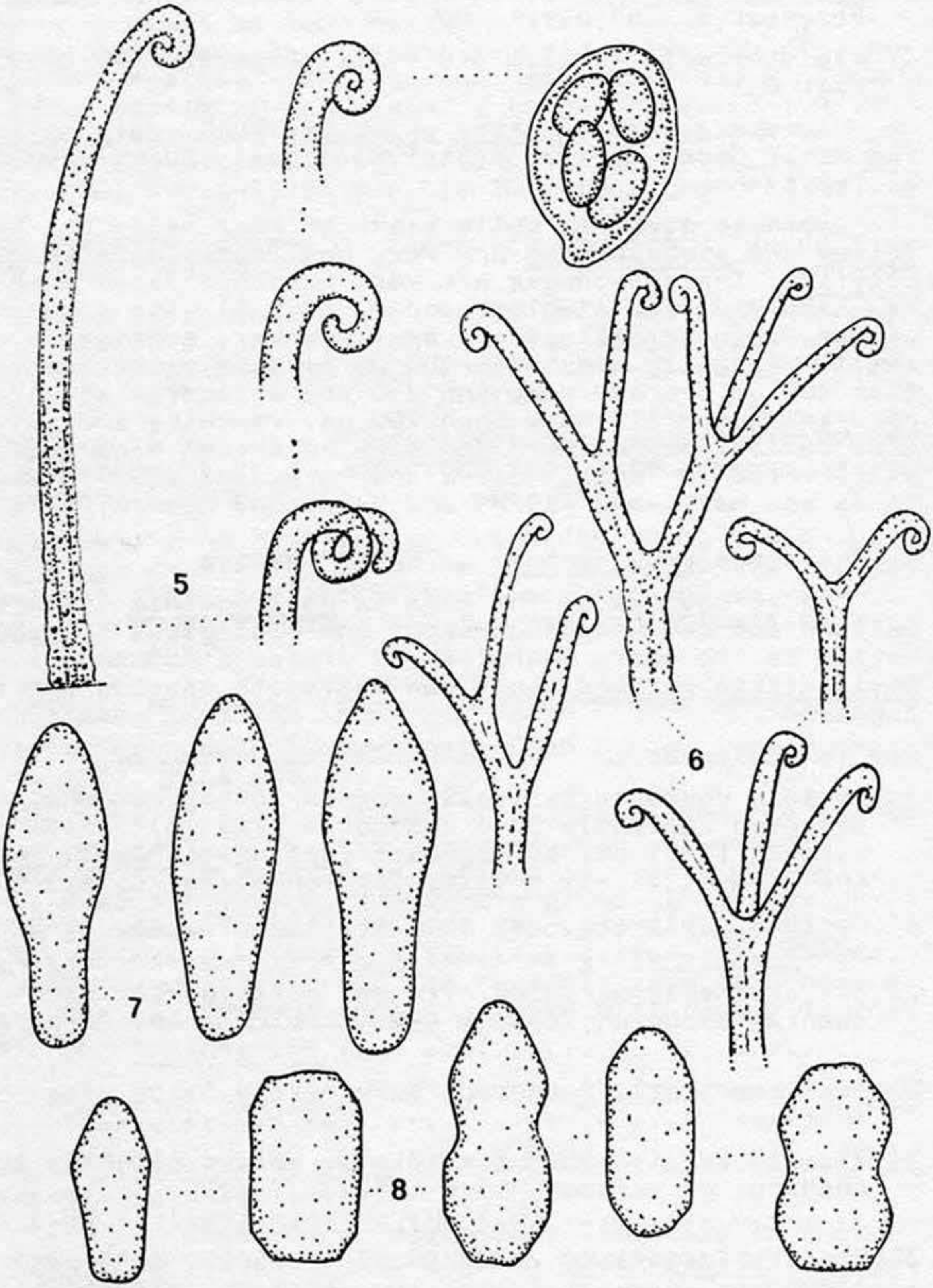

Fig. 5-8. Uncinula togashiana var. rigida (5), appendage, apical parts, ascus. Sawadaia polyfida var. japonica (6), appendages, apical parts. Phyllactinia guttata (7), conidia. Ph. angulata (8), conidia. U. Braun del.

500 (1905).

This species is well characterized by the conidial shape; the mycelium is always well developed, conspicuous, persistent, and the ascocarps are mostly fairly large (ca. 185-310 µm). They are mostly about 200-280 µm in diam. All American Phyllactinia samples on diverse hosts of the genera Castanea, Fagus and Quercus pertain to Ph. angulata. The N. American Ulmus Phyllactinia is morphologically fully agreeing with this species.

(b.) Phyllactinia fraxini (DC.) Fuss, Arch. Ver. Siebenb. Naturk. 14(2), p.463 (1878)

Syn.: Ph. fraxini (DC.) Homma, J. Fac. Agric. Hokkaido Imp. Univ. 38, p.409 (1937). Alphitomorpha lenticularis Wallr., Fl. Crypt. Germ. 2, p.759 (1833). Ph. suffulta var. blumeri de Mendonça & Sequ., Agron. Lusit. 24(2), p. 107 (1962). Ph. guttata var. blumeri (de Mendonça & Sequ.) U. Braun, Gleditschia 6, p.172 (1978).

The species is widely distributed in North America on various hosts of the genus Fraxinus. It is a specialized taxon, distinguished from Ph. guttata by frequently 3-sp. asci. Within the very uniform Ph. guttata complex, this feature seems to be sufficient to recognize Ph. fraxini.

(c.) Phyllactinia guttata (Wallr.: Fr.) Lév., Ann. Sci. Nat., bot., 3 sér., 15, p.144 (1851)

Syn.: Ph. suffulta (Rebent.) Sacc., Syll. Fung. 1, p. 5 (1882). Ph. corylea (Pers.) Karst., Act. Soc. Faun. Fl. Fenn. 2, p.92 (1885).

The present concept of Ph. guttata is wide. The species occurs in N. America on numerous hosts of diverse families. I have studied American material on hosts of the following genera: Alnus, Amelanchier, Berberis, Betula, Carpinus, Celastrus, Cornus, Crataegus, Hamamelis, Ilex, Liriodendron, Morus, Ostrya, Philadelphus, Populus, Ribes, Vaccinium, Xanthophyllum.

(d.) Phyllactinia eleagni Linder, Mycologia 35, p.467 (1943)

It should be discussed if the name can be changed to "elaeagni". I have revised the type of this species (ex FH), but I have not seen conidia. The ascocarps are fairly large. Provided that the conidia are clavate, Ph. eleagni can be recognized. However, if the conidia are angular, it could be a synonym of Ph. hippophaës or angulata.

(e.) Phyllactinia mali (Duby) U. Braun, Feddes Repert. 88, p.657 (1978)

Syn.: Ph. mespili (Cast.) Blumer, Beitr. Krypt.-Fl. 7(1), p.396 (1933). Ph. pyri (Cast.) Homma, J. Fac. Agric. Hokkaido Imp. Univ. 38, p.412 (1937).

In N. America there are two species of Phyllactinia

on Crataegus, Phyllactinia guttata (cleist. ca. 170-250 µm in diam., e.g. on Crataegus rivularis and tomentosa) and Ph. mali (cleist. small, ca. 140-185 µm in diam., average below 170 µm, e.g. on Crataegus douglasii and parvifolia). Collections on other hosts of the Rosaceae in N. America belong to Ph. guttata. Ph. mali is widely distributed in Europe on Crataegus, Malus, Mespilus and Pyrus.

Acknowledgements

I wish to express my sincere thanks to Dr. I. A. Bunkina (Vladivostok), Dr. Y. Nomura (Yotsukaido C., Chiba Pref., Japan), Dr. S. Tanda (Tokyo, TUAMH) and Prof. Dr. Zheng (Beijing, China, HMAS) for the provided collections and the kind co-operation.

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Tanda S., Nomura Y. and Matsunami Y.: Powdery Mildews of the New Hosts in Japan (III). J. Agric. Sci. Tokyo Univ. Agr. 22(1), 15-30 (1977).

Tanda S. and Nomura Y.: Powdery Mildews of the New Hosts in Japan (V). J. Agric. Sci. Tokyo Univ. Agr. 23(1), 19-31 (1978).

MYCOTAXON

Vol. XXII, pp. 97-98 January-March 1985

HYMENOCHAETE CRUENTA (PERS.:FR.) DONK NEW TO SOUTH AMERICA.[1]

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During a taxonomic study of the genus *Hymenochaete* Lév. for Southern South America, a collection was found from Tierra del Fuego that coincides with the description of *H. cruenta* (Pers.:Fr.) Donk, perhaps better known as *H. mougeotii* (Fr.) Cooke. This species does not appear to have been recorded so far from the American continent (Defigio, 1970).

H. cruenta has been considered distinctly Euroasiatic, but was recorded by Cunningham (1963) for Australia and New Zealand. We believe it is of interest to describe this species on the basis of our material.

HYMENOCHAETE CRUENTA (Pers.:Fr.) Donk, Persoonia 1 (1): 51. 1959.

≡ Thelephora cruenta Pers.: Fr., Syst. Mycol. 1: 444. 1821.
= T. mougeotii Fr., Elench. Fung. 1: 188. 1828.
= Corticium mougeotii Fr., Epicr. p. 558. 1838.
= H. mougeotii (Fr.)Cooke, Grevillea 8: 147. 1880.
= H. sphaericola Lloyd, Mycol. Notes 74: 1338. 1925.

Basidiocarp adnate, resupinate, membranous, smooth; hymenial surface purple ("Indian purple", Pl. 47 L 2, according to Maerz & Paul, 1930); margin thin, concolorous.

Fruitbody 250-300 µm thick (Fig. 1 a). Cuticle present, compact, formed by thick-walled, intertwined and cemented hyphae. Abhymenial hairs scant. Context well developed, formed by loosely woven hyphae, 2-3 µm diam., with ascending orientation. Setal stratum seated on context, 80-120 µm thick, formed by 2-3 rows of irregularly arranged setae. Setae 55-90 x 8-12 µm, with acuminate apices, naked, lumen scarce, standing outup to 50 µm over the hymenial layer. Hymenium composed of paraphyses, basidia and basidioles. Paraphyses dendriform, originating in the context and slightly projecting over the hymenium; basidia subclaviform, 18-22 x 4-5 µm, with 4 curved sterigmata each; spores suballantoid, 6-8 x 2,5-3,5 µm, smooth, hyaline (Fig. 1 b).

Material studied: ARGENTINA, Tierra del Fuego: Puerto Harberton, leg. Wright & Del Busto, II.1973 (BAFC 29.230).

1 Research subsidized by the Argentine National Research Council. Publication n°5 of the PRHIDEB.

2 Fellow of the above Council.

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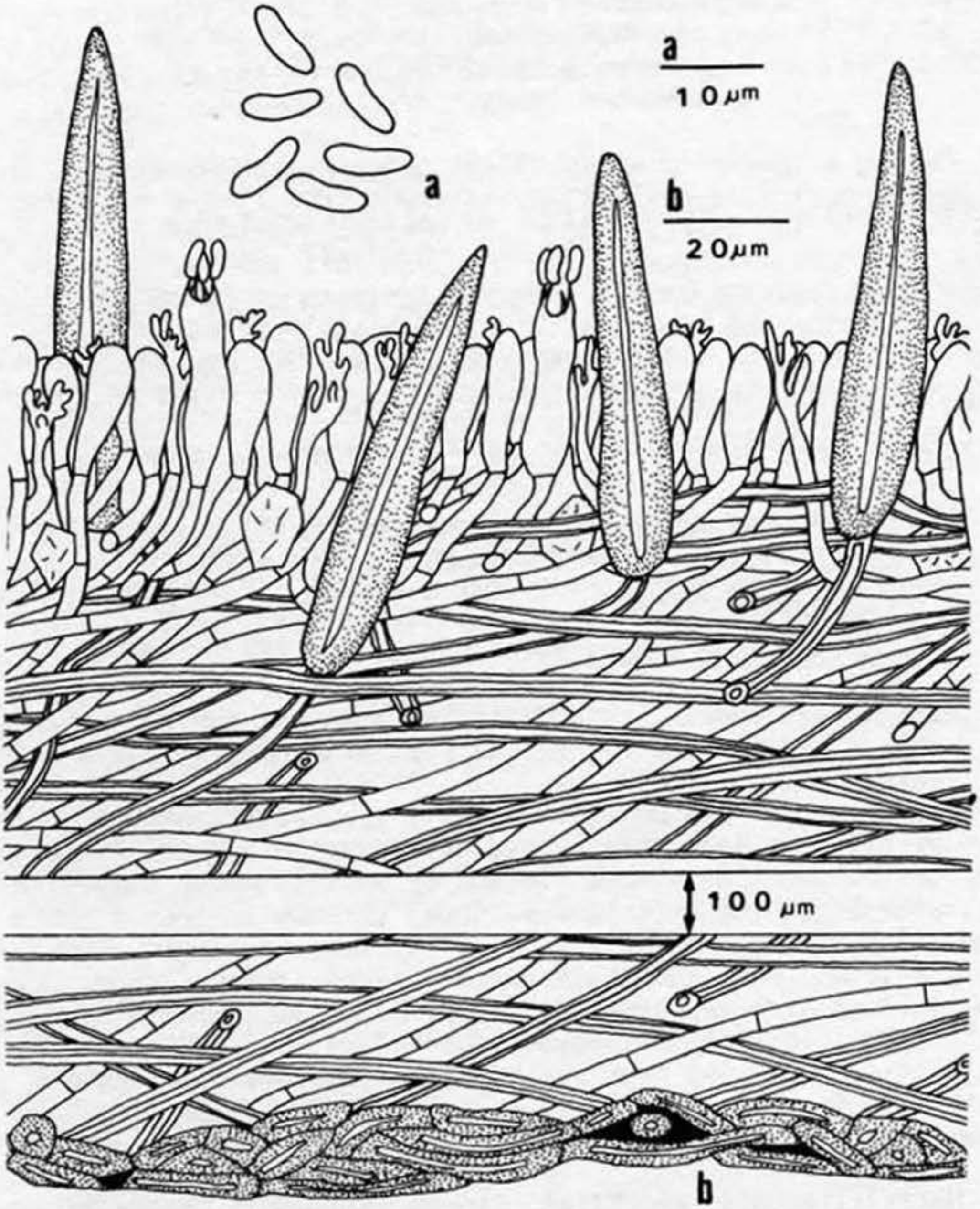

Fig. 1. Cross section through the fruitbody of *Hymenochaete cruenta*. a: spores; b: detail of the basidia, setae and hyphae; in the lower part the amalgamated hyphae can be seen. Arrow in the middle portion indicates thickness.

MYCOTAXON

Vol. XXII, pp. 99-104 January-March 1985

NOTES ON THE GENUS DACRYOPINAX FROM CHINA

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ABSTRACT

Dacryopinax spathularia is widely distributed in different localities of China, and D. fissa is found in the Omei Mts. and Taiwan. A new species, D. xizangensis, is described, occurring on rotten wood of Abies forrestri Rogers, from the southern slope of the Eastern Himalayas, China.

Key words: Dacrymycetaceae, Dacryopinax, China.

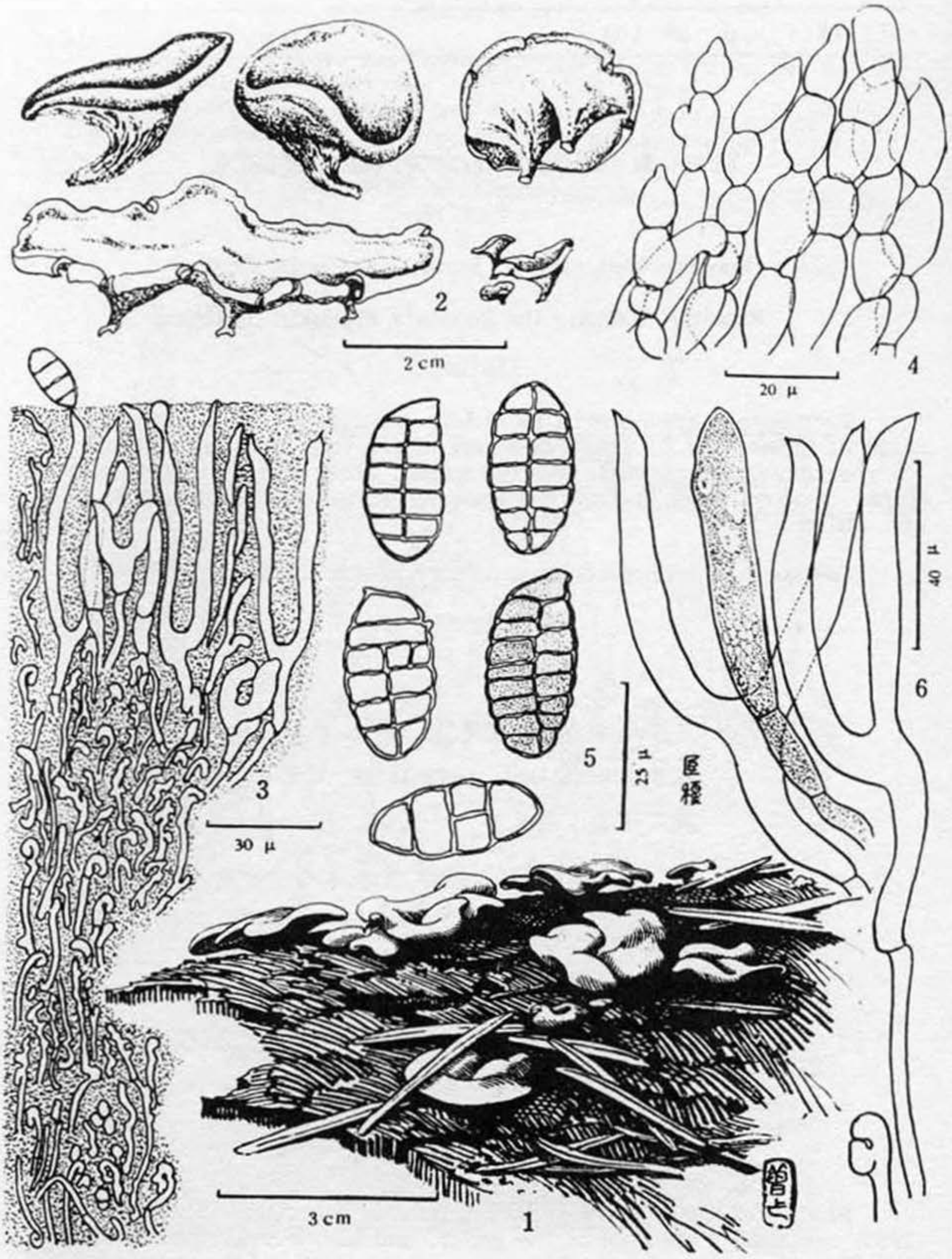
SUMMARY

摘 要

中国分佈的花耳属，現知三種。其中花耳 Dacryopinax spathularia 習見于中國廣大地區；桂花耳 D. fissa 現知見于台湾和四川峨嵋山；新種西藏花耳 D. xizangensis 僅見于西藏墨脫一带的葑氏冷杉 Abies forrestri Rogers 腐木上，本文对此作了描述和附圖。

关键词：花耳 Dacryopinax spathularia 桂花耳 Dacryopinax fissa 和西藏花耳 Dacryopinax xizangensis，中国 China。

Since the genus Dacryopinax Martin was described in 1948, McNabb (1965) reviewed 7 species in the genus, and Lowy (1971) included 6 species from the neotropics in his monograph, two of which were described as new. The genus is mainly of tropical and warm temperature distribution and heretofore in China, only two species of the genus have been recorded (Teng, 1963; Tai, 1979; Wang & Zang, 1983). Nevertheless, the knowledge of Dacryopinax in China appears to be incomplete. Dacryopinax spathularia (Schw.) Martin is widely distributed in China, having been recorded as occurring on the Changbai Mts. in the north, southward to Yunnan and Hainan Island, east from Fujian, and westward to Nyalam



Figs. 1-6. Dacryopinax xizangensis Lowy et Zang (HKAS 13044). 1. Habit sketch (del. Zheng Xiao-lian), 2. Basidiocarps. 3. Vertical section of basidiocarp. 4. Abhymenial hairs. 5. Basidiospores. 6. Probasidium and metabasidia.

(Congdu) County of Xizang (Tibet) (Fig. 7). The other species, D. fissa (Berk.) Martin is found from Taiwan to the Omei Mts. of Sichuan (Fig. 7). It probably occurs in southern and southwestern China as well. Recently, some extensive collecting was carried out in several regions of the Eastern Himalayas and the Hengduan Mountains as part of an ongoing study of the mycoflora (Zang & Zong 1981, 1983), where a new tropical species, Dacryopinax xizangensis has been found. This species is known only from the Medog on the southern flank of the Eastern Himalayas (Fig. 7), where a series of varied ecological conditions prevail. The tropical monsoon rain forest below, and the alpine Abies forest above retain the warmer and wetter air currents from the Indian Ocean. These conditions are highly favourable for the development of tropical and subtropical fungi.

Key to the species of Dacryopinax known from China

1. Basidiocarps spathulate to petaloid, long-stipitate, 2.5-4 X 0.2-0.6 cm, smooth. Basidiospores ovate or cylindroid, becoming 1-septate 2
1. Basidiocarps discoid to subcupulate; short-stipitate, 0.5-0.9 X 0.1-0.5 cm, tomentose. Basidiospores muriform, becoming 4-6 septate.... 3. Dacryopinax xizangensis
2. Broad, simple or more or less branched. Hymenial surface folded.... 1. D. spathularia
2. Irregularly or palmately branched; lobes narrow. Hymenial surface almost smooth..... 2. D. fissa

1. Dacryopinax spathularia (Schw.) Martin, Lloydia 11:116. 1948.
= Merulius spathularia Schweinitz, Schr. Naturf. Ges. Leipzig 1:32. 1822.
= Guepinia spathularia (Schw.) Fries, Elench. Fung. 2:32. 1828.

Specimens examined: YUNNAN. Gaoligong Shan (Gaoligong Mountains), Bijiang County, on rotten wood of Pinus yunnanensis Fr. 1200 m alt. 3 VII 1978. Zang Mu 901 (HKAS 3901); Dai Autonomous Prefecture of Xishuangbanna. VII 1980. Li Xing-jiang 01; SICHUAN (Szechwan Province). Yanyuan (Yi Autonomous County of Yanyuan). 3850 m alt. 9 VIII 1983. Chen Keke 493 (HKAS 13436); XIZANG (Tibet Autonomous Region). Mainling County (Tungdor), Jia Ge, on rotten wood. 26 VII 1975. Zang Mu 365 (HKAS 5365); Nyalam (Congdu) County. VII 1982 Hwang 01; Yadong (Chomo) County. VII 1982. Hwang 002; GUIZHOU (Kweichow Prov.). Fanjingshan Mountains, 1980. Ho 9. (Herbarium of the Academy of Sciences of Guizhou). Other collections: According to Teng (1963), F.L. Tai (1979), Wang & Zang etc. (1983) indicated that it also occurs in the following localities from China: HEBEI (Hopei Province). Xiao Wu Tai Shan (Xiaowutaishan Mts.); SHANXI (Shansi Province). Wutai Mountains; JILIN (Kirin Province). Changbai Mountains; GANSU. Tibetan Autonomous Prefecture of Ganan; JIANGSU (Kiangsu Province). Yixing Xian (Iching County); ANHUI (Anhwei Province). Huang Shan (Yellow Mountains); ZHEJIANG (Chekiang Province). Xi Tianmu Shan (West Tianmu Mountains); JIANGXI (Kiangsi Province). Lu Shan (Lushan Mountains); FUJIAN (Fukien Province). Wuyi Shan (Wuyi Mountains); HUBEI (Hupei Province). Shennongjia County; HUNAN. Yuelu Shan (Yuelu Mountains). GUANGDONG (Kwangtung Province). Zhaoging Prefecture. HAINAN DAO (Hainan Island). Wuzhi Shan (Wuzhi Mountains); GUANGXI (Zhuang Autonomous Region of Kwangsi), Shiwan Dashan (Shiwan Mountains).

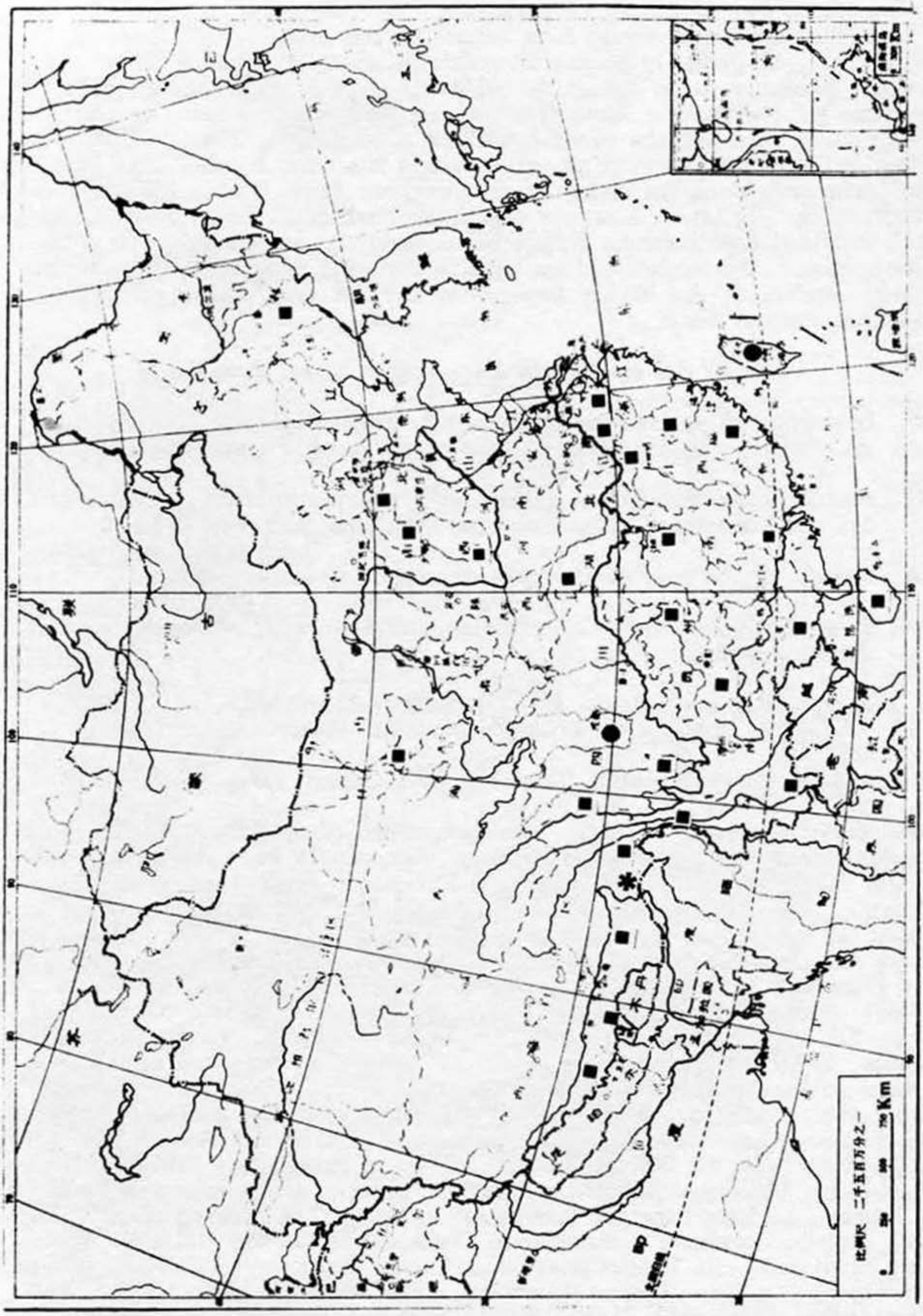


Fig. 7. Distribution of Dacryopinax in The People's Republic of China. Squares: D. spathularia. Circles: D. fissa. Asterisk: D. xizangensis.

2. Dacryopinax fissa (Berk.) Martin, Lloydia 11:116, 1948.
= Guepinia fissa Berk. Ann. Mag. Nat. Hist. 10:383, 1843.
Specimens examined: Sichuan (Szechwan Province). Omei Mts. 30 VII 1944. Shen 106. (Herbarium of Nanjing Teacher's Univ.). Other collections: Taiwan. (Kobayasi, 1939, Sawada, 1959).

Although Martin (1948) considered this to be synonymous with D. spathularia, I found it sufficiently distinct in our collections to retain its status as a separate species.

3. Dacryopinax xizangensis Lowy et Zang, sp. nov. FIGS. 1-6.

Basidiocarpus dispersus, gregarius vel subcespitosus, substrato adhaerens, discoideus, subdiscoideus, cupuloideus vel irregulariter foliaceus, 1-5 cm diam. cartilagineo-gelatineus, basi stipitato vel numeroso-stipitatis. Margine tenui, integra, undulata, in sicco margo revoluto. Stipes 0.5-0.9 X 0.1-0.5 cm, sparse villosus, sursum incrassatus, basim versus attenuatus, albus vel albo-flavus. Hymenium planoconcavum, flavum, aurantiacum, carneum vel armentiacum, in vivo elastico-gelatinosum vel molliusculum, in sicco subalutacum vel subcrustacum. Probasidia cylindracea, ± 58-65 X 6-8 µm. Metabasidia aseptata, bifurcata, 60-80 X 6-9 µm, in gelatina immersa. Basidiosporae subcylindraceae vel subovoideae, hyaline vel subhyalinae, 24-27 µm longae, 12-13.5 µm latae, muriformiter septatae, septatis 3-6, interdum in medio cellulis biseriatis. Abhymenium vesiculo-pilosum, seriatum, multicellulare, catenatum, 8-10 µm latum. Fibulatae absunt.

In ligno carioso Abietis forrestii Rogers, 3250 m alt. Xizang (Tibet Autonomous Region). Motou (Medog), Gou Bu La. 20 XI 1982. Su Yunge 2428 (HKAS 13044, Typus).

Basidiocarps scattered, gregarious or subcespitose, closely adhering to the substratum, orange to orange yellow, usually discoid subdiscoid or subcupulate, sometimes becoming irregularly foliceous, 1-5 cm diam, cartilaginous-gelationous, attenuated below into a stipe or narrowed base, sometimes with numerous stipes. Stipe 0.5-0.9 X 0.1-0.5 cm. villous, whitish, whitish yellow, or whitish orange. Margins thin, entire or undulate, rolled back from edge when dry. Hymenium at first nearly plane, becoming more or less subcrustaceous, orange yellow, flesh to apricot-coloured. Probasidia cylindrical, up to ± 58-65 X 6-7 µm. Metabasidia aseptate, narrowly clavate, forked into two stout sterigmata, 60-80 X 6-9 µm, inbedded in gelatinous material; a single basidiospore produced at the apex of a sterigma. Basidiospores subcylindrical to subovoid, hyaline or subhyaline 24-27 X 12-13.5 µm, muriform, becoming 3-6 septate and slightly constricted at the septa, 1-2 of the median cells longitudinally divided; surface of abhymenium with sparse, vesicular, catenate hairs, hyaline, 80-200 X 8-11.7 µm, occurring singly or in fascicles. Hyphae in a gelatinous matrix, subhyaline, branched, interwoven, smooth, 1.5-2.5 µm diam, hyphal apices more or less distinctly tortuous. No clamp connections seen.

Dacryopinax xizangensis appears to be closest to D. martinii Lowy in its external characteristics (Lowy, 1971), however it may be distinguished from the latter by its muriform basidiospores, presently a unique feature of the genus. Moreover, the sections of the basidiocarp also reveal that the abhymenium produces weak hairs which are made up of catenate, inflated cells (Fig.4). It is known only from the type collection.

ACKNOWLEDGMENTS

I am sincerely indebted to Professor B. Lowy, Department of Botany,

Louisiana State Univeristy, for his guidance and encouragement.

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MYCOTAXON

Vol. XXII, pp. 105-117 January-March 1985

INFRAGENERIC TAXA IN STEREUM, AND KEYS TO NORTH AMERICAN SPECIES

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ABSTRACT

Three subgenera earlier proposed for Stereum (Acanthostereum, Aculeatostereum and Stereum) by Boidin et al. are accepted. Two sections of Stereum subg. Stereum are informally proposed, based on the presence or absence of a distinct cutis. Keys to North American species are provided.

Fries (1838) solidified the concept of Stereum Hill ex Persoon, the foundations for which were laid in his Systema (1821) as an infrageneric division of Thelephora. That concept remained the dominant one well into the twentieth century, as reflected in the Thelephoraceae of North America, Part XII (Burt, 1920). Stipitate, pileate, effuso-reflexed and resupinate forms with upturned margins were represented, most with smooth hymenial surfaces and with hyaline, unornamented spore walls.

Between 1955 and 1968 the concept of Stereum became increasingly narrow. The truly stipitate species were placed in genera such as Aquascypha Reid, Cotylidia Karsten, Cyphellostereum Reid, Cymatoderma Junghuhn, Inflatostereum Reid, Podoscypha Patouillard, and Stereopsis Reid. The taxonomic framework of this group was largely constructed by Reid (1965).

A concept of Stereum which excluded stipitate forms, although not yet fully developed, was adopted by Lentz (1955). He recognized some of the obvious microscopic dissimilarities among the non-stipitate sterea, erecting Laxitextum and exhuming Cryptochaete Karsten. Other differences were not given genus-level consideration.

Boidin (1958), Parmasto (1968) and Pouzar (1959) narrowed the existing concept of Stereum even further, leaving only those species which closely resembled the type species, S. hirsutum (Willd.:Fr.) S.F. Gray. To this end Amylostereum Boidin, Boreostereum Parmasto, Chondrostereum Pouzar, Columnocystis Pouzar, Cystostereum Pouzar and Laurilia Pouzar were erected. Residual species have been placed primarily in genera such as Lopharia Kalchbrenner and MacOwan, Peniophora Cooke, Phanerochaete Karsten and Xylobolus Karsten.

Thus far, nearly all of these genera and generic transfers have gained acceptance. One exception concerns the genus Haematostereum Pouzar. One still sees this genus being used in forest pathology literature; it seems to have been adopted simply because it is "new." Haematostereum was based on the apparent monomiticity and presence of colored contents in conducting hyphae and pseudocystidia shown by basidiomata of S. gausapatum (Fr.:Fr.) Fr., S. rugosum Pers.:Fr. and S. sanguinolentum (Alb. and Schw.:Fr.) Fr.

Haematostereum has been rejected by those (including the present author) who have studied the sterea in a comparative fashion (Eriksson et al., 1984; Jahn, 1971; Jülich and Stalpers, 1980; Parmasto, 1968; Rattan, 1977; Welden, 1971). The color of pseudocystidial and conducting hyphal contents is a variable character (Chamuris, 1985; Welden, 1971), and is certainly not useful taxonomically at the generic or subgeneric level.

As for the other character - miticity - it appears that the hyphal system in Stereum does not fit readily into the "monomitic" and "dimitic" types proposed by Corner (1932). Talbot (1973) stated that Stereum had a dimitic hyphal system. Boidin (1958) and Boidin et al. (1979) also reported a dimitic system. Eriksson et al. (1984) claim that Stereum has a monomitic hyphal system, but Pouzar obviously felt that some species were monomitic and some were dimitic. Lentz (1960, p. 117) conceded that it

is difficult to define the genus as possessing one type of hyphal system or another. In my opinion Corner's classification is not appropriate for Stereum. Therefore, generic delimitation should not be undertaken based on miticity.

By 1968 the genus Stereum represented a homogeneous cluster of species that could be interpreted as comprising a "natural" group. Comparative study of morphology, cultural characters, and nuclear behavior support this interpretation.

Many species however, exhibit an amazing degree of variability in respect to certain characters such as aspect and gross morphology. Dependable characters that could be used to dissect the genus into discrete groups was desperately needed. Boidin et al. (1979) provided such a character: the presence or absence of acanthohyphidia or pseudoacanthohyphidia (Fig. 1c, 1d). Three subgenera were proposed: Acanthostereum, Aculeatostereum and Stereum.

TABLE 1. Terms used by various authors for hyphidial types important in subgeneric circumscription.

Present paper	acanthohyphidium	pseudoacantho-hyphidium	hyphidium
Boidin et al. (1979)	acanthophysis	pseudoacanthophysis	basidiole or hyphidium
Burt (1920)	bottle-brush paraphysis	-	-
Eriksson et al. (1984)	-	acanthocystidium	acutocystidium
Jülich and Stalpers (1980)	acanthohyphidium	acanthohyphidium	cystidiole (?)
Lentz (1955, 1960)	acanthophysis	aculeate-tipped basidiole	basidiole

THE SUBGENERIC CHARACTER

Boidin et al. (1979) proposed three subgenera based on the presence or absence of acanthohyphidia and pseudoacanthohyphidia. Acanthohyphidia are thin- or thick-walled hymenial elements with cylindrical projections all along their length (Fig. 1d). They characterize the subgenus Acanthostereum. Species of Xylobolus (closely related to Stereum) and some Aleurodiscus species also possess acanthohyphidia.

Pseudoacanthohyphidia are thin-walled hymenial elements that bear a few (2-5, rarely up to 10) apical projections (Fig. 1c). Members of the subgenus Aculeatostereum possess pseudoacanthohyphidia. Acanthostereum species may have pseudoacanthohyphidia in addition to acanthohyphidia, but members of Aculeatostereum never possess true acanthohyphidia.

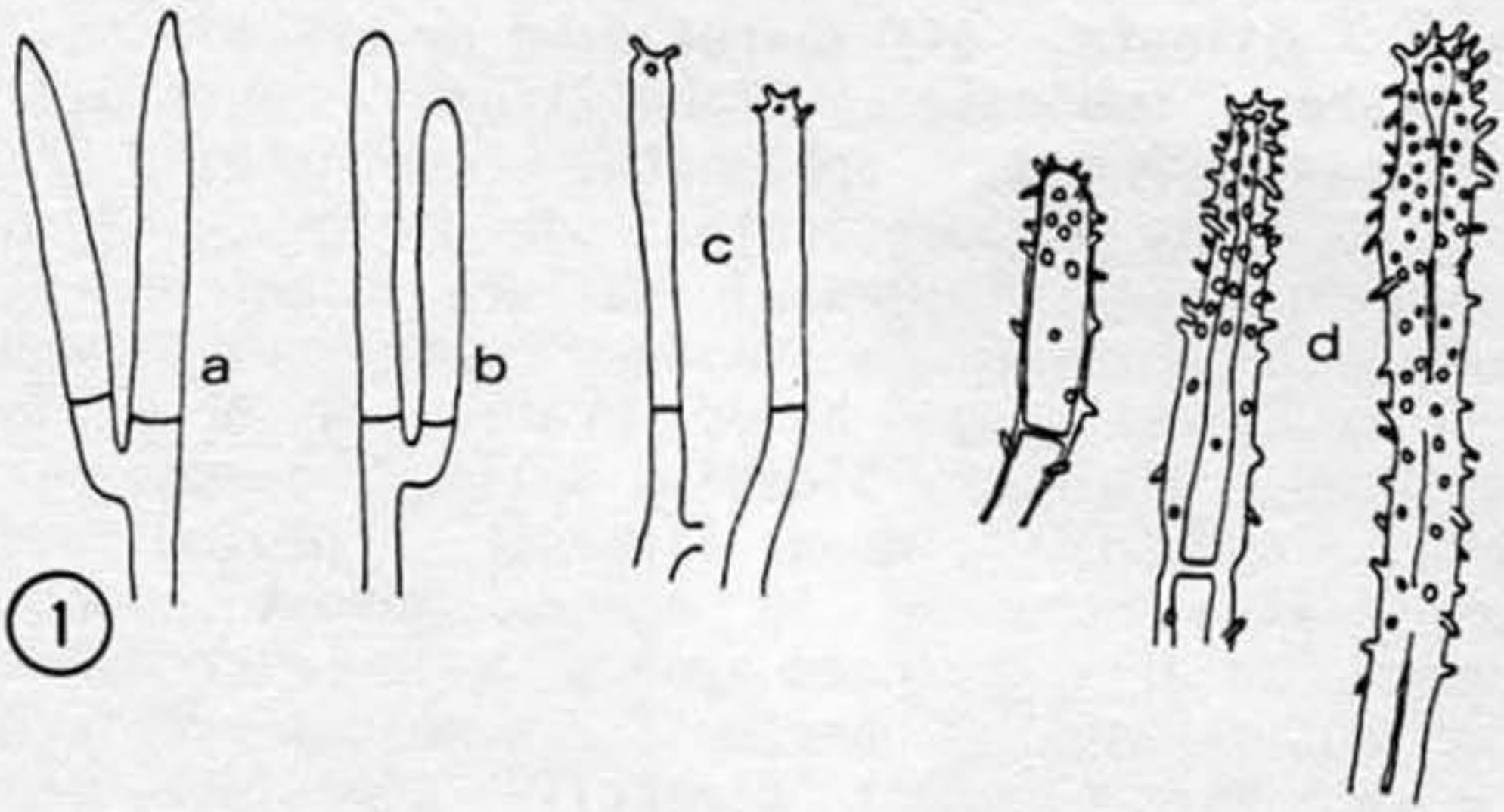
A third type of hymenial element is common to all three subgenera. These are referred to here as hyphidia. They are thin-walled and usually have acuminate apices (Fig. 1a), but occasionally have rounded apices (Fig. 1b). The various terms used to describe acantho-, pseudoacantho- and acuminate-tipped hyphidia are summarized in Table 1.

Jülich and Stalpers (1980) questioned the use of acantho- and pseudoacanthohyphidia in the taxonomy of Stereum. For example, in reference to S. (Aculeatostereum) sanguinolentum, they state that "(Pseudo-)Acanthohyphidia are mentioned in descriptions of American specimens, never in those of European ones". I have seen European material with pseudoacanthohyphidia. Eriksson et al. (1984) illustrate and describe pseudoacanthohyphidia in S. sanguinolentum. Also, Boidin et al. (1979) list S. sanguinolentum as a member of Aculeatostereum. These European authors must have examined European material.

The validity of using hyphidial type as a subgeneric character can be supported by the production of "versions" of the types in culture. Hyphal ends with a few apical outgrowths can be found in S. fasciatum and S. sanguinolentum - both members of Stereum subg. Aculeatostereum (Fig. 2a). These are associated with

hymenia, when the hymenia are well-developed and in the later stages of development (15-20 weeks on malt agar). Such hyphae could not be found in the hymenia formed by cultures of Stereum subg. Stereum species.

I have not studied cultures of Acanthostereum, but cultures of Xylobolus frustulatus and X. subpileatus produce acanthohyphidium-like elements (Fig. 2b). These observations suggest that acantho- and pseudoacanthohyphidia are structures with a stable genetic base, and are therefore of taxonomic value.



FIGS. 1 & 2. Hyphal elements important in subgeneric circumscription. 1. Hymenial elements from basidiomata produced in nature. Hyphidia with a) acuminate, and b) rounded apices (S. hirsutum); c) pseudoacanthohyphidia (S. fasciatum); d) acanthohyphidia (X. subpileatus). 2. From cultures. a) Pseudoacanthohyphidium-like structures (S. fasciatum); b) Acanthohyphidium-like structures (X. subpileatus).

TAXONOMY AND DISCUSSION

STEREUM Hill, Gen. Nat. Hist., Vol 2, Hist. of Plants, p. 34. 1751; ex Persoon, Neues Mag. Bot. 1:110. 1794.

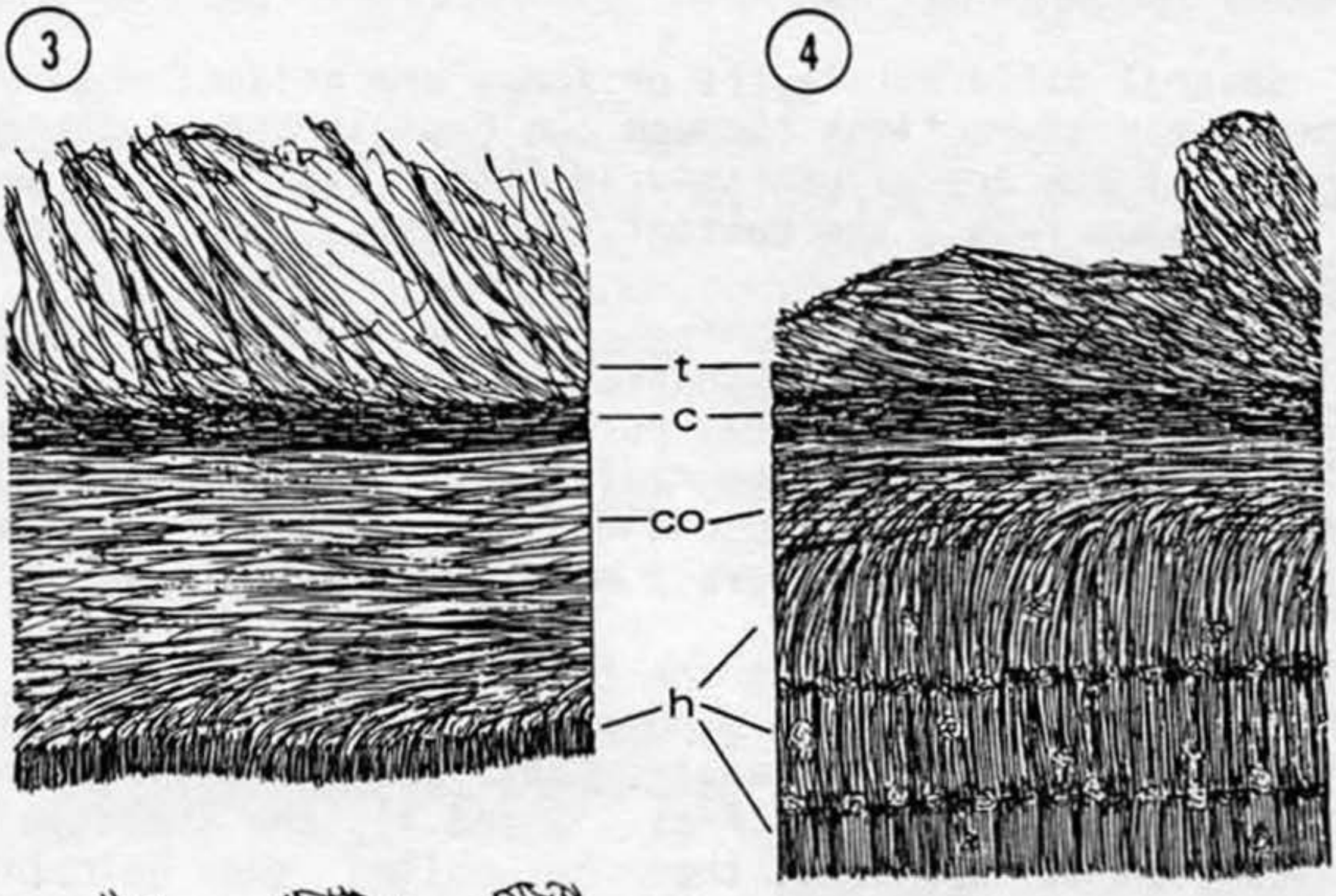
= Haematostereum Pouzar, Česká Mykol. 13:13. 1959.

Type species: Thelephora hirsuta Willd.:Fr.

Basidiomata annual or perennial; coriaceous, papery or hard; pileate, effuso-reflexed or resupinate; pilei substipitate, umbonate, flabelliform, petaloid, or dimidiate; concave, applanate, conchate; radially undulate, plicate or complicate; gregarious, caespitose, imbricate or not. Hymenial surface even or slightly tuberculate, cracking in older specimens, sometimes concentrically ridged; beige, cream, gray or yellow when fresh, often bruising or bleeding yellow, orange or dark red when injured. Tissue layers: hymenium simple or stratose, with crystals in age; context composed of parallel, radially arranged hyphae, pale-colored; compact brownish cutis usually present; tomentum derived from cutis or from context directly, tomentose, hirsute, strigose, hispid or shiny-appressed.

Hyphae of two types: 1) thin- to slightly thick-walled, hyaline, simple-septate, in and near hymenium, in hymenium giving rise to a) basidia and basidioles, b) thin-walled round- or acuminate-tipped hyphidia, c) in subgenus Aculeatostereum, thin-walled pseudoacanthohyphidia with a few (2-5, rarely up to 10) apical projections; 2) slightly thick-walled to almost solid, hyaline to yellowish brown, simple-septate or aseptate with retraction septa; in context, cutis and tomentum, bending toward and ending in the hymenium and subhymenium; in subgenus Acanthostereum modified in hymenium and subhymenium as acanthohyphidia with numerous cylindrical projections; in context, some with hyaline, yellowish or brownish oily contents (conducting hyphae), ending in hymenium and subhymenium as pseudocystidia. Basidia thin-walled, narrowly clavate to subcylindrical, with four sterigmata, contents homogeneous. Basidiospores ellipsoid to cylindrical, sometimes slightly curved, hyaline, thin-walled, smooth, amyloid, binucleate.

Monosporous and polysporous cultures very similar; mat at first white, low-cottony, woolly or downy, with floccose patches, usually becoming felty, often with shades of yellow, orange, brown and dark red. Hyphae multinucleate, thin-walled to solid, hyaline to yellowish, aseptate, simple-septate, or with 1-6 verticillate clamp connections per septum; hyphal coils often present; no special structures produced; fertile or sterile hymenia may be formed on agar media after extended periods of



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FIGS. 3-6. Radial sections through pilei. 3. S. hirsutum. 4. S. rugosum. 5. S. ochraceo-flavum. 6. S. striatum. t, tomentum; c, cutis; co, context; h, hymenium.

incubation. Extracellular phenoloxidase activity variable, present as laccase and tyrosinase.

Habitat: Lignicolous on hardwood and coniferous tree species; some facultative parasites, usually entering through wounds, causing heart and sap rots; all saprobic; causing a white rot of fairly sound, usually corticate twigs, limbs and stems.

Distribution: Worldwide.

Several different layers or zones are evident when one examines radial sections through the basidiomata of Stereum species. These are illustrated in Figs. 3-6. They are: the hymenium (-ia), the context, the cutis (when present), and the tomentum.

The hymenium tends to thicken as the basidioma ages. In S. rugosum, a regularly perennial species, there is a series of hymenia which give radial sections a stratified appearance (Fig. 4). Occasionally other species have stratified hymenia, with rarely more than two strata.

The uppermost layer is the tomentum. This layer is of variable thickness, being exposed to the weathering agents of the biotic and abiotic environment. When a well-defined cutis is present (e.g. Figs. 3 and 4), the tomentum is derived from it and may then be called the epicutis. However in two species (S. striatum and S. ochraceo-flavum) such a cutis is lacking or poorly developed; the tomentum is derived from the pale-colored context. In this case the tomentum should not be referred to as an epicutis.

Key to the Subgenera of Stereum

Hymenium possessing acanthohyphidia, pseudoacanthohyphidia, or both

Acanthohyphidia absent . . subg. ACULEATOSTEREUM

Acanthohyphidia present . . subg. ACANTHOSTEREUM

Hymenium lacking acanthohyphidia and pseudoacanthohyphidia . . . . . subg. STEREUM

STEREUM Hill ex Pers., subgenus ACANTHOSTEREUM Boidin, Parmasto, Dhingra and Lanquetin, Persoonia 10:320. 1979.

Hymenium with acanthohyphidia; pseudoacanthohyphidia and acuminate-tipped hyphidia present; basidia and pseudocystidia rarely with short outgrowths.

Type species: S. peculiare Boidin, Parmasto and Dhingra.

Distribution: Eurasia. No North American species known.

STEREUM Hill ex Pers., subgenus ACULEATOSTEREUM Boidin, Parmasto, Dhingra and Lanquetin, Persoonia 10:320. 1979.

Hymenium with pseudoacanthohyphidia; acuminate-tipped hyphidia present; acanthohyphidia lacking; basidia and pseudocystidia rarely with short outgrowths.

Type species: S. insignitum Quél.

Distribution: Worldwide.

TABLE 2. Characters used to distinguish members of the S. hirsutum-complex, sensu Chamuris.

	hirsutum	complicatum	versicolor
Distribution	temperate and tropical		tropical and subtropical
Tomentum	thick	scant or appressed	
Pileus surface	tomentose, hirsute, strigose or hispid; concentrically furrowed	glabrous or scantily tomentose, shining; concentrically zonate with thin, alternating bands of orange and brownish	
Pilei	solitary or gregarious; some confluence	caespitose; strongly confluent; often imbricate	solitary or gregarious
Pileus "folding"	applanate or radiately undulate	radiately complicate	applanate or concave

Key to North American Species of Stereum subg. Aculeatostereum

Restricted to wood of coniferous trees . . . . . S. sanguinolentum

On hardwoods

Basidiospores 7-12 x 3-6 µm; basidiomata hard, perennial, resupinate or with slightly reflexed margins; rare in North America . . S. rugosum

Basidiospores 4-7 x 2-3 µm; basidiomata coriaceous, annual (occasionally biennial), pileate, sub-stipitate or effuso-reflexed; common in North America south of 42°N. Lat. . . . . S. fasciatum (The use of this epithet is discussed by Chamuris (1984).) (= S. ostrea, S. lobatum, S. australe)

STEREUM Hill ex Pers., subgenus STEREUM

Hymenium with acuminate-tipped hyphidia; acanthohyphidia and pseudoacanthohyphidia absent.

Type species: Thelephora hirsuta Willd.:Fr.

Distrubution: Worldwide.

This subgenus contains the greatest number of species. Two informal sections can be recognized, based on the presence or absence of a distinct cutis. One section contains two species: S. striatum (Fr.:Fr.) Fr. and S. ochraceo-flavum (Schw.) Ell., both of which lack a well-defined cutis (Figs. 5 and 6). Mature pilei at the end of the season (especially in the south), or during a second season of growth, may show a pale yellow zone where the cutis would be. This layer is not morphologically distinct (compact) as in other sterea, and is far from being dark brown.

The tomentum is derived from the pale-colored context directly, giving the pileus surface a whitish appearance. If the tomentum is more or less appressed (Fig. 6), the pileus surface appears to be lineate-striate, shining and sericeous, as in S. striatum. If the tomentum is composed of erect hairs of conglutinate hyphae (Fig. 5), then the surface takes on a strigose-hirsute or hispid texture. This condition characterizes S. ochraceo-flavum.

The other section of Stereum subg. Stereum constitutes a group of species which displays much variation in gross morphology. All of these species possess a distinct cutis (Fig. 3). This section has been a taxonomically difficult group; as a result dozens of names have been proposed for the many variations in form. The other extreme, to lump all the species into a single taxon, the "S. hirsutum-complex", was suggested by Welden (1971). The intent behind such an action is appreciated, but the extreme position is unwarranted. S. gausapatum, for example, can be distinguished from other members of the "complex" on the bases of pseudocystidial wall thickness and substrate (Chamuris, 1985). For this reason all future reference to the S. hirsutum-complex excludes S. gausapatum.

In the temperate zone, one can usually distinguish S. complicatum (Fr.:Fr.) Fr. from S. hirsutum on gross morphological grounds. It is recognized, however, that such a separation is often not possible, especially when the basidiomata are young. As Welden suggested (1971), intermediate specimens are likely to be encountered, and placement in one of the three available species may be an arbitrary decision. But the existence of intermediate specimens does not necessarily negate the value of the groups themselves. In doubtful cases, assigning the specimen to the S. hirsutum-complex is a pragmatic, last-resort decision; the "complex" concept should be retained. When, however, the specimen in hand is clearly a "complicatum" or a "hirsutum", it is desirable to maintain the distinctions. Completely ignoring the differences may prejudice future ecological, mycelial interaction and forest pathological studies. A compromise situation would involve the use of (awkward?) phrases like "complicatum form of S. hirsutum". A summary of the principal characters used to separate S. hirsutum, S. complicatum and S. versicolor (Sw.:Fr.) Fr. is given in Table 2.

Key to North American Species of Stereum subg. Stereum

Compact, brownish cutis absent; tomentum whitish

Tomentum of erect hairs; pileus surface soft, strigose-hirsute or hispid; on a variety of hardwoods (not known on Carpinus spp. or Nyssa spp.) . . . . S. ochraceo-flavum (= S. sulphuratum)

Tomentum of short appressed hairs; pileus surface lineate-striate, shining, sericeous; on Carpinus spp., rarely Nyssa spp. . . . . S. striatum (= S. sericeum)

Compact, brownish cutis present (ca. 50 µm thick); tomentum with some shade of brown, yellow (gray when old)

Pseudocystidial walls less than 1.5 µm thick; contents brownish; restricted to wood of Quercus spp. . . . . S. gausapatum

Pseudocystidial walls greater than 1.5 µm thick; contents hyaline or yellowish, (may be brownish in tropics, S. versicolor); on a variety of hardwoods . . . . S. hirsutum-complex, sensu Chamuris (S. hirsutum = S. styracifluum, S. complicatum, S. versicolor) (See Table 2)

ACKNOWLEDGMENTS

The descriptions, keys and concepts presented herein are extracted from the author's doctoral dissertation entitled: The Non-Stipitate Stereoid Fungi of the Northeastern United States and Adjacent Canada. The author wishes to thank his major professor, Dr. C.-J.K. Wang for her advice and support during the entire study. Also, thanks to Dr. J.L. Lowe for reviewing the manuscript.

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MYCOTAXON

Vol. XXII, pp. 119-148 January-March 1985

OBSERVATIONS ON THAMNIDIACEAE (MUCORALES). III. MYCOTYPHACEAE FAM. NOV. AND A RE-EVALUATION OF MYCOTYPHA SENSU BENNY & BENJAMIN ILLUSTRATED BY TWO NEW SPECIES[1]

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SUMMARY

A new family, Mycotyphaceae, is proposed for Benjaminiella and Mycotypha based on the ability of these fungi to produce a yeast-like phase and, especially, their unique mode of sporangiolum secession. This occurs through fracture of a circumscissile zone of weakness formed at the junction of the denticle and the pedicel. The genus Mycotypha, sensu Benny & Benjamin, is reassessed. Mycotypha poitrasii is referred to Benjaminiella, a genus characterized by globose fertile vesicles, monomorphic sporangiola and denticles, and long pedicels. Mycotypha, characterized by cylindrical fertile vesicles, dimorphic sporangiola and denticles, and short pedicels, is retained for M. africana and M. microspora. Two new species are introduced. Benjaminiella multispora is distinguished from B. poitrasii by its multispored sporangiola. Mycotypha indica resembles M. microspora but is homothallic. Further, in M. indica, the sporangiola borne

1) Florida Agricultural Experiment Station Journal Series No. 5765.

in the outer row are obovoid whereas they are cylindrical in M. africana. Keys to the genera and species of the Mycotyphaceae are provided.

INTRODUCTION

Mycotypha was introduced (Fenner, 1932) for a single species, M. microspora Fenner, and placed in the tribe Cephalideae of the Mucoraceae according to the system of Gäumann (1928). Zycha (1935), and Naumov (1939) omitted Mycotypha from their respective treatments of the Mucorales and, while Bessey (1950) placed Mycotypha in the Choanephoraceae, Hesseltine (1952) referred it to the Cunninghamellaceae. This latter treatment was subsequently followed by many students of the Mucorales (Benjamin, 1959; Cole and Samson, 1979; Hesseltine, 1955; Hesseltine and Ellis, 1973; Mil'ko, 1967, 1974; Pidoplichko and Mil'ko, 1971), although Zycha and Siepmann (1969) included it in their relatively broad concept of the Choanephoraceae. Young (1969), however, clearly demonstrated that Mycotypha should be transferred to the Thamnidiaceae.

The inclusion of Mycotypha in the Mucorales was questioned (Wolf, 1957; Boedijn, 1958) until the zygomycetous affinities of the genus were confirmed with the description of a second species, M. africana Novak & Backus (1963), morphologically similar to M. microspora but forming zygospores.

Benny and Benjamin (1976) transferred Cokeromyces poitrasii R.K. Benjamin (1960) to Mycotypha because it showed closer affinities to M. microspora and M. africana than to the type species of Cokeromyces, C. recurvatus Poitras (Shanor et al. 1950). This treatment was accepted by other workers (Benjamin, 1979; Brain and Young, 1979; O'Donnell, 1979) although Pidoplichko and Mil'ko (1971) had earlier made C. poitrasii the type of Benjaminia Pidopl. & Mil'ko (non Ahmad, 1967) and placed that genus in the Cunninghamellaceae. Von Arx (1981) introduced Benjaminiella von Arx for the illegitimate (Art. 64.1) Benjaminia Pidopl. & Mil'ko.

It is our primise that the characters employed by Benny and Benjamin (1976) to include C. poitrasii in Mycotypha (deciduous sporangiola, and vegetative and

colony characters, especially hyphal dimorphism), are indicative of relationships at the suprageneric level. The superficial differences between M. poitrasii (R.K. Benjamin) Benny & R.K. Benjamin and the other two species of Mycotypha, M. africana and M. microspora, are augmented when it is considered that characters such as pedicel and sporangiolum dimorphism, ontogeny, and mechanism of secession in the two latter species are unique within the Mucorales.

The purpose of this paper is to clarify the systematic position of Mycotypha sensu Benny & Benjamin (1976), introduce two new species, and elucidate interspecific and intergeneric relationships.

MATERIALS AND METHODS

The source of specimens of the new species is given in the text. In addition cultures of the following fungi were examined as part of this study: Benjaminiella poitrasii (RSA 903; =ATCC 13844; =CBS 158.60; =IMI 81585; =NRRL 2845--culture derived from the holotype); Mycotypha microspora (RSA 1183; IMI 282443--FINLAND: Asikkala EH, Vähä-Äiniö, tract 26, near the shore of Lake Päijänne, ca. 30 km NNW of Lahti, on mouse dung, coll. Anni and Veikko Hotinen, June 2, 1979, isol. G.L. Benny); Mycotypha africana (RSA 1193;=ATCC 15344;=CBS 122.64;=IMI 139108;=NRRL 2978--culture derived from the holotype). Institutional designations are those of Holmgren et al. (1981). Holotype specimens have been deposited at IMI, and isotypes have been sent to NY, FLAS, RSA, BPI, K, and FH. Cultures derived from the holotype have been sent to ATCC, CBS, IMI, and NRRL (Northern Regional Research Center, Peoria, Illinois 61604, U.S.A.).

Descriptions of cultural characteristics, and vegetative and reproductive structures, are based on pure cultures grown on MEYE (malt extract-yeast extract agar, Benny and Benjamin, 1975; Mycotypha indica), or YpSs (Emerson's yeast extract-soluble starch agar, Difco; Benjaminiella multispora). Cultures were grown in an incubator at 26 C under a 12 hrs light/12 hrs dark cycle. Additional media used were: YpD (YpSs Agar (Difco) + 5 gm dextrose/liter), MSMA (Modified Synthetic Mucor Agar, Benny and Benjamin, 1975), LYE (Leonian's agar + 1 gm yeast extract/liter, Malloch and Cain, 1971), V8 (V-8

Juice agar, Miller, 1955), Whey (Whey agar, based upon Schipper, 1969;--powdered whey, 20 gm; dextrose, 10 gm; agar, 15 gm; distilled water, 1 liter), and PDA (Potato Dextrose Agar, Difco). Estimates of reproductive ability are measured from the highest (5+) to the lowest (1+) number of fruiting heads or zygospores produced.

Measurements and drawings were made according to the procedures of Benny and Benjamin (1975). Capitalized color names are those from Ridgway (1912).

The scanning electron micrograph of Benjaminiella multispora in Fig. 4a was produced using the methods employed by Samson et al. (1979). Scanning electron micrographs of some zygospores (Figs. 4b, 5g, 6n) were made from cultures grown on MEYE agar at 26 C for 10-14 days, fixed at room temperature in one-half strength Karnovsky's fixative (Karnovsky, 1969) in 0.05 M cacodylate buffer (pH 7.2), washed in the buffer four times, post-fixed in 1% osmium tetroxide in 0.05 M cacodylate buffer (pH 7.2) overnight at 4 C, washed twice in the buffer and twice in distilled water, dehydrated in a graded (25%, 50%, 75%, 95%, 100%) ethanol series (15 min each change), and then held overnight in a second change of 100% ethanol. The material was then critical point dried in a Balzer's CPD010 drying apparatus. The remainder of the specimens observed by SEM were fixed in 1% osmium tetroxide vapors at room temperature for 96 hrs and then air dried according to the procedure of Quattlebaum and Carner (1980). All material, except Fig. 4a, was coated with gold in a Hummer Jr. sputter coater, and observed with a Hitachi S-450 scanning electron microscope.

TAXONOMY

Mycotyphaceae Benny & R.K Benjamin, fam. nov.

Sporophora e hyphis submersis oriunda, simplicia vel ramosa, in summo vesiculam fertilem sporangiolis pedicellatis, uni- vel multisporis, aequalibus vel dimorphis obtectam ferentia; stolones absentes. Sporangiola in zona praeformata liberata, denticulos truncatos in vesicula relinquentia. Sporangiosporae forma et magnitudine variabiles, oriunda e sporangiolis unisporis sporangiolo simillima. Zygosporangia globosa vel subglobosa, projectionibus conicis obtecta, suspensores oppositi, appendicibus carentes. Species seu

homothallicae seu (verisimile) heterothallicae.

Genus typicum Mycotypha Fenner.

Sporophores arising directly from the submerged mycelium, simple or branched, stolons not produced; sporophores terminating in a fertile vesicle bearing pedicellate, unispored or multispored, monomorphic or dimorphic sporangiola. Sporangiola dehiscing by a circumscissile fracture at a preformed zone of weakness leaving monomorphic or dimorphic, truncate denticles on the fertile vesicle. Sporangiospores of various shapes and sizes; those from the unispored sporangiola of similar shape and size to the intact sporangiolum. Zygosporangia globose to subglobose; ornamented with more or less conical projections; suspensors opposed, non-appendaged. Homothallic, or presumably heterothallic.

Type genus: Mycotypha Fenner.

The ease in which the yeast-like budding phase is produced, and especially, the mode of sporangiolum dehiscence, separate species of Benjaminiella and Mycotypha from the other members of the Thamnidiaceae, sensu Benny and Benjamin (1975, 1976). These characteristics are sufficiently distinct to warrant placing the two genera in a separate family.

Mycotypha is restricted to those taxa producing dimorphic sporangiola and denticles, and cylindrical fertile vesicles. Benjaminiella (von Arx, 1981) contains those species forming monomorphic sporangiola and denticles, and globose to obpyriform fertile vesicles. Several currently accepted genera in the Mucorales contain species that produce unispored and multispored sporangiola. These include Radiomyces (Ellis and Hesseltine, 1974), Mortierella (Gams, 1977), and Blakeslea (Thaxter, 1914; Mehrotra and Baijal, 1968; Kirk, 1984--the species of which usually form either all unispored or all multispored propagules), and Backusella (Benny and Benjamin, 1975--a genus where all of the species form unispored and multispored sporangiola simultaneously). Species of Benjaminiella and Mycotypha are readily distinguished by the shape of the fertile vesicle, the length of the pedicel, and whether the sporangiola and denticles are monomorphic or dimorphic (Fig. 1). The genera can be distinguished using the following key:

KEY TO THE GENERA OF MYCOTYPHACEAE

A. Fertile vesicle globose to more or less ovoid; pedicels relatively long and twisted and contorted; sporangiola and denticles monomorphic.....Benjaminiella

AA. Fertile vesicles cylindrical; pedicels relatively short, straight; sporangiola and denticles dimorphic.....Mycotypha

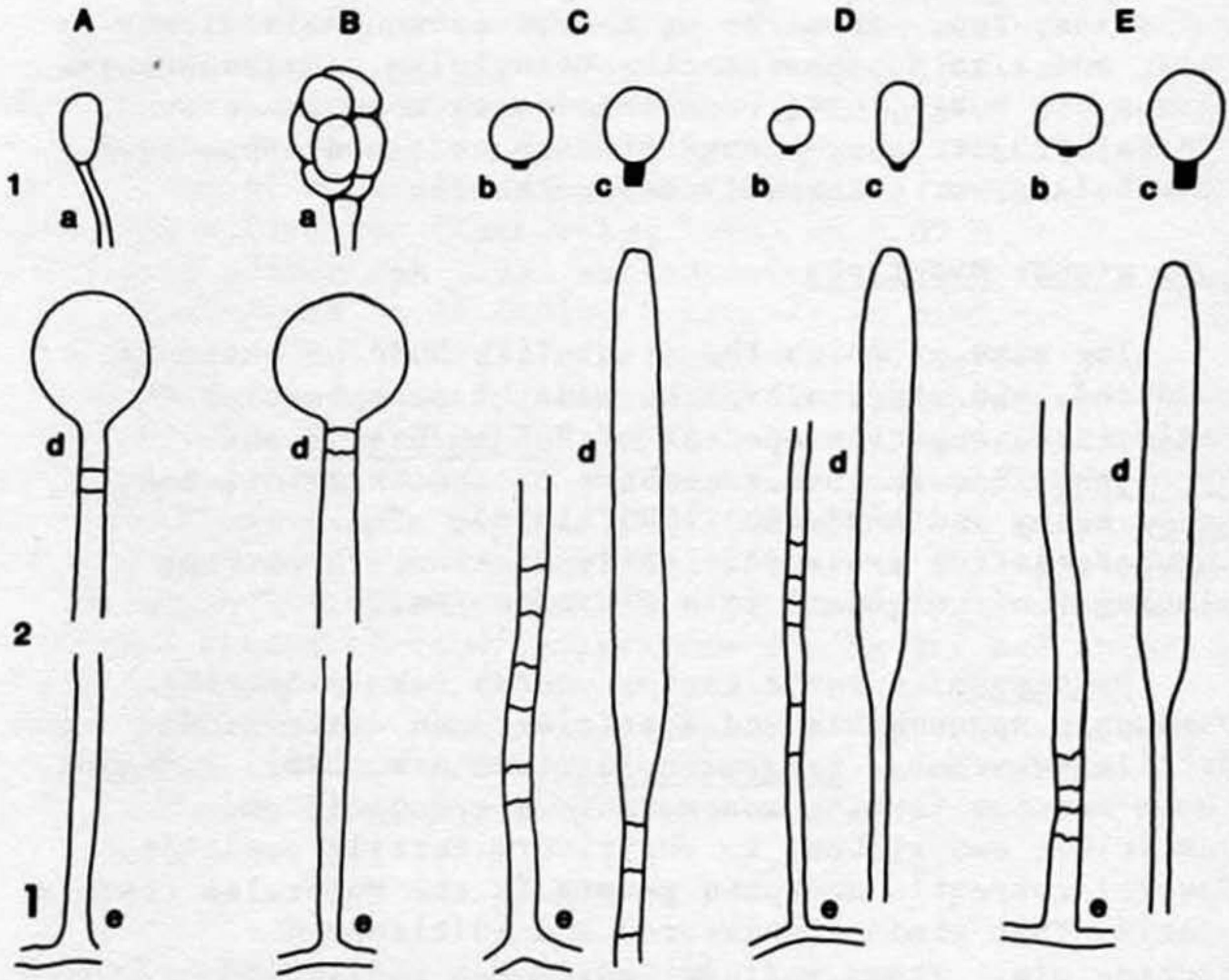

Fig. 1. Characteristics of the anamorph of species of Mycotyphaceae useful in identification. Legend: (1). Sporangiola. a. Monomorphic sporangiola. b, c. Dimorphic sporangiola. b. Globose sporangiola. c. Obovate or cylindrical sporangiola. (2). Fertile vesicle and base of sporophores. d. Fertile vesicle and apex of sporophore. e. Sporophore base. Note placement of septa in the sporophore. A) Benjaminiella poitrasii; B) B. multispora; C) Mycotypha microspora; D) M. africana; E) M. indica.

Benjaminiella multispora Benny, Samson & Srinivasan, sp. nov. Figs. 1B, 2a-m, 3a-l, 4a-e.

Coloniae fere lente crescentes, exiguae, plus minusve zonatae, griseae. Sporophora simplicia, vulgo erecta, 1-3 mm alta, 6.5-7.5 µm lata, primum hyalina, deinde dilute brunnea, raro septata, pariete asperulata; vesiculae et sporangiola velut capitula fere globosa 85-210 µm diam apparent. Vesiculae fertiles leves, 14-33 µm diam, obpyriformes ad quasi globosae, undique sporangiola pedicellata proferentes; pedicelli sporangiolorum longitudine variabilia (10-150 µm), 1-1.5 µm lata, fere recta vel recurvata vel contorta, decidua, post secessionem denticulos plus minusve conicos, truncatos, 1.5-2.0 x 1.5 µm, relinquentia. Sporangiola 2-9 sporas continentia, cylindrica vel obovoidea, (10-)12-14(-15) x (5-)6-6.5(-7.5), plerumque 12.5 x 6 µm, levia, cito a pedicello separata; columellae plus minusve turbinatae, saepe sursum concavae, 1.5-3 µm diam, leves. Sporangiosporae leves, tenuitunicatae, plus minusve globosae vel late ellipsoideae vel forma irregulares, (3-)3.5-4(-6) x (2.5-)3-4(-4.5), plerumque 3.7 x 3.2 µm. Hyphae submersae vulgo in cellulas hyalinas, globosas, zymoideas transeuntes usque ad 30 µm diam proferentes. Zygosporae formatae inter sporophoras, zygophoras, aut sporophoras et zygophoras, ad praecipue in superficie substrati, singulae vel paulae aggregatae, globosae vel subglobosae, (49-)57-74(-80), in medio 66 µm diam (projectionibus inclusis), pariete fusco projectionibus conicis, 2.5-6.5 µm altis obtecta; suspensores oppositi, inaequales, leves, hyalini vel dilute brunnei. Species homothallica.

Holotypus IMI 234109, isotypus CBS 421.70, isolatus e terra humosa prope Poona in India, Feb. 1969, a M.C. Srinivasan.

Colonies on MEYE 7-7.5 cm diam in 12-14 days at 26 C, turf sparse, more or less zonate, Mouse Gray to Deep Mouse Gray, becoming near Light Drab in age. Sporophores simple, more or less erect, up to 1-3 mm high, 6.5-7.5 µm diam, hyaline at first, becoming light brown, sparsely septate in age; wall roughened; fertile vesicle and sporangiola forming more or less globose heads 85-210 µm diam. Fertile vesicles smooth, 14-33 µm diam, obpyriform to more or less globose, bearing pedicellate sporangiola over their entire surface. Pedicels bearing sporangiola

variable in length, 10-150 µm long, 1-1.5 µm in diam, more or less straight to recurved or strongly twisted and contorted; deciduous, with the base more or less the same diam as the pedicel above the abscission zone; pedicel base after dehiscence forming a more or less conical, truncate denticle, 1.5-2 µm high, 1.5 µm wide at the base. Sporangiola multispored, usually containing 2-9 sporangiospores, cylindrical to obovoid, (10-)12-14(-15) x (5-)6-6.5(-7.5), av. 12.5 x 6 µm, smooth, readily separating from the pedicel; columella more or less turbinate, often with a concave apex, 1.5-3 µm diam, smooth. Sporangiospores smooth, thin-walled, more or less globose to broadly ellipsoid or irregular, (3-)3.5-4(-6) x (2.5-)3-4(-4.5), av. 3.7 x 3.2 µm. Substrate hyphae at first non-septate, becoming irregularly septate in age; giving rise to hyaline, globose, yeast-like budding cells up to 30 µm diam. Zygospores formed aerially between zygophores, sporophores, or zygophores and sporophores, at all levels above the agar surface either singly or in small groups; globose to subglobose, (49-)57-74(-80), av. 66 µm diam including projections; wall dark brown, covered with more or less conical projections, 2.5-6.5 µm high; suspensors opposed, anisogamous, smooth, hyaline to light brown. Homothallic.

HOLOTYPE.--INDIA: Maharashtra State, Poona, humus rich soil, February, 1969, iso. M.C. Srinivasan (IMI 234109--Holotype;=CBS 421.70--Isotype).

ETYMOLOGY.--from multi (L.), many, and spora (L.), spore, referring to the many spored sporangiolum.

DISTRIBUTION.--India; known only from the type locality.

NOTES.--Benjaminiella multispora produces unbranched sporophores (Figs. 1Bd-e, 2a) which bear a single apical fertile vesicle (Figs. 1Bd, 2a,b, 3d) and may form a zygospore (Fig. 2a) at a random point along its length. The fertile vesicles (Figs. 1Bd, 2b, 3d) are obpyriform to more or less globose and produce pedicels over their entire surface, forming a more or less globose fruiting head (Figs. 2b, 3a). The pedicels are relatively long, recurved to twisted and contorted (Figs. 2b-d, 3b) and are more or less of constant diameter over most of their length. The pedicel, which is not swollen basally, detaches at a proximal circumscissile zone of weakness (Figs. 2f,i, 3g-i) leaving a truncate denticle (Figs. 2e,

31, 4a) on the fertile vesicle. Distally the pedicellar apex forms a columella (Figs. 2g,h, 3c) which is produced at the base of a multispored sporangiolum (Figs. 1Ba, 2c,d, 3b,c,j,k). The sporangiospores (Figs. 2j, 3e) are hyaline, smooth walled, and irregular in shape. Zygosporangia (Figs. 2k, 4b-d) are formed between opposed, non-appendaged suspensors, and they contain a single, thick walled and roughened zygospore (Figs. 21, 4e). Yeast-like budding cells (Figs. 2m, 3f), which are formed in or on the agar, are relatively thick walled.

The isolate of Benjaminiella multispora studied here, like that of B. poitrasii, sporulates well on MSMA, although it is more prolific when growing on YpSs than it is on MEYE. Optimal (5+) sporulation has been observed on V8 and YpSs, it is excellent (4+) on YpD, good (3+) on LYE and Whey, but poor (2+) on MEYE and PDA. Zygospore formation is excellent (4+) on LYE, good (3+) on YpD, Whey, V8, and YpSs, and poor (1+) on MEYE and PDA. Benjaminiella multispora produces a sectored or highly zonate colony that is off-white where sporulation does not occur. There is no pigment released into the agar.

Benjaminiella poitrasii (R.K. Benjamin) von Arx, "The Genera of Fungi Sporulating in Pure Culture," 3rd Ed., p. 60, 1981. Figs. 1A, 5a-k.
≡Cokeromyces poitrasii R.K. Benjamin, Aliso 4: 523. 1960.
≡Benjaminia poitrasii (R.K. Benjamin) Pidopl. & Mil'ko, "Atlas of Mucoralean Fungi," Acad. Sci. Ukran. S.S.R., Kiev, p. 96, 1971.
≡Mycotypha poitrasii (R.K. Benjamin) Benny & R.K. Benjamin, Aliso 8: 409. 1976.

Descriptions and illustrations of B. poitrasii are presented by Benjamin (1960), Zycha and Siepmann (1969)(both as Cokeromyces poitrasii), and Benny and Benjamin (1976)(as Mycotypha poitrasii). Additional figures are presented by Cole and Samson (1979), Brain and Young (1979), and O'Donnell (1979).

Benjaminiella poitrasii (Figs. 1A, 5a-k) produces sporophores (Figs. 1Ad-e, 5a) that consist of globose to obpyriform fertile vesicles (Figs. 1Ad, 5b), and pedicels of various lengths, each with a basal swelling (Fig. 5j), and have a single unispored sporangiolum apically (Fig.

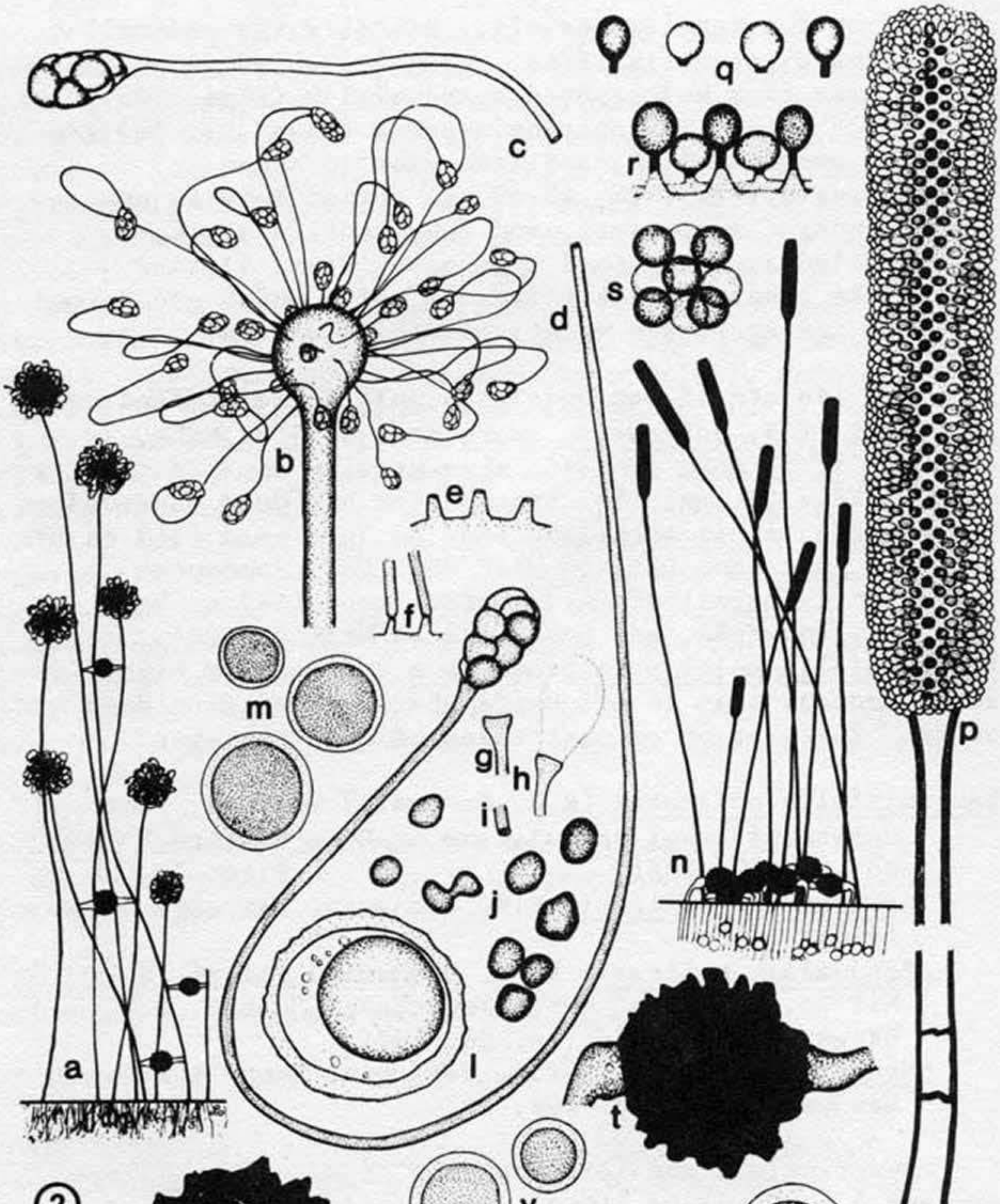

Fig. 2a-m. Benjaminiella multispora--a. Habit sketches of sporophores (stalk length not to scale).--b. Fertile head terminating sporophore showing arrangement of multispored sporangiola on long recurved to twisted and contorted

lAa, 5c,k). Only a single type of denticle is formed on the fertile vesicle (Fig. 5i). The zygosporangium is translucent, brown and covered with coarse, conical projections (Fig. 5d,g,h), has smooth walled opposed suspensors and contains a single, smooth walled zygospore (Fig. 5e). The yeast-like budding cells are relatively thin walled (Fig. 5f).

The two species of Benjaminiella (Figs. lA,B, 2a-m, 3a-l, 4a-e, 5a-k) can be distinguished by: (1) the number of spores in the sporangiolum; (2) the presence or absence

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pedicels.--c,d. Two multispored sporangiola. Note the variable length of the pedicels which are of a relatively constant diameter through their entire length except at the apex (immediately below the columella).--e. Optical section through a fertile vesicle showing three denticles after pedicel secession.--f. An optical section through a fertile vesicle showing two pedicel bases and subtending denticles. Note the constriction at the junction of the denticle and pedicel, the location of the circumscissile zone of weakness.--g. Pedicel apex showing columella after sporangiolum has been removed.--h. Pedicel apex showing columella and sporangiolum wall, but no spores.--i. Pedicel base.--j. Several sporangiospores showing variation in size and shape.--k. Zygosporangium showing ornamentation and both suspensors.--l. Zygospore showing the rough wall and large eccentric globule.--m. Three typical yeast-like budding cells.--n-v. Mycotypha indica.--n. Habit sketches of sporophores (stalk length not to scale).--o. Septate basal portion of a sporophore.--p. Aseptate upper portion of sporophore and elongate fertile vesicle bearing sporangiola.--q. Subglobose and obovoid sporangiola.--r. Lateral view of fertile vesicle showing two rows of sporangiola, the outer composed of obovoid sporangiola on longer denticles and the inner layer of globose sporangiola subtended by short denticles.--s. Sporangiola viewed from above showing the outer obovoid sporangiola (darkly stippled) and inner subglobose sporangiola (lightly stippled).--t. Zygosporangium showing ornamentation and two suspensors.--u. Zygospore showing conical ornamentation and large, eccentric globule.--v. Three relatively thick walled yeast-like budding cells. Mags.: a,n, X47; b,k,o,p,t, X470; c-j,q-s, Xl,225; l,m,u,v, X520.

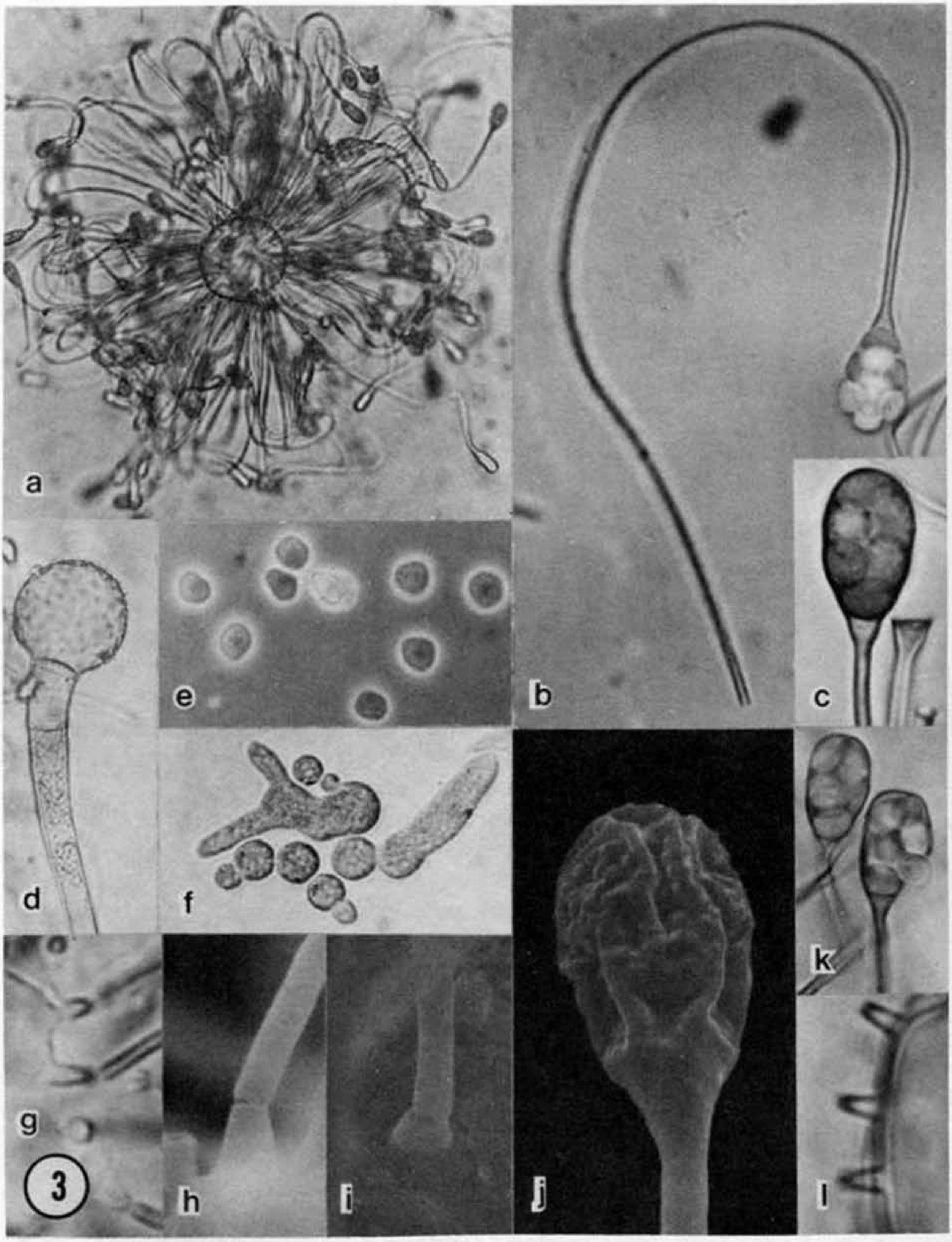

Fig. 3a-l. Benjaminiella multispora (CBS 421.70).--a-d,f,g,k,l. Light microscopy.--e. Phase contrast.--h-j. SEM.--a. Fruiting head.--b. Multispored sporangiolum on long pedicel.--c. Enlarged view of the apices of two pedicels, on one the sporangiolum has been released revealing the columella, the sporangiolum remains on the other.--d. Fertile vesicle after dehiscence.--e. Several sporangiospores--f. Several yeast-like budding cells, some

of sporophore branching; and (3) whether zygospores are formed aerially or immediately above the agar surface. They can be separated by use of the following key:

KEY TO THE SPECIES OF BENJAMINIELLA

A. Sporangiola unispored; some sporophores branched; zygospores formed near the surface of the substrate.....B. poitrasii

AA. Sporangiola multispored; sporophores unbranched; zygospores usually formed above the substrate surface, in the aerial hyphae.....B. multispora

Mycotypha indica P.M. Kirk & Benny, sp. nov.
Figs. 1E, 2n-v, 6a-n

Coloniae fere lente crescentes, dense lanosae, plus minusve zonatae, griseae. Sporophora primum simplicia, sed subinde saepe ramulos gerentia, plus minusve erecta, ad 3-4 mm alta, (4-)6-9(-12) µm lata; primum hyalina, deinde grisescentia et in parte proxima multiseptata, pariete exigue asperulata, praecipue in parte distali. Vesiculae fertiles longitudine variabiles, ovideae vel clavatae, sed plerumque plus minusve cylindricae, parce asperulatae, (15-)150-300(-500) µm longae, (12-)16-24(-32) µm diam (sporangiolis exclusis), sursum rotundatae, undique (summo apice excluso) sporangiolis obtecta. Sporangiola in duobus stratis disposita, dimorpha: sporangiola strati exterioris late ellipsoidea vel obovoidea, 4-6.5 x 3-4.5 µm, plerumque 4.8 x 3.7 µm, dilute columbina, levia, pedicellis plus minusve conicis, ca. 2 x 1.5 µm, ad 0.5 µm angustatis supportata, liberata vestigium pedicelli ca. 1

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germinating to produce hyphae.--g. Portion of fertile vesicle showing pedicel dehiscence.--h,i. Pedicel base and subtending denticle. Note that the pedicel base is not swollen.--h. Lateral view.--i. Oblique view.--j. A sporangiolum.--k. Two sporangiola. Note that the sporangiolum wall of one has broken and a sporangiospore is being released.--l. Margin of fertile vesicle showing three denticles after dehiscence. Mags.: a, X305; b,k, X1,375; c, X1,910; d, f, X475; e, X1,145; g,l, X2,225; h-j, X5,400.

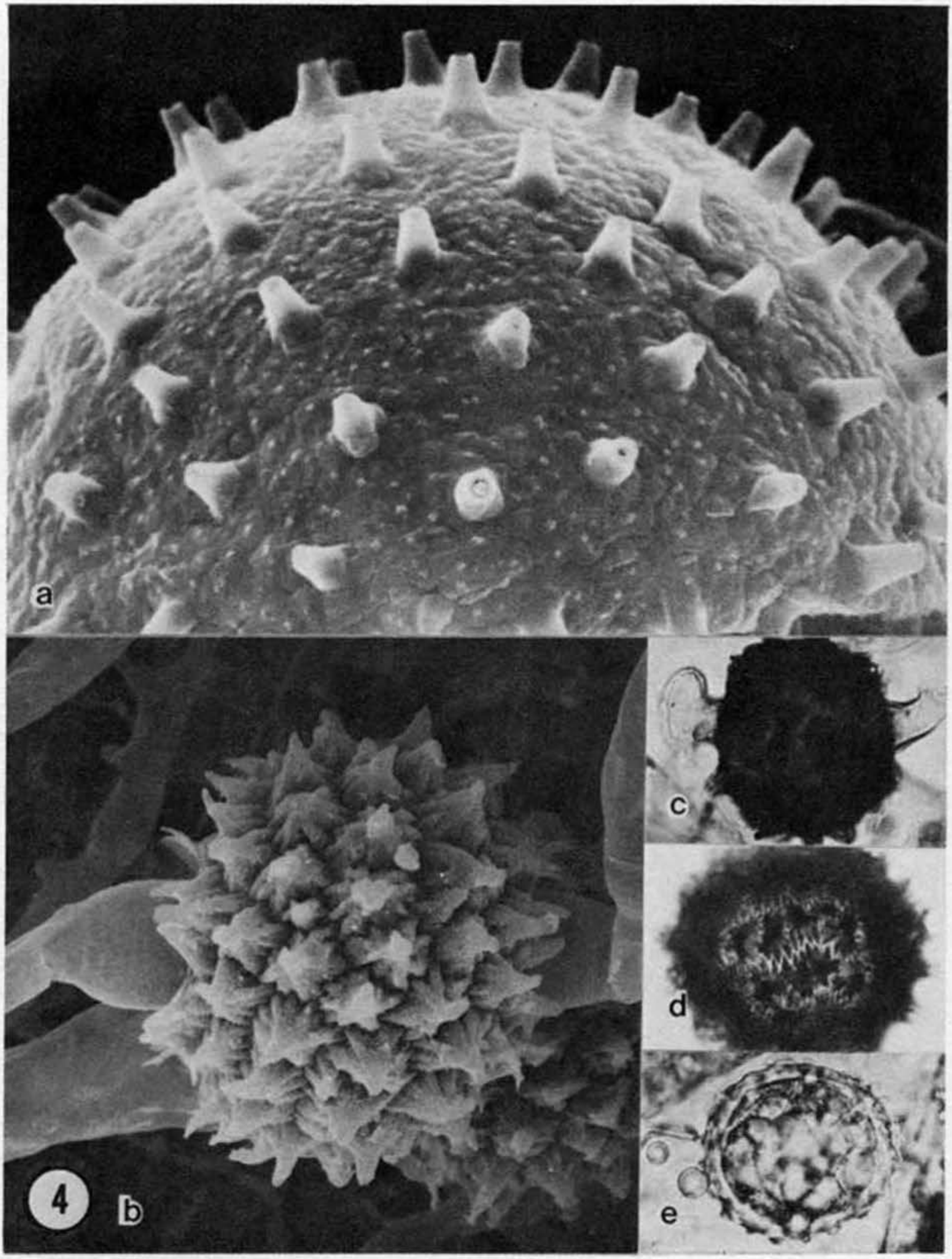

Fig. 4a-e. Benjaminiella multispora (CBS 421.70).--a, b. SEM.--c-e. Light microscopy.--a. Portion of fertile vesicle after dehiscence showing morphology and arrangement of denticles.--b. Zygosporangium showing ornamentation and opposed suspensors.--c. Zygosporangium showing opposed suspensors.--d. Surface view of zygosporangium showing ornamentation.--e. Optical

µm longum ferentia; sporangiola strati interioris globosa ad subglobosa, 3-4, in medio 3.6 µm diam, dilute columbina, levia, pedicellis ca. 1 µm longis, conicis supportata, liberata vesitgium pedicelli ca. 0.5 µm longum ferentia. Vestigia pedicellorum amborum stratorum denticulos conicos 0.5-1 µm longos in vesicula relinquentia. Sporangiola unispora. Hyphae submersae vulgo in cellulas hyalinas, globosas, zymoideas transeuntes usque ad 50 µm diam proferentes; interdum veterum cellularum chlamydosporas tenuitunicatas formantes. Zygosporae copiosae, in hyphis aeriis vel ad superficiem substrati formatae, globosae vel subglobosae, (45-)65-80(-90), plerumque 72 µm diam (projectionibus inclusis), pariete fusco, projectionibus conicis ad 10 µm vel magis altis obtecta; suspensores oppositi, inaequales, leves, hyalini vel diluti grisei vel atrobrunnei. Species homothallica.

Holotypus IMI 211999, isotypus CBS 245.84, isolatus ex terra prope Jabalpur in India, Mar. 1977, a D.N. Tiwari (N 40).

Colonies on MEYE 4-5 cm diam in 12-14 days at 26 C; turf dense, more or less zonate, near Mouse Gray, becoming Light Drab to Drab in age. Sporophores simple at first, often secondarily branched; more or less erect, up to 3-4 mm high, (4-)6-9(-12) µm diam; hyaline at first, becoming pale bluish gray, grayish brown in age; non-septate distally below the fertile vesicle; becoming irregularly multiseptate proximally; wall minutely roughened, especially distally, thicker proximally. Fertile vesicle variable in length, ovoid to clavate, but mostly short- to long-cylindrical; minutely roughened; (15-)150-300(-500) µm long, (12-)16-24(-32) µm diam without sporangiola; rounded at the apex; bearing sporangiola over the entire surface except at the extreme tip. Sporangiola dimorphic, forming two distinct layers over the surface of the fertile vesicle: (1) Sporangiola comprising the outer layer broadly ellipsoid to obovoid, 4-6.5 x 3-4.5, av. 4.8 x 3.7 µm, pale bluish gray, smooth, borne on more or less conical pedicels ca. 2 µm long, 1.5 µm wide at the base, ca. 0.5 µm wide above; after secession, sporangiolum

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section through zygospore. Mags.: a, X 4,200; b, X1,230; c-e, X505.

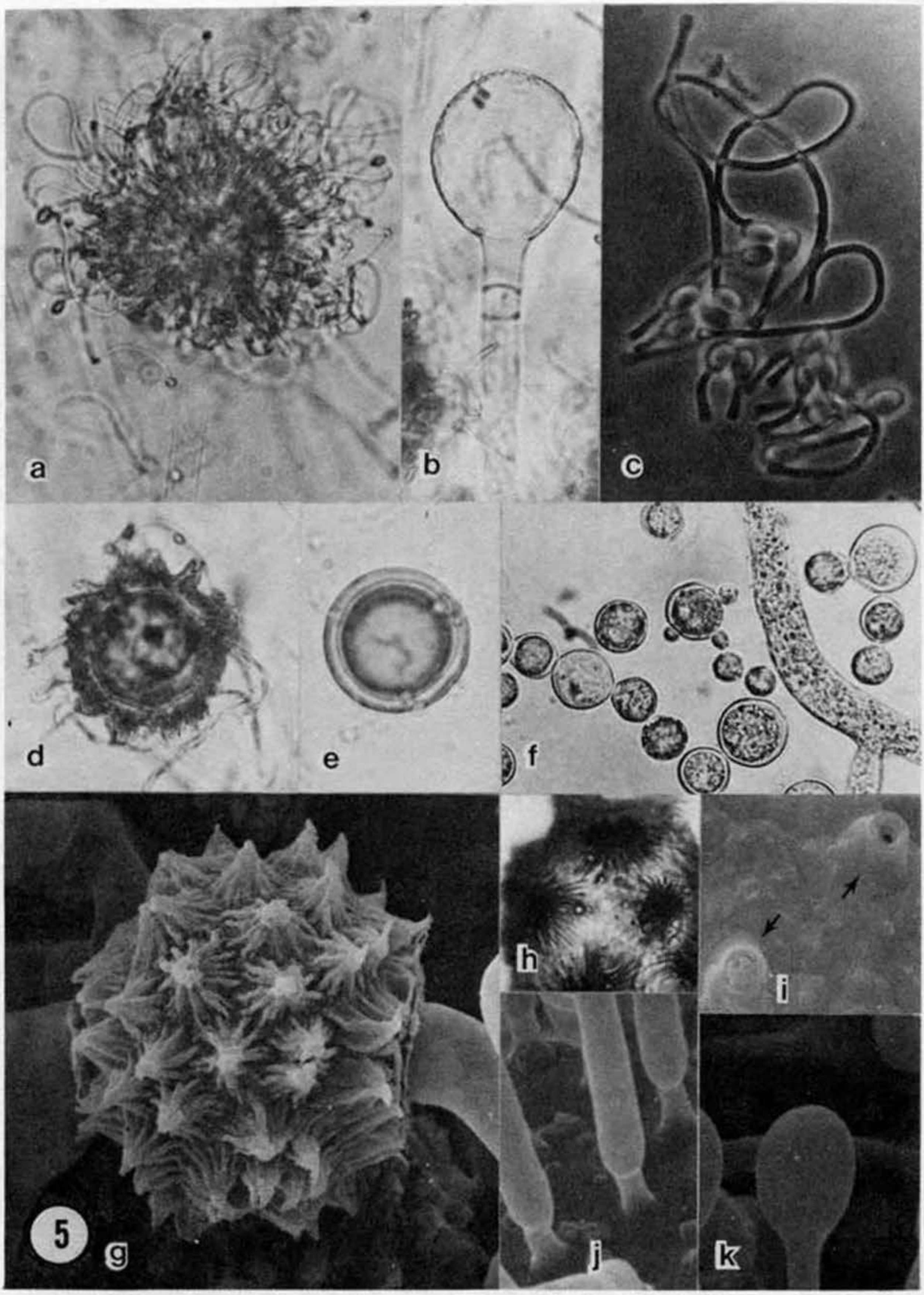

Fig. 5 a-k. Benjaminiella poitrasii (RSA 903).--a, b, d-f, h. Light microscopy.--c. Phase contrast.--g, i-k. SEM.--a. Fruiting head.--b. Fertile vesicle after dehiscence.--c. Several sporangiola, some on relatively short and curved pedicels, others on long, twisted and contorted pedicels

bearing remnant of pedicel ca. 1 µm long; pedicellar base forming a conical, truncate to rounded denticle ca. 1 µm high on the fertile vesicle. (2) Sporangiola comprising inner layer globose to subglobose, 3-4, av. 3.6 µm diam, pale bluish gray, smooth, borne on short, conical pedicels ca. 1 µm or less high, ca. 1 µm wide at the base; after secession, sporangiolum bearing remnant of pedicel ca. <0.5 µm long; pedicellar base forming an inconspicuous, truncate denticle ca. <0.5 µm high on the fertile vesicle. Sporangiospores of similar size and shape to the sporangiola. Substrate hyphae branched, non-septate at first, becoming irregularly septate; giving rise to hyaline, globose, yeast-like budding cells up to 50 µm diam, occasional cell segments forming relatively thin-walled chlamydospores. Zygospores abundant, formed on aerial hyphae near surface of substrate; globose to subglobose, (45-)65-80(-90), av. 72 µm diam including projections; wall brownish black to black, covered with coarse, conical projections up to 10 µm or more high; suspensors opposed, anisogamous, smooth, hyaline to pale gray or blackish-brown. Homothallic.

HOLOTYPE.--INDIA: Madhya Pradesh, Jabalpur, soil, March, 1977, D.N. Tiwari (N 40)(IMI 211999--Holotype; CBS 245.84 --Isotype).

ETYMOLOGY.--from indica (L.), referring to India, the country of origin.

DISTRIBUTION.--India; known only from the type locality.

OTHER SPECIMEN EXAMINED.--INDIA: Madhya Pradesh, Jabalpur, Jabalpur Botanic Gardens, Bambusa leaf litter, January 1984, N. Singh (NS/32)(IMI 287391).

NOTES.--Mycotypha indica produces unbranched sporophores

--d. Zygosporangium and suspensors.--e. Zygospore showing smooth wall.--f. Vegetative hyphae and yeast-like budding cells from colony surface.--g. Zygosporangium showing ornamentation and opposed suspensors.--h. Zygosporangium surface showing ornamentation.--i. Portion of fertile vesicle showing two denticles (arrows) after dehiscence. --j. Oblique view of three pedicel bases and their subtending denticles. Note that each pedicel base is swollen.--k. Lateral view of young sporangiolum. Mags.: a,b,d-f,h, X500; c, X1,200; g, X1,220; i-k, X5,775.

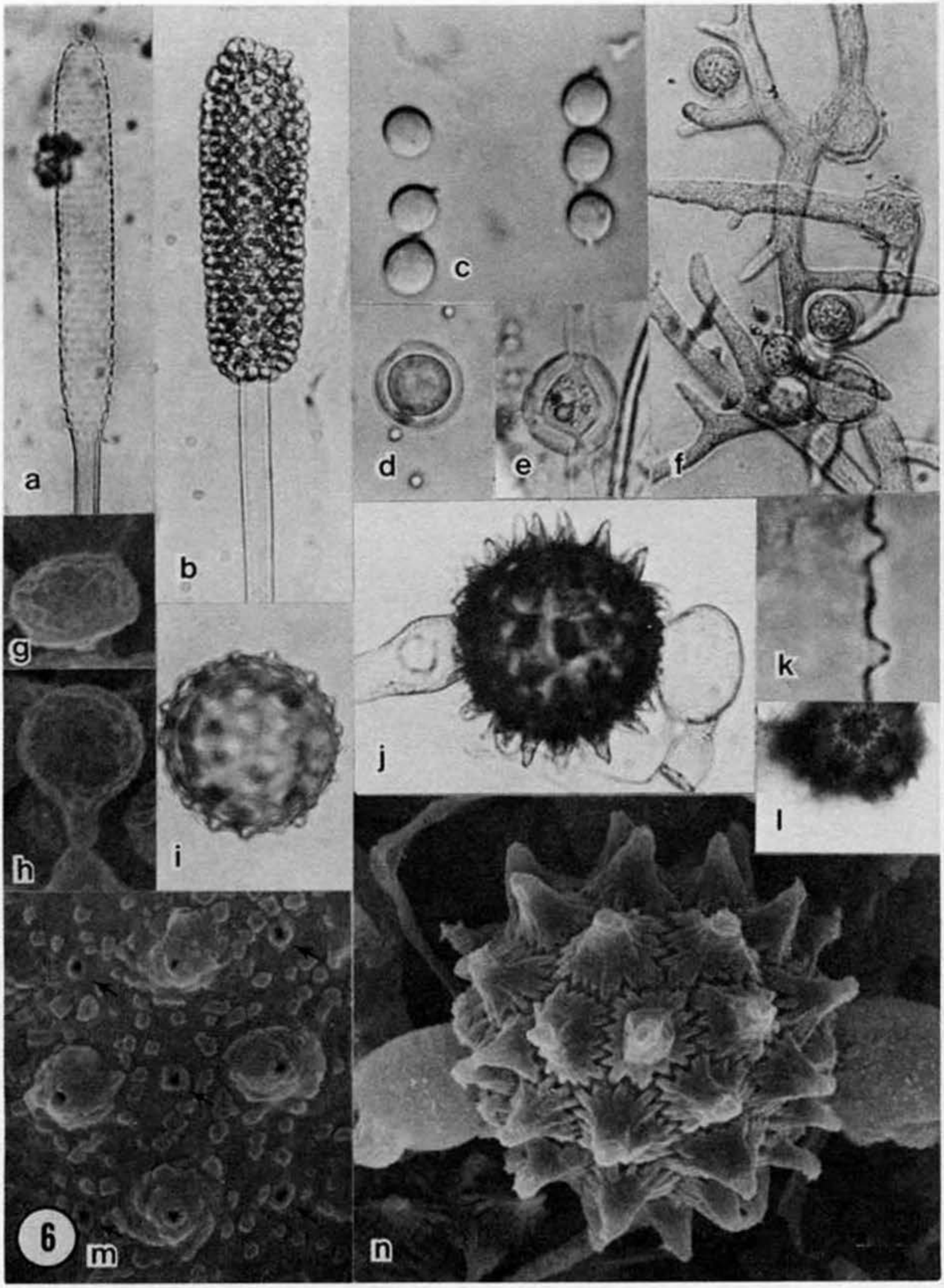

Fig. 6 a-n. Mycotypha indica (IMI 211999).--a, b, d-f, i-l. Light microscopy.--c. Nomarski Interference Phase Contrast.--g, h, m, n. SEM. --a. Fertile vesicle after sporangiolum dehiscence.--b. Fertile vesicle before sporangiolum dehiscence.--c. Dimorphic sporangiola.--d. Thick walled yeast-like budding cell.--e. Thick walled yeast-like budding cell after germination.--f. Vegetative

(Fig. 2n) with basal septa (Fig. 1Ee, 2o) that bear a single apical, cylindrical fertile vesicle (Figs. 1Ed, 2p, 6a,b), and zygospores near the surface of the substratum (Fig. 2n). The sporangiola are unispored, dimorphic (Figs. 1Eb-c, 2q,r, 6c,g,h), and since they are formed on dimorphic denticles (Fig. 6g,h,k,m) they are arranged in two layers (Fig. 2r,s). Zygosporangia (Figs. 2t, 6j,l,n) are formed between opposed, non-appendaged suspensors and they contain a single relatively thick walled, coarsely ornamented zygospore (Figs. 2u, 6i). Yeast-like budding cells (Figs. 2v, 6d-f) are formed in and on the agar, and they can be relatively thick walled (Fig. 6d,e).

Mycotypha indica, like M. microspora and M. africana, sporulates poorly on MSMA, although there is extensive growth of subaerial hyphae. Sporophore and sporangiolum formation is excellent (4+) on LYE and Whey agars, good (3+) on MEYE, V8, and YpSs agar media, but poor (1+) on YpD and PDA. Zygospore formation is optimal (5+) on YpD, excellent (4+) on V8, and good (3+) on LYE, MEYE, and Whey, with some (2+) zygospores being formed on YpSs and PDA. There is a tendency for the isolate of M. indica studied to sector, not form the anamorph which leaves the zygospores exposed, and thus produce a dark blackish-brown colony. The colonies are slightly zonate when the anamorph is produced but zonation is lacking when only the zygospores are formed. A brownish pigment is released

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hyphae and yeast-like budding cells. Note yeast-like cells are still relatively thin walled.--g, h. Dimorphic sporangiola.--g. Sporangiolum from inner row of spores on a short denticle. Note that this is the globose sporangiolum figured in 6c.--h. Sporangiolum from outer row of spores on a long denticle. Note that this is the obovate sporangiolum figured in 6c.--i. Zygospore covered with conical ornaments.--j. Zygosporangium showing suspensors.--k. Optical section through fertile vesicle showing two denticles which subtend the outer row of sporangiola.--l. Surface view of a zygosporangium showing ornamentation.--m. Surface view of fertile vesicle showing arrangement of small (arrows) and larger denticles.--n. Zygosporangium showing ornamentation and opposed suspensors. Mags.: a,b, d-f, i,j,l, X470; c, X1,350; g,h,m, X5,400; k, X2,185; n, X1,145.

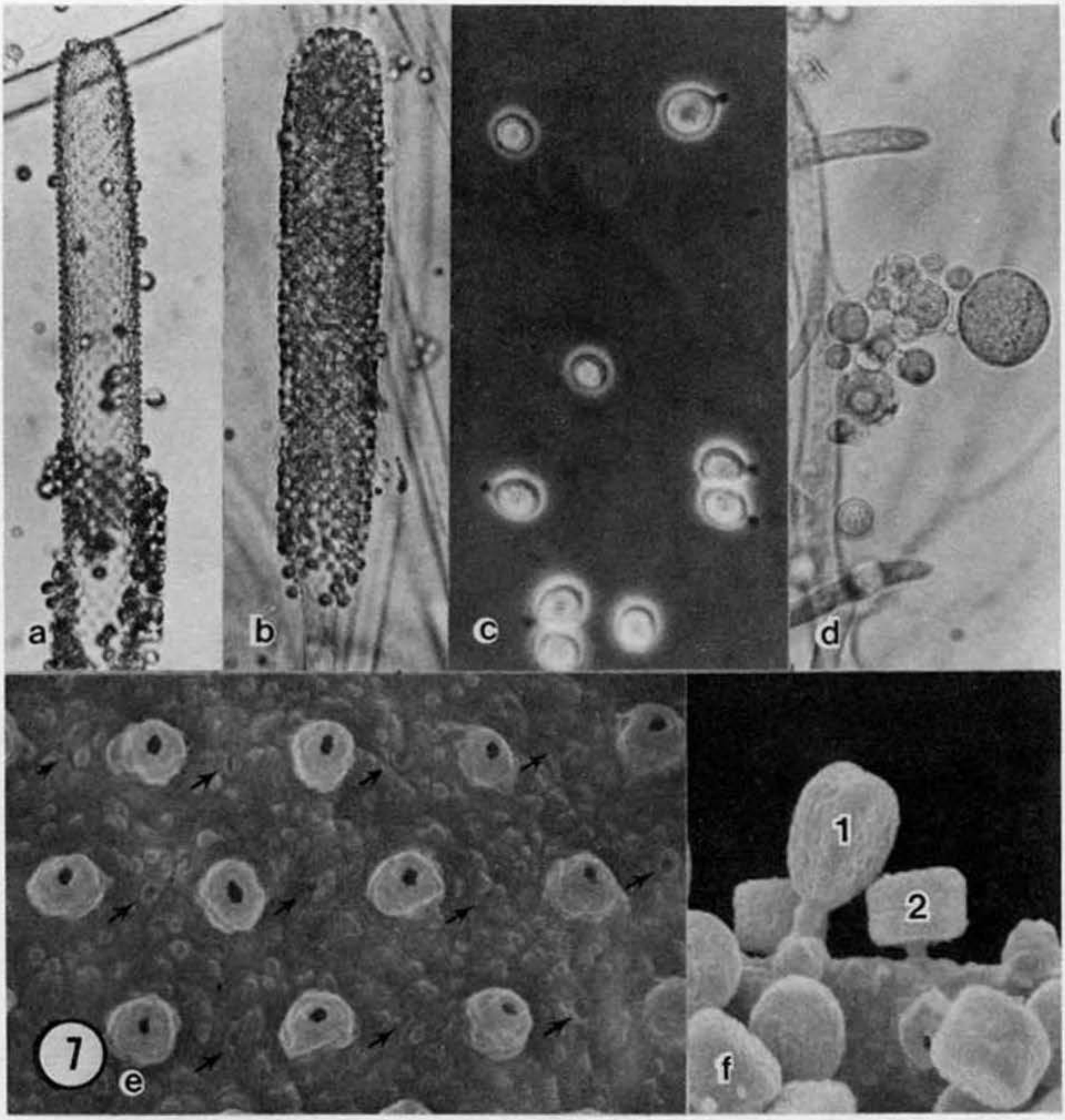

Fig. 7a-f. M. microspora (a,c, RSA 1183; b,d-f, IMI 282443).--a, b, d. Light microscopy.--c. Phase contrast.--e,f. SEM.--a. Fertile vesicle after sporangiolum dehiscence.--b. Fertile vesicle before sporangiolum dehiscence.--c. Dimorphic sporangiola.--d. Vegetative hyphae and yeast-like budding cells.--e. Small (arrows) and large denticles on the surface of the fertile vesicle as viewed from above.--f. Lateral view of dimorphic sporangiola and denticels. Note the obovoid sporangiolum (1) is on the larger denticle and the rectangular (globose when mounted in KOH-Phloxine; compare with Fig. 6c) sporangiolum (2) is on the smaller denticle. Mags.: a,b,d, X475; c, X1,145; e,f, X5,400.

into the agar when M. indica is grown on MEYE at 26 C under a 12 hrs dark/12 hrs light cycle.

Mycotypha microspora Fenner, Mycologia 24: 196. 1932. Figs. 1C, 7a-f, 9A-D.
≡Microtypha microspora (Fenner) Monte, Oddo & Tonolo , Ann. Ist. Super. Sanità 3: 737. 1967.

Descriptions and illustrations of M. microspora are presented by Fenner (1932), and Benny and Benjamin (1976). Additional figures can be found in Young (1969), and Cole and Samson (1979). Mycotypha microspora (Figs. 1C, 7a-f, 9) produces a cylindrical fertile vesicle (Fig. 1Cd, 7a), and septa both at the apex and base of the sporophore (Figs. 1Cd-e). The fertile vesicle at maturity and before dehiscence, is completely covered with sporangiola (Fig. 7b). The sporangiola (Figs. 1Cb-c, 7c,f, 9) are dimorphic, with both obovoid and globose types being produced on dimorphic denticles (Fig. 7e,f). The yeast-like budding cells (Fig. 7d) are thin walled. Zygospore production in this species is unknown (Benny and Benjamin (1976).

Mycotypha africana Novak & Backus, Mycologia 55: 793. 1963. Figs 1D, 8a-j.
≡Microtypha africana (Novak & Backus) Monte, Oddo & Tonolo, Ann. Ist. Super. Sanità 3: 737. 1967; as "(Backus & Novack)."

Descriptions and illustrations of M. africana are presented by Novak and Backus (1963), and Benny and Benjamin (1976). Additional figures of this taxon can be found in Young (1969), Brain and Young (1969), Cole and Samson (1979), and O'Donnell (1979). Mycotypha africana (Figs. 1D, 8a-j) produces a cylindrical fertile vesicle (Figs. 1Dd, 8a), and septa in the sporophore base (Fig. 1De). The fertile vesicle at maturity and before dehiscence, is completely covered with sporangiola (Fig. 8b). The sporangiola are dimorphic, some are cylindrical while the others are globose (Figs. 1Db-c, 8c,g) and are produced on dimorphic denticles (Fig. 8g,i). Thin walled yeast-like budding cells are readily formed by the submerged vegetative hyphae (Fig. 8d). The zygosporangia are dark and rough walled, and are formed between short, smooth, opposed suspensors (Fig. 8e,h,j). The zygospores have a hyaline, relatively thin, sculptured wall bearing

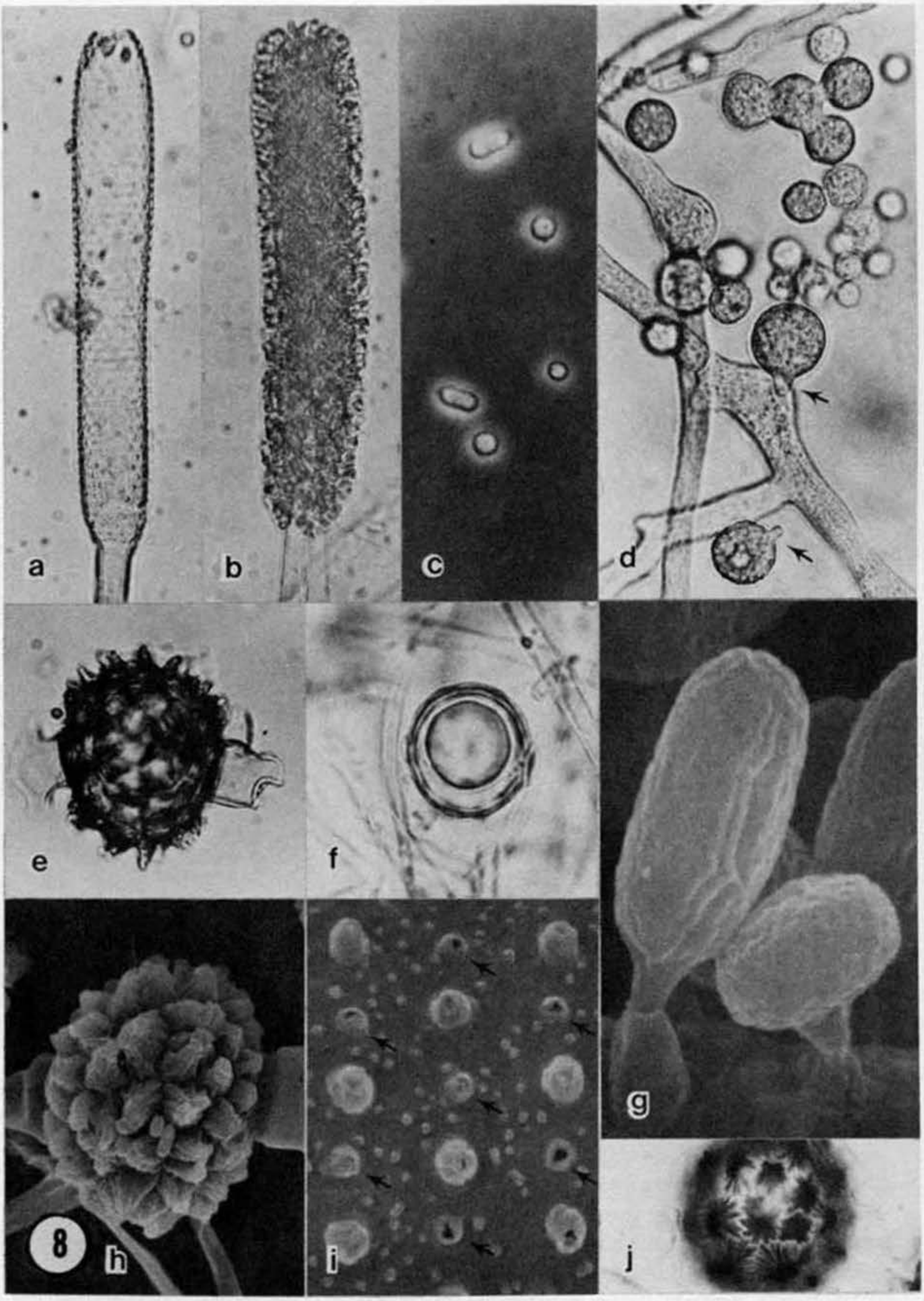

Fig. 8a-j. Mycotypha africana (RSA 1193).--a, b, d-f, j. Light microscopy.--c. Phase contrast.--g-i. SEM.--a. Fertile vesicle after sporangiolum dehiscence.--b. Fertile

suspensor remnants, and contain a single eccentric globule (Fig. 8f).

Mycotypha indica (Figs. 2n-v, 6a-n) can be readily distinguished from the two previously known species, M. microspora (Fig. 7a-f) and M. africana (Fig. 8a-j), because of differences in the shape of the external sporangiola, the location of adventitious septa in the sporophore, and the presence or absence of zygospores. The morphology of the external sporangiola readily distinguishes Mycotypha indica (sporangiola broadly ellipsoid to ovoid) from M. africana (sporangiola cylindrical with rounded ends). The position of sporophore septa and presence of zygospores distinguish M. indica (septa at sporophore base; zygospores formed, homothallic) from M. microspora (septa usually near sporophore apex, but sometimes formed basally; zygospores unknown, presumably heterothallic). They can be separated by use of the following key:

KEY TO THE SPECIES OF MYCOTYPHA

A. Sporangiola in outer row cylindrical....M. africana
AA. Sporangiola in outer row broadly ellipsoid to ovoid or obovoid.....B
  B. Septa produced near the base of the sporophore; homothallic.....M. indica
  BB. Septa usually produced near apex but some may be formed near base; zygospores unknown, presumably heterothallic.....M. microspora

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vesicle before sporangiolum dehiscence.--c. Dimorphic sporangiola.--d. Vegetative hyphae and yeast-like budding cells. Note that two yeast-like cells are germinating (arrows).--e. Zygosporangium showing suspensors.--f. Zygospore containing a single eccentric globule. Note gametangial remnants.--g. Dimorphic sporangiola and denticles.--h. Zygosporangium showing ornamentation and opposed suspensors.--i. Portion of fertile vesicle showing small (arrows) and larger denticles as viewed from above. Note arrangement of denticles.--j. Surface view of a zygosporangium showing ornamentation. Mags.: a,b, d-f, j, X490; c, X1,175; g, X11,990; h, X1,200; i, X5,560.

DISCUSSION

The dehiscence mechanism of the sporangiola in species of Benjaminiella and Mycotypha (Khan and Talbot (1975) may be unique in the Mucorales. They produce a circumscissile zone of weakness in the pedicel at a predetermined point and it is this zone of weakness which is responsible for the mechanism of sporangiolum secession. The location of this zone is readily observed as a slightly constricted area at the junction of the narrowest portion of the denticle and the base of the pedicel in carbon replicas or silhouettes observed by TEM (Young, 1969; in M. microspora and M. africana), SEM (Cole and Samson, 1979; Brain and Young, 1979; O'Donnell, 1979; in M. africana, M. microspora, and B. poitrasii), ultrathin sections or freeze fractures observed with TEM (Cole and Samson, 1979; in M. microspora). The constriction at the base of the pedicel has also been observed during the investigations reported here (Figs. 2f, 3h, 5j, 6g,h, 7f, 8g). In Mycotypha microspora (Fig. 9A-D) this condition is the result of the formation of two wall layers in the denticle, the outer of which terminates at the abscission zone, while the inner layer is continuous with the sporangiolar wall (Khan and Talbot, 1975; Brain and Young, 1979; Higham, 1980). In members of the Thamnidiaceae sporangiolum dehiscence is via one of two mechanisms: (1) rupture of the sporangiolum wall and subsequent release of the sporangiospore(s), or (2) fracture of the subtending pedicel which liberates the sporangiolum and the enclosed spore(s) as a single unit (Benny and Benjamin, 1975, 1976). A third method has been observed by one of us (GLB). In Thamnidium elegans Link, a circumscissile fracture occurs in the sporangiolum wall at its junction with the base of the columella, the pedicel and columella remaining intact following secession.

A second characteristic, common to all five species of Benjaminiella and Mycotypha, is their ability to form a yeast-like budding phase (hyphal dimorphism), on the surface of a variety of ordinary, solid, laboratory media. Hyphal dimorphism in spp. of Mycotypha has been discussed several times in recent years (Price et al., 1973; Schulz et al., 1974; Hall and Kolankaya, 1974). Cole et al. (1980) determined that the changes in morphology of the vegetative hyphae correlated with differences in wall chemistry. All of the above workers induced the

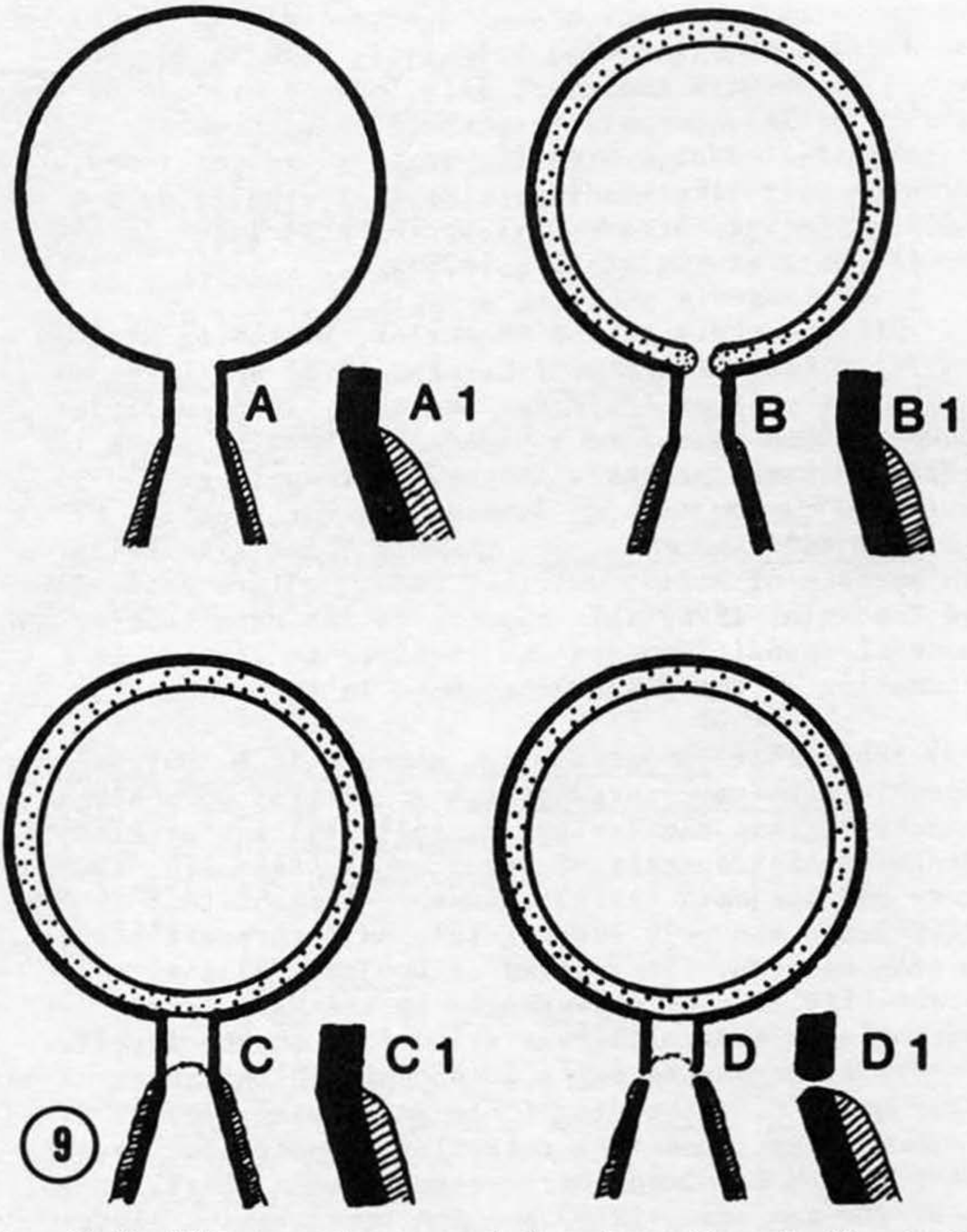

Fig. 9A-D. Diagram of sporangiolum formation in Mycotypha microspora (Based on Khan and Talbot, 1975; Brain and Young, 1979; Higham, 1980). A. Inner wall of denticle is continuous with sporangiolum wall. B. Sporangiospore wall formation. C. Mature sporangiolum. D. Sporangiolum and denticle after dehiscence. A1,B1,C1,D1. Enlarged view of the wall on the lower portion of the pedicel and the upper portion of the denticle in Figs. A,B,C,D, respectively. Legend: Cross-hatched layer=outer wall of denticle; stippled layer=sporangiospore wall; solid line=inner wall of denticle and sporangiolum wall.

yeast-like budding phase in liquid culture but it has been demonstrated here that hyphal dimorphism also occurs on the surface of agar media relatively rich in sugars. Hyphal dimorphism can be readily induced by seeding the surface of an appropriate agar medium with mature sporangiola. The germinating sporangiospores immediately produce yeast-like budding cells that usually do not form the intermediate or mycelial phase until later in the growth cycle (Evans et al., 1978).

Other members of the Mucorales, including Amylomyces rouxii Calmette (Bartnicki-Garcia, 1978) and Cokeromyces recurvatus Poitras (Jeffries and Kirk, 1976; Jeffries and Young, 1983a) also form a yeast-like budding phase in liquid culture, probably induced by reduced oxygen and/or increased carbon dioxide levels. However, species of Benjaminiella and Mycotypha produce yeast-like cells on the surface of solid, nutrient rich, culture media (Benny and Benjamin, 1976) This appears to indicate that slightly anaerobic conditions are not required to induce the production of the yeast-like phase in these taxa.

Species of Benjaminiella, especially B. multispora, resemble Cokeromyces recurvatus in general morphology. Because of this similarity, B. poitrasii was originally described as a species of Cokeromyces (Benjamin, 1960). Benny and Benjamin (1976), however, thought that this resemblance was only superficial, an interpretation which is adopted here. In species of Benjaminiella a circumscissile zone of weakness in the base of the sporangiolum pedicel leaves a denticle on the fertile vesicle after secession, a phenomenon which has never been observed in C. recurvatus (Cole and Samson, 1979). A pigmented deposit with a reticulate appearance, readily visible with the light microscope (Shanor et al., 1950; Benny and Benjamin, 1976) and the transmission electron microscope (Jeffries and Young, 1983b), is produced on the inner surface of the sporangiolum wall in C. recurvatus. Such a deposit is apparently absent from the sporangiola of the superficially similar B. multispora

The presently monotypic Cokeromyces is excluded from the Mycotyphaceae primarily because of its different sporangiolum sucession mechanism and, to a lesser extent, the unique nature of the morphology of the sporangiolum wall.

Benjaminiella and Mycotypha spp. are reported to have a columella at the base of each sporangiolum. This has been observed in M. africana (Brain and Young, 1979; Higham, 1980), M. microspora (Khan and Talbot, 1975; present but not noted by Cole and Samson, 1979), and B. poitrasii (Brain and Young, 1979). A columella in Benjaminiella multispora has been observed with the light microscope (Fig. 3c) but its presence in Mycotypha indica must be confirmed by observing ultrathin sections of the fungus with the transmission electron microscope.

Zygospores in species of Benjaminiella, and Mycotypha are all of the Mucor-type (zygosporangium ornamentated and pigmented; suspensors opposed), and ornamentation of the zygosporangial wall places these fungi in the following groups (Schipper et al., 1975): A1 (Benjaminella poitrasii); A2 (Benjaminiella multispora, Mycotypha africana, M. indica).

ACKNOWLEDGEMENTS

The authors are indebted to Dr. R.K. Benjamin for providing some of the micrographs and reviewing the manuscript, Dr. D.L. Hawksworth for reviewing the manuscript, and Dr. W. Gams for kindly writing the Latin diagnoses.

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MYCOTAXON

Vol. XXII, pp. 149-158 January-March 1985

ADDITIONS TO THE LICHEN FLORA OF THE FAROES

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SUMMARY

Fourteen species of lichens are reported as additions to the known lichen flora of the Faroes, viz. Acarospora fuscata (Nyl.) Arn., Arthrorhaphis citrinella (Ach.) Poelt, Aspicilia caesiocinerea (Nyl. ex Malbr.) Arn., Caloplaca nivalis (Körb.) Th.Fr., Cladonia luteoalba Wils. & Wheld., C. merochlorophaea Asah., C. cf. subulata (L.) Wigg., Huilia flavocaerulescens (Hornem.) Hert., Lecanora dispersa (Pers.) Sommerf., Lecidella scabra (Tayl.) Hert. & Leuck., Massalongia carnosa (Dicks.) Körb., Pertusaria corallina (L.) Arn., Rhizocarpon lavatum (Fr.) Hazsl. and Staurothele fissa (Tayl.) Zw. Taxonomic notes and notes on fertility and ecology of the species are given.

INTRODUCTION

Owing to their isolated situation in the middle of the North Atlantic, their homogenous geological composition and their modest size, the Faroe Islands are comparatively poor in lichens. About 250 species have previously been reported from the Faroes. Most of them (c. 150 species) are micro-

lichens (K. Hansen & Johansen 1982).

The present authors are of the opinion that the lichen flora of the Faroes is somewhat richer than indicated by the above figures. Recent lichenological papers, e.g., Degelius 1966 and K. Hansen 1968, focus the attention on the more conspicuous macrolichens, and the former of these authors also on some characteristic crustaceous lichens.

The papers dealing more thoroughly with the very intriguing group of Faroese microlichens are relatively old, and the nomenclature used is out of date (Rostrup 1870; Branth 1901). Nevertheless these papers are still of great value, as they are rich in information on localities and habitats for the lichens. A number of lichen communities, e.g., those occurring on the very steep nesting cliffs along the coast, have, however, been neglected previously, mostly because of their inaccessibility.

The Faroe Islands are part of the North Atlantic basalt area and thus are geologically comparable to N.E. Ireland, W. Scotland, N.W. and S.E. Iceland, Jan Mayen, C.E. and C.W. Greenland and Baffin Island. The Faroese plateau-basalt consists of three series of basalt with alternating layers of tuft-agglomerate, coal and clay and intrusive formations.

In 1983 one of us (E.S.H.) received a grant from the Danish Natural Science Research Council for carrying out a quantitative investigation of epilithic lichen communities on the Faroes. During this work, which took place in the summer of 1983, he was assisted by Anna Maria Fosaa. About 400 specimens of lichens were collected. These are now deposited at the Botanical Museum of Copenhagen (C). The present paper is restricted to the lichens that appear to be additions to the known lichen flora of the Faroes.

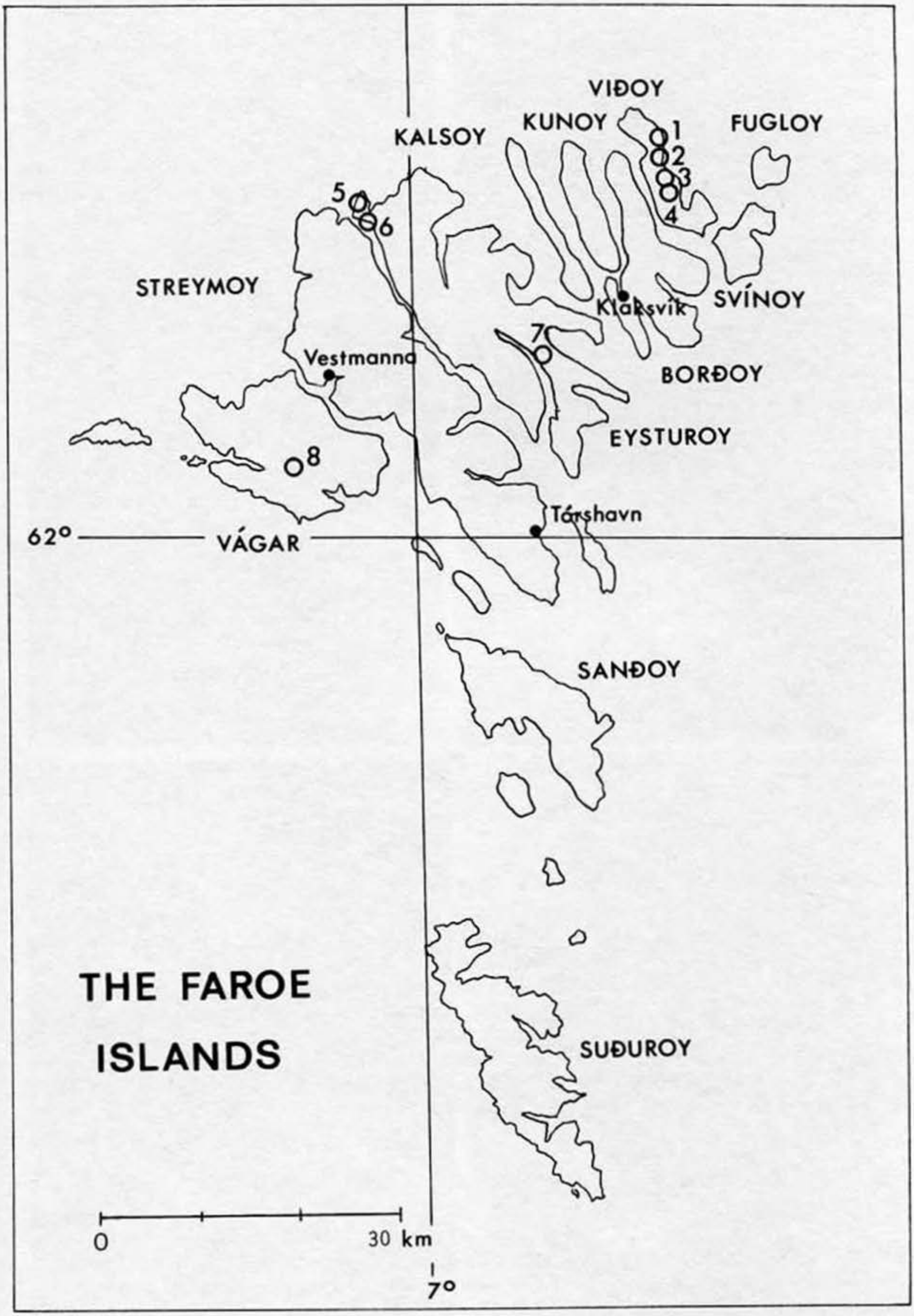
LIST OF LOCALITIES AND SPECIES

The situation of the eight collecting sites in the Faroe Islands shown on the map (Fig. 1).

Locality 1. Villingadalsfjall (Vidoy). 62°23'N 6°31'W.
Locality 2. Eidsvík (Vidoy). 62°22'N 6°31'W.
Locality 3. Dalá (Vidoy). 62°20'N 6°30'W.
Locality 4. Mýrnafjall (Vidoy). 62°19'N 6°29'W.
Locality 5. Kollur (Eysturoy). 62°19'N 7°07'W.
Locality 6. Eidi (Eysturoy). 62°18'N 7°06'W.
Locality 7. Sydrugöta (Eysturoy). 62°11'N 6°46'W.
Locality 8. Tjørndalsá (Vágar). 62°05'N 7°15'W.

The following 14 species are new to the Faroes:

ACAROSPORA FUSCATA (Nyl.) Arn.-Eysturoy: Sydrugöta, on the top surface of basaltic boulder manured by birds, together



THE FAROE ISLANDS

Fig. 1. Location of the eight collecting sites in the Faroe Islands.

with Lecanora intricata (Ach.) Ach. C. ap. The species was determined by J. Poelt.

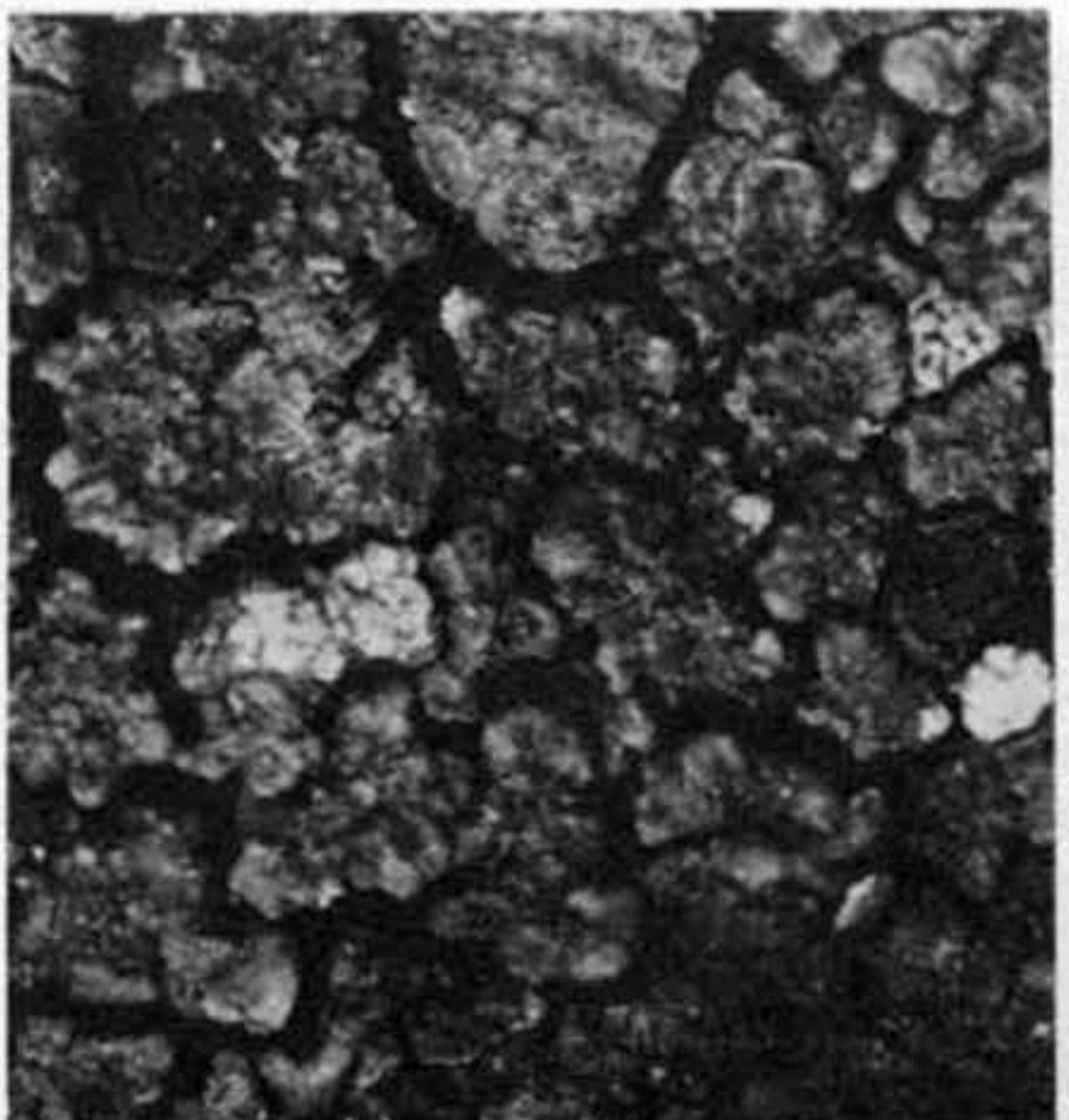
ARTHRORHAPHIS CITRINELLA (Ach.) Poelt (Syn. Bacidia flavovirescens (Dicks.) Anzi). Vidoy: Eidsvík, in Calluna-Nardus heath; Dalá, in openings of Calluna heath; Eysturoy: Kollur, in open Vaccinium heath. C. ap. or ster. - All specimens can be referred to var. citrinella, as the areoles break up into soredia, and as the spores in fertile specimens are 7-11-septate and > 60 µm (Poelt & Vězda 1977). The specimen from Suduroy called Bacidia vacillans (= Arthrorhaphis vacillans Th.Fr.) by Rostrup (1870) and Branth (1901) presumably belongs to the present taxon, which in the Faroes usually is closely associated with Baeomyces placophyllus Ach. or B. rufus (Huds.) Rebent. On Kollur Baeomyces was found to be infested both with Arthrorhaphis citrinella and Epilichen scabrosus (Ach.) Clem. ex Haf.

ASPICILIA CAESIOCINEREA (Nyl. ex Malbr.) Arn. (Syn. Lecanora caesiocinerea Nyl. ex Malbr.).-Vidoy: Eidsvík, on basaltic rock manured by birds, growing together with Lecanora badia (Pers.) Ach.; Dalá, on manured, SW.-exposed face (inclination 55°) of basaltic boulder in Calluna heath, in association with Parmelia saxatilis (L.) Ach. and Candelariella vitellina (Hoffm.) Müll. Arg. C.ap.

CALOPLACA NIVALIS (Körb.) Th.Fr. (Syn. Candelariella nivalis (Körb.) Lett.). - Vidoy: Eidsvík, on mosses on basaltic rock. C. ap. The species was determined by J. Poelt.

CLADONIA LUTEOALBA Wils. & Wheld. - Vágar: Tjørndalsá, in opening of Calluna heath together with, e.g., Baeomyces placophyllus Ach., Cladonia floerkeana (Fr.) Flörke and Botrydina sp. C. luteoalba has been found to contain three different chemical strains (Østhagen 1972; Krog, Østhagen & Tønsberg 1980). The present first specimen from the Faroes contains usnic acid and zeorin (TLC by T. Tønsberg) and accordingly belongs to the zeorin strain, which is previously known from Great Britain, Western Norway and Svalbard (Dahl & Krog 1970; Østhagen 1972).

Fig. 2: Acarospora fuscata (Nyl.) Arn. Areoles with a few (darker) apothecia occurring on basaltic rock at Sydrugöta. 12.7.83 (x7). 3: Arthrorhaphis citrinella (Ach.) Poelt. Fertile thallus growing on soil rich in humus from a heath at Eidsvík. 9.7.83 (x9). 4: Aspicilia caesiocinerea (Nyl. ex Malbr.) Arn. Central part of thallus with numerous apothecia from a basaltic rock near Dalá. 5.7.83 (x7). 5: Caloplaca nivalis (Körb.) Th.Fr. Fertile thallus growing on Andraea at Eidsvík. 9.7.83 (x10).



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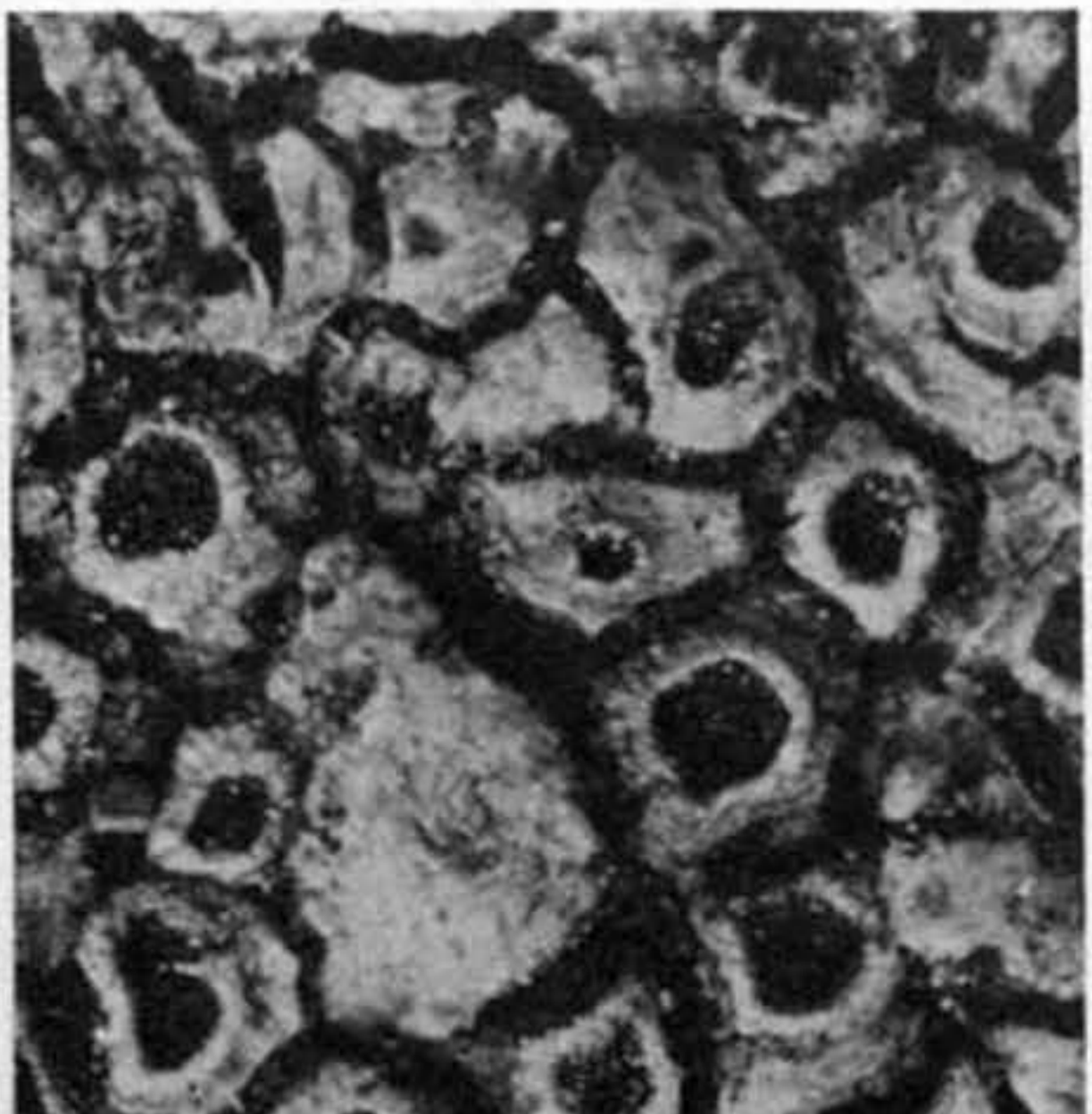

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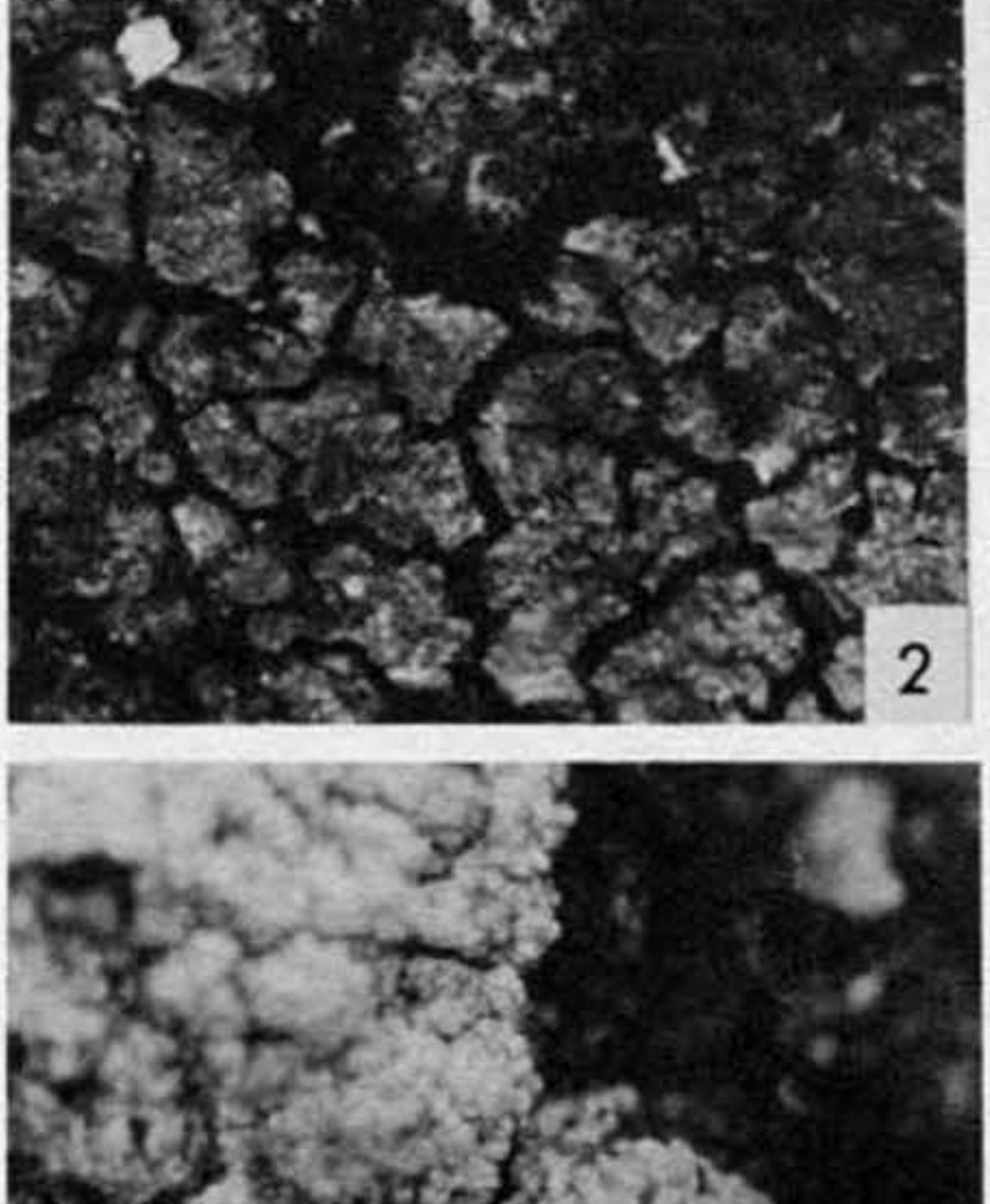

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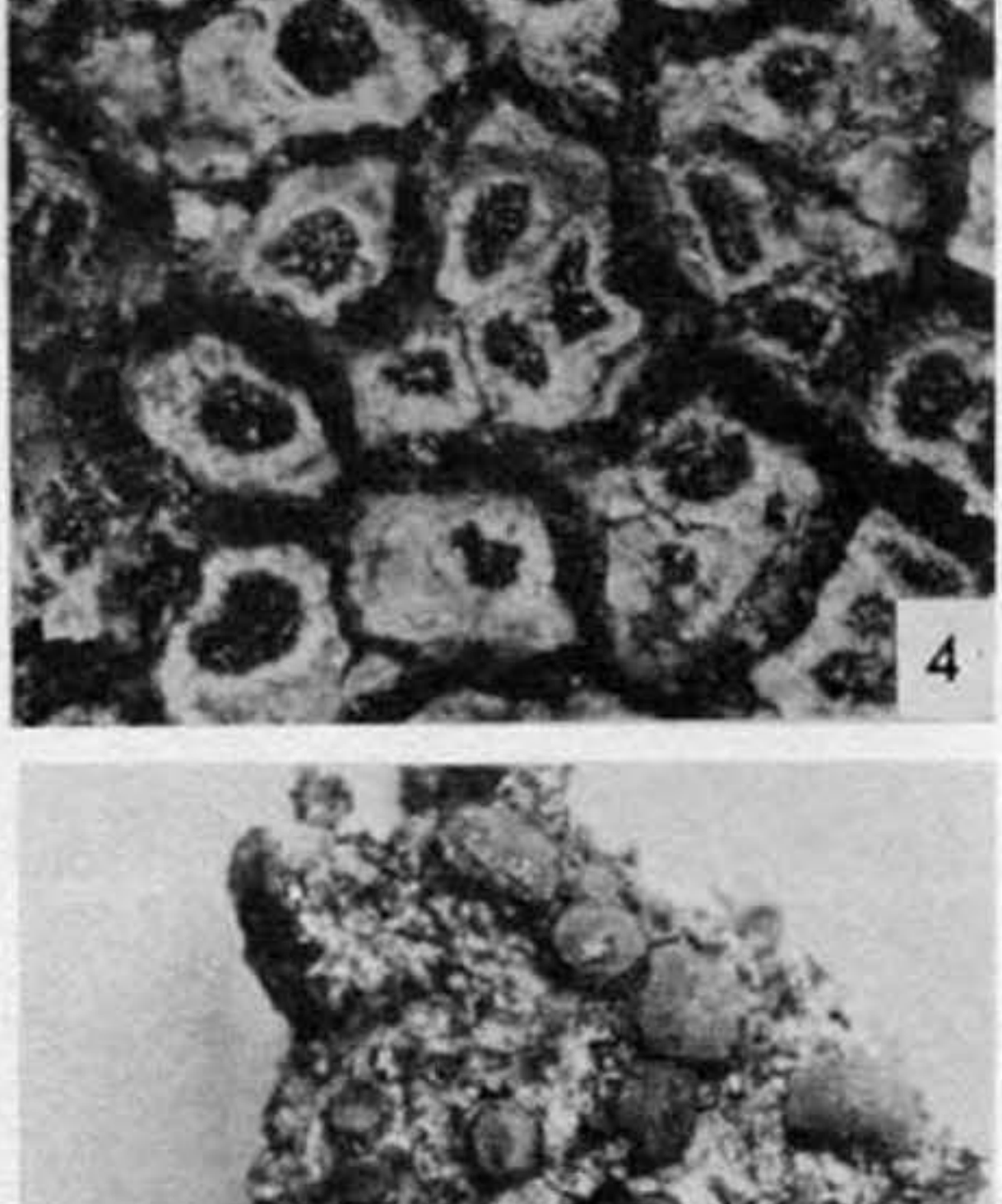

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CLADONIA MEROCHLOROPHAEA Asah. - Vidoy: Dalá, in opening of Calluna heath together with Cladonia squamosa (Scop.) Hoffm. Ster. The species was determined by T. Tønsberg, who found the following chemical contents (TLC): merochlorophaeic acid, 4-0-methylcryptochlorophaeic acid, fumarprotocetraric acid and accessories. Novochlorophaeic acid, a more or less common component of C. merochlorophaea in some areas, e.g., Greenland (Dahl 1950; Ahti 1966), was not found. C. merochlorophaea is considered a well defined species, distinct in chemical as well as morphological characters (Santesson 1984).

CLADONIA cf. SUBULATA (L.) Wigg. (Syn. C. cornutoradiata (Coem.) Vain). - Vidoy: Dalá, in open Calluna heath. Ster. A more definite determination of this single collection with c. ten podetia, 1-2 cm tall, is not possible. T. Tønsberg found (TLC) a content of fumarprotocetraric acid and protocetraric acid.

HUILIA FLAVOCAERULESCENS (Hornem.) Hert. (Syn. Lecidea flavocaerulescens Hornem.). - Vidoy: Dalá, on SW.-exposed, sloping surface of basaltic rock; growing together with Lecidea confluens (Web.) Ach. C. ap. The apothecia are distinctly pruinose contrary to those of Huilia macrocarpa (DC.) Hert., which appears to be more common than H. flavocaerulescens in the localities visited in 1983.

LECANORA DISPERSA (Pers.) Sommerf. - Vidoy; Eidsvík, on mortar in small bridge and on basaltic stones (covered with nutritious dust!) in house. - Eysturoy: Eidi, on old bone.- Vágar; Tjørndalsá, on mortar in sheepfold. C. ap. The hymenium does not show any visible colour reaction to HNO_3, precluding Lecanora albescens (Hoffm.) Flörke in the sense of, e.g., Wirth (1980).

Fig. 6: Cladonia luteoalba A. Wils, & Wheld. Primary squamules growing among mosses near Tjørnadalsá. 15.7.83 (x7). 7: Huilia flavocaerulescens (Hornem.) Hert. Central part of fertile thallus from a basaltic rock at Dalá. 6.7.83 (x18). 8:Lecanora dispersa (Pers.) Sommerf. Fertile thallus growing on a basaltic stone at Eidsvík. 10.7.83 (x18). 9: Pertusaria corallina (L.) Arn. Sterile thallus with numerous isidia from Dalá, 7.7.83 (x8).

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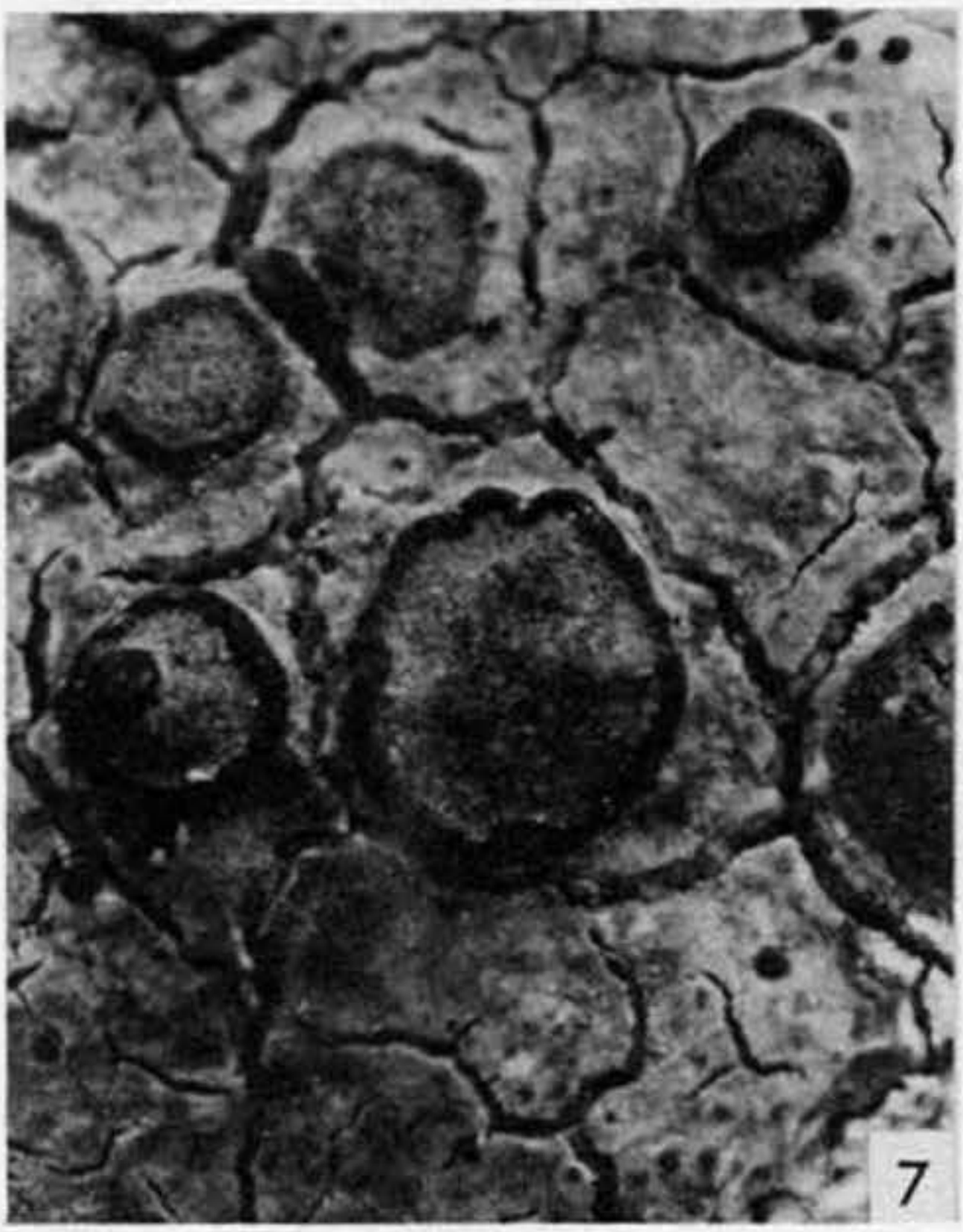

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LECIDELLA SCABRA (Tayl.) Hert. & Leuck. (Syn. Lecidea scabra Tayl.). - Vidoy: Eidsvík, on basaltic stones covered with nutritious dust. - Eysturoy: Eidi, on basaltic rocks influenced by highly nutritious water. Associated lichens: Caloplaca ferruginea (Huds.) Th.Fr. var. festiva (Ach.) Th.Fr.; Catapyrenium lachneum (Ach.) R. Sant. C. ap. The species usually occurs on somewhat weathered, basic to neutral surfaces of siliceous or basaltic rocks, but occasionally grows on wood (Poelt & Vězda 1981; Degelius 1982).

MASSALONGIA CARNOSA (Dicks.) Körb. - Vidoy: Villingadalsfjall, 300 m, among mosses on E.-exposed basaltic rock (inclination 30°); Dalá, among mosses on NW.-exposed face (inclination 30°) of basaltic boulder in Calluna heath, in association with Cladonia squamosa (Scop.) Hoffm. and C. subcervicornis (Vain.) Kernst. C. ap. or ster. - Both Henssen (1963) and Thomson (1979) have drawn attention to the fact that Massalongia carnosa is easily confused with Pannaria praetermissa Nyl. (=Parmeliella praetermissa (Nyl.) P. James). In his paper Thomson discusses some important vegetative diagnostic characters that separate these two species. Here the diagnostic spore characters shall be emphasized: M. carnosa has ellipsoid to fusiform, 2-3-celled spores, while those of P. praetermissa are ellipsoid and only 1-celled (see also Jørgensen 1978). - M. carnosa has an arctic-alpine distribution in Europe, North America and Greenland (Poelt 1969; E.S. Hansen 1978; Thomson 1979). In the last-mentioned area (S.W. and C.W. Greenland) it occurs among mosses on moderately sloping to vertical (rarely overhanging) faces of siliceous or basaltic rocks, especially rocks moistened by seeping water.

PERTUSARIA CORALLINA (L.) Arn. - Vidoy: Mýrnafjall, 400 m, on wind-exposed basaltic rocks together with Lecidea confluens (Web.) Ach., Tremolecia atrata (Ach.) Hert. and Hymenelia lacustris (With.) Poelt & Vězda. Ster. Richly isidiate.

RHIZOCARPON LAVATUM (Fr.) Hazsl. (Syn. R. obscuratum (Ach.) Mass. f. lavatum (Fr.) Th.Fr.). - Vágar: Tjørndalsá, on mortar in sheepfold, together with, e.g. Xanthoria parietina (L.) Th.Fr. C. ap. The species was determined by J. Poelt. The above-mentioned habitat is not typical, but the present specimen has presumably been dispersed to the sheepfold by wind from the basaltic rocks in the vicinity. The characteristic habitat of R. lavatum has previously been described by, e.g., Poelt & Vězda (1981) and Santesson (1981): the inundation zone of rocks by streams and the shore of lakes.

STAUROTHELE FISSA (Tayl.) Zw. (Syn. S. umbrina (Wahlenb.) Tuck.). - Vidoy: Dalá, on basaltic rock temporarily moistened by seeping water, growing together with Hymenelia lacustris (With.) Poelt & Vězda. C. pe. - The species differs from Staurothele clopima Th.Fr., previously reported from the Faroes by Branth (1901), i.a., by its almost spherical hymenial algae, frequently with 2 cells united, cf. Thomson (1979). The hymenial algae of S. clopima are usually elongate.

ACKNOWLEDGEMENTS

We wish to thank Professor Josef Poelt and Dr. Tor Tønsberg for their help with the determination. Professor Rolf Dahlgren read the manuscript. The photographs were made by Flemming Sarup, who used a Wild Photomakroskop M 400 granted by the Danish Natural Science Research Council.

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MYCOTAXON

Vol. XXII, pp. 159-167 January-March 1985

NEW AND NOTEWORTHY BASIDIOMYCETES (APHYLLOPHORALES) FROM TIERRA DEL FUEGO, ARGENTINE

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SUMMARY

52 species of Aphyllophorales are reported from Tierra del Fuego, Argentine, for the first time. Leptosporomyces luteofibrillosus and Tubulicrinis subfusiformis are described as new. The combination Phellinus andinopatagonicus (Wright & Dechamps) Ryv. is proposed. The phytogeography is discussed and among the polypores there is a strong element of Australian species while northern boreal species dominate among the corticoid species.

The mycoflora of Tierra del Fuego is probably the best known in the whole of South America because of "Flora criptogamica de Tierra del Fuego" of which there has been published 15 volumes. However, the Corticiaceae s. l. has not been treated and one of us (L.R.) was invited to Tierra del Fuego to do the necessary collecting before a flora as such can be undertaken. This paper is the first contribution to the knowledge of the group from the area. However, a second visit will be desirable to do more collecting and thus make the flora more complete, especially because the season during the last collecting was rather dry.
The Polyporaceae flora has been written up by Wright and Deschamps (1975). Thus, for this group only hitherto unrecorded species are included in the list. The species are arranged by families and within each family alphabetically according to genus. For each species one or several collection numbers are cited behind the name, and this, taken in connection with the following list of localities, should give the necessary information.

All collections are deposited in the herbarium of Instituto de Botanica "C. Spegazzini" (LPS) with duplicates in the Oslo University Herbarium (O).
List of localities, all in Tierra del Fuego, Argentine, 1982.
Coll. 19091-19210: Estancia Harberton, 18. Feb.
Coll. 19211-19333: Lapataia Nat. Park, W. of Ushuaia, 19.-20. Feb.
Coll. 19334-19389: Lago Escondita, 60 km N. Ushuaia, 21. Feb.
Coll. 19389-19433: Ensanada, W. of Ushuaia, 22. Feb.
Coll. 19434-19502: Monte Olivia, 23. Feb.
All collections were made on Nothofagus sp. unless otherwise stated.

CORTICIACEAE s. lato

Aleurodiscus cerussatus (Bres.) Höhn. & Litsch. 19242.
Asterostroma aff. andinum Pat. 19359, 19390, 19426.
We have not been able to identify with certainty this taxon. According to Parmasto (1970) it seems to be A. andinum s.s.
Athelopsis glaucina (Bourd. & Galz.) Parm. 19337, 19425, 19476. Similar to the species concept but the spores have a slightly navicular appearance, but they are characteristically agglutinated in pairs or 3-4.
A. subinconspicua (Litsch.) Jülich. 19408.
Botryobasidium botryosum (Bres.) John Erikss. 19093.
B. candicans John Erikss. 19462 (anamorph lacking), 19464 (with anamorph).
B. subcoronatum (Höhn. & Litsch.) Donk. 19357, 19456.
Brevicellicium olivascens (Bres.) Larss. & Hjortst. 19221.
Ceraceomyces borealis (Rom.) John Erikss. & Ryv. 19235. Short-spored form, 5-6 µm long.
Coniophora arida (Fr.) Karst. 19347.
Gloeosoma vitellinum (Lév.) Bres. 19334. This poorly known species needs further study in order to confirm its generic status. Primarily because of its cyphelloid and substipitate fruitbody we prefer to maintain Gloeosoma Bres. instead of Aleurodiscus. See also Lemke (1964).
Hyphoderma argillaceum (Bres.) Donk. 19158
H. praetermissum (Karst.) John Erikss. & Strid. 19366, 19367, 19380, 19485, 19489.
H. puberum (Fr.) Wallr. 19455.
H. roseocremeum (Bres.) Donk. 19305.
H. setigerum (Fr.) Donk. 19433/c.
Hyphodontia alutaria (Burt) John Erikss. 19135, 19441, 19447, 19449, 19468, 19469. The lagenocystidia which occur abundantly are more robust and longer than normal, mostly up to 70 µm in length. In other characteristics, such as macromorphology and size of the spores, the specimens conform to the species concept.
H. rimosissima (Peck) Gilbn. 19502.
H. sambuci (Pers.) John Erikss. 19092, 19094, 19152, 19243, 19244, 19255, 19256, 19393, 19410, 19420, 19433/b,

19436. No. 19436 is a rather thick form and the spores are close to those of var. angustispora Parm.
H. subalutacea (Karst.) John Erikss. 19225, 19484.
Hypochniciellum cremeoisabellinum (Litsch.) Hjortst. 19123, 19395.
Kavinia alboviridis (Morgan) Gilbn. & Bud. 19109, 19248, 19378, 19463. This well-known species is easily recognized by its greenish aculei and rough (warted) spores. No. 19463 is a young specimen but deviates from the normal circumscription in having echinulate spores which are best observed in cotton-blue.

LEPTOSPOROMYCES LUTEOFIBRILLOSUS Hjortst. & Ryv. spec. nov. Fructificatio resupinata, effusa, laxe adnata, cremeoalbida vel subochracea; rhizomorphae distinctae, luteae; systema hyphale monomiticum, hyphae basales plus minus rectae, hyalinae, in parte lutescentes, 2.5-3.5, raro 4.5-5 µm latae, fibulatae, hyphae subhymeniales confertae, fibulis indistinctis; basidia subclavata, modice pedunculata, 11-15 x 3.5-4 µm, 4 sterigmatibus; sporis anguste ovatis, tenuitunicatis, hyalinis, laevibus, generatim 3.5-4 x 2-2.2 µm, neque amyloidibus, neque dextrinoidibus, neque cyanophilis. Holotypus: Argentina. Tierra del Fuego. Lapataia Nat. Park, 15 km W. of Ushuaia. 19-20.II.1982. L. Ryvarden 19211 (O). Isotypus: (LPS and GB).

Fruitbody resupinate, effuse, loosely adnate, pellicular to slightly membranaceous, pliable, smooth, cream-coloured to light ochraceous, margin indefinite; rhizomorphs yellowish, running below the subiculum; hyphal system monomitic, basal hyphae thin-walled or with slight wall thickening, hyaline or becoming light yellowish next to the substratum, usually 2.5-3.5 µm broad, rarely up to 5 µm, with clamps, subhymenial hyphae with cells more or less compressed and irregular, with clamps but rarely observed; basidia subclavate, indistinctly pedunculate, 11-15 x 3.5-4 µm, with 4 sterigmata and a basal clamp; spores narrowly ellipsoid, thin-walled, hyaline, smooth, generally 3.5-4 x 2-2.2 µm, non-amyloid, non-dextrinoid, non-cyanophilous.
Remarks. This is a striking species as the yellow rhizomorphs could scarcely be overlooked under a lens.
Further characteristics are the athelioid fruitbody, the narrowly ellipsoid spores and the irregularly and short subhymenial hyphae. Among the athelioid fungi the new species is similar to Confertobasidium olivaceoalbum (Bourd. & Galz.) Jülich and Leptosporomyces roseus Jülich. It is readily separated from the former by lacking brown pigmented hyphae and from the latter by its narrowly ellipsoid spores and smooth hymenium. The blistery hymenial surface of L. roseus is also a striking characteristic. Further, neither C. olivaceoalbum nor L. roseus have yellowish rhizomorphs but rather brownish (in the former) and rosy to light brown (in the latter).
The various segregates from Athelia Pers. have been placed into several genera, e.g. Confertobasidium, Fibulomyces and Leptosporomyces. The delimitation of these genera remains

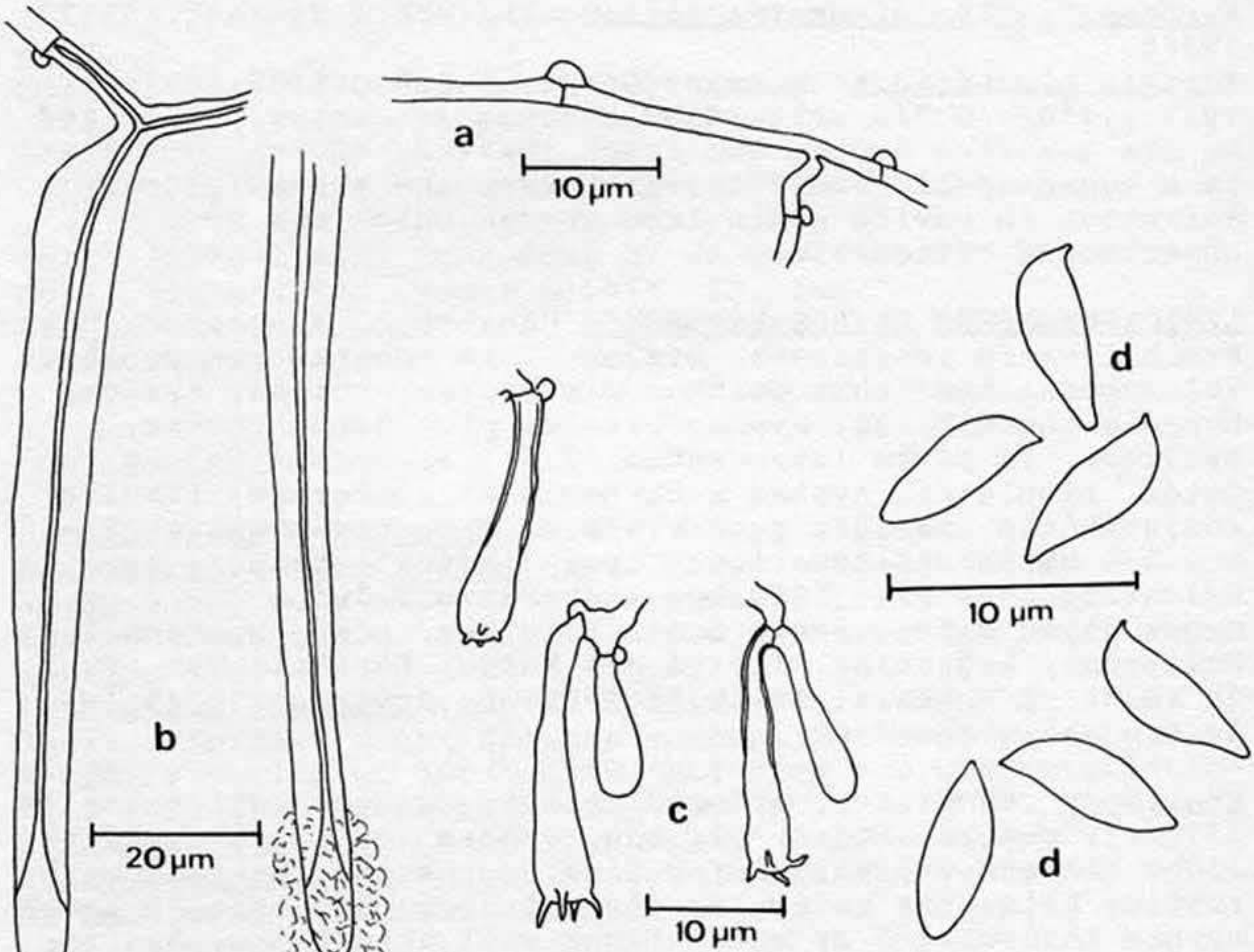

Fig. 1. Leptosporomyces luteofibrillosus, a) hyphae from the rhizomorphs, b) hyphae from the subhymenium, c)-d) basidia, e) spores. From the holotype.

vague. C. olivaceoalbum, L. roseus, and L. luteofibrillosus can scarcely be separated at generic level. The fruit-bodies, occurrence of rhizomorphs, and the appearance of basidia and spores are very similar and in our opinion applicable only on specific delimitation.

Melzericium udicolum (Bourd.) Hauersl. 19251, 19292, 19433/a. Variable, spores often more than 10-12 um long. vague (linje 46 her begynner øverste linje fra gamle s. 4)

Peniophora incarnata (Pers.:Fr.) Karst. 19157, 19289, 19409, 19452.

Phanerochaete sordida (Karst.) John Erikss. & Ryv. 19373.

Phlebia rufa (Pers.:Fr.) M.P. Christ. 19160, 19374, 19392.

Ph. subcretacea (Litsch.) M.P. Christ. 19120.

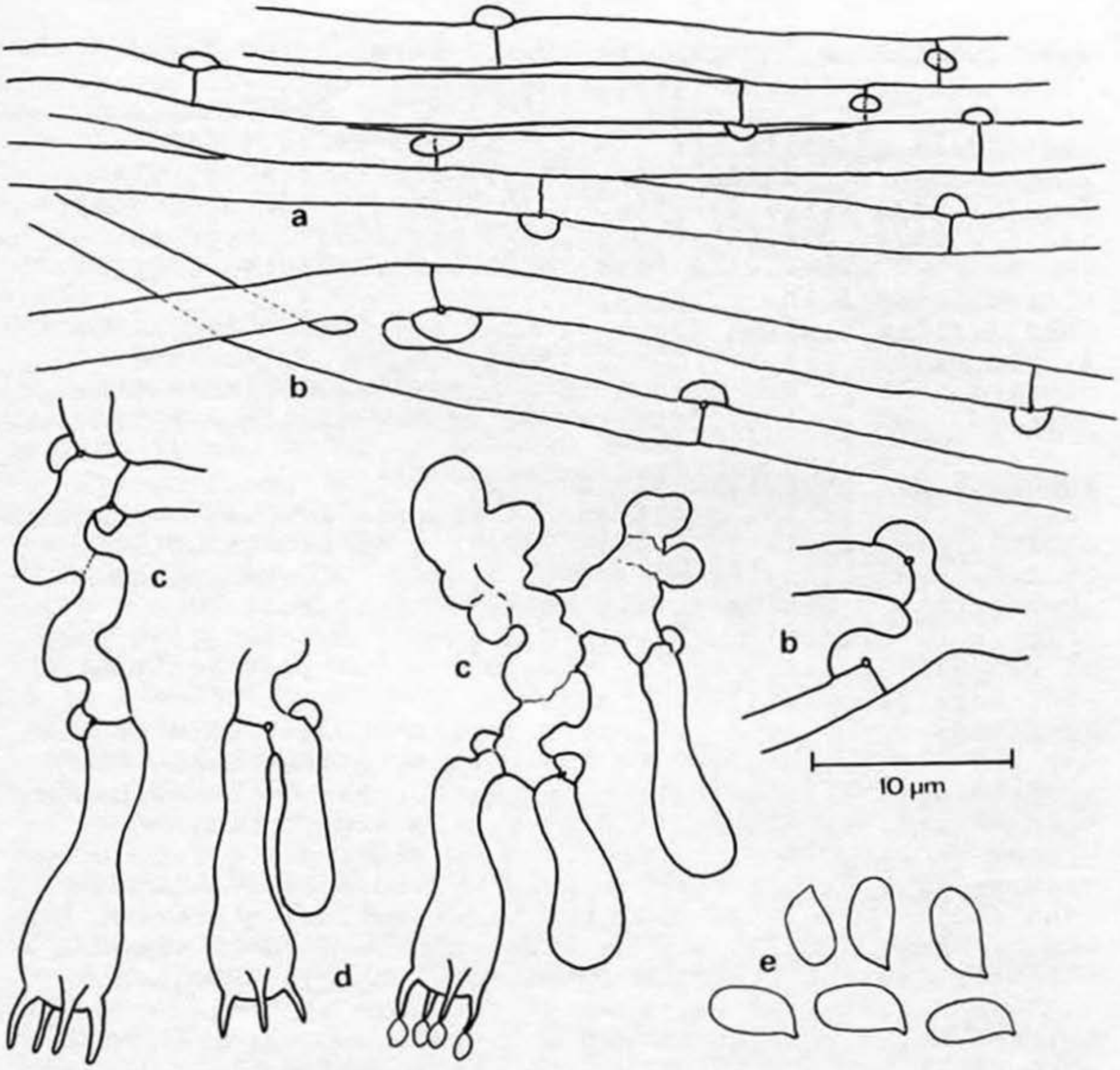

Fig. 2. Tubulicrinis subfusiformis, a) hyphae, b) cystidia, c) basidia, d) spores. From the holotype.

Plicatura nivea (Sommerf.:Fr.) Karst. 19460. The spores are not amyloid and slightly broader than normal, generally 1.5-1.8 um in diam.. The amyloidity, however, is very little pronounced also in specimens seen from the northern hemisphere and is best studied when the spores are packed together.
Schizopora paradoxa (Schrad.:Fr.) Donk. 19097, 19111, 19147, 19230, 19311, 19344, 19435, 19458.
Scopuloides hydnoides (Cooke & Massee) Hjortst. & Ryv. 19368, 19372.
Scytinostroma ochroleucum (Bres. & Torr.) Donk. 19142, 19148. The gloeocystidia have a very strong aldehyde reaction.
Serpula himantioides (Fr.:Fr.) Karst. 19180, 19216, 19375, 19473.
Sistotrema brinkmannii (Bres.) John Erikss. 19151, 19346/b, 19369, 19437, 19486. No. 19346/b is not typical and has spores with adaxial side mostly convex or straight. The fruitbody is also more yellow but still with a grandinioid appearance.
Sistotremastrum niveocremeum (Höhn. & Litsch.) John Erikss. 19309, 19446, 19457.
Stereum hirsutum (Willd.:Fr.) S.F. Gray. 19107,19115,19127.

Subulicystidium longisporum (Pat.) Parm. 19161, 19342, 19343. No. 19342 has very large spores, up to 25 um in length and 1.5-2 um wide.
Tomentella crinalis (Fr.) M.J. Larsen. 19095.
Trechispora farinacea (Pers.:Fr.) Liberta. 19099, 19400.
T. aff. vaga (Fr.) Liberta. 19101, 19143, 19214, 19348, 19379, 19472. All these specimens are readily recognized to the section Ramariella Parm. and appear related to T. christiansenii and T. vaga.
Tubulicrinis hamatus (Jacks.) Donk. 19104.
T. glebulosus (Bres.) Donk. 19096, 19318, 19443. The species is here determined in a broad sense with spores and cystidia somewhat different. See also following species.

TUBULICRINIS SUBFUSIFORMIS Hjortst. & Ryv. spec. nov. Species Tubulicrini glebuloso et angusto affinis sed sporis subfusiformibus (6-)6.5-7 x (2.2-)2.5 um lyocystidiis cylindricis, circiter 90-100 um longis, versus apicem acuminatis, 3.5-5 um latis, neque amyloidibus.
Holotypus: Argentina. Tierra del Fuego. Ensanada, 15 km W. of Ushuaia. 22.II.1982. L. Ryvarden 19422 (O). Isotype: LPS. Paratypus: 19113 (O, LPS, GB).
Fruitbody resupinate, effuse, closely adnate, thin or with age thickening, whitish to ochraceous, pilose owing to protruding cystidia; hyphal system monomitic, basal hyphae thin-walled, straight, (1.8-)2-2.5 um wide, subhymenial hyphae short-celled, up to 2.5-3 um wide, all hyphae with clamps; lyocystidia more or less cylindrical, 90-100 um long and 9-10 um wide near the base, narrowing towards the obtuse apex, and 3.5-4.5 um wide, non-amyloid or with slightly greyish reaction in Melzer; basidia subclavate, 12-20 x 3.5-4(-4.5) um, towards the base with slight wall thickening, 4 sterigmata and a basal clamp; spores subfusiform (6.)6.5-7.5 x (2.2-)2.5 um, thin-walled, hyaline, smooth, non-amyloid, non-dextrinoid, non-cyanophilous.
Remarks. The distinctive features of this new species are the subfusiform to navicular spores and cylindrical, non-amyloid cystidia with the capillary lumen ending gradually towards the obtuse apex. This species must be regarded as closely related to T. glebulosus (Bres.) Donk and T. angustus (Jacks. & Weres.) Donk which have similar cystidia but both differ from T. subfusiformis by their cylindrical to slightly curved spores.
Xenasmatella tulasnelloidea (Höhn. & Litsch.) Oberw. ex Jülich. 19141, 19149, 19166.

HYMENOCHAETACEAE

Phellinus andinopatagonicus (Wright & Deschamps) Ryv. comb. nov. Basionym: Pyrrhoderma andinopatagonicus Wright & Deschamps. Rev. Invest. Agrop. INTA, ser. 5. Pat. Vegetale 9(3):154, 1972. 19175, 19384.
This is a common species in the area. As we prefer to keep Phellinus in a rather wide sense, it is transferred to this genus. The presence of a crust on the pileus alone is hardly a generically significant character.

POLYPORACEAE

Antrodia gossypina (Speg.) Ryv. 19114, 19461. The species was originally described from La Plata close to Buenos Aires, and the type was the only collection known from the country until it was found in Tierra del Fuego. Rajchenberg (1982) cites also one collection from southern Chile. The species causes a strong degrading brown rot in the attacked wood.

Ceriporia reticulata (Fr.) Dom. 19376. According to Rajchenberg (1982:49) the species has not previously been found in Argentine. It has a World-wide distribution.

Macrohyporia dictyopora (Cooke) Joh. & Ryv. 19434. Previously not known from South America but recorded from Australia and Malawi (Johansen & Ryvarden 1980:422).

Polyporus melanopus Fr. 19228. It may be that this is the same fungus as Wright & Deschamps (1975) recorded as Polyporus dictyopus Mont. Coll. 19228 had the typical warm brown colour of P. melanopus as it is seen in Northern Europe from where it was described. P. dictyopus Mont. was described from Juan Ferdanez and according to our concept it is a widespread taxon with a predominantly tropical distribution.

Trametes pubescens (Fr.) Pil. 19236. The species is related to T. versicolor (Fr.) Pil. which is very common in Tierra del Fuego, but easily separated by its thicker fruitbodies which dry distinctly pale straw-coloured.

Rigidoporus undatus (Fr.) Donk. 19363. According to Rachjenberg (1982) not previously known from Argentine.

Tyromyces campylus (Berk.) Ryv. 19427. An Australian species restricted to Nothofagus and previously not known from South America.

T. dissectus (Lév.) Ryv. 19351, 19397, 19492. Originally described from Southern Chile, but previously not reported from Argentine. It is very similar to T. exiquis (Col.) Cunningh., from Australia, and ultimately the two names may prove to be synonymous. Furthermore, T. floriformis (Quel.) Donk from the Northern hemisphere and mostly found on conifers, is also related, but normally it remains white with age and on drying. T. dissectus darkens with brown colours with age and on drying.

T. pelliculosus (Berk.) Cunningh. 19110, 19385, 19475. Syn.: Spongipellis chubutensis Wright & Deschamps. After having examined specimens collected in Australia with those from Tierra del Fuego, we concluded the two species were synonymous.

SEPTOBASIDIALES

Septobasidium spp. 19416, on living Nothofagus. It is rather surprising to find a Septobasidium in Tierra del Fuego with its harsh and cold climate, the genus is in general confined to tropical or warm temperate zones because of the host insects. In Couch (1938:54-55) we have been unable to find any species reported from Nothofagus, and probably the specimen represents a new species.

However, as we have only a single sterile specimen (only a few allantoid spores, 20 x 5 um, were observed) we refrain from making a formal description until more and fertile material is available.

Discussion

Nothofagus has a fascinating distribution with its occurrence in southern part of South America and then Australia, New Zealand and Papua, New Guinea. It is now known that these areas were formerly connected but then drifted thousands of kilometres apart. Not only Nothofagus became disjunct with this development, but also many species of fungi connected with the genus. A prominent example is the ascomycete genus Cyttaria known only from Nothofagus and following the host almost everywhere. Among the species reported here and in the paper of Wright Deschamps (1975) the following species comes also into this category: Macrohyporia dictyopora, Piptoporus portentosis, Tyromyces campylus, T. pelliculosus and T. dissectus (assumed synonymous with the Australian species T. exiquis). In the same group, but not connected with Nothofagus is Phaeotrametes decipiens which in South America is known north of the Nothofagus area. In addition to the few endemic species, the Polyporaceae include widespread boreal-temperate species like Trametes versicolor, T. pubescens, Pol. melanopus, Rigidoporus undatus and Ceriporia reticulata. It is interesting to note that the two disjunct areas have no species in common from the Hymenochaetaceae but rather have endemic species on Nothofagus in both areas, such as Phellinus andinopatoganicus and Inonotus crustosus in Argentine, and Phellinus nothofagi, Phellinus kamahi and Ph. tawhai in Australia-New Zealand. It could be an indication that Hymenochaetaceae evolved rather late so there was no common species from the family when the Nothofagus area was coherent. Later immigration to the two independent areas then led to different species formation in this family. Apart from the endemic species and a few American ones, almost all recorded species in the Corticiaceae are also known from Scandinavia and has a wide distribution in the northern hemisphere. They must either have migrated along the Andes mountain chain or have been part of a common flora which later was split into two grossly disjunct areas. The Corticiaceae of Australia is in spite of Cunningham's monograph (1963) rather poorly known as collecting in Australia has been rather scarce. Thus a comparison between the two groups remain difficult.

Acknowledgements

Financial support from the Norwegian Research Council and Flora Criptogamica de Tierra del Fuego Project is deeply acknowledged. My sincere thanks goes to Professor Dr. I.J. Gamundi de Amos who made my stay in Tierra del Fuego a very pleasant and profitable one. Dr. D. Pegler, Kew, has

suggested linguistic improvements for which we are grateful.

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MYCOTAXON

Vol. XXII, p. 168 January-March 1985

N O T I C E

NORTHEAST MYCOLOGY CONFERENCE

The 8th annual Northeast Mycology Conference (formerly New England Mycology Conference) will be held at the New York State Museum in Albany, New York on Saturday, April 20th, 1985. It will feature a symposium on the history of mycology in the northeastern U. S.

Registration forms, directions, and information on accommodations will be mailed by the end of February. The nominal registration fee is planned to include a published copy of the symposium proceedings.

Because of the symposium, there will be no time for contributed papers this year, but a limited number of poster session spaces are available. Historical topics are particularly encouraged but all topics are welcome. If you wish to submit a poster, there will be a form in the February mailing.

For further information contact either:

J. H. Haines
New York State Museum
Room 3132 CEC
Albany, NY 12230
(518) 474-5809

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Wadsworth Center for
Labs. & Res.
N.Y. State Dept. of Health
Albany, NY 12201
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MYCOTAXON

Vol. XXII, pp. 169-195 January-March 1985

NEW OR INTERESTING MEMBERS OF THE LICHINACEAE FROM SOUTHERN AFRICA I. SPECIES FROM NORTHERN AND EASTERN TRANSVAAL

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SUMMARY

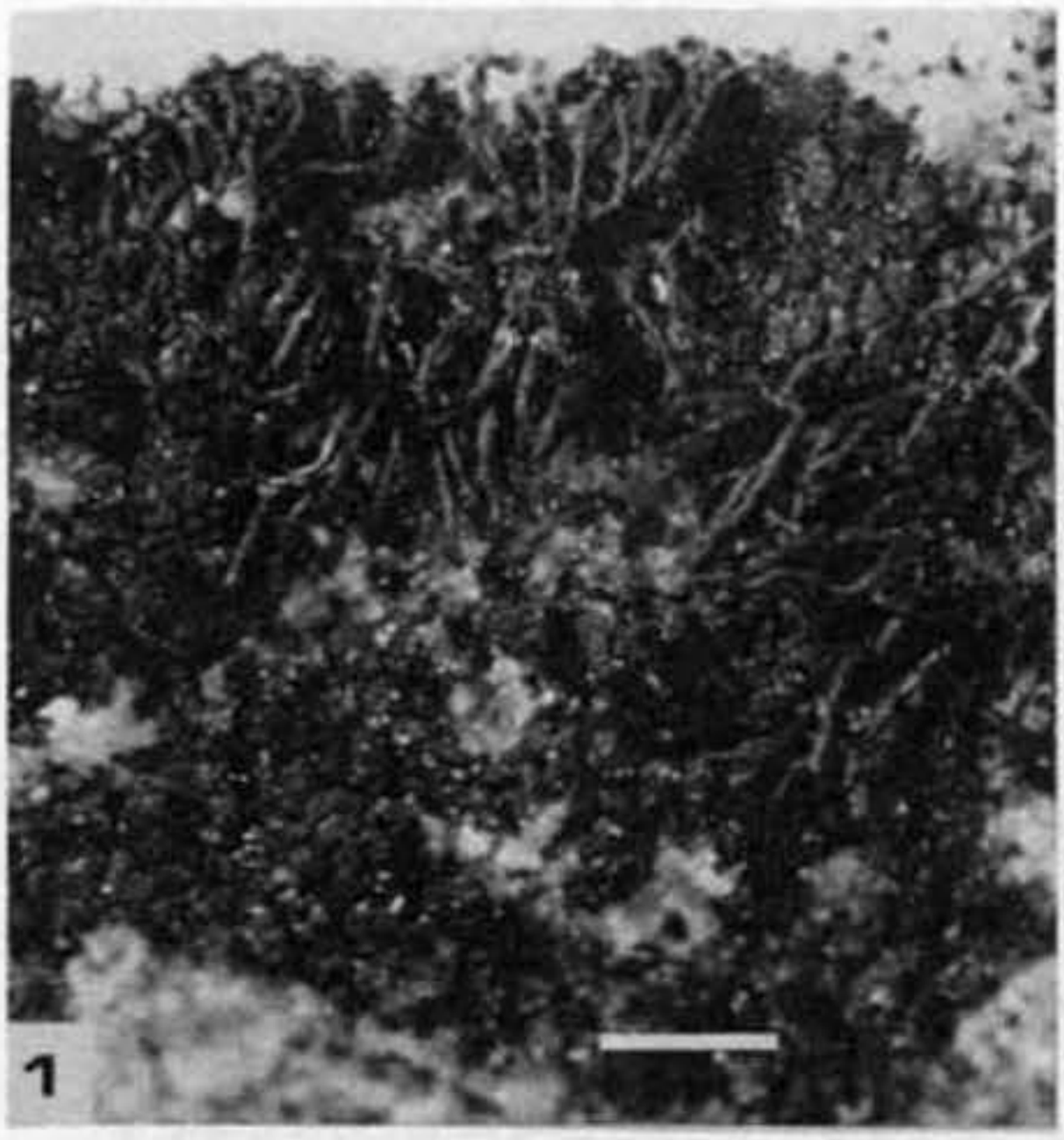
The new species Lichina macrospora, Pterygiopsis convexa, P.melanophthalma, P.submersa, and Thyrea rotundata are described from the northern and eastern Transvaal. A second, newly found locality of Porocyphus effiguratus is reported from the northern parts of Transvaal.

INTRODUCTION

This paper represents the first in a series which will deal with members of the Lichinaceae collected on seepage rocks along the escarpment of the northern and eastern Transvaal. Five new species of the genera Lichina, Pterygiopsis and Thyrea are described, and a new locality of Porocyphus effiguratus Henssen is reported. This lichen was previously only known to occur in Zimbabwe (Rhodesia).

MATERIAL AND METHODS

MATERIAL. Porocyphus effiguratus Henssen (Henssen 1974). Zimbabwe, Inyanga, Erin, on partly submerged rocks of a waterfall at 2000 m (isotype: MB). Pterygiopsis atra Vain., isotype (TUR, herb. Vain. 12479). Thyrea polyglossa (Nyl.) Zahlbr., lectotype (H, herb. Nylander 42671).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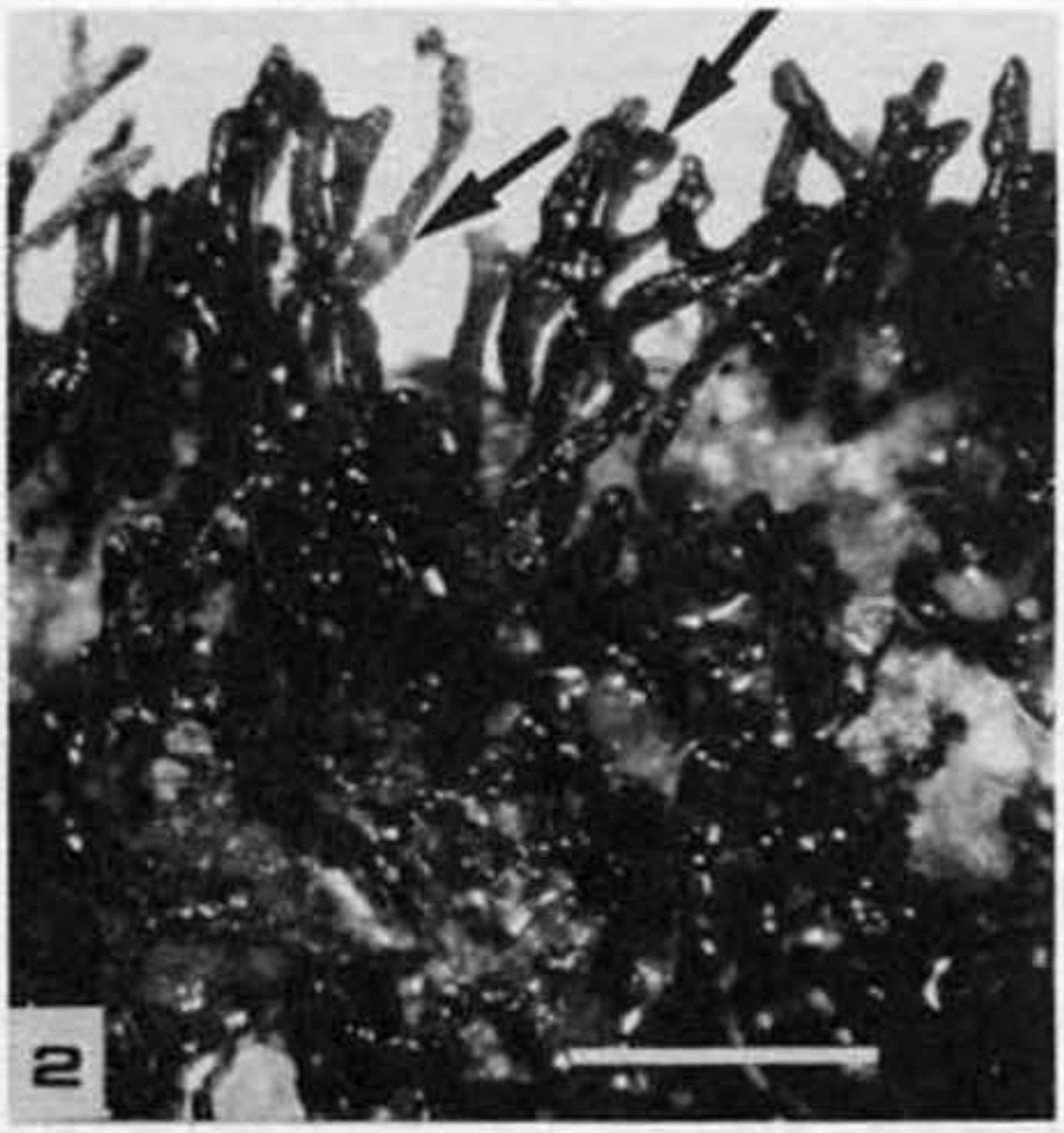
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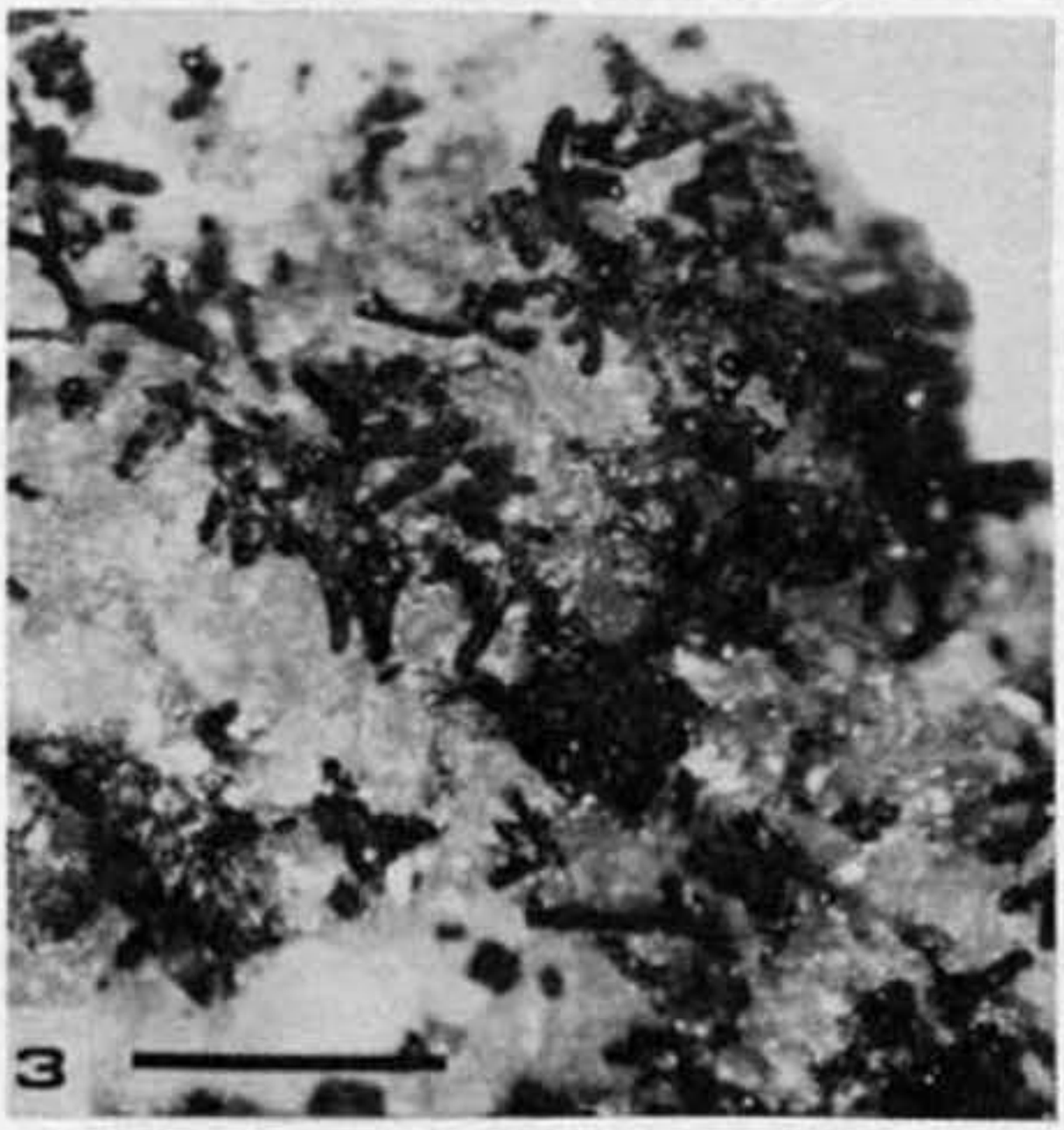
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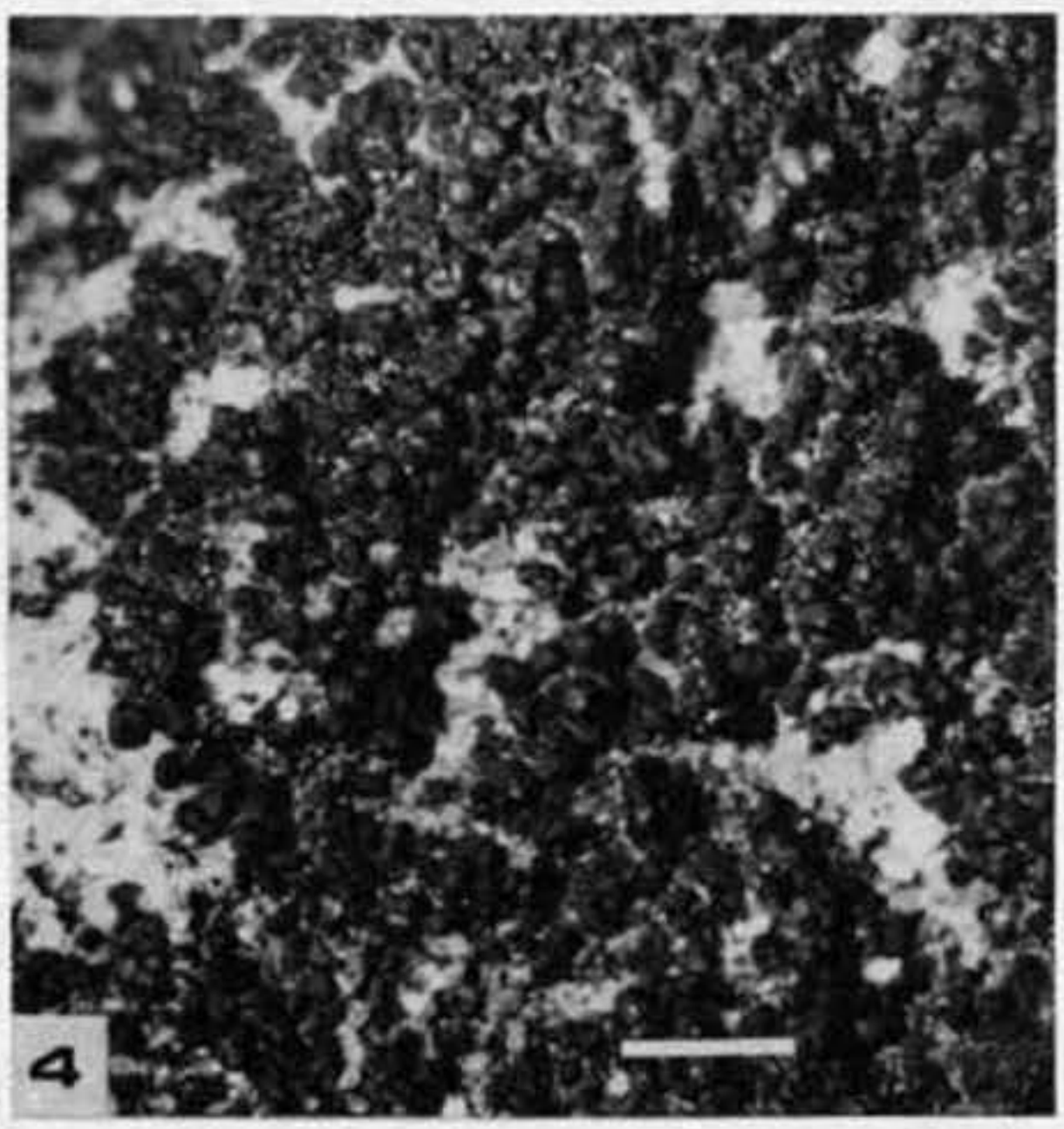
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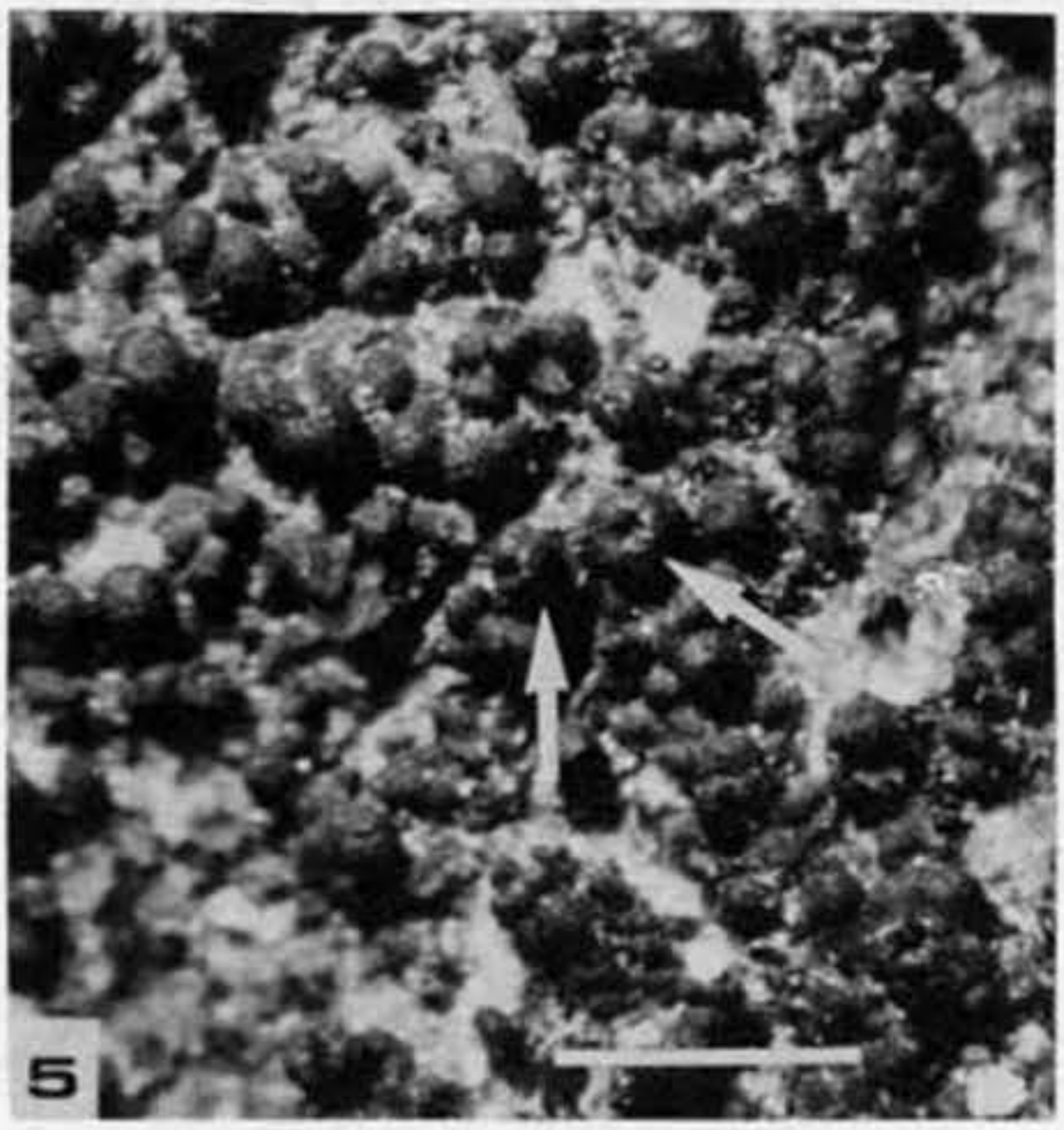
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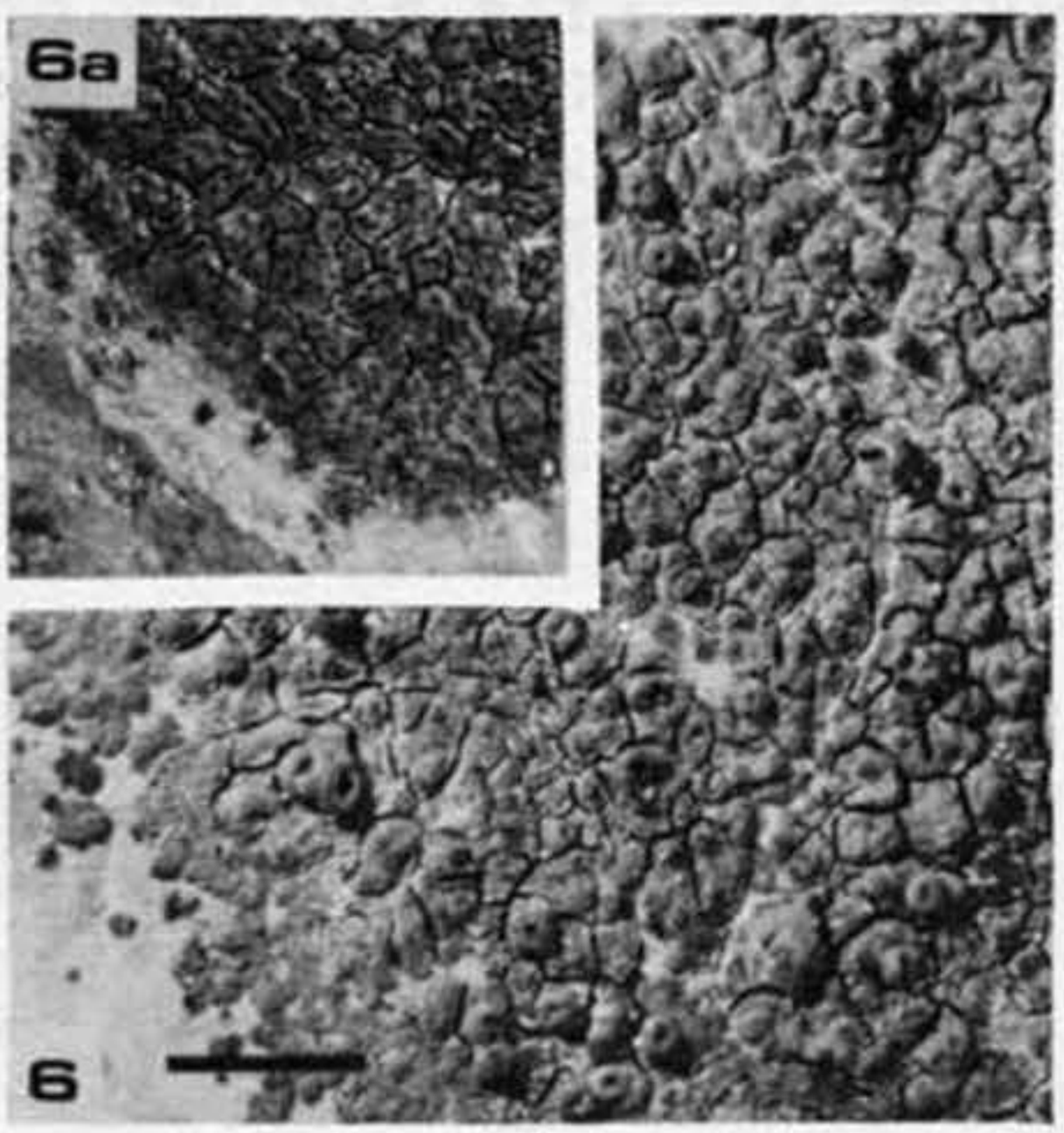
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METHODS. The internal morphology of the thallus and fruiting structures were studied by means of freezing microtome sections embedded in lactophenol cotton-blue (LPCB). For the determination of the iodine reaction, a solution of J-KJ was added to sections or squash preparations without pretreatment. The given measurements either refer to sections and squash preparations in LPCB, or to air dry material.

TAXONOMIC PART

1. A new non-marine species of *Lichina*

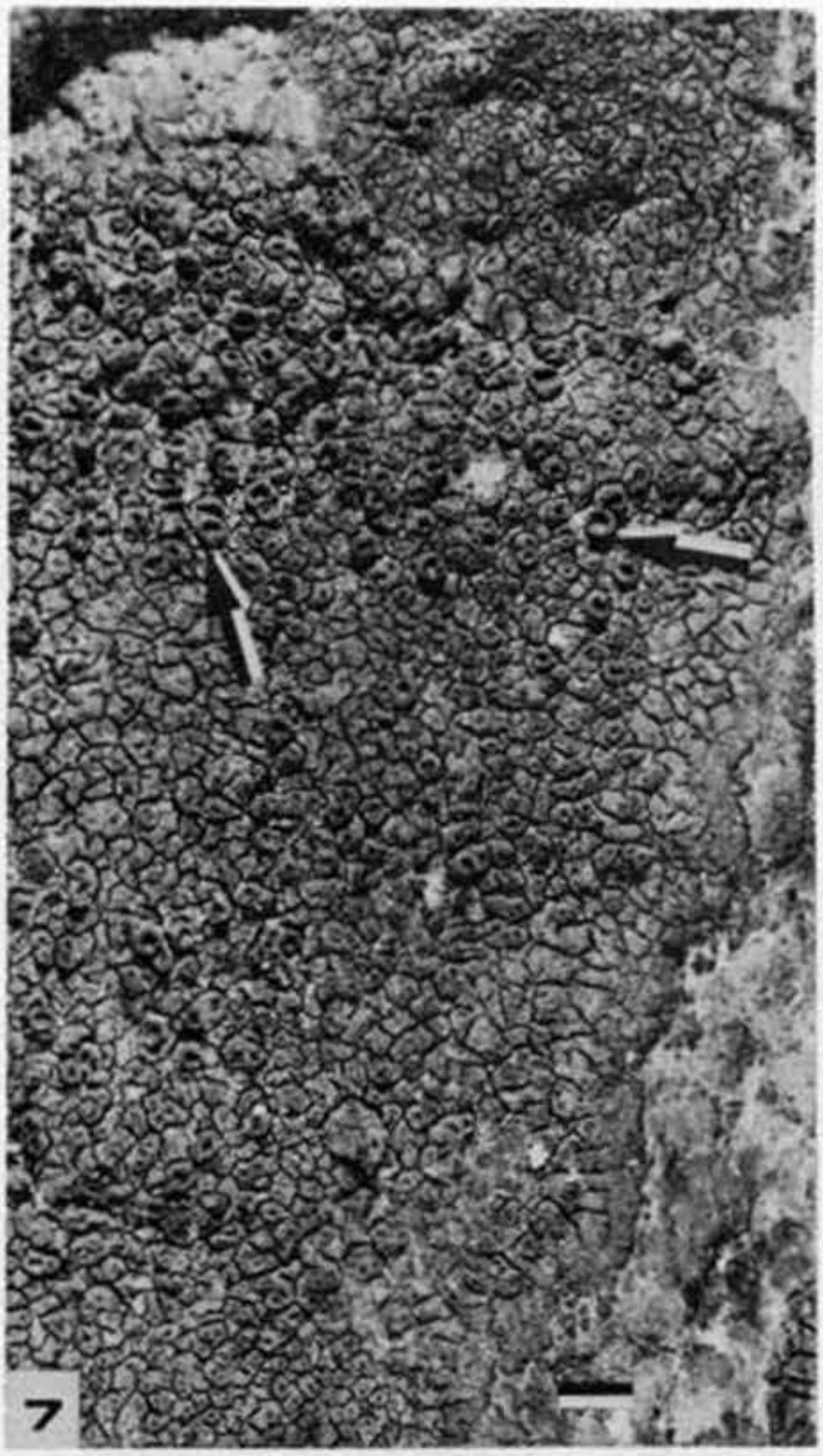
The new species *Lichina macrospora* represents an additional species of the non-marine members of the genus. It is very closely related to *L.willeyi* (Tuck.) Henssen and *L.tasmanica* Henssen. The three species might be included in the *Lichina willeyi*-group which is separated from the other non-marine species of the genus by the presence of terminal ascocarps, as well as the protrusion of algal filaments from the thalli under certain environmental conditions.

Lichina macrospora Henssen, Büdel et Wessels sp. nov.

Figs. 1-3, 16-22.

DIAGNOSIS. Thallus minutus, fruticulosus, nigricans, substrato affixus disco basali. Lobi erecti teretes, simplices vel sparsim ramosi, 0.6-1.6 mm longi et 0.05-0.15 mm lati. Hyphae velut scaturi-

Figs. 1-3. *Lichina macrospora* (parts of holotype). 1. Slender lobes, in part overgrowing a species of *Pterygiopsis*. 2. Slender, wettened lobes with intercalar or subterminal pycnoascocarps. 3. Development of vertical lobes from horizontal initial stages. Figs. 4-5. *Pterygiopsis convexa* (holotype). 4. Thalli composed of densely aggregated, in part effigurate lobes. 5. Lobes and apothecia (arrows) at a higher magnification. Fig. 6. *Pterygiopsis submersa* (holotype). 6. Zonated, young thallus. 6a. Juvenile thallus surrounded by a distinct prothallus. Scale = 1 mm.



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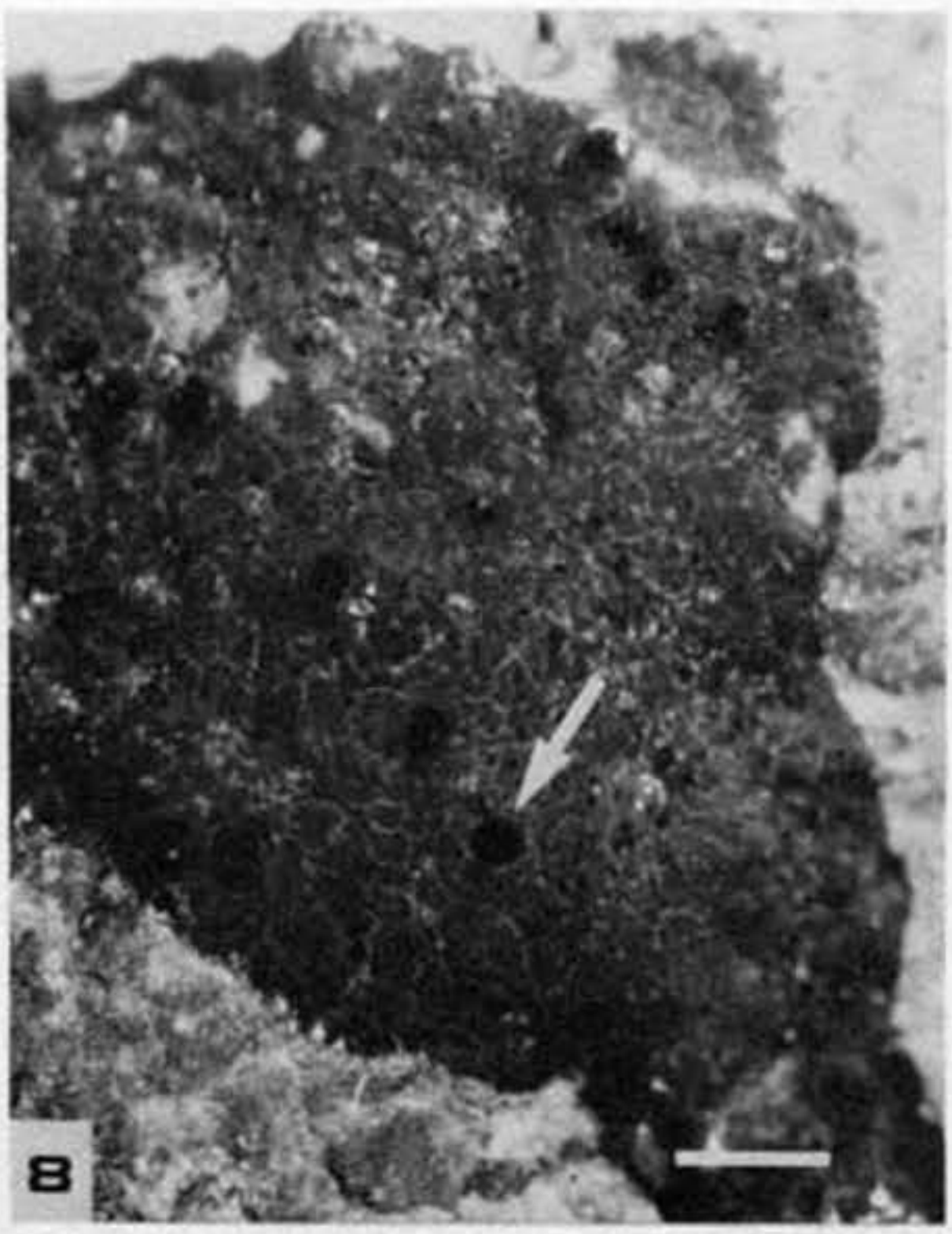

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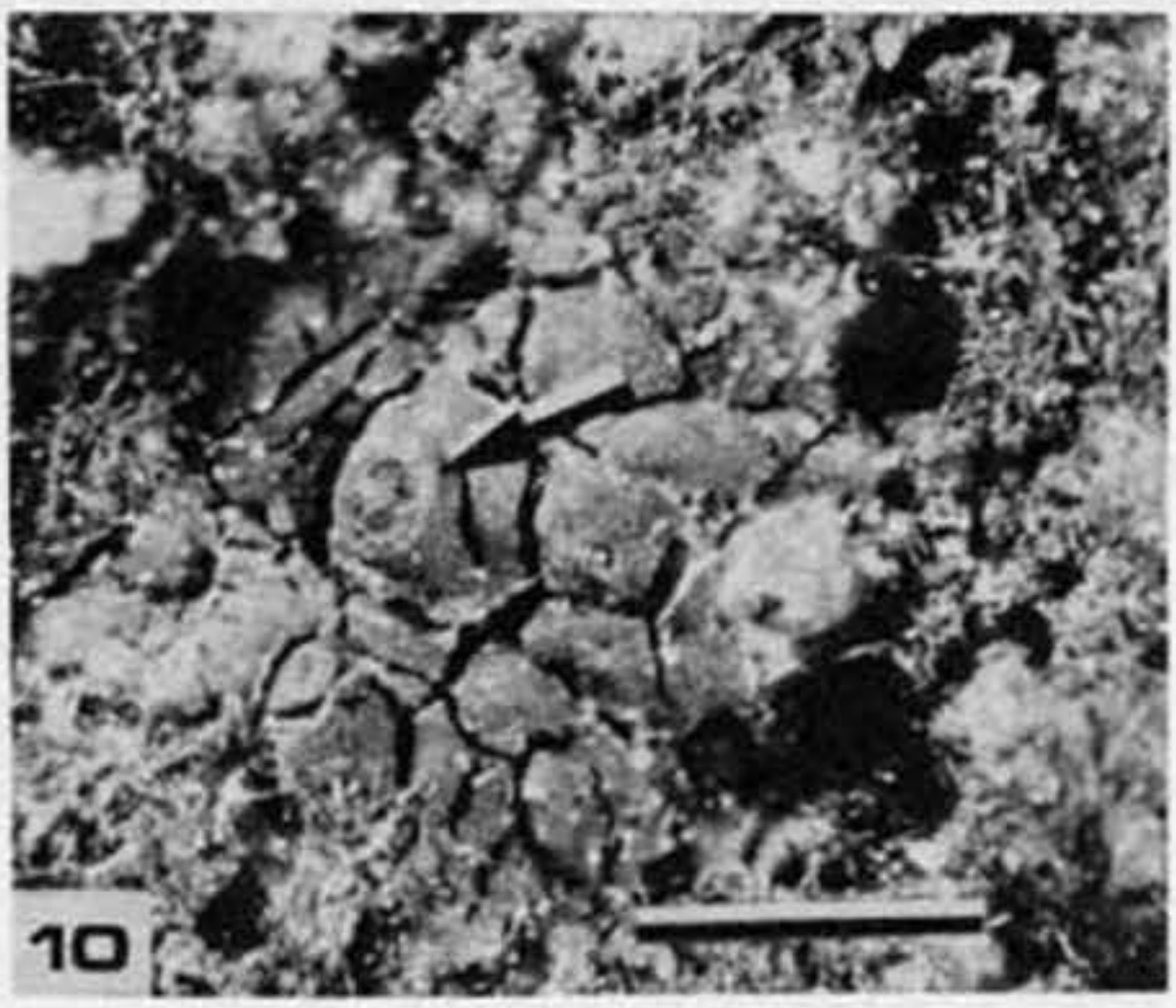

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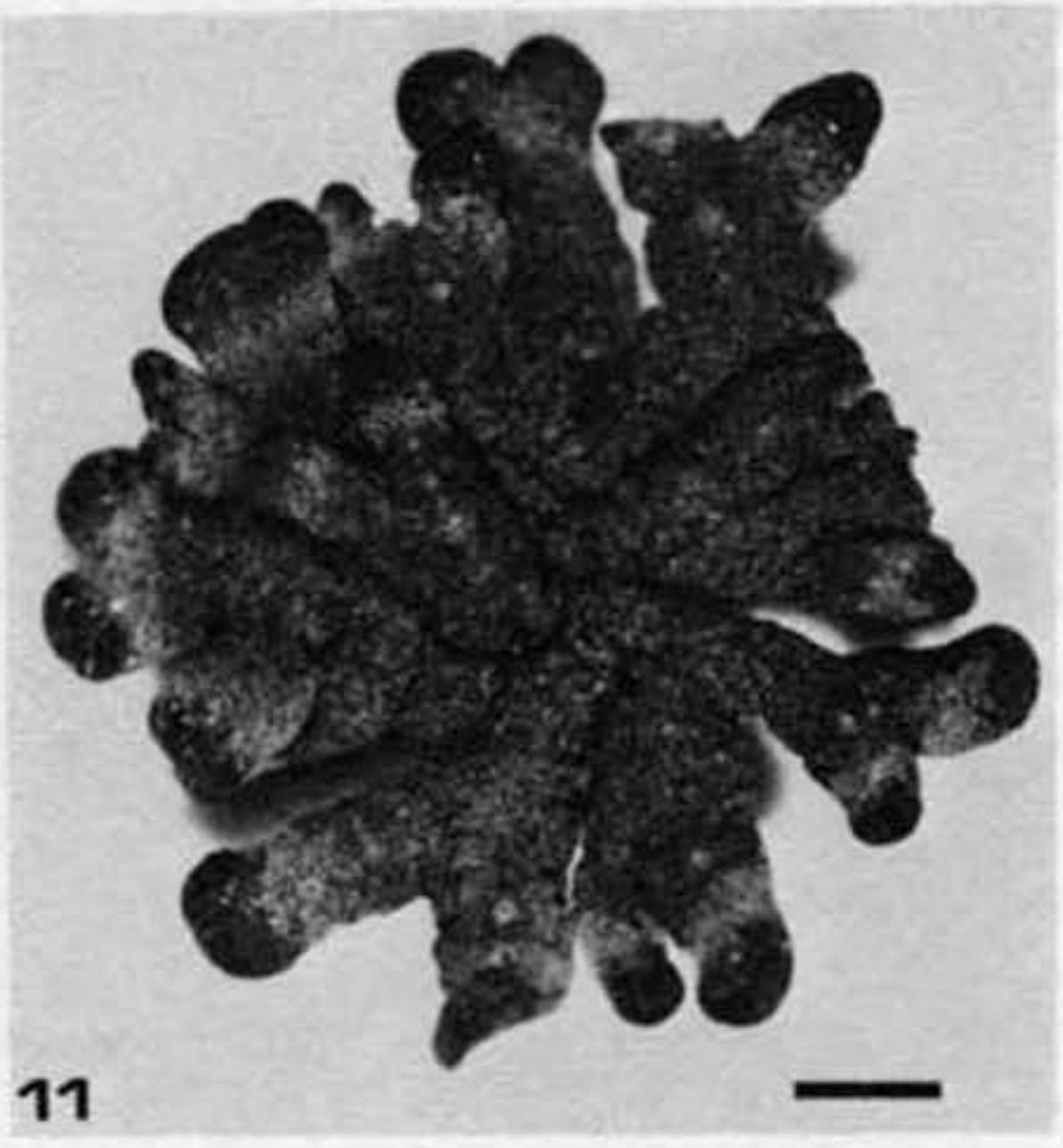

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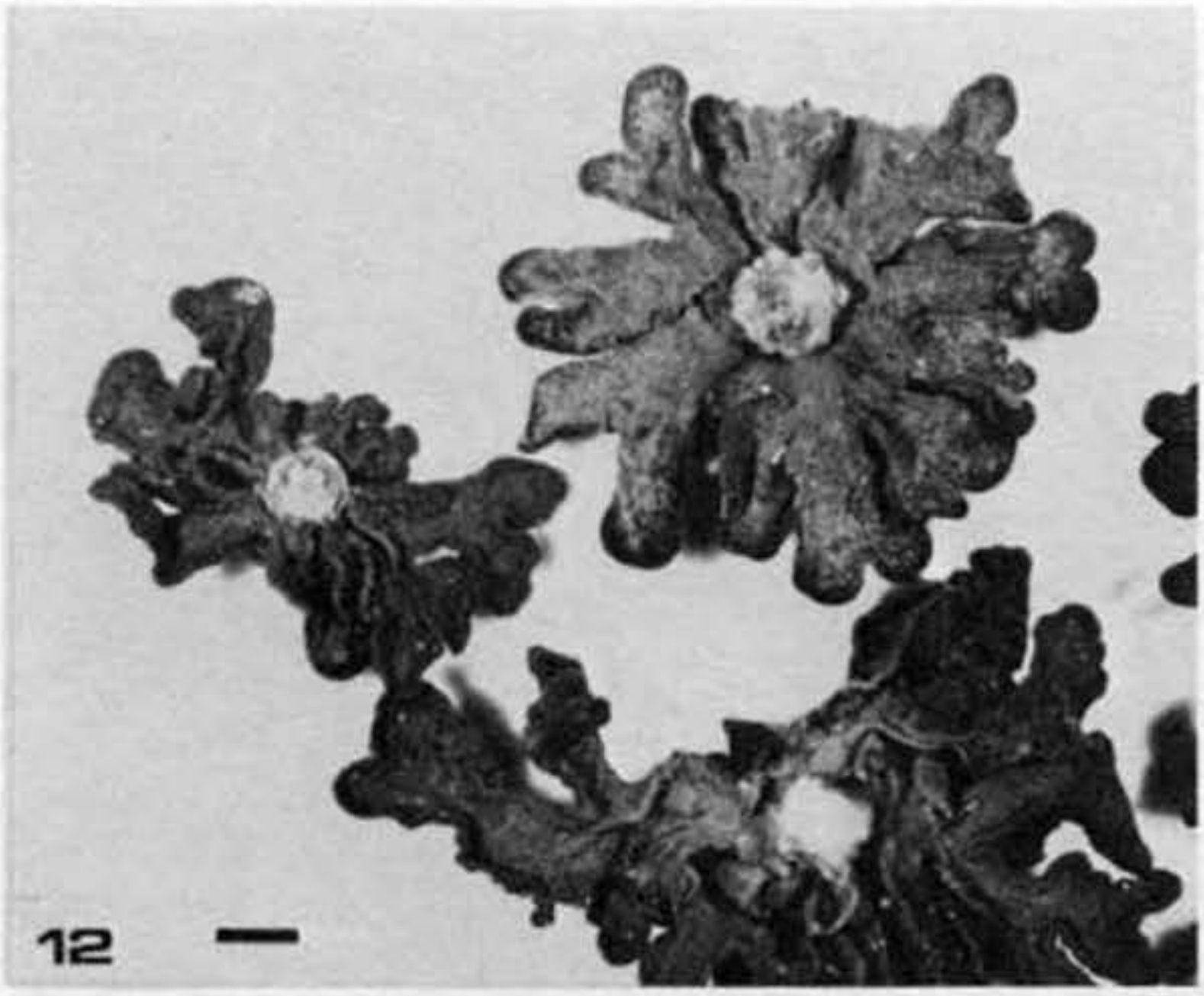
go, cellulae cylindraceae vel angulares, 6-7(-12) µm longae. Apothecia typo pycno-ascocarpo, terminalia, usque 0.3 mm lata; Hymenium amyloideum, (150-)190-265 µm altum, superne fuscum; paraphyses c. 1 µm crassae, deinde apicem versus moniliformes et 4 µm latae. Asci cylindracei (vel obclavati), (60-)105-140 x (9-)12-14(-21) µm, octospori. Sporae eseptatae, incolores, ellipsoideae vel plus minusve angulatae (in asco), 14-18 x 8-12 µm. Conidia bacilliformia, 3.5-4.5 x 1-1.5 µm. Alga ad familiam Rivulariacearum pertinens.

Holotype: Republic of South Africa, Eastern Transvaal, Graskop 2430DD, Panorama Falls, Lookout Point, on sandstone plates along the edges of rivulets and streams, c. 1400 m, 1982, Henssen & Wessels 28405a (MB); (isotype: PRE); additional collection from the same site Henssen no. 28392b.

Thallus minute, blackish, composed of scattered or aggregated decumbent or erect, terete lobes. Lobes simple or sparsely branched, 0.6-1.6 mm long and 0.05-0.15 mm wide. Thallus in sections 100-220 µm thick. Hyphae in the characteristic fountain-like arrangement, the lateral parts gradually arcuate to the thallus edge. Hyphal cells mostly angular and 6-7 x 3-5 µm, infrequently cylindrical and up to 12 µm long, cells inconspicuously elongated in the central part of the lobes. Phycobiont probably a species of Dichothrix. Filaments confined to the outer parts of the thallus, the tapering tips protruding or not; if protruding then surrounded by a gelatinous sheath c. 7 µm thick; filaments 95-130 µm long, 6-7 µm broad at the base, tapering to 1.5-2 µm at the tip, basal heterocyst 6-7 x 6-7 µm.

Fig. 7. Pterygiopsis submersa (holotype). Part of thallus with large apothecia, majority without hymenium. Figs. 8-10. Pterygiopsis melanophthalma (8-9, holotype; 10, Henssen 28392a). 8. Black apothecial discs within moist thallus. 9. Dry thallus, apothecium indicated by an arrow. 10. Small thallus bearing large protruding apothecium (arrow). Fig. 11. Thyrea rotundata (holotype). Thallus, upper surface view. Scale = 1 mm.



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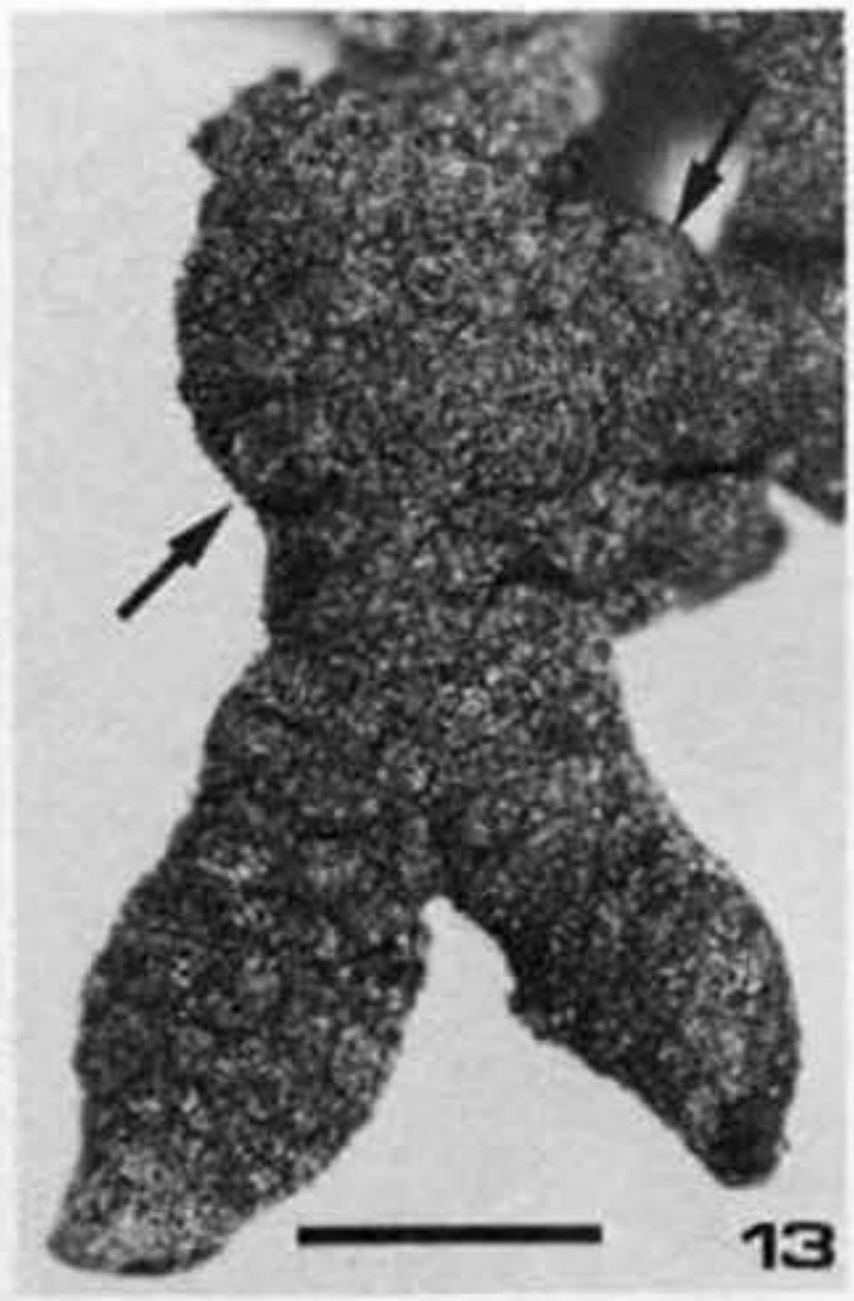

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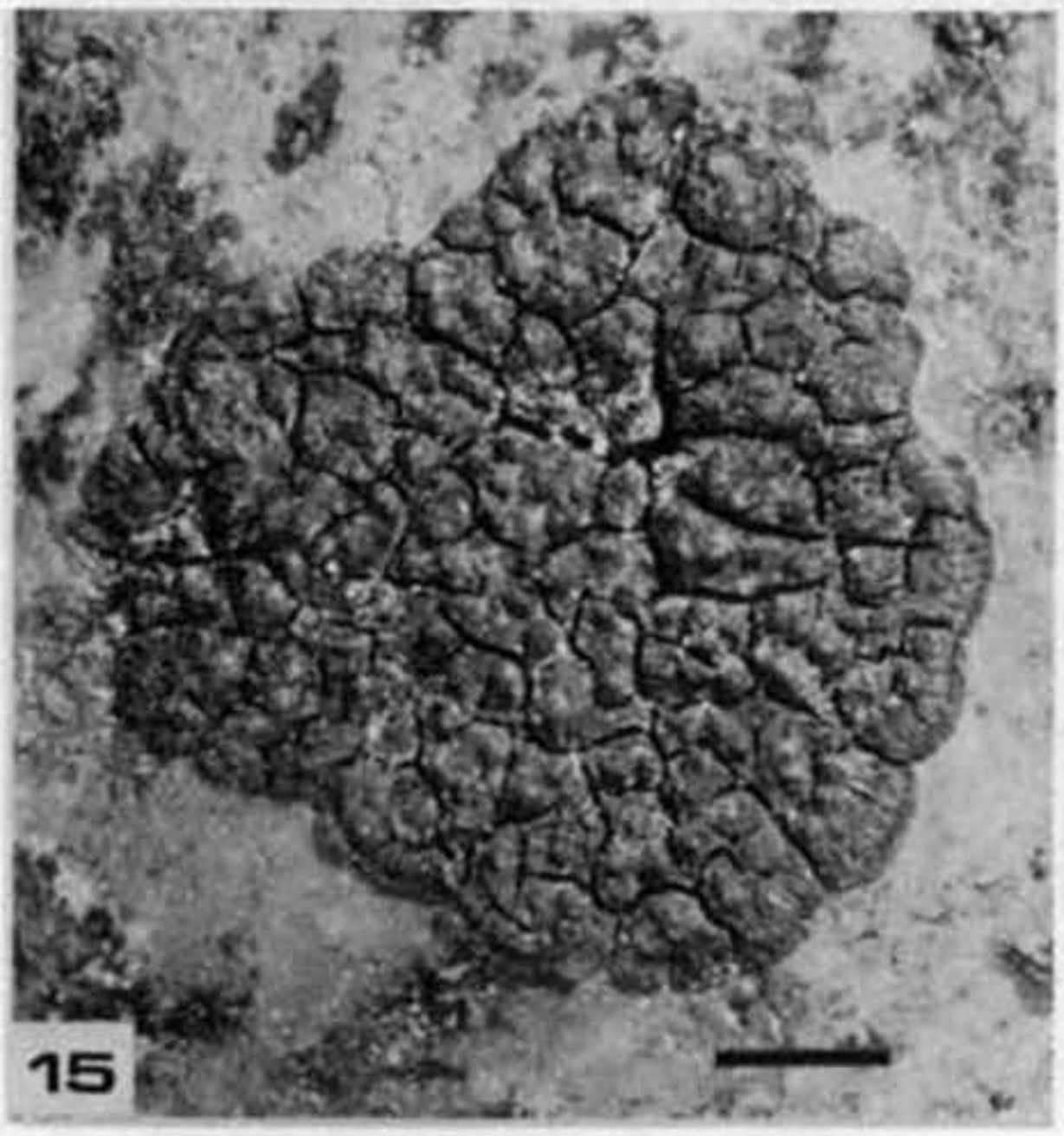

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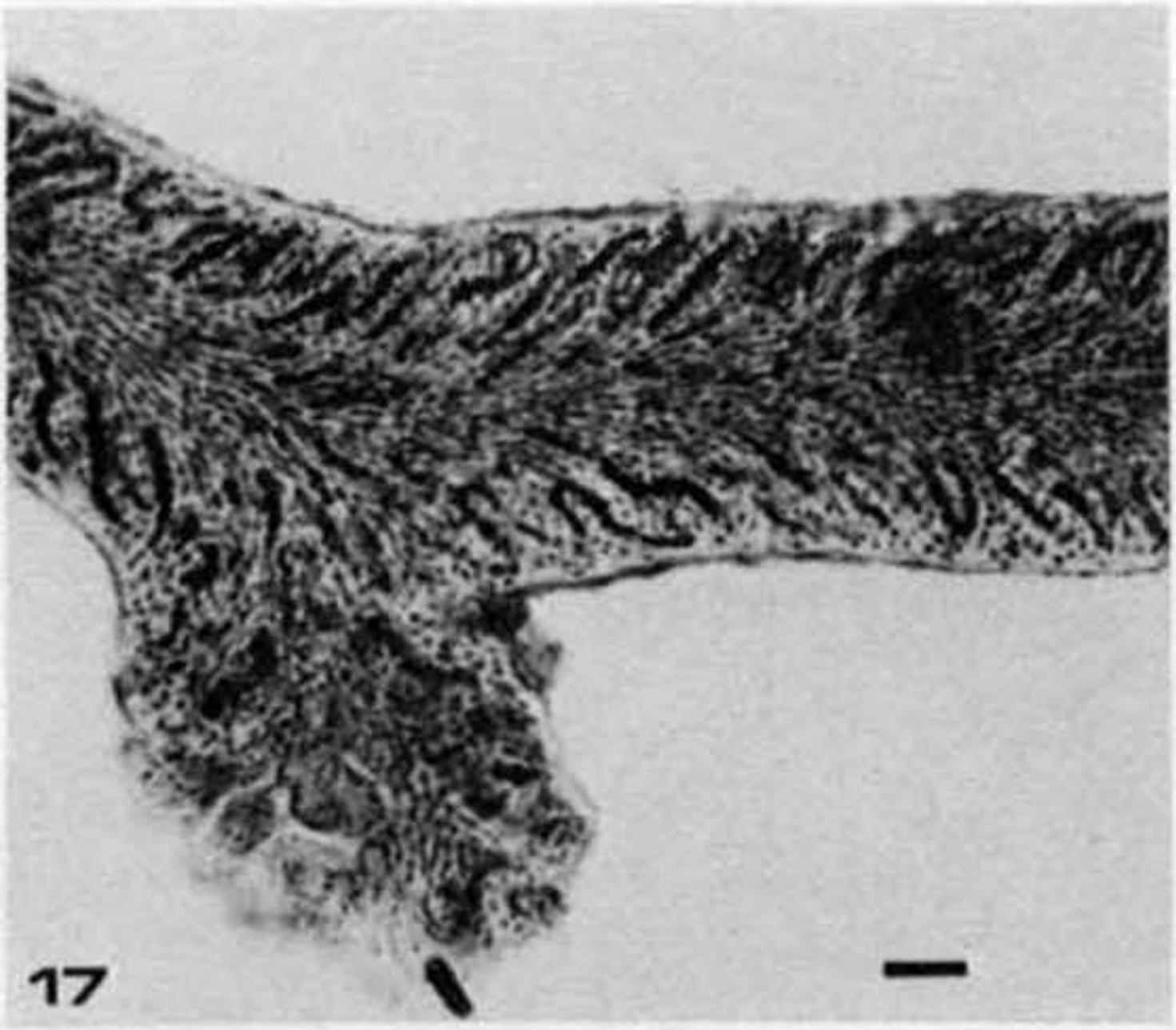
Apothecia pycnoascocarps, with a thalline margine, terminal or superimposed, up to 0.3 mm broad, disc punctiform and brownish. Primary paraphyses (= elongated conidiophores) gelatinizing, secondary paraphyses sparsely branched and anastomosing, the tips enlarged to 4 µm and moniliform. Hymenium (150-)190-265 µm high, subhymenium 120-150 µm, staining intensely in LPCB, hymenium gelatine staining blue in iodine. Excipulum (the former pycnidial envelope) restricted to the marginal part, 15-30 µm broad, composed of loosely interwoven hyphae, thalline margin 50-60 µm broad. Asci cylindrical with spores uniseriate 105-140 x (9-)12-14 µm, or obclavat with spores partly biseriate 60 x 21 µm; ascus wall evanescent. Conidia rod-shaped, 3.5 x 1-1.5 µm.

Ecology and distribution. Lichina macrospora was found on the banks of a rivulet, in the proximity of where it flows down the edge of the escarpment from the socalled Panorama falls. The lichen was growing on hard sandstone plates of the western facing (gentle) slope which is dissected by slow running seepage streams with a permanent water supply. Only during prolonged drought do the seepage streams dry out. The area has a predominantly summer rainfall with an average of more than 1700 mm yr^{-1} (Middleton et al. 1981). Fog and dew frequently occurs during the year. Lichina macrospora is only known from the type locality.

Figs. 12-13. Thyrea rotundata (holotype). 12. thalli seen from below with distinct umbilicus and furrowed lobes. 13. Upper surface view of lobe tip, apothecia indicated by arrows. Figs. 14-15. Porocyphus effiguratus (Büdel 14036c). 14. Part of large thallus with effigurate margin, apothecia indicated by arrows. 15. Young, compact thallus. Fig. 16. Lichina macrospora (holotype). Thallus overgrowing a species of Pterygiopsis, lobes stout with terminal or superimposed pycnoascocarpia (arrows). Scale = 1 mm.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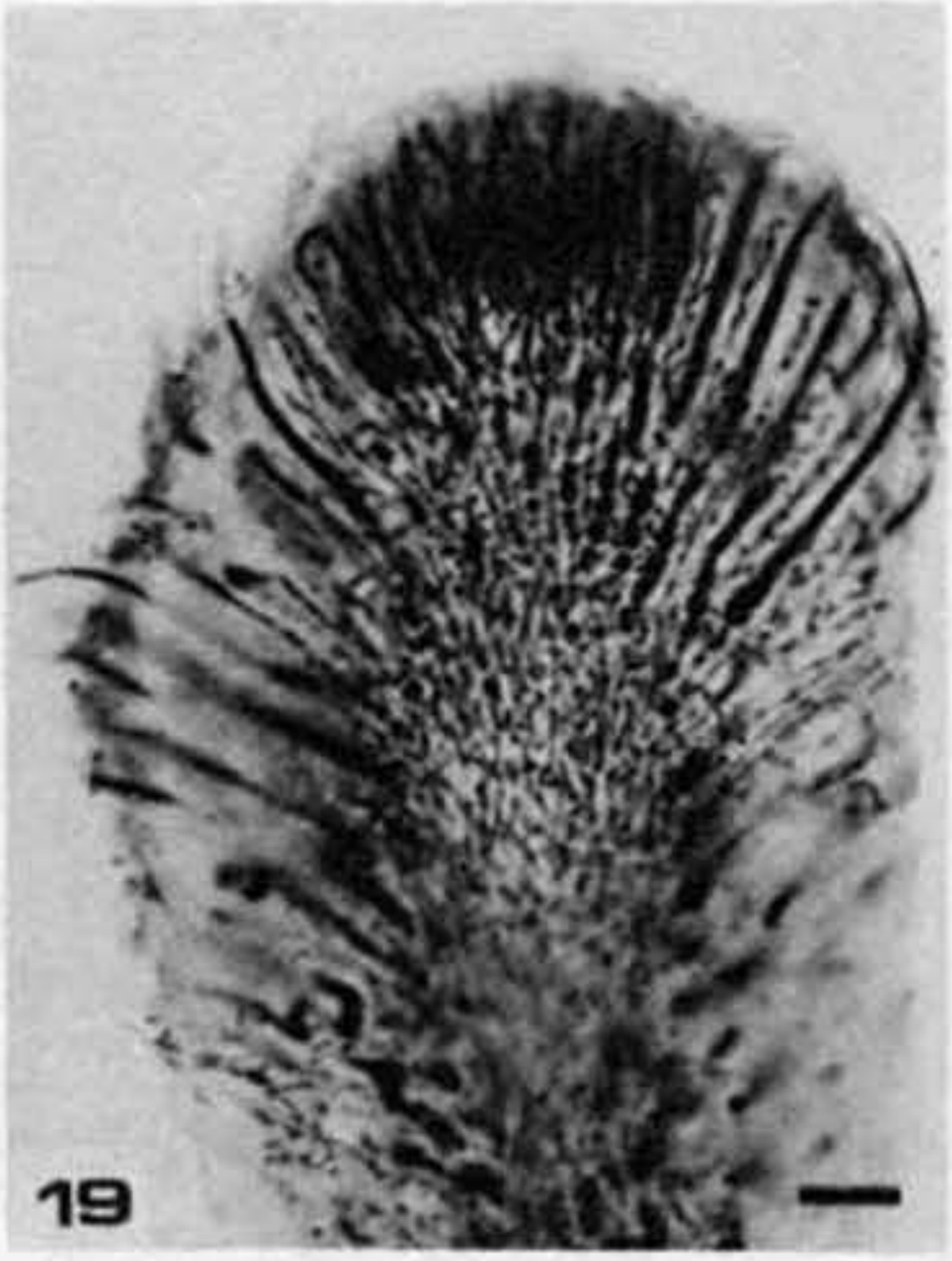
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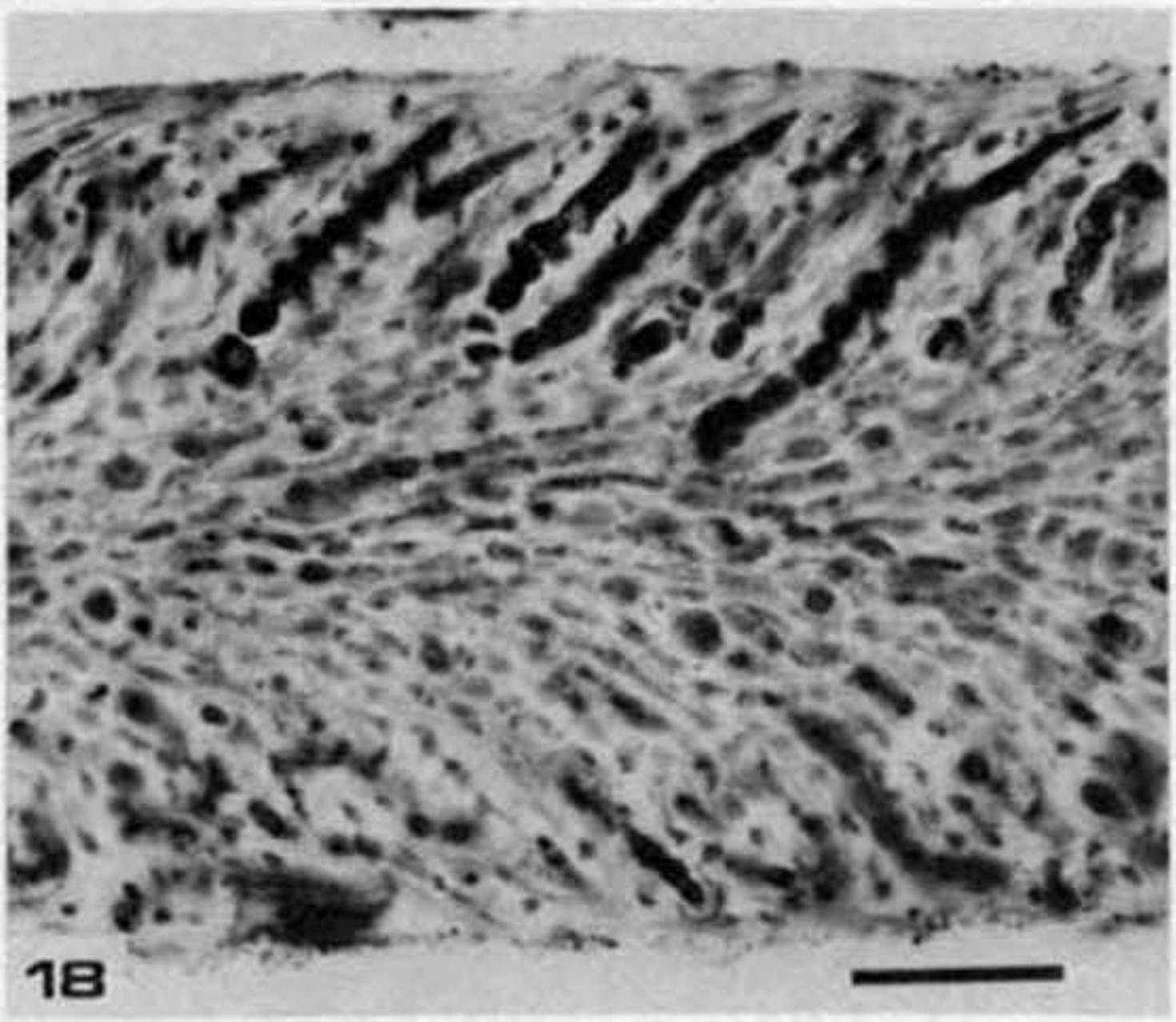
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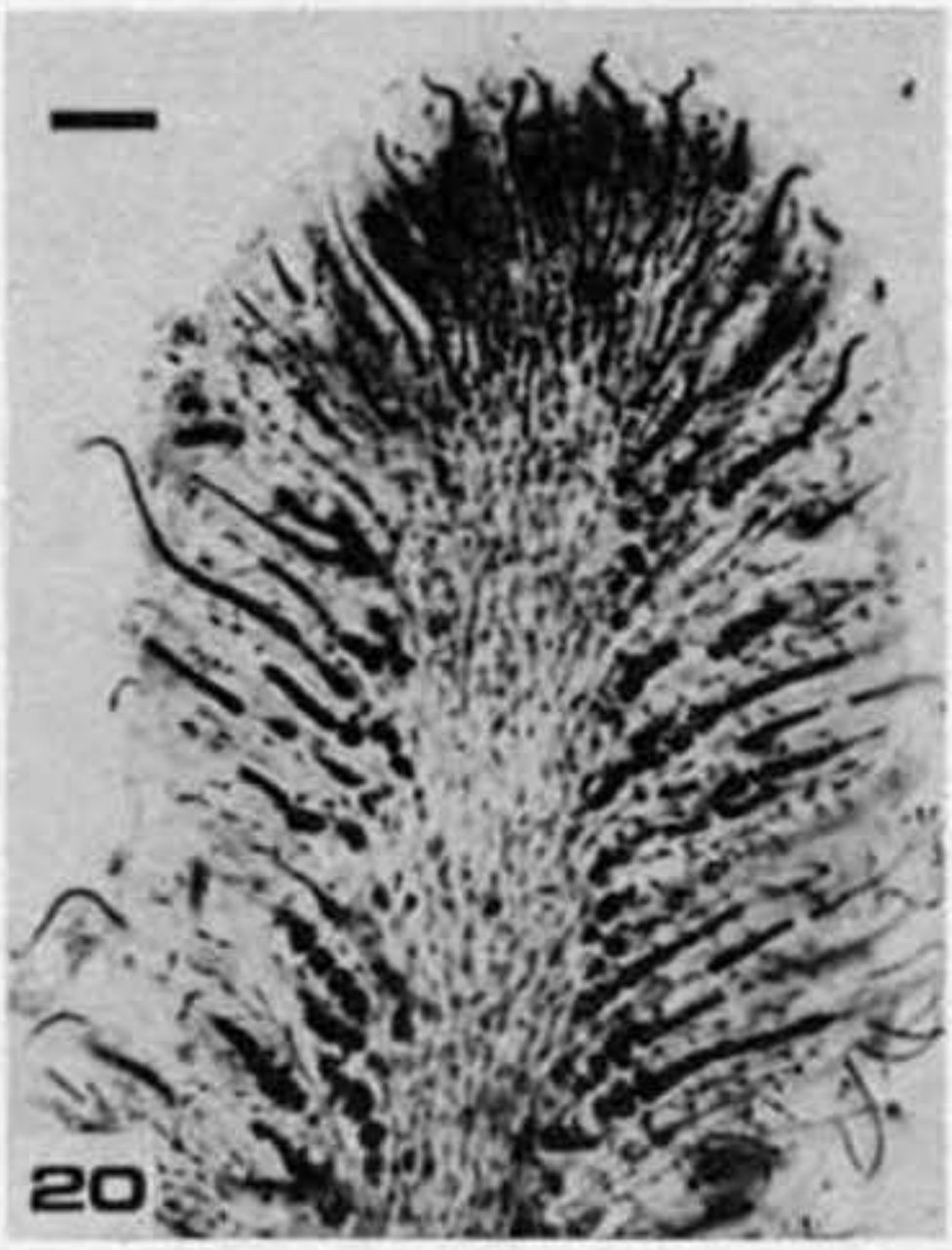
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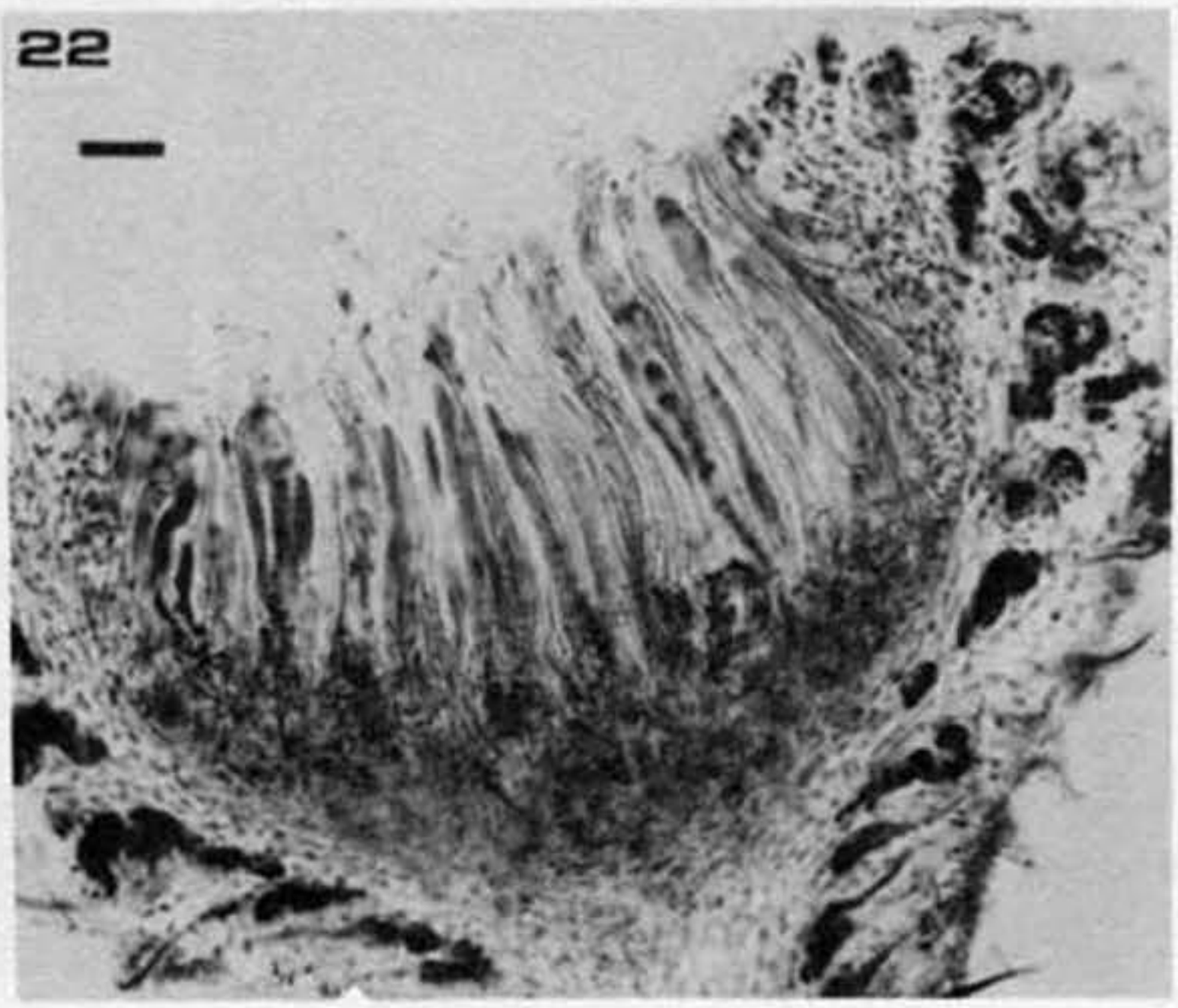
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Remarks. The thalli were either growing on stone at the water level of seepage streams with only their basal parts frequently inundated, or they were overgrowing the new species Pterygiopsis melanophthalma and other crustose lichens. The latter sites were sometimes temporarily flooded by the seepage streams. The lobes of thalli from the former sites were relatively long and slender (Figs. 1, 2), and the algal filaments did not protrude (Figs. 17, 18). Thalli collected from the temporarily flooded sites had stout lobes with protruding algal filaments and were covered by a thick layer consisting of a variety of blue-green algal species (Figs. 16,19-22). A discusion of the lichen association found on these rocks is given under Pterygiopsis melanophthalma.

The vertical part of a mature thallus develops from a horizontal initial stage (Fig. 3). Fully developed thalli are composed of either scattered or densely aggregated lobes which can be erect or decumbent.

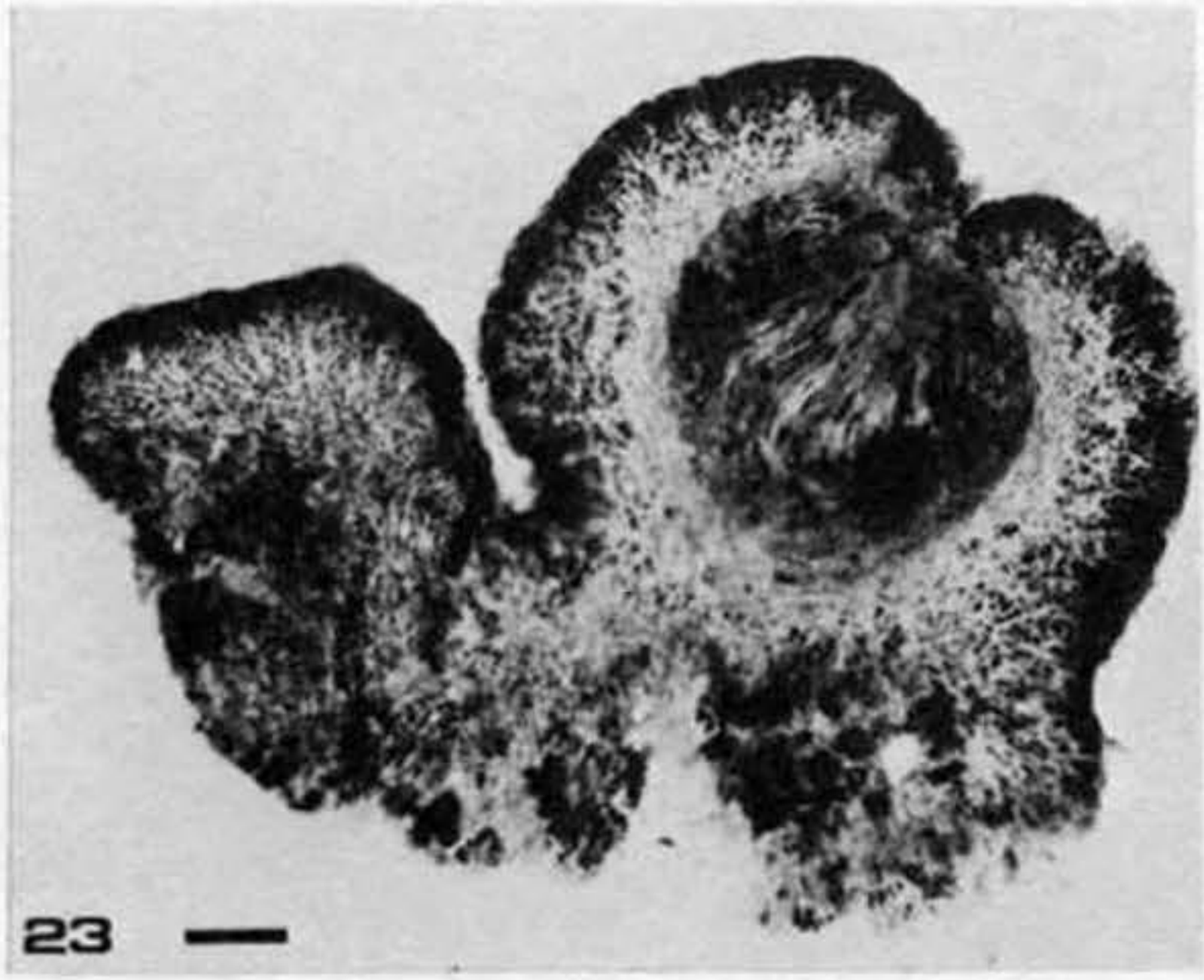
Tab. 1

Differentiating characteristics of the Lichina willeyi-group

	L.macrospora	L.tasmanica	L.willeyi
size of ascocarps	0.3 mm	0.6 mm	0.4 mm
size of spores (µm)	14-18 x 8-12	13-16 x 7-12	11-14 x 8-12
length of lobes	0.6 - 1.6 mm	7 - 10 mm	1 - 3 mm
width of lobes	0.05 - 0.15 mm	0.2 - 0.5 mm	0.1 0.15 mm

Lichina macrospora is characterized by the presence of relatively small lobes in combination with large spores. Tabel 1 summarizes the characteristics differentiating the three species be-

Figs. 17-21. Anatomy of Lichina macrospora (holotype). 17-18. L.s. of slender lobes, the algal filaments not protruding. 19-20. Lobe tips with protruding algal filaments. 21-22. Different parts of apothecia. Scale = 20 µm.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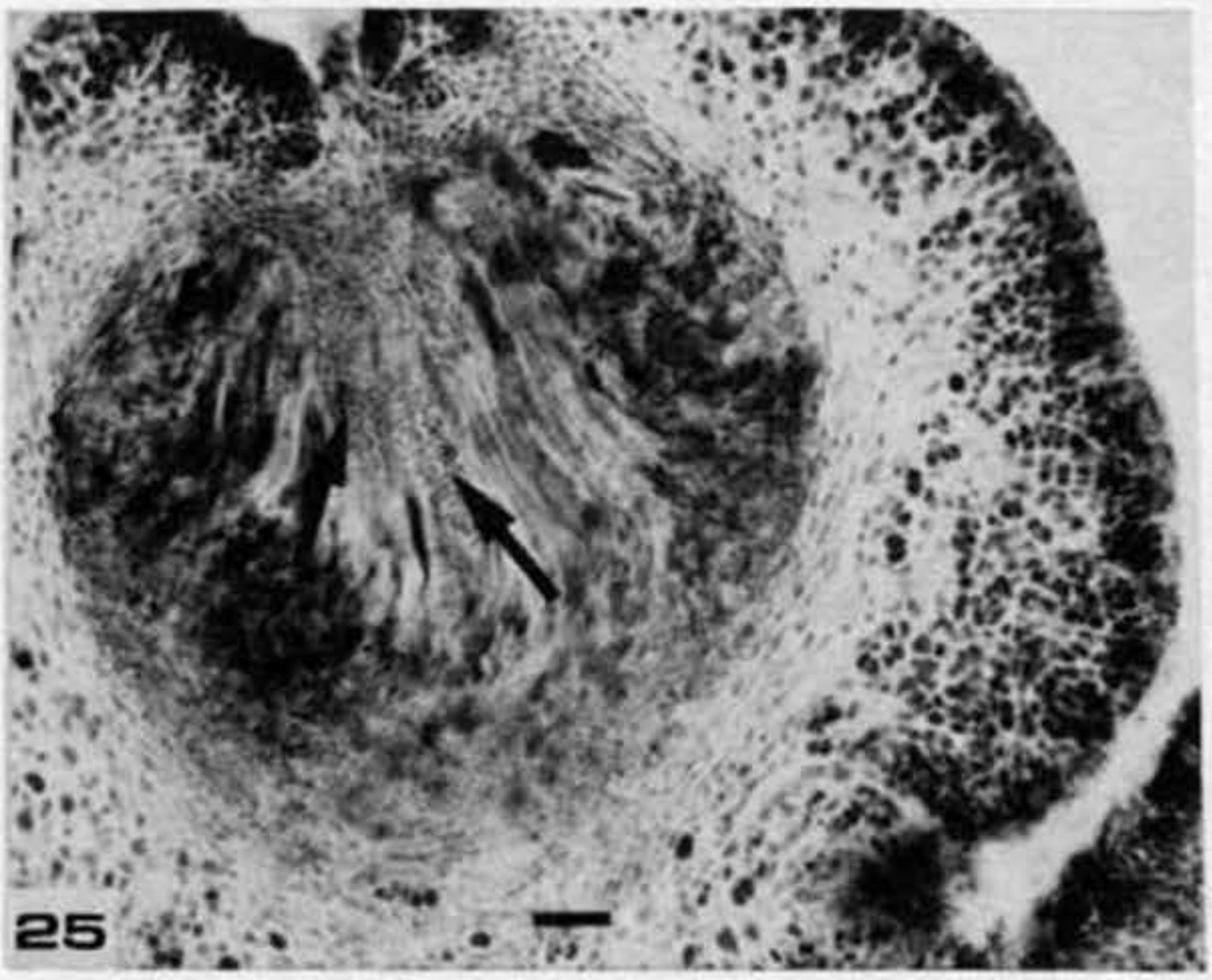
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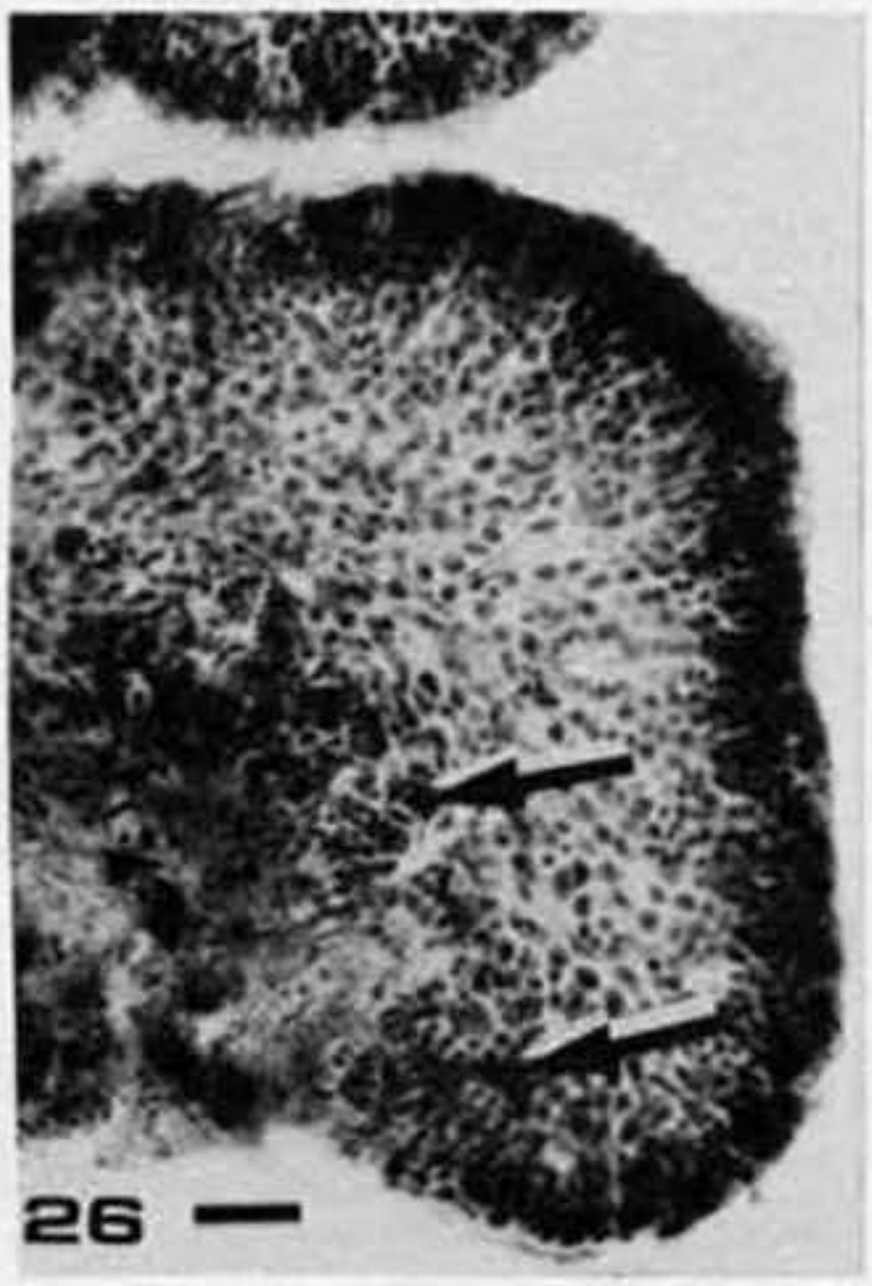
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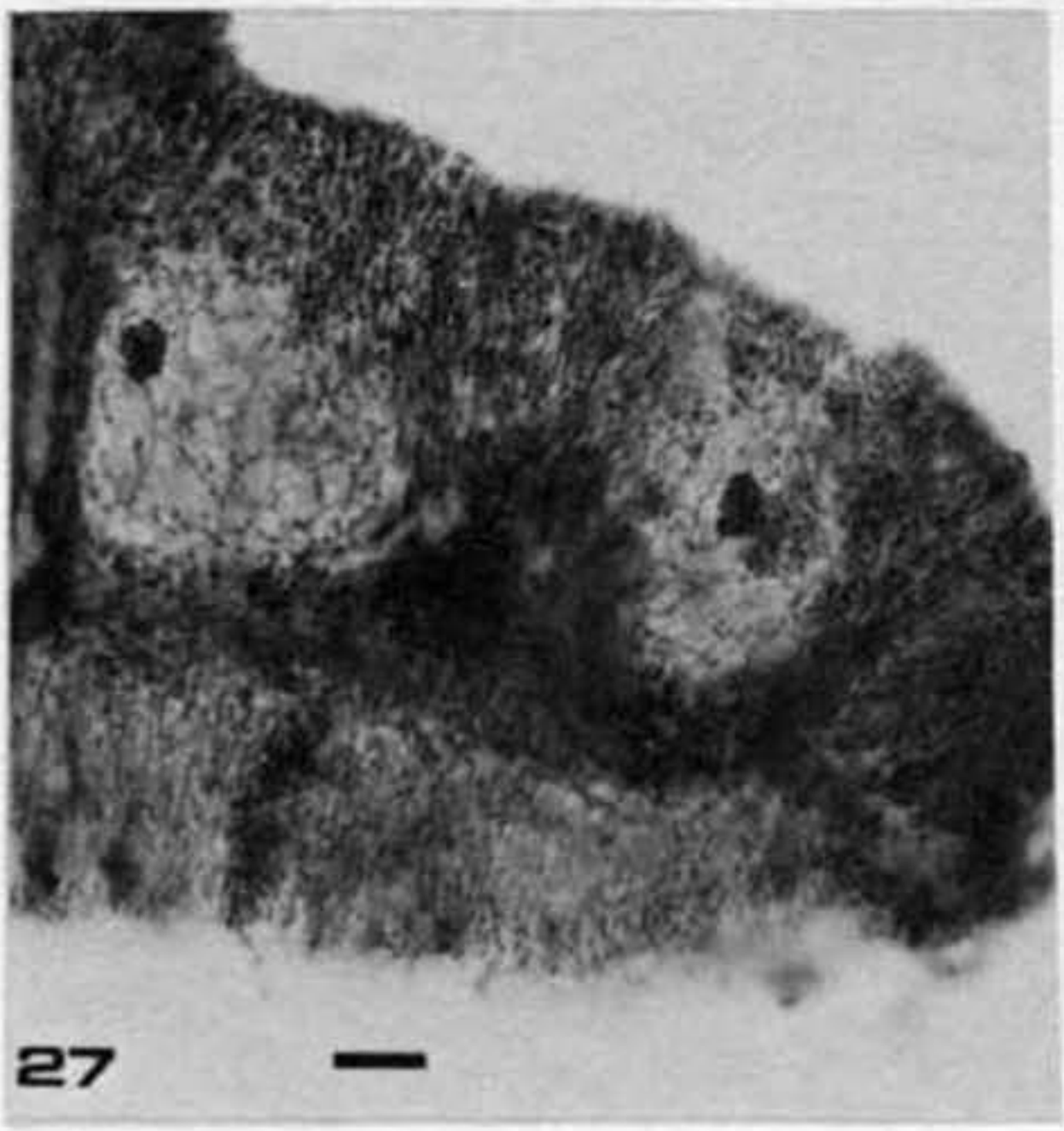
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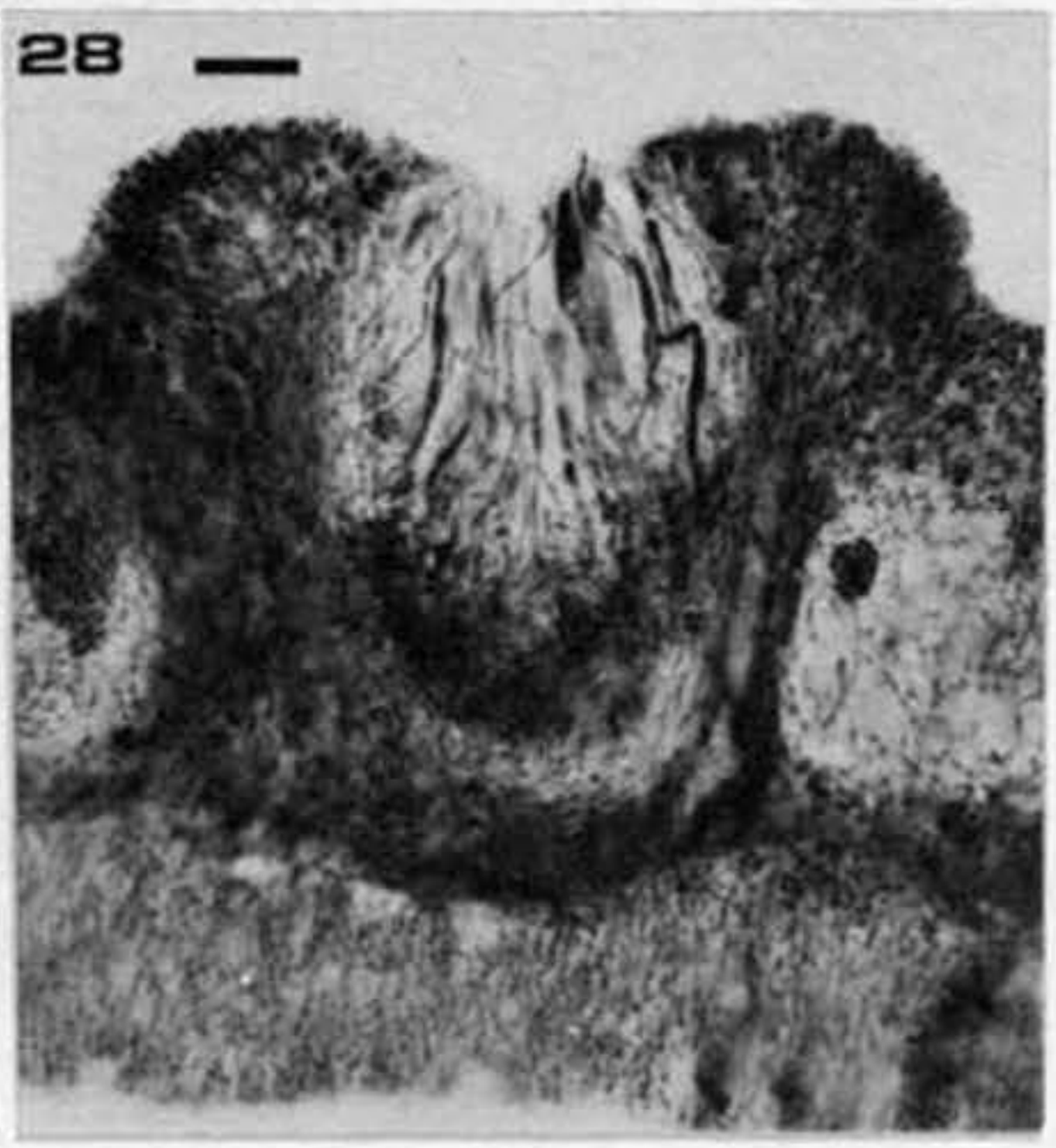
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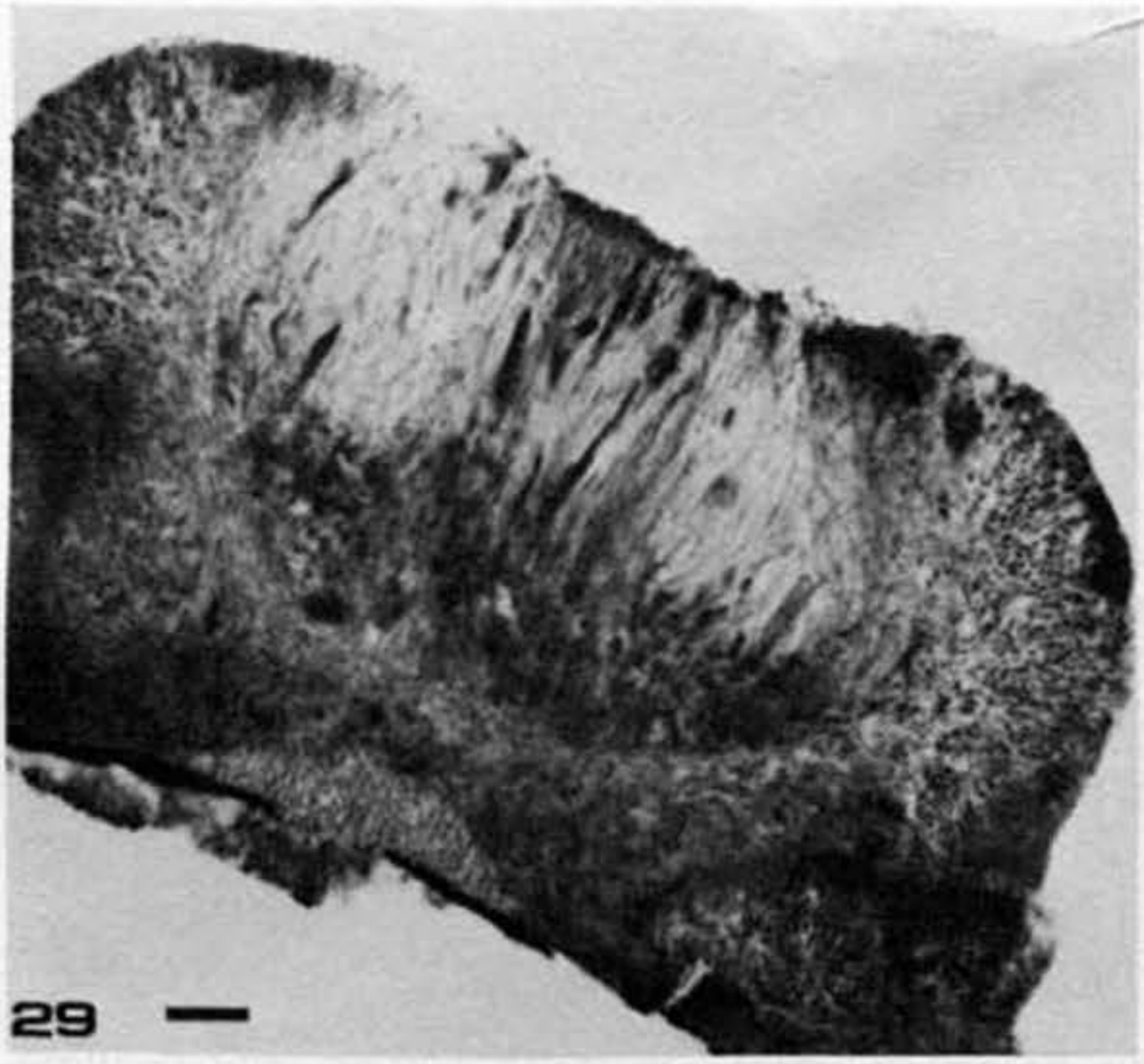
longing to the Lichina willeyi-group. In habit L. macrospora closely resembles L.willeyi. In contrast to the other two species, the hyphal cells of the central strand of L.macrospora are inconspicuously elongated (Fig. 18). The apothecia of L.macrospora are pycnoascocarps, as found in all other non-marine species of Lichina (Henssen, 1969; 1973). True (secondarily formed) paraphyses with moniliform tips are distinctly visible in old apothecia (Fig. 21).

2. Three new species of Pterygiopsis

Three species of our lichen collections made in the north-eastern Transvaal turned out to belong to Pterygiopsis, a genus which has not been previously recorded from Africa. Pterygiopsis is characterized by thick-walled asci and a fan-shaped arrangement of hyphae in a placoid thallus (Henssen, 1963). Similar to the type species, P. atra Vain. (Henssen, 1979), the new species have octosporous asci. An initial stage of ascocarp development was observed in Pterygiopsis convexa and P.submersa. In P.submersa the primordium consisted of spirally coiled ascogonia and relatively few hyphae of generative tissue embedded in a gelatinous matrix (Fig. 30). A later stage was observed in P.convexa (Fig. 43). Well developed apothecia were found only in P.melanophthalma. The hymenium in P.melanophthalma and P.submersa is secondarily divided by hyphal strands forming columns which are wider at the top, an excipulum is restricted to the upper margin (Figs. 27, 29,

Figs. 23-28. Anatomy of Pterygiopsis species. Figs. 23-26. P.convexa (holotype). 23. L.s. of lobe and apothecium. 24. Ascus and paraphyses. 25. L.s. of apothecium, hymenium containing intruding filaments of associated blue-green alga. 26. L.s. of lobe, cells of phycobiont aggregated at the lower surface (arrow). Figs. 27-28. P.submersa (holotype). 27. L.s. of lobe with attachment base and two apothecial primordia. 28. L.s. of apothecium. Scale in 23 = 50 µm, in 24-28 = 20 µm.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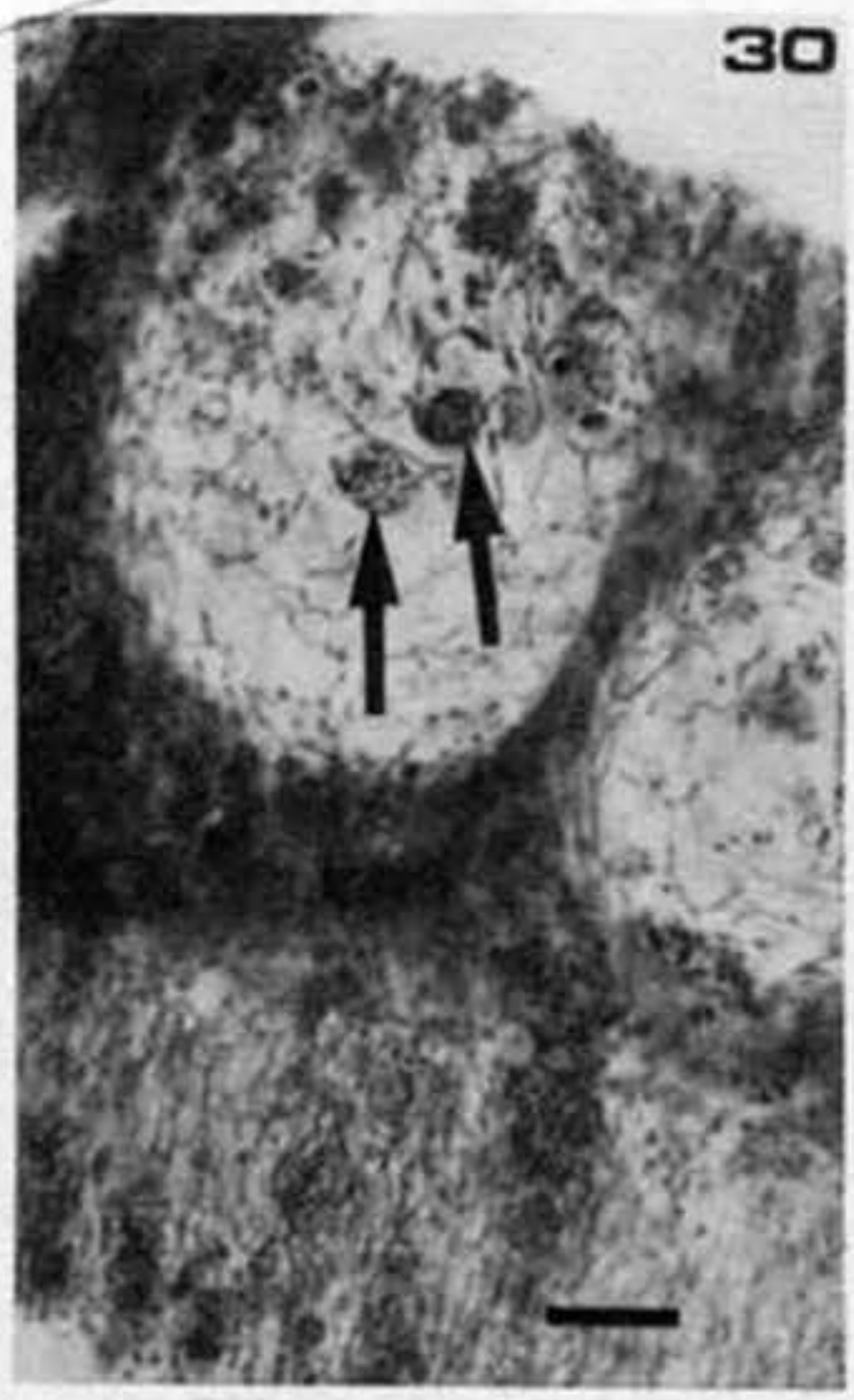
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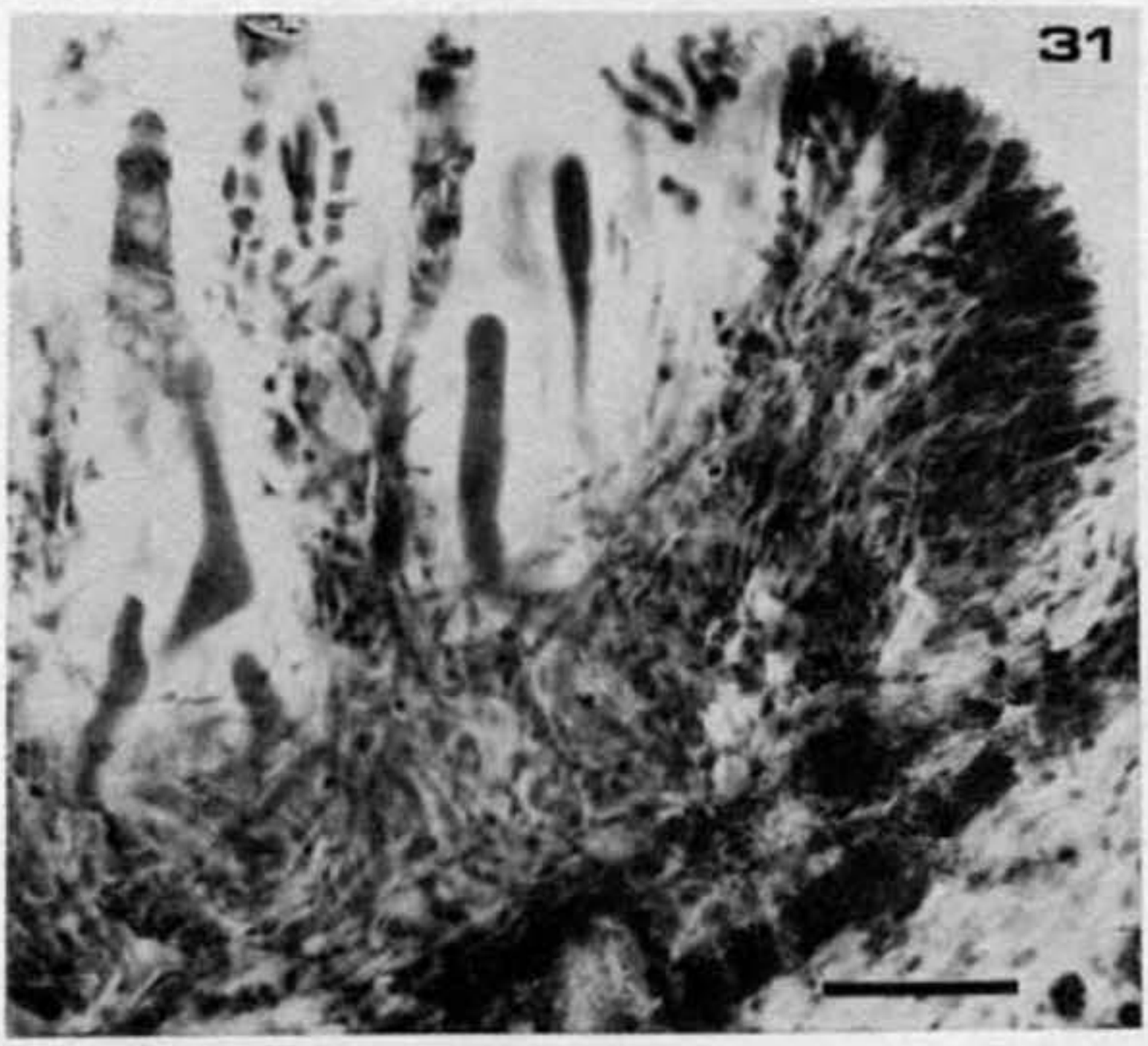
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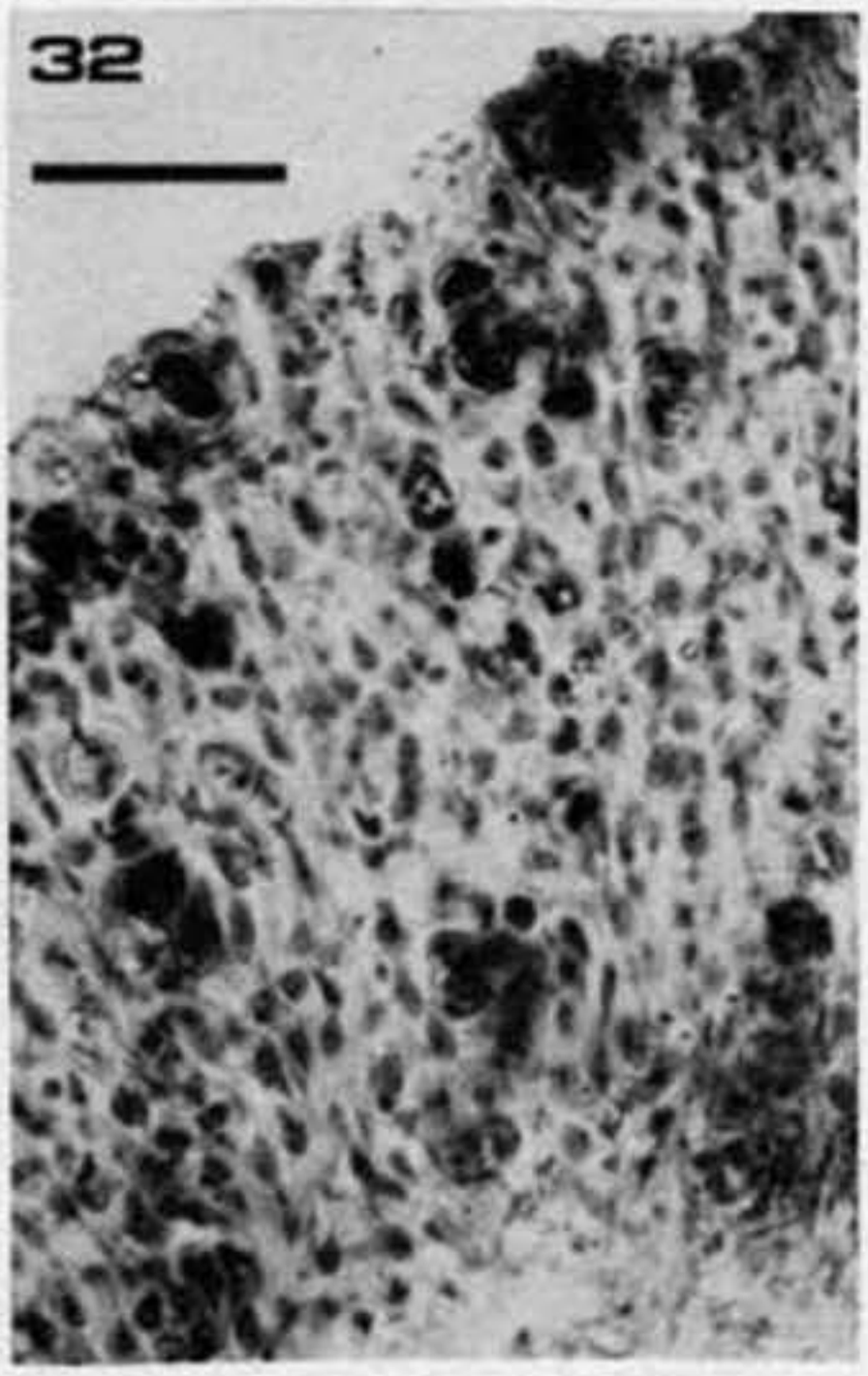
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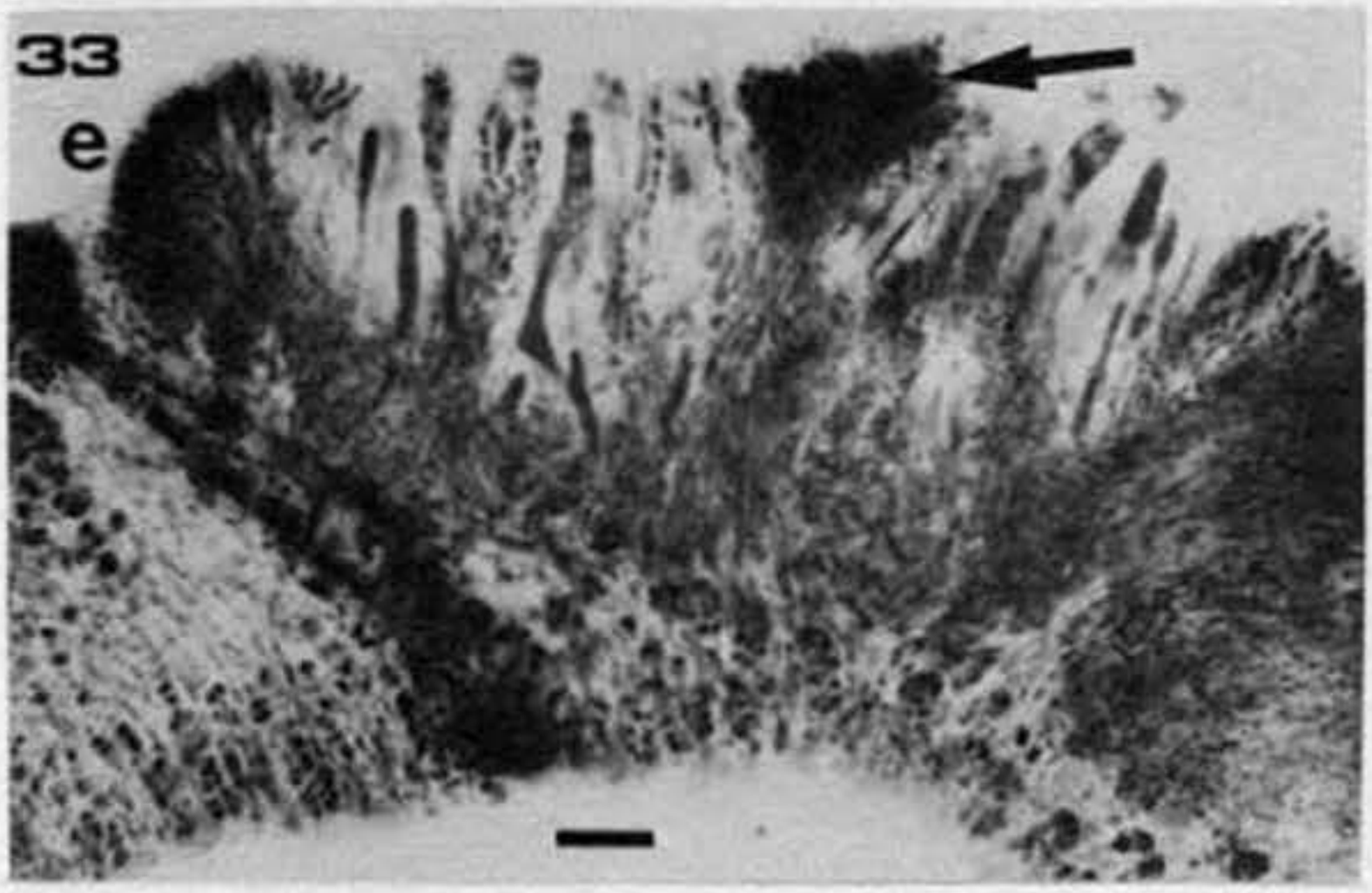
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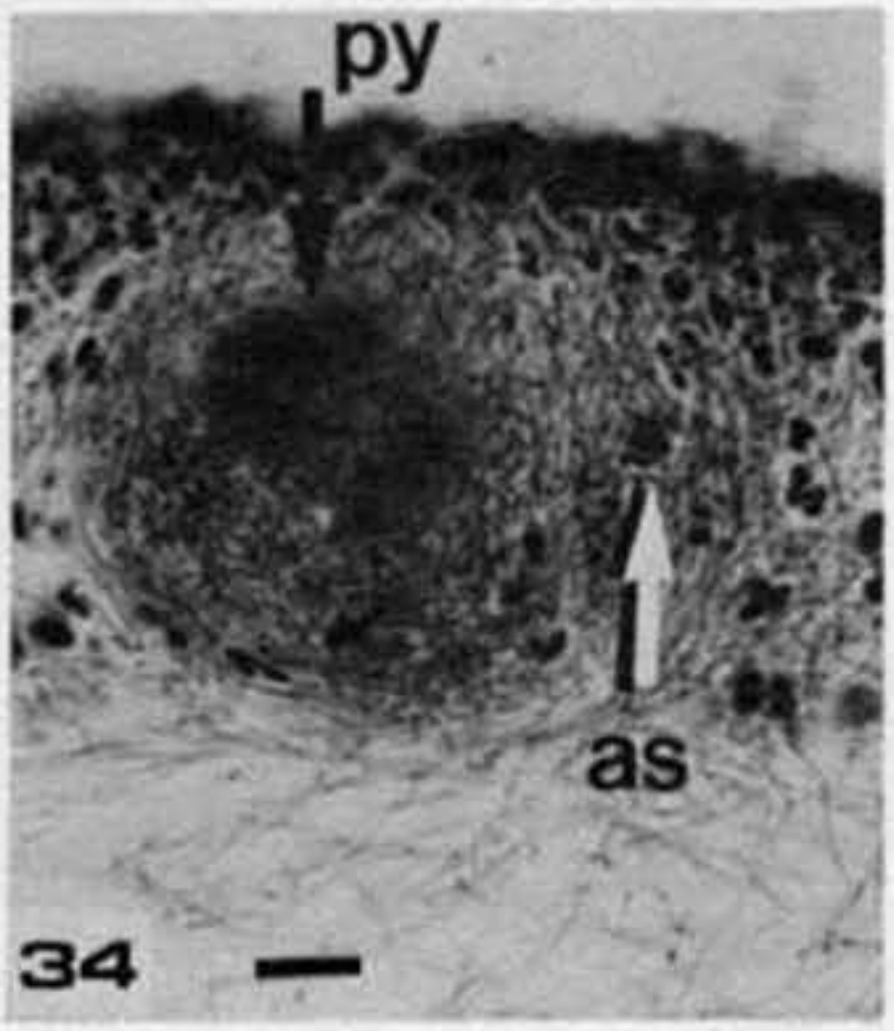
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33). The upper parts of both structures are darkly pigmented. In the mature apothecia of P.melanophthalma, short hyphae grow inwards from the excipulum and upper parts of the hyphal strands (Figs. 31, 33). Structurally these apothecia closely match those of Phyliscidium monophyllum (Krph.) Forss. (Henssen, 1979, Abb. 2i; Henssen & Büdel, 1984a, Plate 8E). In contrast to those of P. melanophthalma and P.submersa, apothecia of P.convexa have constricted bases, similar to those of P.atra (Figs. 23, 28, 29, 33). The phycobiont in P.submersa is probably a species of the Chro- ococcales. The algal cells are very small and the gelatinous sheath is difficult to recognize. In the other two South African Pterygiopsis-species the phycobiont might be a member of the Pleurocapsales. Species of Chroococcidiopsis and Myxosarcina, have recently been recognized as phycobionts in some genera of the Lichinaceae (Büdel & Henssen, 1983, Henssen & Büdel, 1984b) and proved to be the symbiotic alga in other lichen genera.

The new South African species of Pterygiopsis differ considerably from one another in relation to the habit of the thallus. P.submersa forms orbicular thalli which are zonated or surrounded by a prothallus (Figs. 6, 6a, 7). In P.melanophthalma the thallus is areolate (Figs. 9, 10), and in P.convexa the lobes are scattered and might be effigurate at the margin (Figs. 4,5). In terms of

Figs. 29-33. Anatomy of Pterygiopsis species. Figs. 29-30. P.submersa (holotype). 29. L.s. of apothecium, hymenium divided by hyphal strand. 30. Apothecial primordium with spirally coiled ascogonia (arrows). Figs. 31-33. P.melanophthalma (Henssen 28392a). 31. Marginal part of apothecium with well developed excipulum. 32. T.s. of thallus. 33. L.s. of apothecium, hymenium divided by a hyphal strand, excipulum (e) and sterile part of hymenium darkly pigmented. Fig. 34. Thyrea rotundata. L.s. of thallus including primordium composed of generative tissue with spirally coiled ascogonia (as) and pycnidium (py). Scale = 20 µm.

their ecology, the three new species are quite unlike. Pterygiopsis submersa was found submersed in a waterfall stream, P.melanophthalma occured on seepage rocks and P.convexa was collected along the rim of a rock pool. The characteristic attachment base observed in P.atra (Henssen,1979, Abb. 10E) was just as prominently developed in P. submersa (Figs. 27, 28, 30). In contrast to all other species of Pterygiopsis thus far known, only P.submersa is surrounded by a prominent prothallus (Figs. 6, 6a).

Key to Pterygiopsis species occurring in Transvaal

1. Thallus with prominent prothallus or zonated, growing submersed, hymenium non-amyloid..... .....P.submersa
1. Thallus without a prominent prothallus and is not zonated, lichen not growing submersed, hymenium amyloid.....2
2. Thallus composed of scattered lobes, apothecia constricted at the base, hymenial gelatine blue in iodine.....P.convexa
2. Thallus areolate, apothecia not constricted at the base, discs strikingly black when moist, hymenial gelatine wine-red in iodine. .....P.melanophthalma

Pterygiopsis convexa Henssen, Büdel et Wessels sp. nov.

Figs. 4, 5, 23-26, 42-44.

DIAGNOSIS. Thallus crustaceus, areolo-lobatus, pro parte effiguratus, nigricans, usque ad 6 cm latus, strato gelatinoso substrato affixus. Areolae dispersae vel aggregatae, convexae 0.15-0.3 µm vel elongatae usque ad 0.35 mm. Hyphae radianes, 2-6 µm crassae. Apothecia (juvenilia) pseutdoangiocarpa, ad 0.3 mm lata, basi constricta, margine thallino circumdata. Hymenium 120 µm altum, in iodo caerulescens, subhymenium 45-50 µm altum. Asci cylindracei vel obclavati, 70 x 12-15 µm, 2-8 spori. Sporae eseptatae, incolores, el-

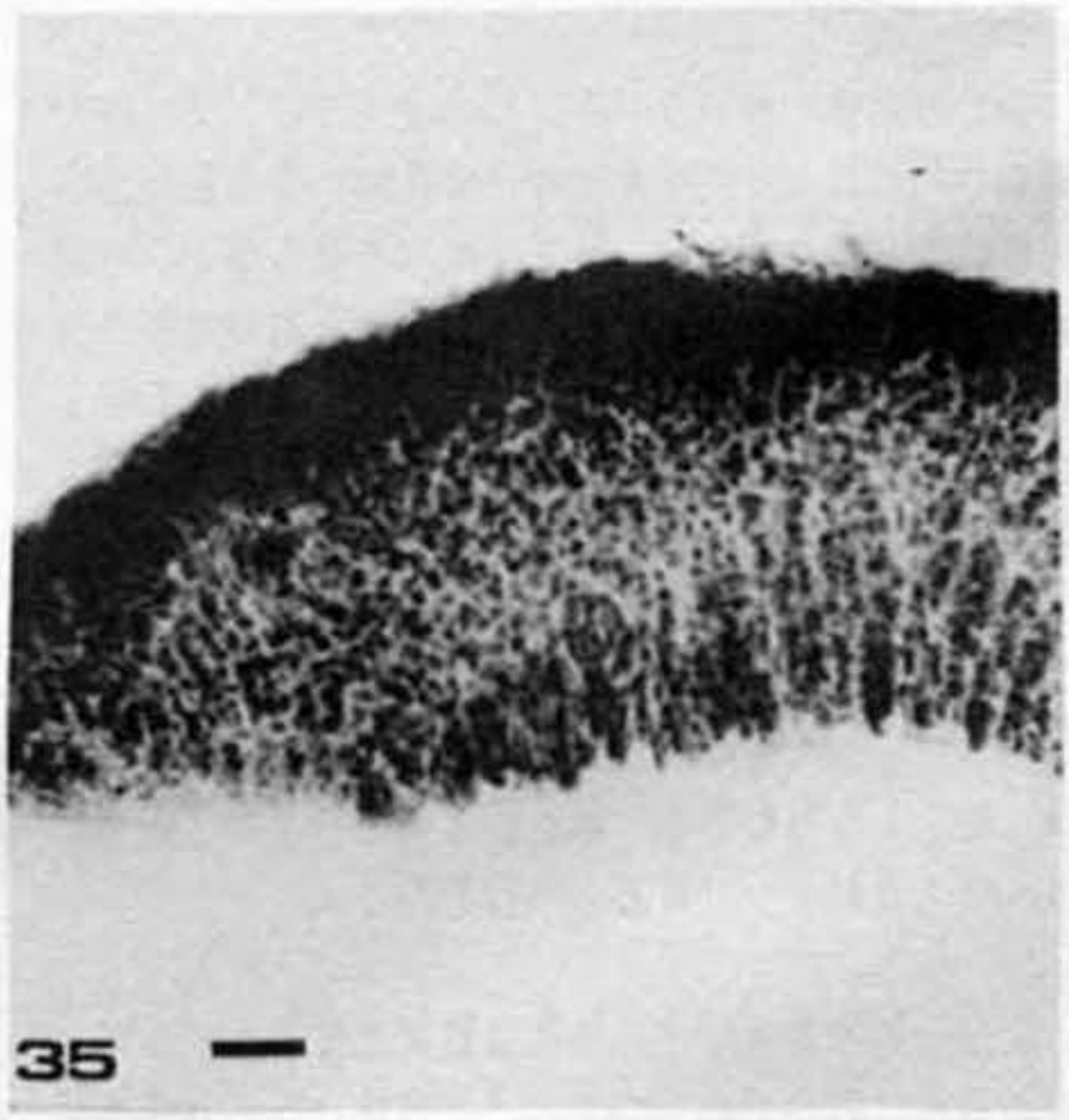
lipsoideae, 8-15 x 6-7 µm. Paraphyses simplices vel sparsim ramosae. Pycnidia ad 0.3 mm lata, adnata, basi constricta, margine thallino circumdata. Conidia bacilliformia, terminaliter formata, 2.5-3.5 x 1 µm. Alga ad ordo Chroococcales vel Pleurocapsales pertinens.

Holotype: Republic of South Africa, Northern Transvaal, Willie's Poort 2229DD, Mutamba, alongside the road to Messina, on sandstone along the rim of a rockpool, c. 660 m, 1982, Henssen & Wessels 28342g (MB) (isotypes: BM, PRE, UPS).

Thallus crustose, 1 to 6 cm broad, blackish, in part effigurate, composed of more or less scattered lobes, closely attached to the substrate. Lobes of irregular shape, 0.15-0.3 mm broad or up to 0.35 mm when elongated. Thallus in sections 120-150 µm high. Hyphae anticlinally arranged, 2-4 µm thick or enlarged to 6 µm when roundish in shape, 2 µm thick in the gelatinouse attachmend base which might be well developed and 45(-120) µm high. Phycobiont a member of the order Chroococcales or Pleurocapsales. Algal cells 2-5(-6) µm wide, mostly in groups of 2 or 4 cells, distributed throughout the thallus, frequently attacked by fungal haustoria.

Apothecia (only immature ones seen) to 0.3 mm wide, pseudoangiocarpous, constricted at the base (Fig. 23), with thick thalline margin. Hymenium 120 µm high, gelatine blue in iodine. Asci cylindrical or obclavate (Fig. 24), 70 x 12-15 µm, usually containing less than 8 spores. Spores simple, hyaline, ellipsoid, 8-15 x 6-7 µm (immature). Paraphyses simple or sparsely branched, with cylindrical, slightly vacuolated cells, 1-2 µm thick. Pycnidia adnate, to 0.3 mm broad and then constricted at the base. Conidia rod-shaped, 2.5-3.5 x 1 µm, terminally produced.

Ecology and distribution. Pterygiopsis convexa was collected on a cave sandstone koppie where it occurred along the upper edge of a rock pool, which was dry at the time of collecting. The koppie is situated in the Mopaniveld (Acocks, 1975). Rainfall averages 300 mm yr^{-1}. The lichen was associated with Peltula clavata (Krph.) Wetm.



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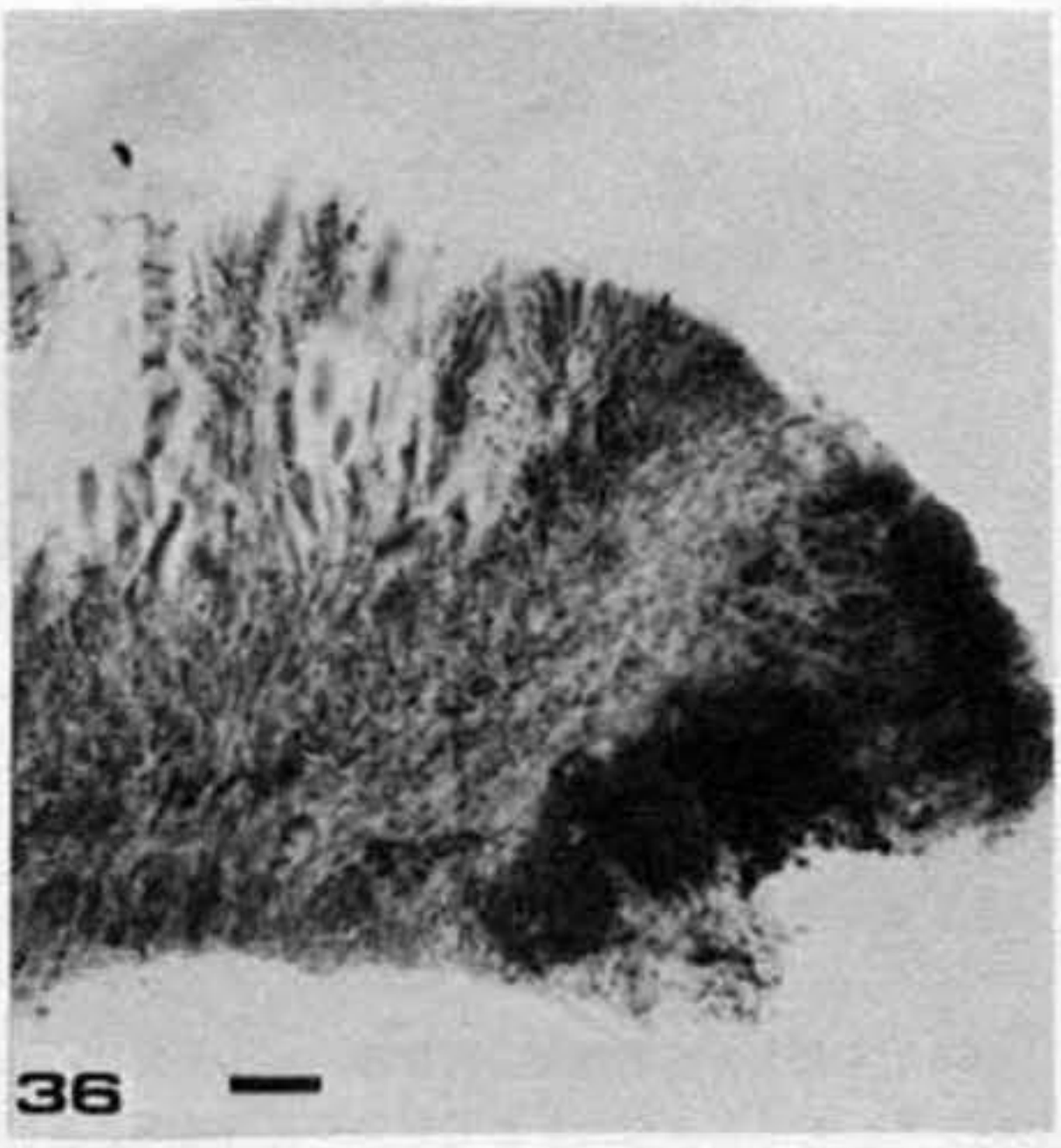

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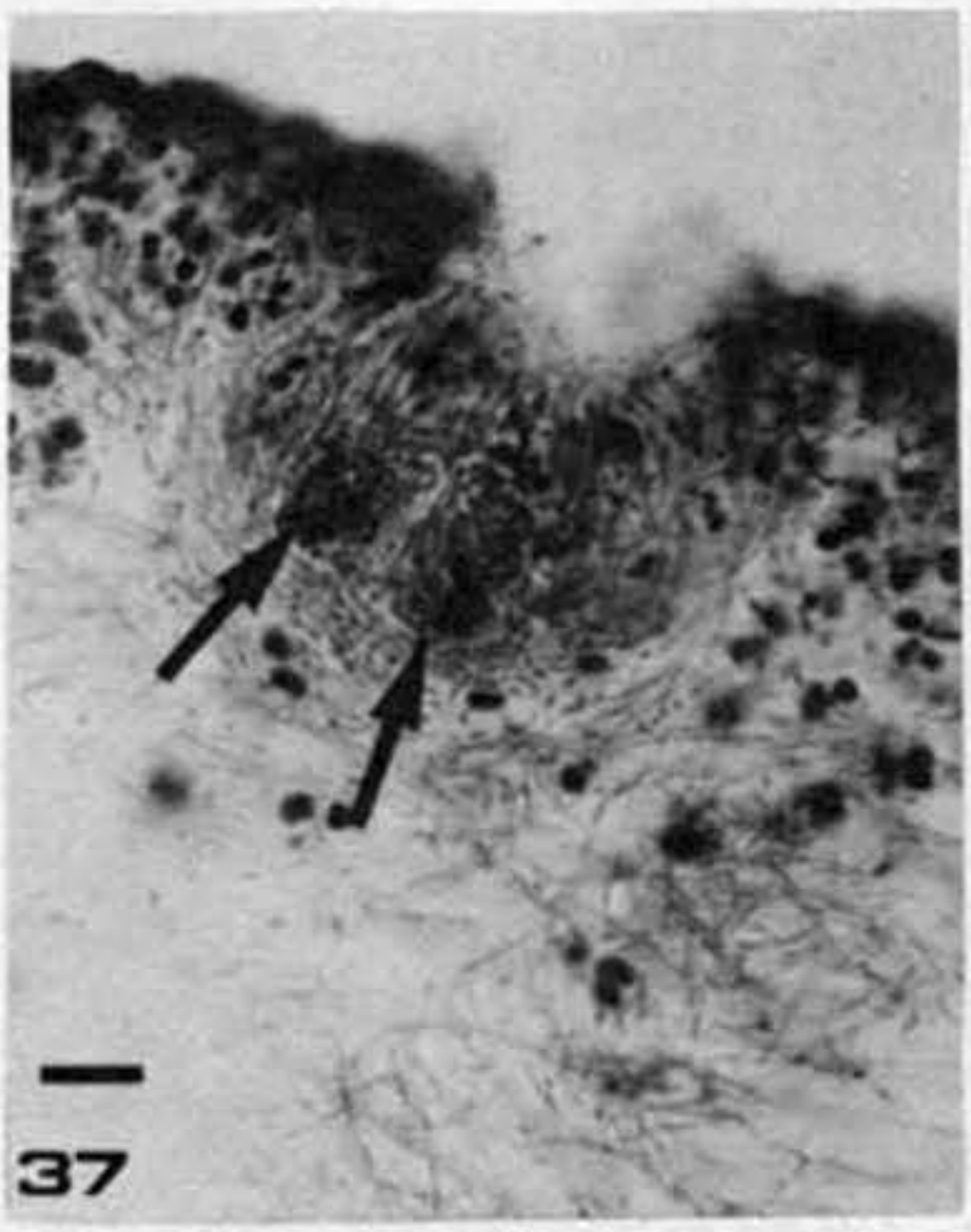

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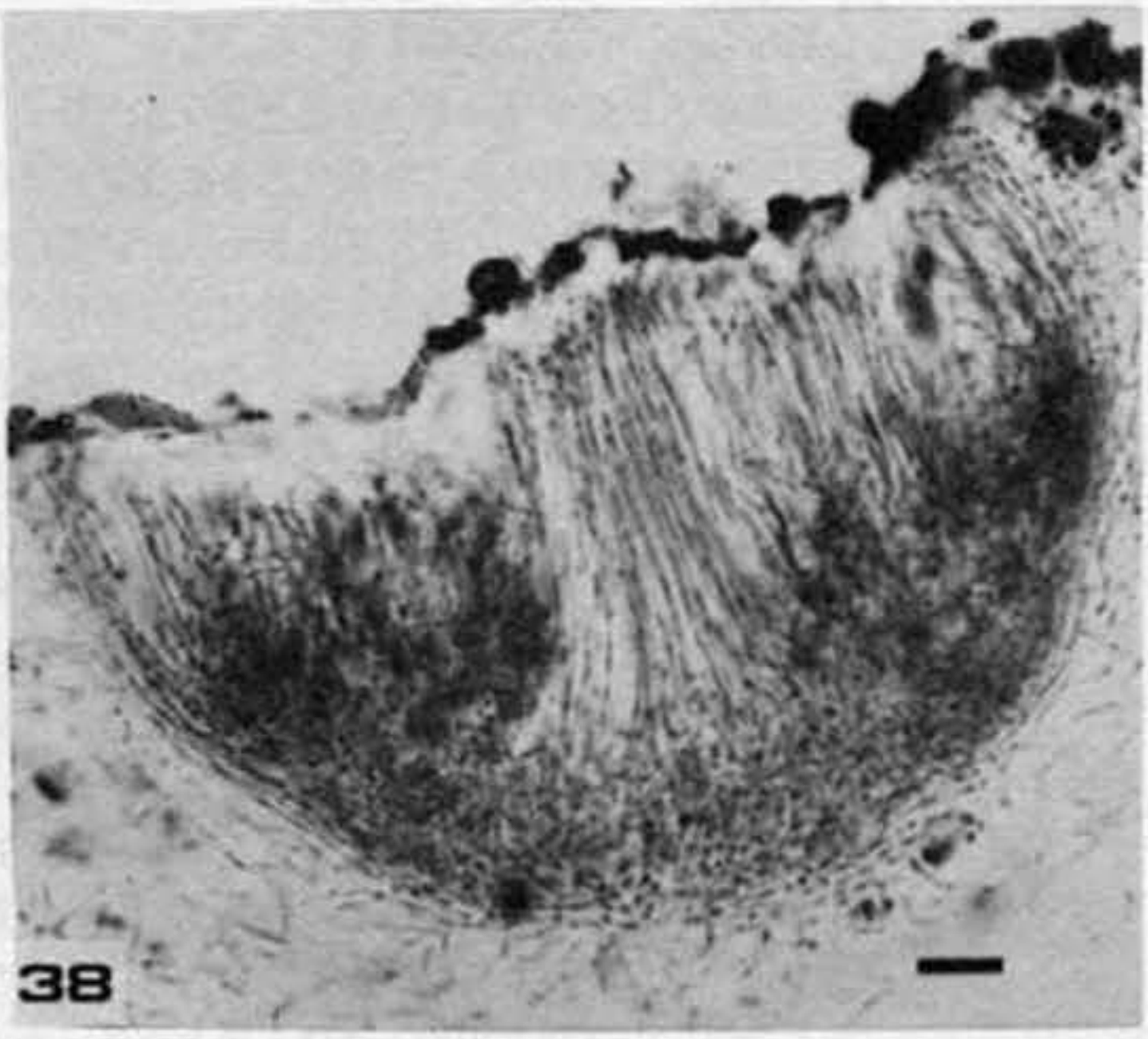

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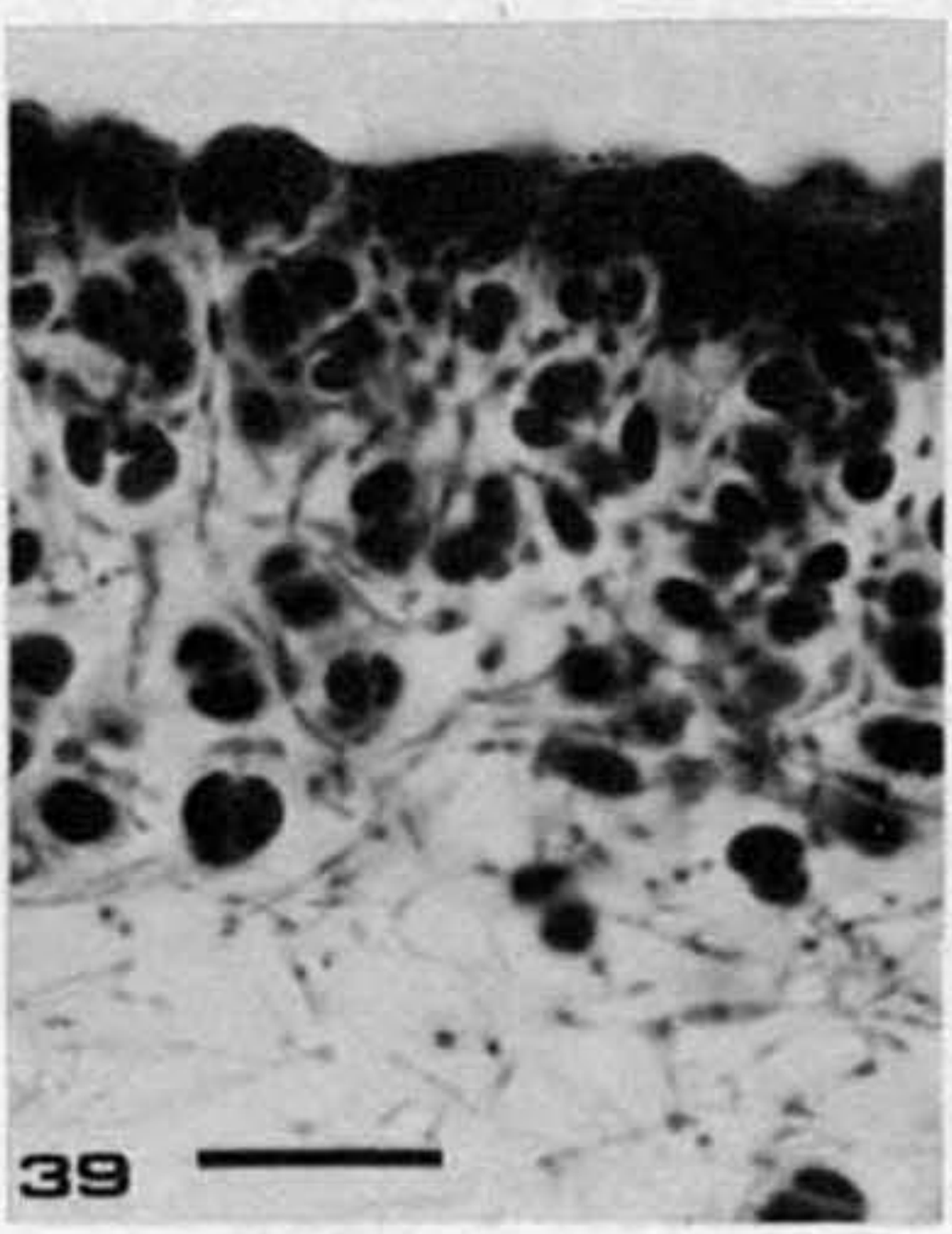

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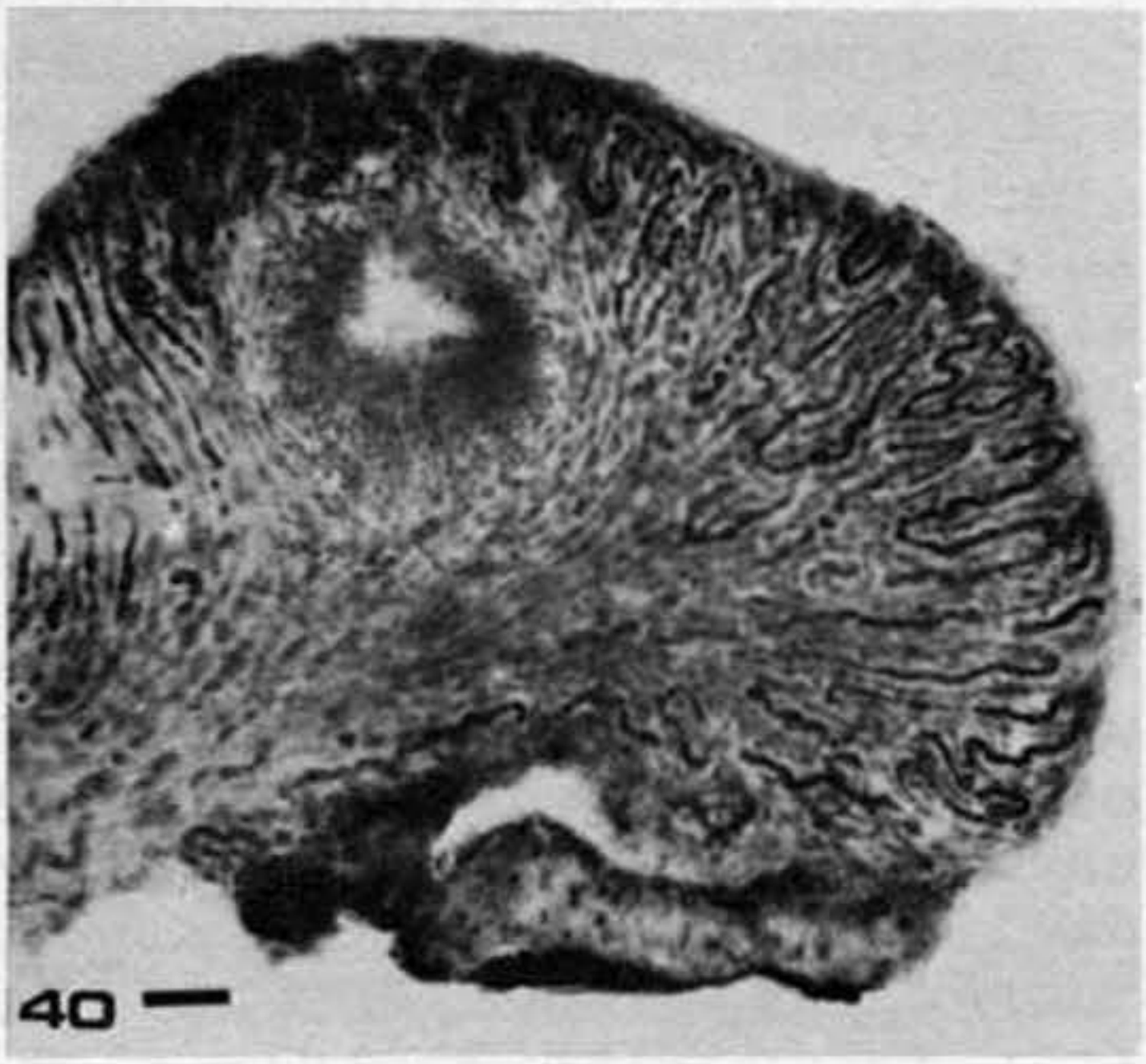

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which grew amongst different species of Peltula and an undescribed species of Synalissa. The lichen is known only from the type locality.

The name "convexa" was chosen to emphasize the convex shape of the lobes in this species.

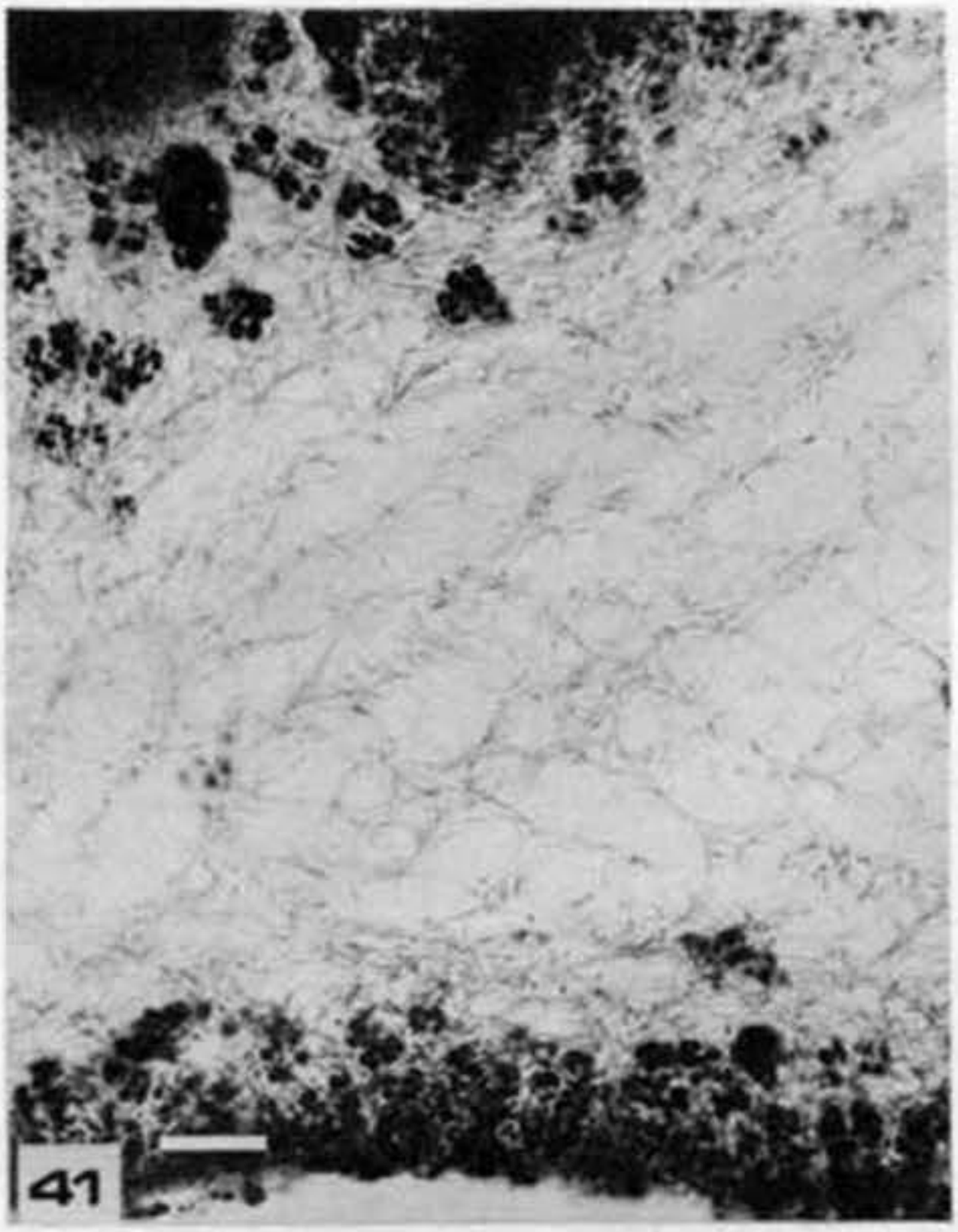
Remarks. Of the three species described here, Pterygiopsis convexa shows a large degree of similarity to P.atra. Both species are distinctly placoid and, at least in part, effigurate. Very large pycnidia which can be easily mistaken for young apothecia may occur in both species. P.convexa differs from P.atra mainly by the presence of more scattered convex lobes (Figs. 4, 5). The collection only contained immature ascocarps with still punctiform discs. The presence of blue-green aglal filaments inside the hymenium of the globose apothecia (Figs. 25, 42) was one of the outstanding features of the species. It is assumed that these algae use the apothecial cavity as a shelter against the unfavourable environmental conditions.

Pterygiopsis melanophthalma Henssen, Büdel et Wessels, sp. nov.

Figs. 8-10, 31-33, 35, 36.

DIAGNOSIS. Thallus crustaceus indistincte limitatus, areolatus, ad 10 cm latus, nigricans, strato gelatinoso substrato affixus. Areolae angulares, 0.1-0.4(-0.65) mm. Hyphae radiantes, 2-5 µm crassae. Apothecia immersa vel elevata, usque ad 0.5 mm, margine thallino circumdata. Hymenium 95-120 µm altum, in iodo vinosum, subhymenium 45-50 µm altum. Asci cylindracei vel obclavati, 70 x

Figs. 35-36. Pterygiopsis melanophthalma (holotype). 35. T.s. of thallus, basal attachment relatively indistinct. 36. L.s. of apothecium with divided hymenium. Figs. 37-39. Thyrea rotundata (holotype). 37. Primordium of apothecium with coiled ascogonia in generative tissue (arrows). 38. Divided hymenium. 39. Anatomy of thallus margin. Fig. 40. Porocyphus effiguratus (Büdel 14036c). L.s. of thallus and enclosed pycnidium. Scale = 20 µm.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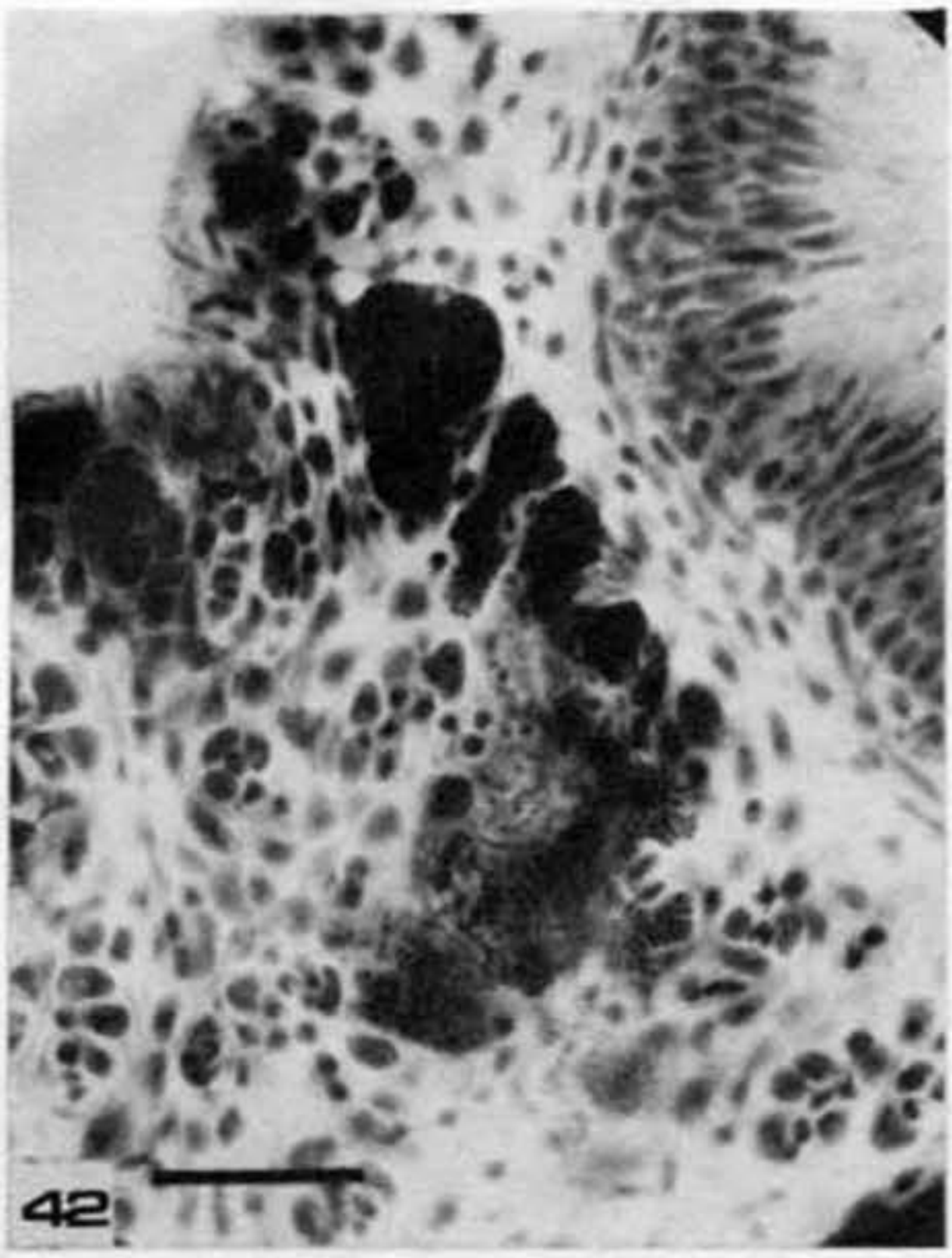
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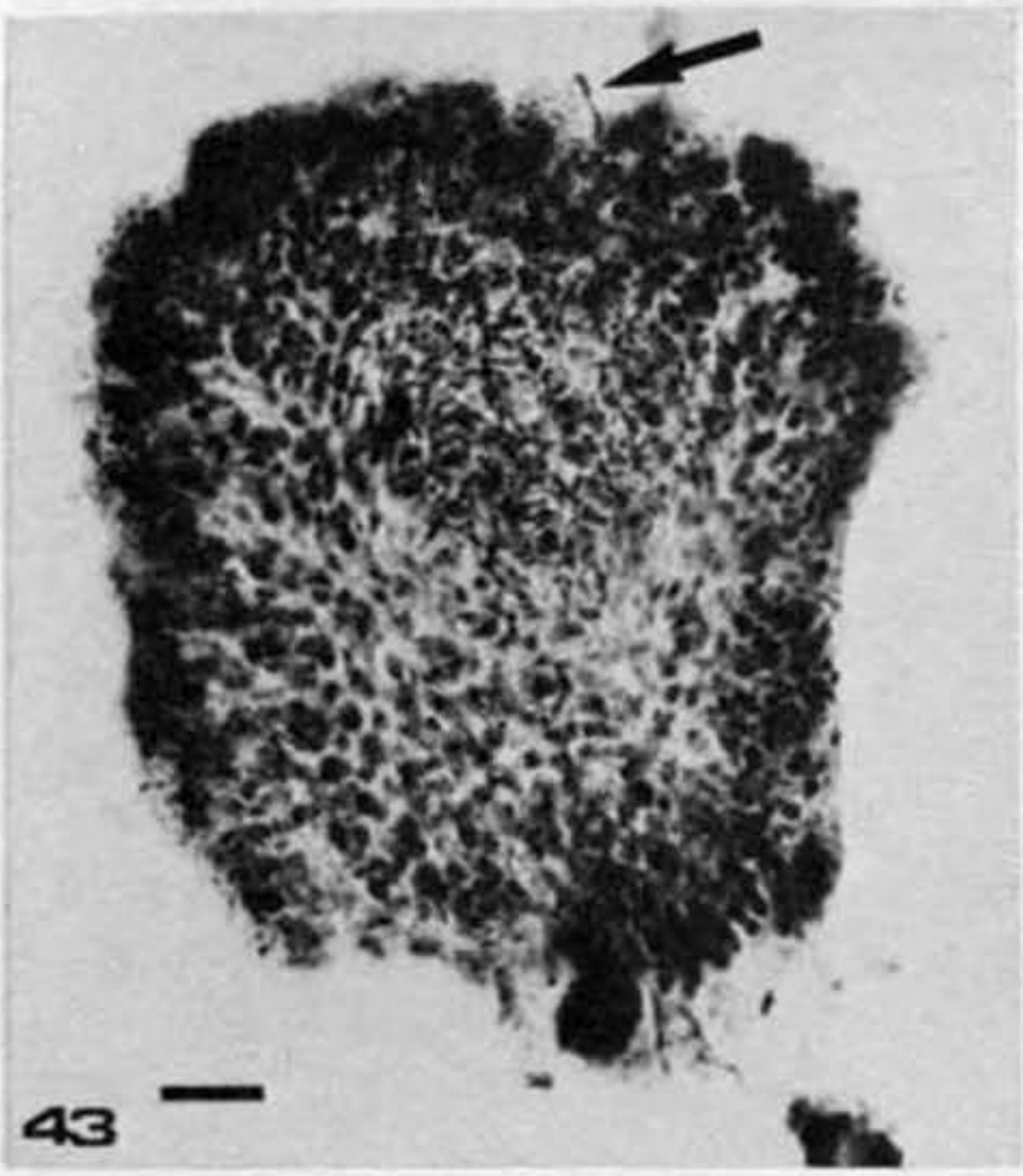
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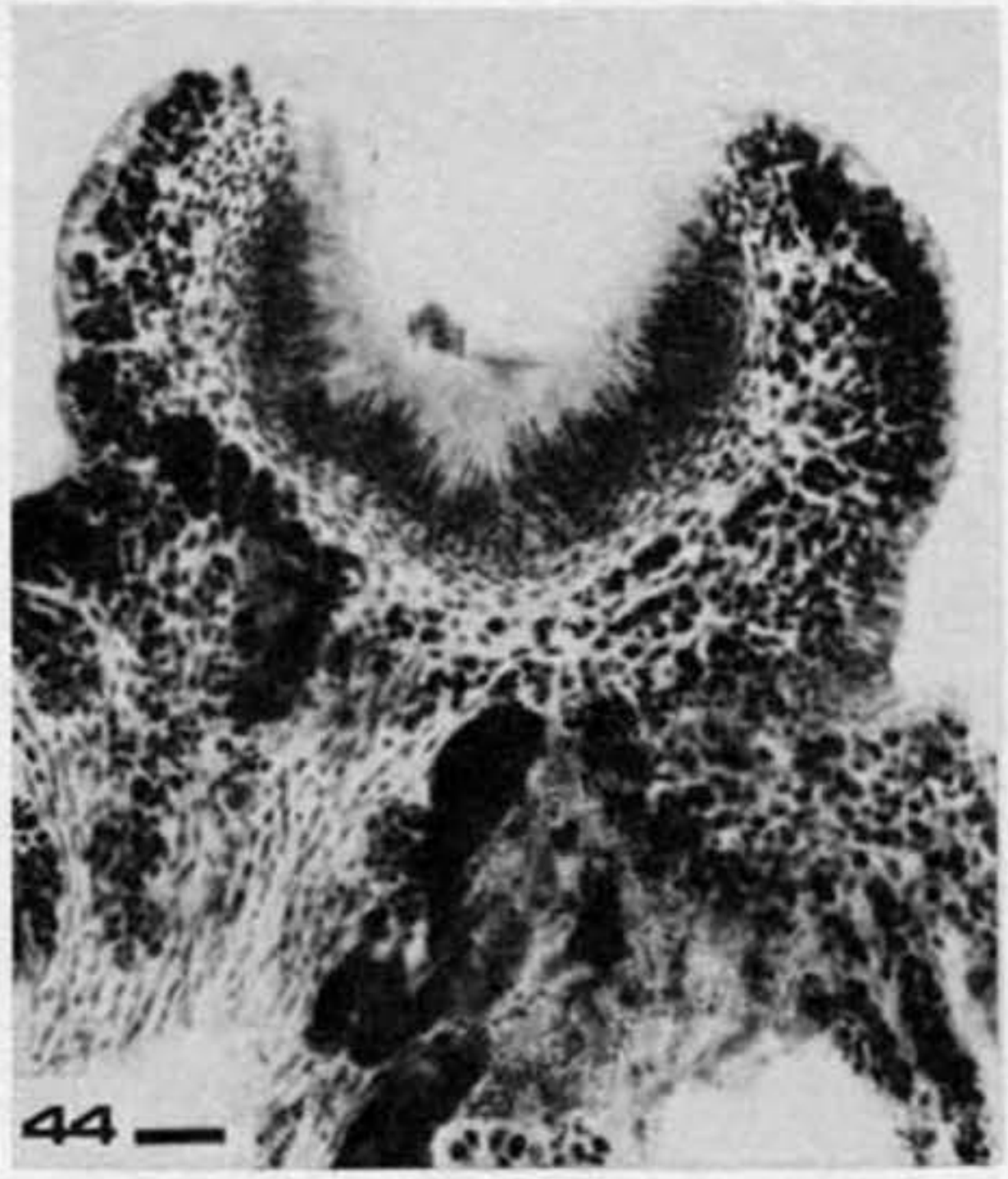
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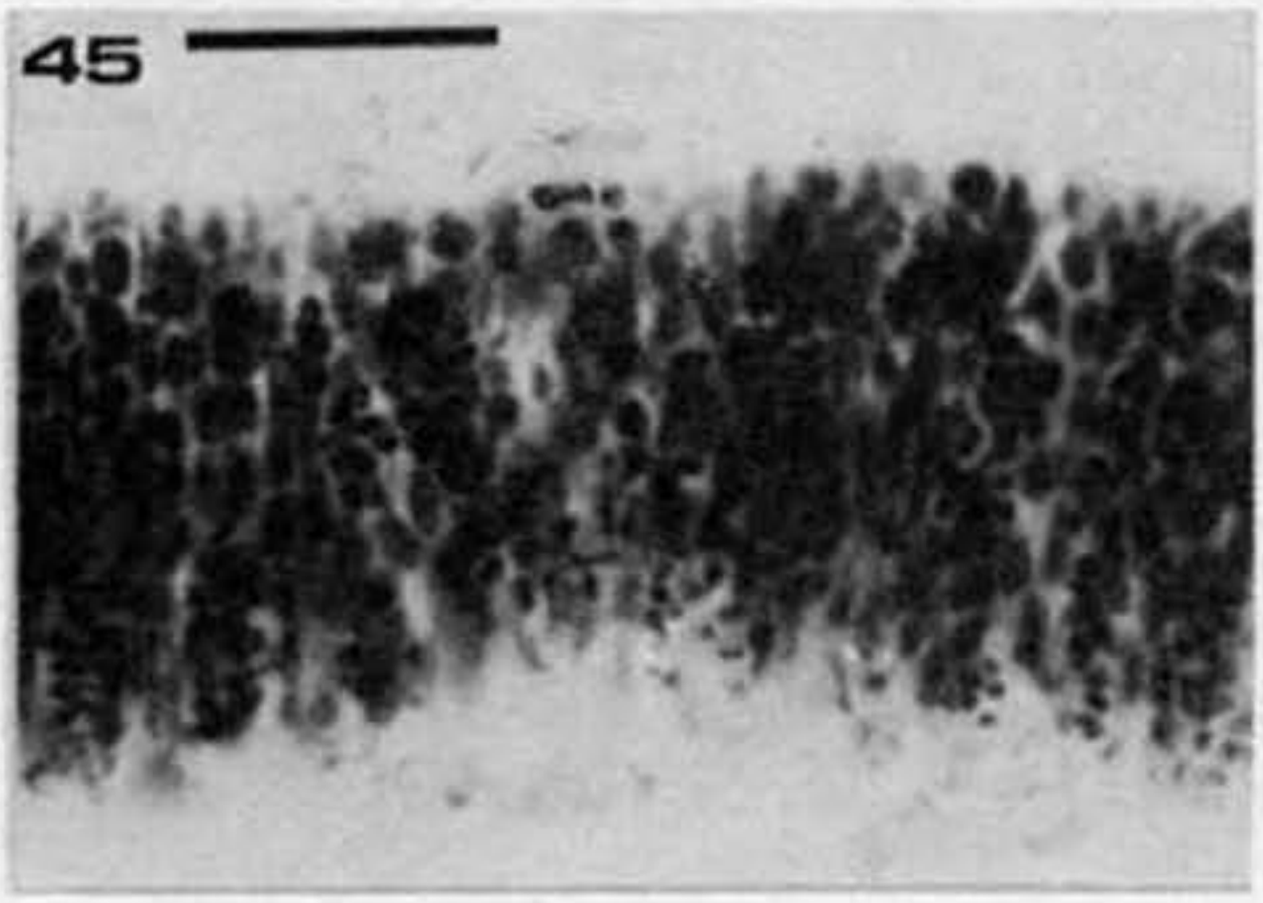
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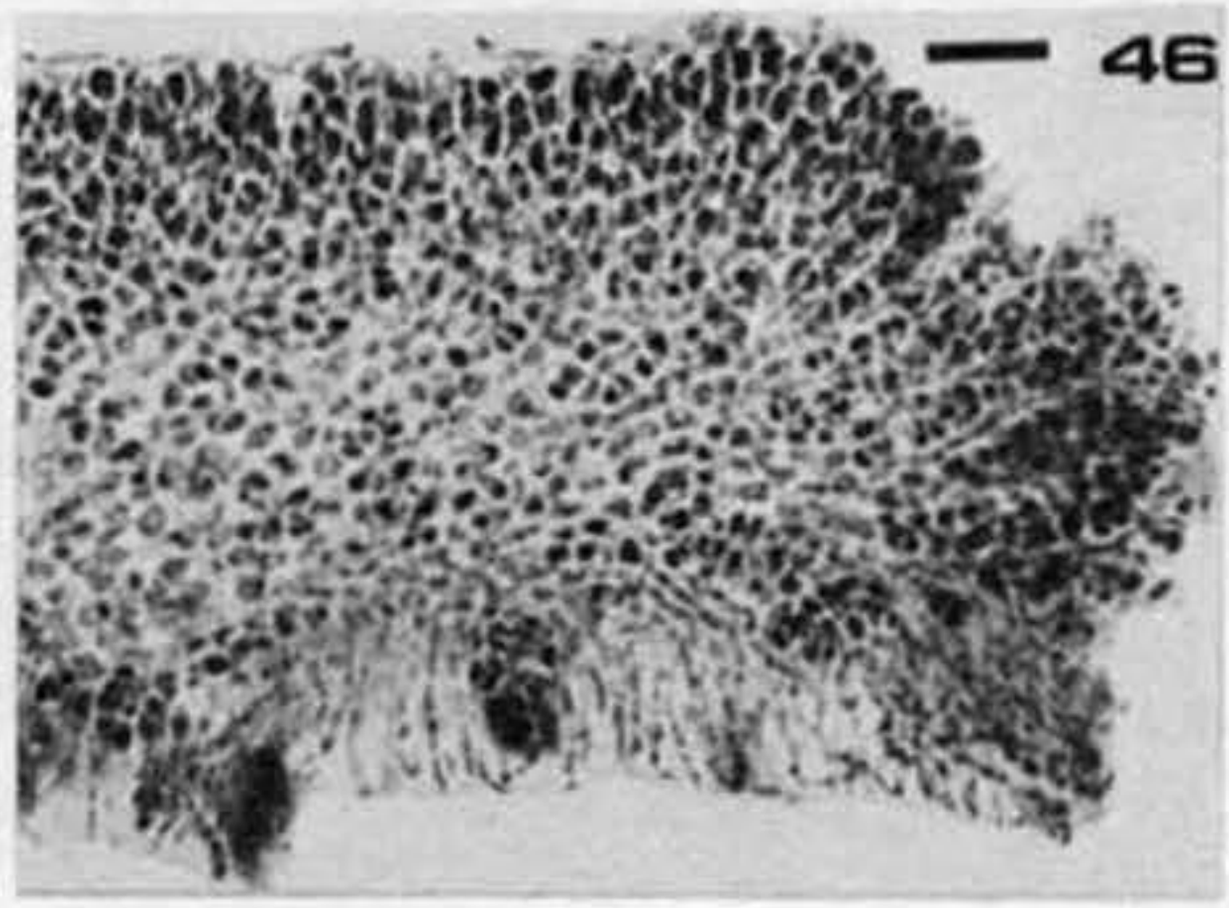
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12-13 µm, octospori. Sporae eseptatae, incolores, ellipsoideae, 12-18 x 5-9.5 µm. Paraphyses ramosae, 1.5-2 µm crassae. Pycnidia immersa, ad 0.5 mm lata, conidia bacilliformia, 2.5-3 x c.1 µm. Alga ad ordo Chroococcales vel Pleurocapsales pertinens.

Holotype. Republic of South Africa, Eastern Transvaal, Graskop 2430DD, Panorama Falls, Lookout Point, on seepage sites of hard sandstone rocks, c. 1400 m, 1982, Henssen & Wessels 28405b (MB) (isotype: PRE); additional collection from the same site: Henssen no. 28392a (MB).

Thallus crustose, areolate, irregular in shape, blackish, up to 10 cm in diameter, closely attached to the substrate. Areoles angular, 0.1-0.45 or 0.4-0.65 mm when fertile, closely aggregated. Thallus in sections 115-120 µm high, attachmed base more or less indistinct. Hyphae anticlinally arranged, cells cylindrical and c. 2 µm thick or enlarged and roundish to 5 µm thick and vacuolated. Phycobiont a member of the order Chroococcales or Pleurocapsales. Alagl cells 2.5-5 µm, single or in groups of 2 (-4), distributed throughout the thallus.

Apothecia immersed or slightly elevated and surrounded by a thalline margin, up to 0.5 mm wide, disc conspicuously black when moist (Figs. 8-10). Hymenium 95-120 µm high, multiply divided by hyphal strands, columns darkly pigmented at the surface. Hymenial gelatine initially blue, later turning wine-red with iodine. Subhymenium 45-50

Figs. 41-46. Anatomy of Thyrea and Pterygiopsis species. Fig 41. T.rotundata (holotype). L.s. of thallus, the hyphae arranged in a netted pattern. Figs. 42-44. P.convexa (holotype). 42. Lichen thallus penetrated by different species of blue-green algae (arrows). 43. Ascocarp primordium with protruding trichogyne (arrow). 44. T.s. of a large pycnidium. Fig. 45. P.submersa (holotype). L.s. of the prothallus, cells of the phycobiont darkly stained. Fig. 46. P.atra (isotype: TUR). L.s. of thallus with well developed attachment base. Scale in 41 = 50 µm, in 42-46 = 20 µm.

µm. Only the upper part of the excipulum is well developed, 40-50 µm wide and on the surface darkly pigmented. Paraphyses branched, short-celled, 1.5-2 µm thick, short paraphyses developing from the upper part of the excipulum and hyphal columns (Fig. 31). Asci cylindrical or obclavate, 70 x 12-13 µm (immature), containing 8 spores. Spores simple, hyaline, ellipsoid to subglobose, 12-18 x 5-9.5 µm. Pycnidia immersed, up to 0.5 mm wide, opening by means of fissures. Conidia rod-shaped, 2.5-3 x 1 µm, produced terminally.

Ecology and distribution. Pterygiopsis melanophthalma was found on seepage plates at the locality described in detail under Lichina macrospora, P.melanophthalma was frequently overgrown by the latter species. Other lichens associated with P.melanophthalma were undescribed species of Pyrenopsis, together with Peltula clavata and P. lingulata (Vain.) Swinsc. & Krog. The lichen is known only from the type locality.

The name "melanophthalma" is chosen to emphasize the conspicuous black colour of the apothecial disc under moist conditions.

Remarks. Pterygiopsis melanophthalma is characterized by a uniform areolate thallus which is never effigurate, the partly immersed apothecia and the multiply divided hymenium. The species is easily distinguished from the other two South African species by the forementioned characteristics, but in particular by the black colour of the discs under moist conditions.

Pterygiopsis submersa Büdel, Henssen et Wessels sp. nov.

Figs. 6-7, 27-30, 45.

DIAGNOSIS. Thallus crustaceus, orbicularis, umbrinus, zonatus, in statu juvenile prothallo circumdatus, usque ad 4 cm latus, strato gelatinoso substrato affixus. Areolae angulares, 0.25-0.45 mm latae. Hyphae radiantes, 1-3 µm crassae. Apothecia pseudoangiocarpa, usque ad 0.5 mm lata cum margine thallino. Hymenium 160-180 µm altum, non amyloideum. Paraphyses ramosae et anastomosantes, 2 µm crassae. Asci cylindraceae vel obclavati,

60-80 x 5-8 µm, 3-4 spori. Sporae eseptatae, incolores, ellipsoideae, 9.5-14 x 7 µm. Pycnidia immersa, 60 µm lata. Conidia ellipsoideo-fusiformia, 3 x 1 µm. Alga ad ordo Chroococcales pertinens.

Holotypus. Republic of South Africa, Northern Transvaal, Tzaneen 2330CC, De Hoek State Forest, Debengeni Fall, on granite plates covered by running water, c. 1200 m, 1983, Büdel & Wessels 14036a (MB) (isotype: PRE).

Thallus crustose, orbicular, brownish, zonate, cracky areolate, up to 4 cm broad, closely attached to the substrate. Juvenile thalli surrounded by an ochraceus, pseudoparenchymatous prothallus, up to 0.5 mm wide. Areoles angular, 0.25 -0.45 mm, at the thallus margin in part elongated, up to 0.65 mm. Thallus in sections 100-25 µm high with distinct attachment base along the lower third. Hyphae anticlinally arranged, 1-3 µm thick, cells short or elongated, in prothallus enlarged to 4.5 µm, in attachment base embedded in gelatinous matrix and at first reticulately orientated. Phycobiont a member of Chroococcales. Algal cells 2-4.5 µm, rarely penetrated by haustoria, distributed throughout the thallus.

Apothecia numerous, up to 0.5 mm wide, with thalline margin, juvenile stages immersed, adnate in later stages, disc up to 0.3 mm broad, circular or angular, frequently umbonate or hymenium washed out and apothecia then urceolate. Hymenium 160-180 µm high, in later stages divided by a hyphal strand forming a column 25-30 µm wide in the upper part. Hymenial gelatine does not stain in iodine. Subhymenium 20-30 µm. Paraphyses richly branched and anastomosing, c. 2 µm broad. Hyphal strands and excipulum darkly pigmented at the surface. Thalline margin 40-60 µm thick. Asci cylindrical to obclavate, 60-80 x 5-8 µm (immature) containing less than 8 spores. Spores 9.5-14 x 7 µm (immature). Pycnidia immersed, in sections c. 60 µm, conidia elliptic-fusiform, 3 x 1 µm.

Ecology and distribution. Pterygiopsis submersa occured on hard granite plates where it was per-

manently inundated by a shallow stream of water. It was associated with Porocyphus effiguratus Henssen. The lichen was overgrowing a species of Hildenbrandia, which covered the whole site. The site receives shade early in the afternoon. The De Hoek State Forest is a tropical forest type (Acocks, 1975). The area has a summer rainfall with an average of 1757 mm yr^{-1} (Strydom, Forester of the De Hoek State Forest, personal communications), fog frequently occurs.

The name "submersa" is chosen to emphasize the habitat of the new species.

Remarks. The thallus of Pterygiopsis submersa varies considerably. In juvenile stages the ochraceus prothallus is very distinct (Fig. 6a), 45-50 µm thick, the pseudoparenchyma is composed of strongly adglutinated, anticlinally arranged hyphae which might include a few algal cells. Irregularly shaped patches of thalli develop on the surface of the prothallus, which become closely aggregated during further development. During later stages, the prothallus gradually disappears, and the thallus becomes zonated by a 1 to 1.5 mm broad, blackish zone. This zone lacks fruiting structures and is slightly elevated along the margin (Figs. 6, 7). The prothallus of P.submersa is of special interest in that it is pseudoparenchymatous instead of beeing plectenchymatous, as in other lichens, e.g. in species of Placynthium and in members of the Pannariaceae. Most of the apothecia in the type specimen were either immature or very old without a hymenium (Fig. 7). The measurements of the asci and spores must therefore be considered as precursory. Pycnidia were rarely observed in well developed thalli, but were noticed in the prothalli of juvenile stages. As far as is known, P.submersa is the only member of the genus to grow under submersed conditions and to have a distinct prothallus and zonation (Figs. 6, 6a, 7). These distinct characteristics clearly separate P.submersa from the other South African species. The structure of the apothecia of P.submersa closely resembles that of P.melanophthalma. The two species seem to be closely related.

3. A new species of Thyrea

Thyrea rotundata Büdel, Henssen et Wessels sp. nov.

Figs. 11-13, 34, 37-39, 41.

DIAGNOSIS. Thallus rosulatus, nigricans, umbilico-lobatus, usque ad 11 mm latus. Lobi applanati, sparsim ramosi, 1-4 mm longi et 1-1.5 mm lati. Thallus umbilico affixus. Hyphae centrales reticulum regulare formantes, 1.5-2.5 µm crassi. Hyphae ad marginem 4.5 µm crassae. Alga ad ordinem aut Chroococcales aut Pleurocapsales pertinens. Cellulae algarum 4.5-6 x 8-10 µm latae. Apothecia laminalia, primo immersa deinde elevata, in sectione 280 µm lata. Hymenium saepe divisum, 130-190 µm altum, in iodo caerulescens. Paraphyses 1.5-2 µm crassae. Asci clavati, c. 60 x 10 µm, 3-4spori. Sporae eseptatae, incolores, ellipsoideae, c. 12 x 7 µm. Pycnidia immersa vel modice elevata. Conidia bacilliformia, 1.5 x 3 µm lata.

Holotype: Republic of South Africa, Eastern Transvaal, Mogaba 2430DA, Kaspersnek, 30°42'30"E, 24°43'50"S, at 1280 m, in seepage lines of volcanic rock outcrops. West north westerly facing side of the moutain which forms part of a river valley. Collectionsite 100 m from a river and is situated in the North-Eastern Moutain Sourveld (Acocks, 1975). 1983, Büdel & Wessels 14038a (MB) (isotype: PRE; further isotypes will be distributed in Henssen, Lichenes cyanophili exsiccati).

Thallus rosette-shaped, umbilicate, up to 11 mm in diameter, branched into flattened lobes, blackish when dry, olive coloured when wet. Lobes 1-4 mm long and 1-1.5 mm wide, sparsely branched, rounded at the tips. Upper surface rough except for the lobe tips which are more or less smooth, darker in colour (Fig. 11) and shiny during the wet stage. Lower surface furrowed. Holdfast irregularly round (Fig. 12), c. 1mm wide, composed of anticlinally arranged hyphae. Thallus in sections 650-750 µm thick. Hyphae in the central part 1.5-2.5 µm thick, loosely interwoven giving rise to a netted pattern (Fig. 41). Hyphae towards the thallus margin anticlinally orientated,

forming a network, cells sphaerical to angular in shape and up to 4.5 µm thick (Fig. 39). Phycobiont a member of the order Chroococcales or Pleurocapsales, algal cells 4.5-6 x 8-10 µm, arranged in packets of 2 to 8, usually 4 cells, each cell penetrated by a haustorium.

Apothecia very rare, laminal, pseudoangiocarpous, with talline margin, immersed or slightly protruding, disc 0.02 mm in diameter. Apothecia in sections 280 µm wide. Ascocarp develops from hyphal web of generative tissue (Fig. 37). The upper part of a primordium might in addition contain a pycnidium (Fig. 34). Hymenium sometimes divided (Fig. 38), 130-190 µm, gelatine staining blue in iodine. Asci clavate, c. 60 x 10 µm (immature), containing less than 8 spores (3 or 4). Spores simple, hyaline, ellipsoid, c. 12 x 7 µm. Secondary (true) paraphyses 1.5-2 µm thick, cells irregular in length. Pycnidia laminal, immersed or slightly protruding, in sections 150350 µm broad, conidia terminally produced, rod-shaped, 1.5 x 3 µm.

Ecology and distribution. Thyrea rotundata occurs on rocks of volcanic origin. The thalli were found growing in rock crevices and on flat parts of the rock. Because of the west north westerly exposure of the site it is representative of a hot, dry habitat. The thalli are moistened only during the rainy season and afterwards during relatively short periods when the seepage streams are actively running. The lichen is known only from the type locality.

The name "rotundata" was chosen to emphasize the roundish lobe tips characteristic for this species.

Remarks. T.rotundata is closely related to T. polyglossa Nyl. from Cuba and to undescribed species which occur in similar habitats in East Africa or Mexico respectively. The species form a distinct section within the genus Thyrea. The taxonomy of the aforementioned species which will be discussed in a forthcoming paper.

4. A second locality for Porocyphus effiguratus

Porocyphus effiguratus was until now only known from the type locality in Zimbabwe (Henssen, 1974). The new material was collected by Büdel & Wessels during 1983 (no. 14036c). A description of the site can be found under Pterygiopsis submersa (see above) with which it was associated.

The internal and external morphology of the new collection closely resembles that of the type specimen. Other than the type specimen which was only an old thallus, several stages of thallus development are present in the specimen from the Transvaal (Figs. 14, 15).

The fan-shaped arrangement of the thallus hyphae in Porocyphus effiguratus resembles the anatomy of Pterygiopsis species (Fig. 40). The apothecia are pycnoascocarps, a characteristic which is not associated with Pterygiopsis.

ACKNOWLEDGEMENTS

The study was supported by the Deutsche Forschungsgemeinschaft, Council of Scientific and Industrial Research (RSA) and by grants of the Deutscher Akademischer Austauschdienst (given to B.Büdel and D.Wessels). The authors are indebted to their respective institutions for financial assistance and to the Department of Forestry (RSA) for their aid and permission to collect in state forests. Mrs. Traute is thanked for technical assistance. Prof. D.Müller-Doblies, Berlin, kindly corrected the Latin diagnoses.

ZUSAMMENFASSUNG

Es werden fünf neue Arten der Lichinaceen von Nordost-Transvaal beschrieben. Lichina macrospora Henssen, Büdel & Wessels ist eine nicht-marine Art und gehört zur L.willeyi-Gruppe mit aufrechten,drehrunden Loben, die interkalar und terminal Pycnoascocarpien tragen und bei denen die Fäden der symbiotischen Dichothrix-Alge aus dem Lager ausragen können.

Der Thallus von Pterygiopsis convexa Henssen, Büdel & Wessels besteht aus zerstreuten bis zu-

sammenhängenden Loben und ist teils am Rande effiguriert. Von der Typusart, P.atra, mit ähnlich placoidem Lager und Fruchtkörperbau unterscheidet sich P.convexa durch die kleineren und konvexen Loben. Pterygiopsis melanophthalma Henssen, Büdel & Wessels ist durch ein gleichmäßig areoliertes Lager und durch beim Anfeuchten auffällig schwarze Apothecienscheiben gekennzeichnet. Pterygiopsis submersa Büdel, Henssen & Wessels ist die einzige bisher bekannte Art der Gattung mit zoniertem Lager und einem Prothallus im Jugendstadium sowie submersem Standort. Bei P.melanophphthalma und P.submersa ist das Hymenium durch Hyphenstränge unterteilt, die Scheiben sind entsprechend umbonat oder uneben.

Thyrea rotundata Büdel, Henssen & Wessels hat ein rosettiges Lager mit flachen, an den Spitzen abgerundeten Loben. Die Hyphen bilden ein regelmäßiges Maschennetz, teils ein Rautenmuster. Die Apothecien sind Pycnoascocarpien.

Porocyphus effiguratus Henssen wird als neu für Südafrika angegeben. Die Flechte war bisher nur aus Zimbabwe bekannt.

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MYCOTAXON

Vol. XXII, pp. 197-208 January-March 1985

NEW SPECIES OF FUNGI FROM INDONESIAN DRIED FISH

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Abstract

Polypaecilum pisce, Penicillium chalybeum, Penicillium corynephorum and Penicillium patens are described from Indonesian dried fish. Basipetospora halophila (van Beyma) Pitt & Hocking comb. nov., synonym Scopulariopsis halophilica Tubaki, is also described.

Introduction

During a study of fungal spoilage of dried fish from Indonesian sources, several interesting fungi were encountered. The most significant spoilage organisms were an undescribed Polypaecilum species and the halophilic fungus commonly known as Scopulariopsis halophilica Tubaki. Studies in this laboratory several years ago showed that S. halophilica was conspecific with Oospora halophila van Beyma 1933; more recent work by us using scanning electron microscopy has shown that it is not a Scopulariopsis but a species of Basipetospora Cole and Kendrick. These two fungi are described below, together with three new Penicillium species isolated from the same source.

Methods

For the Penicillium species, the methods, media and plating regime described by Pitt (1979) have been followed, i.e. cultures have been incubated for 7 days on Czapek yeast autolysate agar (CYA) at 5, 25 and 37°; and malt extract agar (MEA) and 25% glycerol nitrate agar (G25N) at 25°. For the Polypaecilum species, these three media were used at 25°, and also malt yeast 50% glucose agar (MY50G), a medium suitable for the majority of xerophilic fungi (Pitt and Hocking, 1982) and malt yeast 5% salt 12% glucose agar (MY5-12), a newly formulated medium suitable for halophilic fungi. MY50G has the following formulation: malt extract, 2.0%; yeast extract, 0.5%; glucose, A.R., 50% (w/w); agar, 2.0%. MY5-12 contains the following ingredients: malt extract, 2.0%; yeast extract, 0.5%; NaCl, A.R., 5% (w/v); glucose, 12% (w/v); agar, 1.5%. MY5-12 has a water activity of 0.93 and should be sterilised by autoclaving; MY50G, of water activity 0.89, can be effectively sterilised by steaming at 100° for 30 min.

Capitalised names of colours used in the following descriptions are from the "Methuen Handbook of Colour" (Kornerup and Wanscher, 1978).

Basipetospora halophila cultures were incubated at 25° on the same media as were used for Polypaecilum. Also included as more suited to this fungus was a medium of higher salt concentration, malt yeast 10% salt 12% glucose agar (MY10-12). This medium is formulated in a similar way to MY5-12, but contains 10% (w/v) NaCl. It has a water activity of 0.88, and should be sterilised by heating at 100°.

Basipetospora halophila (van Beyma) Pitt & Hocking, comb. nov. Fig. 1

Basionym: Oospora halophila van Beyma, Zentbl. Bakt. ParasitKde, Abt II, 88: 134 (1933).
Synonym: Scopulariopsis halophilica Tubaki, Trans. Mycol. Soc. Japan 14: 367 (1973).

On CYA or MEA at 25°, 14 days, no growth.

On G25N, 25°, 14 days, colonies 4-8 mm diam, occasionally 12 mm, of dense and tough mycelium, centrally raised, sulcate or irregularly wrinkled; margins entire, narrow; mycelium persistently white, with little or no sporulation; reverse pale.

On MY50G, 25°, 14 days, colonies 4-8 mm diam, similar to those on G25N.

On MY5-12, 25°, 14 days, colonies 10-16 mm diam, low or umbonate, plane or irregularly wrinkled, of dense mycelium overlaid by floccose to funiculose aerial hyphae; mycelium persistently white, sporulation light to moderate in lower layers of the mycelium; reverse pale to yellow brown.

On MY10-12, 25°, 14 days, colonies 18-22 mm diam, similar to those on MY5-12, but growth more rapid and vigorous; sporulation in surface mycelial layers moderate to heavy; mycelium and conidia persistently white; reverse pale to yellow brown.

Reproductive structures short, solitary conidiophores borne at irregular intervals along vegetative hyphae, sometimes bearing a short chain of conidia, but more commonly a single developing conidium, shed at maturity and succeeded by another blown out terminally from the conidiophore, the conidiophore shortening a little with successive conidia; conidiophores often curved, usually cylindrical, 2.0-3.0 µm diam, but sometimes narrowing towards the apex; when young 8-20 µm long, in age down to 3-4 µm long, smooth walled; mature conidia spherical to broadly ellipsoidal or pyriform with a truncate base, 3.5-6.0 µm diam, with heavy walls, smooth to finely roughened, in wet mounts usually solitary, but sometimes in chains of 3 or 4. No teleomorph known to be produced.

Typification. CBS 232.32, van Beyma's original isolate, is type.

Taxonomy. This distinctive species was described as Oospora halophila by van Beyma (1933) and catalogues of the Centraalbureau voor Schimmelcultures have more recently recorded two further isolations. The name has not been used by later authors, however, and the genus Oospora was rejected as illegitimate by Hughes (1958). Tubaki (1973) described Scopulariopsis halophilica in terms which did not lead to association with van Beyma's species. Several years ago, as part of our studies on xerophilic fungi, the CBS isolates of Oospora halophila were obtained and recognised as being synonymous with the type of S. halophilica. Subsequent studies of S. halophilica by scanning electron microscopy (SEM) showed it was not a Scopulariopsis, and isolation of several fresh isolates of this species from Indonesian fish has prompted publication of the new combination.

Under light microscopy, conidiophores sometimes narrow towards the apices, and bear a remarkable resemblance to solitary phialides or annelides (Fig. 1B). However, study of the development of the conidia by light microscopy and SEM showed clearly that the conidiophores are not annelides but produce conidia by the meristematic elongation characteristic of Basipetospora (Cole and Kendrick, 1968; Cole and Samson, 1979; Figs. 5-25 to 5-29). Figs 1E to 1G show that each successive conidium is blown out from the tip of the conidiophore without elongation at that point, after a septum is laid down. When conidia do not secede (Fig. 1D, 1G), the developing structure is strikingly similar to that published by Cole and Kendrick (1968) for Basipetospora rubra.

The differences in rates of growth of this fungus on MY50G and MY5-12, media of similar water activity and nutritional status, show clearly that growth is much more rapid in the presence of sodium chloride. It is concluded that this species is a true halophile, unlike other previously described

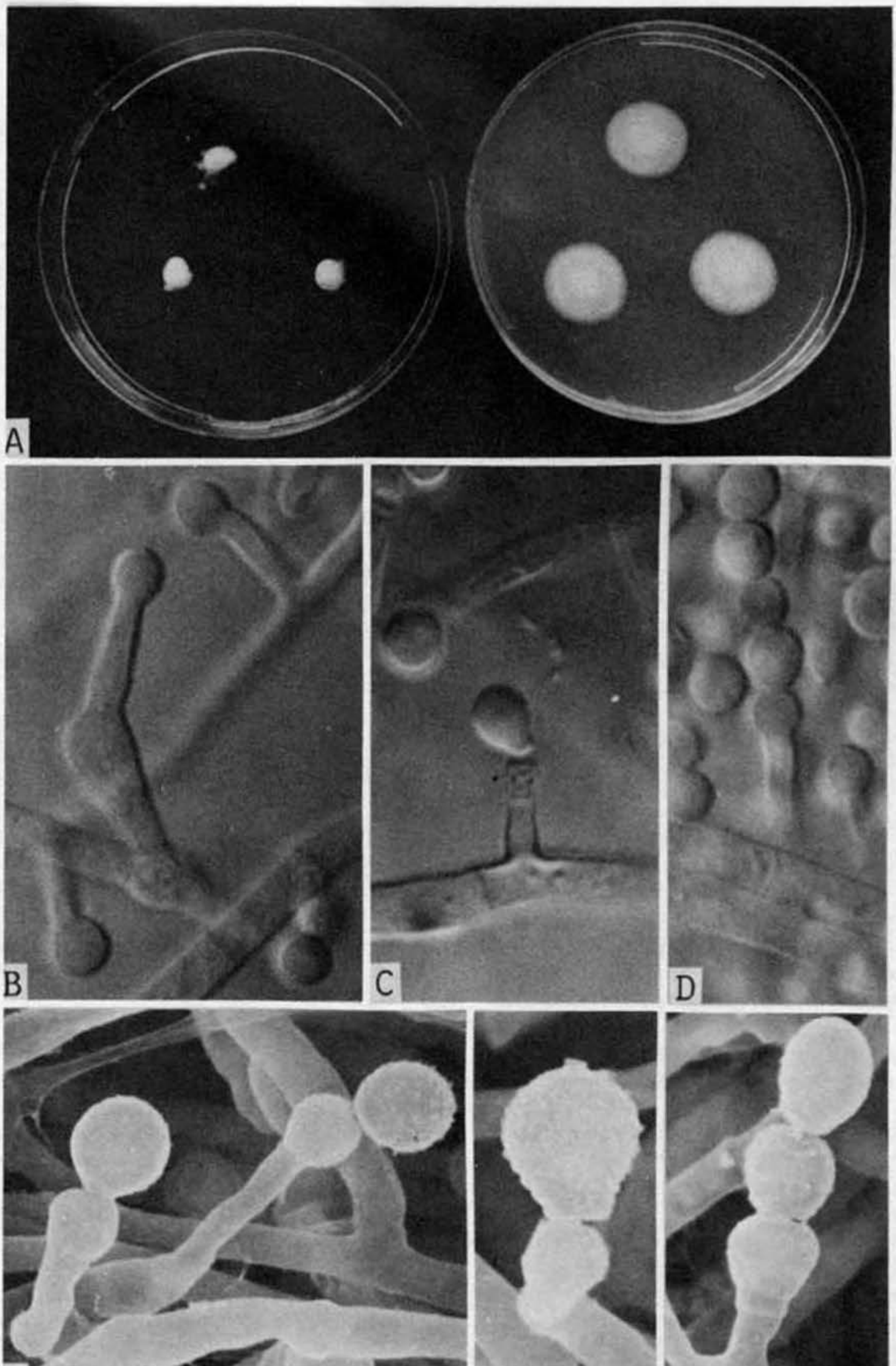

Fig. 1. Basipetospora halophila. A, colonies on MY5-12 and MY10-12 agars, 14 days at 25°; B-D, conidiophores and conidia, Nomarski interference contrast light microscopy, X1875; E-G, conidiophores and conidia, scanning electron microscopy, E, X4000, F,G, X5000.

"halophilic" fungi, which are relatively indifferent to solute type at low water activities (Pitt, 1975). Studies on the water relations of this species will be published elsewhere (Andrews and Pitt, in preparation).

Isolates examined: FRR 2425 (CBS 232.32), ex type of Oospora halophila, from salt crystal, Utah, U.S.A., 1932, F.H. van Beyma; FRR 2184 (= IFO 9650, IMI 184617, CBS 380.74, ATCC 42877), ex type of Scopulariopsis halophilica, from salted (dried) seaweed, Undaria pinnatifida, Osaka, Japan, 1971, M. Baba; FRR 2187, from imported Asian dried fish, Sydney, N.S.W., Australia, 1979, A. D. Hocking; FRR 2426 (CBS 141.40), from dried cod, ca 1940, J.F.W. Holtz; FRR 2427 (CBS 348.68), from salt fish, 1960, at CBS; FRR 2608, from dried Japanese fish, Sydney, N.S.W., Australia, 1984, S. Andrews; FRR 2609, from gelatine hydrolysate, Japan, T. Awao; FRR 2611, from indigo solution for batik dyeing, Japan, S. Udagawa; FRR 2787, from Saurida sp., 1984, K. A. Wheeler.

Polypaecilum pisce Hocking & Pitt, sp. nov. Fig. 2

In agaro MY5-12 coloniae veteres duarum hebdomadum 35-45 mm diam radiante sulcatae vel irregulariter caperatae et elevatae ad centri; humiles densae et velutinae vel rudimentariis fasciculis vel bene evolutis funiculis; mycelium album; conidiogenesis profusa, alba; reverso pallido vel bubalino. Reproductivae structurae polyphialides portatae singulariter super conidiophoris ex vegetativis hyphis; polyphialides profusae corporibus 15-60 x 3-5 um parietibus tenuis levibus inramoses vel dichotome vel irregulariter ramoses prope apices, unusquisque ramus 2-5 collulis 3.0-5.0 x 2.0-2.5 um; conidia ellipsoidea vel limoniforma 5-8 x 3.5-4.0 um, hyalina parietibus levibus portatis in columnis longis.

Typus: FRR 2732, ex pisce sicca Java, Sydney, Novo Wallio Australi, 1984, K. A. Wheeler.

Etym.: Latin pisce = from a fish.

On CYA and MEA, 25°, 14 days, colonies usually low and sparse, sometimes centrally umbonate or irregularly wrinkled, with a dense, velutinous or weakly funiculose texture; margins entire or fimbriate; sporulation light, mycelium and conidia persistently white; on CYA, sclerotia formed by a few isolates, white to buff, 250-400 um diam, with walls of pseudoparenchymatous cells, becoming firm at maturity; reverse pale to yellow brown.

On G25N, 25°, 14 days, colonies low and sparse, often deeply and irregularly wrinkled centrally, texture usually velutinous, sometimes floccose or funiculose centrally; margins often irregular or fimbriate; mycelium persistently white; conidia sparsely produced, uncoloured; exudate and soluble pigment not produced; reverse pale.

On MY50G, 25°, 14 days, colonies 10-18 mm diam, plane and sparse, margins entire, velutinous to floccose, heavily sporing; mycelium and conidia persistently white; exudate and soluble pigment absent; reverse pale.

On MY5-12, 25°, 14 days, colonies developing more vigorously than on other media tested, 35-45 mm diam, radially sulcate or irregularly wrinkled and often centrally raised; some isolates with growth low, dense and velutinous, others with rudimentary fascicles bearing conidial structures terminally, or sometimes with quite well developed funicles, up to 1 mm high, with scattered conidial structures; conidial structures borne in profusion, mostly terminal on ascending or trailing hyphae, each bearing several short chains of conidia clearly visible under the low power microscope; mycelium and conidia persistently white; exudate and soluble pigment not produced; reverse pale to buff.

Reproductive structures polyphialides, borne solitarily on short conidiophores from vegetative hyphae; polyphialides large and complex, with a body 15-60 µm long and of varying width, usually 3-5 µm, with thin, smooth walls, unbranched or more commonly dichotomously or irregularly branched near the apex, each branch terminating in 2-5 necks, 3.0-5.0 x 2.0-2.5 µm, each bearing conidia; conidia elipsoidal to limoniform, 5-8 x 3.5-4.0 µm, hyaline, smooth walled, borne in long chains, breaking up in wet mounts.

Fig. 2. Polypaecilum pisce. A, colonies on G25N and MY5-12 agars, 14 days, 25°; B-C, polyphialide necks and conidium, SEM, B, X2500, C, X5000; D, upper portions of polyphialides.

Typification. The herbarium specimen FRR 2732 is designated as holotype of Polypaecilum pisce. It was isolated from Indonesian dried fish, Ophiocephalus striatus, Sydney, N.S.W., Australia, 1984, K. A. Wheeler. A culture from the type isolate has been accessioned by the Commonwealth Mycological Institute (CMI) as IMI 288726, and the American Type Culture Collection (ATCC) as ATCC 56982.

Taxonomy. This species produces conidia from polyphialides and belongs in the genus Polypaecilum G. Smith. In erecting this genus, Smith (1961) stated that the reproductive structures were annellophores, but more recent reports have indicated that the conidiogenous structures characteristic of this genus are polyphialides (Cole and Samson, 1979: 69).

Other species in this genus, Polypaecilum insolitum G. Smith and P. capsici (van Beyma) G. Smith, have not been reported to grow on media of reduced water activity. A close relationship to the new species is therefore doubtful.

Occurrence. Polypaecilum pisce appears to be a major cause of spoilage of dried fish in Indonesia, samples showing a profuse white growth being not uncommmon in our experience. This species has been isolated from 42% of the 31 samples of Indonesian fish so far examined in this study, and 20% showed extensive growth of this fungus. In view of this, it is surprising that it apparently has not been described previously: however, an extensive search of the literature has failed to find a recognisable description. Like Basipetospora halophila, P. pisce is a halophile, growing much more rapidly and vigorously on MY5-12 than on MY50G. Studies on the water relations of this species will be published elsewhere (Andrews and Pitt, in preparation).

Isolates examined were all isolated in Sydney, N.S.W., Australia: FRR 2185, from dried fish commercially imported into Australia from unknown Asian source, 1979, A. D. Hocking; and the following from dried fish imported from Indonesia for mycological studies: FRR 2732, ex type, as detailed above; FRR 2606 (= IMI 288720, ATCC 56981), 1983, S. Andrews; FRR 2607, 1984, J.I. Pitt; FRR 2733 (= IMI 288727, ATCC 56983), from dried squid, Loligo sp., 1984, K. A. Wheeler; FRR 2789, from Katsuwonus sp., 1984, K. A. Wheeler; FRR 2788, from Scomberomonus sp., 1984, K. A. Wheeler; FRR 2791, from Rastrelliger kanagurta, 1984, K. A. Wheeler.

Penicillium corynephorum Pitt & Hocking, sp. nov. Fig. 3

In agaro CYA coloniae veteres unius hebdomadis 32-40 mm diam planae humiles et velutinae vel profunde floccosis superauctis mycelii ad centri; mycelium album floccosis areis vel ad margines primulinos; conidiogenesis moderate turcosa vel glauca; flavida excudata et flava solutum pigmentum formati; reverso pallido vel primulino interdum aurantiaco. Conidiophora portata ex hyphis paginis stipites 200-500 x 3.0-4.0 um parietibus levibus vel rugulosis; penicilli biverticillati semper terminales; metulae 10-12 um longae appressae asymmetrice vesiculatae ad apices 4.5-5.5 um diam; phialides ampulliformae 7-9 x 2.0-2.2 um curvae intro collulis brevibus; conidia spherica 2.0-2.5 um diam parietibus levibus portatis in columnis longis.

Typus: Herb. FRR 2663, ex pisce sicca Java, Sydney, Novo Wallio, Australi, 1983, J. I. Pitt.

Etym.: Greek coryne- = club plus Latin -phorus = bearing; the epithet refers to the distinctive club-shaped metulae produced by this species.

On CYA, 25°, 7 days, colonies 32-40 mm diam, plane, low and velutinous or with deeply floccose mycelial overgrowths in central areas; margins subsurface; mycelium white in floccose areas, but in marginal areas greenish yellow; conidiogenesis moderate, Greyish Turquoise to Dull Green (24-25E3); pale yellow exudate and bright yellow soluble pigment usually produced; reverse pale to Bright or Greenish Yellow (1-2A-B6), sometimes with orange areas.

On MEA, 25°, 7 days, colonies 45-55 mm diam, plane, low and sparse, velutinous, sometimes with a light floccose overlay; margins subsurface; mycelium conspicuous only in floccose areas, white; conidiogenesis moderate, Dull Green near Cactus Green (28E4); exudate and soluble pigment absent; reverse dull to

bright greenish yellow.

On G25N, 25°, 7 days, colonies 10-15 mm diam, plane, low to moderately deep, dense; mycelium white; conidiogenesis moderate to heavy, Greyish Turquoise (24D-E3); reverse dull to bright greenish yellow.

At 5°, CYA, 7 days, at least germination, sometimes microcolonies formed.

At 37°, CYA, 7 days, usually no growth, occasionally colonies up to 5 mm diam produced.

Conidiophores borne from subsurface hyphae, stipes long and slender, 200-500 x 3.0-4.0 µm, characteristically swelling to 5-6 µm diam just below the first septum, i.e. 25-30 µm from the penicillus, with walls smooth to distinctly roughened, bearing strictly terminal biverticillate penicilli; metulae in closely

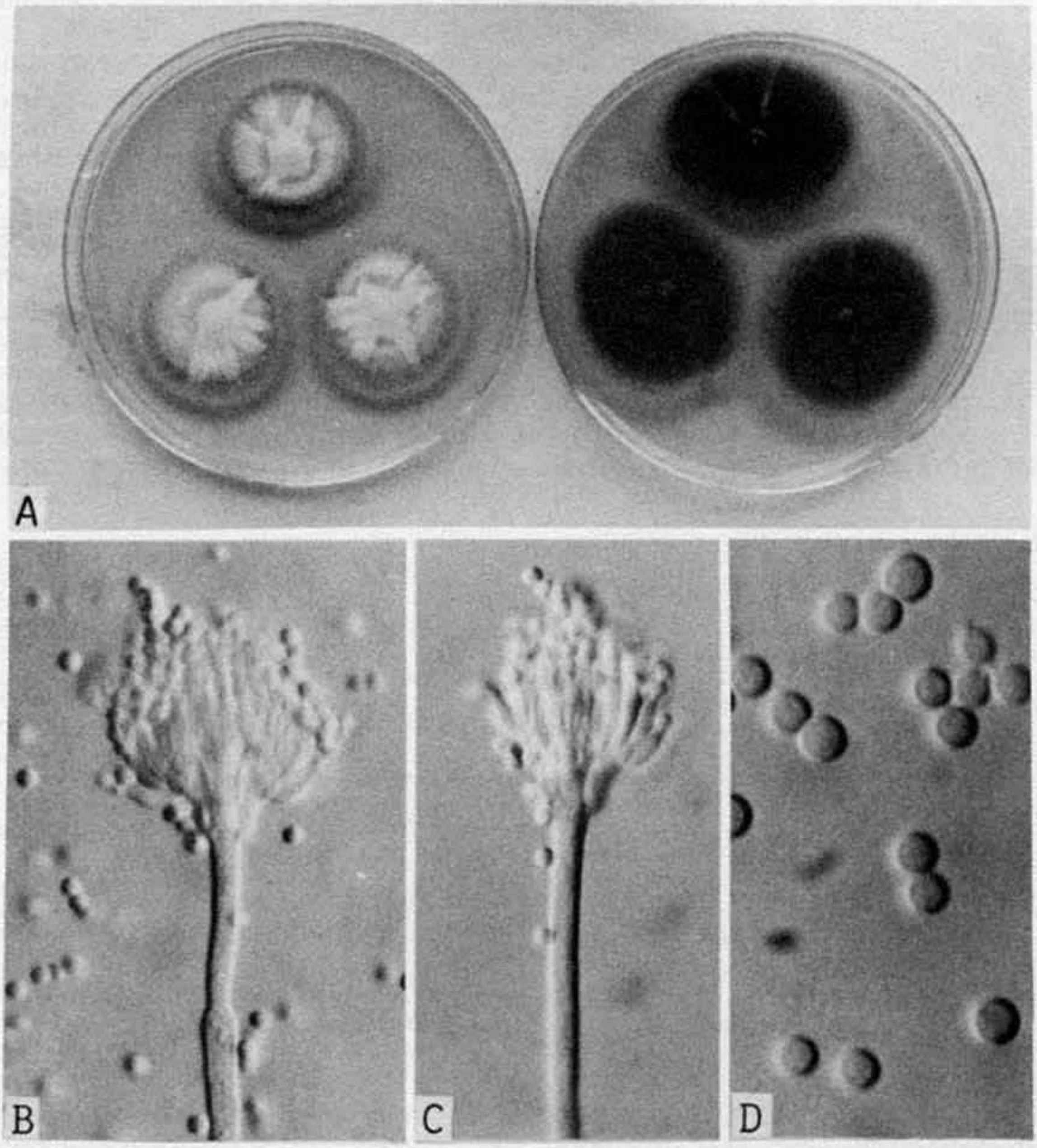

Fig. 3. Penicillium corynephorum. A, colonies on CYA and MEA, 7 days, 25°; B, C penicilli, X750; D, conidia, X1875.

appressed clusters of 4-6, asymmetrically vesiculate, swollen on the side away from the penicillus axis, fertile from the apex outward over the swollen area, 10-12 µm long, 2 µm diam at the base and 4.5-5.5 µm diam at the apices; phialides ampulliform, slender, 7-9 x 2.0-2.2 µm, inwardly curved in proportion to distance from the penicillus axis, with short collula; conidia spherical, 2.0-2.5 µm diam, smooth walled, borne in long uniform columns, one per stipe.

Typification. The herbarium specimen FRR 2663 is designated as holotype of Penicillium corynephorum. It was isolated from Indonesian dried fish, Decapterus sp., Sydney, N.S.W., Australia, 1983, J. I. Pitt. A culture of the type isolate has been accessioned by CMI as IMI 288724 and ATCC as ATCC 56976.

Distinguishing characteristics. The character of the Penicillium corynephorum penicillus is distinctive: appressed asymmetrically swollen metulae and slender phialides which curve according to distance from the penicillus axis, combine to produce a precisely formed penicillus bearing conidia in long, defined columns. The swelling below the first, and sometimes lower, septa of the stipes is unique in the genus. Bright yellow soluble pigment is usually produced on CYA at 25°.

Taxonomic position. In the classification of Pitt (1979), Penicillium corynephorum belongs in subgen. Furcatum. In the key to that subgenus (Pitt, 1979: 237) it will key out to couplet 26 along with P. novae-zeelandiae and P. raistrickii. It shows obvious affinities with these two species, but is readily distinguished by the absence of sclerotia and by the other characters listed above.

Isolates examined. Two isolates of this species have been isolated in this laboratory from Indonesian dried fish, FRR 2663, details above, and FRR 2676 (= IMI 288725, ATCC 56977), from Rastrelliger kanagurta, 1984, K. A. Wheeler.

Penicillium chalybeum Pitt & Hocking, sp. nov. Fig. 4

In agaro CYA coloniae veteres unius hebdomadis 42-50 mm diam planae vel irregulariter caperatae humiles moderate densae et velutinae; mycelium inconspicuum album; conidiogenesis moderate turcosa vel glauca; reverso pallido vel helvolo marginibus et centris atrovirenibus subinde olivaceis. Conidiophora portata ex hyphis submersis stipites 150-250 x 3.0-4.0 um parietibus crassis tuberculis; penicilli biverticillati 2-3 metulis terminalibus vel interdum subterminalibus; metulae 12-25 x 3.0-4.0 um parietibus asperis apicibus saepe dilatatis; phialides ampulliformes 9-15 x 2.0-2.5 um; conidia ellipsoidea 3.0-3.5 x 2.0-3.0 um parietibus crassis levibus portatis inordinate catenis.

Typus: Herb. FRR 2660, ex pisce sicca Java, Sydney, Novo Wallio, Australi, 1983, J. I. Pitt.

Etym.: Latin chalybeus = steel grey, and here refers to the unusual conidial colour of this species.

On CYA, 25°, 7 days, colonies 42-50 mm diam, plane or irregularly wrinkled, low, moderately dense, strictly velutinous; margins subsurface, fimbriate; mycelium inconspicuous, white; conidiogenesis moderate, in marginal areas Greyish Turquoise (24B-C3), elsewhere Greyish Green (25-26D2); exudate and soluble pigment absent; reverse characteristically pale brown to Golden Brown (5D7) with Dull to Deep Green (26D-F4) margins and central areas, occasionally Olive Brown (4D-F4) or similar colours in all areas.

On MEA, 25°, 7 days, colonies 50-60 mm diam, plane, low and sparse, strictly velutinous; margins subsurface; mycelium subsurface or inconspicuous; conidiogenesis light to moderate, Greenish Grey (25-26D2-3); exudate and soluble pigment absent; reverse pale, pale brown or Greyish Yellow near Wheat (4B5).

On G25N, 25°, 7 days, colonies 12-16 mm diam, plane, moderately dense, velutinous; margins and mycelium subsurface; conidiogenesis moderate, Dull Green near Almond Green (27-28E3); exudate and soluble pigment absent; reverse pale to greenish yellow or brown.

At 5°, CYA, 7 days, at least germination, usually microcolony formation, or barely visible colonies formed.

At 37°, CYA, 7 days, colonies 3-8 mm diam, dense and leathery, wrinkled, coloured brown or greyish if conidia produced; pale yellow soluble pigment usually produced; reverse usually Yellowish Brown (5C-E5).

Conidiophores generally borne from subsurface hyphae, stipes 150-250 x 3.0-4.0 µm, with stout, conspicuously roughened walls; penicilli a cluster of 2-3 terminal metulae, with sometimes a subterminal metula or cluster of metulae as well; metulae 12-25 x 3.0-4.0 µm, rough walled, often slightly enlarged apically; phialides ampulliform, in verticils of 6-12, measuring 9-15 x 2.0-2.5 µm, with undistinguished collula; conidia ellipsoidal, 3.0-3.5 x 2.0-3.0 µm, smooth walled, borne in disordered chains.

Typification. The dried herbarium specimen FRR 2660 is designated as holotype of Penicillium chalybeum. It was isolated from Indonesian dried fish, Decapterus sp., in Sydney, N.S.W., Australia, 1983, J. I. Pitt. A culture of the type isolate has been accessioned by CMI as IMI 288722 and by ATCC as ATCC 56975.

Distinguishing characteristics. This species is distinguished by rapidly growing, low, strictly velutinous colonies with an unusual smoky blue grey conidial colour, rough walled stipes and metulae in verticils of 2-3, sometimes with subterminal metulae as well, and often by unusual dull green marginal reverse colours on CYA.

Taxonomy. In the classification of Pitt (1979), Penicillium chalybeum is a member of subgen. Furcatum. In the key to that subgenus (Pitt, 1979: 237), it belongs in ser. Oxalica and will key to couplet 23 with P. rolfsii Thom and P. oxalicum Currie and Thom. Rough walled stipes distinguish P. chalybeum from the latter two species, and also suggest a possible affinity with P. raistrickii G. Smith and P. novae-zeelandiae van Beyma.

Isolates examined. Three isolates have been examined, from different samples of Indonesian dried fish: FRR 2660, type isolate, details above; FRR 2658 (= IMI 288721, ATCC 56974), from Trichogaster sp., and FRR 2659, from Decapterus sp., Sydney, N.S.W., Australia, 1983, J. I. Pitt.

Penicillium patens Pitt & Hocking, sp. nov. Fig. 4

In agaro CYA coloniae veteres unius hebdomadis 50-60 mm diam humiles et sparsae vel moderate densae velutinae radiatim sulcatae vel irregulariter caperatae; mycelium album involventia sclerotia; conidiogenesis sparsa vel moderata glauca; reverso castaneo vel brunneo. Sclerotia incolorata vel bruneola molles 130-200 x 130-150 um; teleomorphus absens. Conidiophora portata ex hyphis submersis vel paginis stipites 500-800 x 2.5-3.0 um parietibus tenuis et rugulosis monoverticillatae nonvesiculatae; phialides ampulliformae 8-10 x 2.5-3.0 um collulis decrescentibus; conidia ellipsoidea 3.0-3.5 x 2.0-2.5 um parietibus tenuis portatis inordinate catenis.

Typus: Herb. FRR 2661, ex pisce sicca Java, Sydney, Novo Wallio, Australi, 1984, J. I. Pitt.

Etym.: Latin patens = spreading, here referring to the colony habit of this species.

On CYA, 25°, 7 days, colonies 50-60 mm diam, low and sparse to moderately dense, strictly velutinous, finely radially sulcate or irregularly wrinkled; margins low; mycelium white, enveloping tardily developing sclerotia; conidiogenesis sparse to moderate, Greyish Green (27D3); exudate and soluble pigment absent; reverse orange to brown, in age sometimes becoming dark brown near Teak (6-7F5).

On MEA, 25°, 7 days, colonies 50-60 mm diam, low, sparse and velutinous, plane; margins subsurface; mycelium white, enveloping a layer of numerous, tardily developing sclerotia; conidiogenesis light to moderate, Dull Green near Nile Green (27-28D3); exudate and soluble pigment absent; reverse pale to dark brown near Teak (6F5).

On G25N, 25°, 7 days, colonies 15-18 mm diam, low to moderately deep,

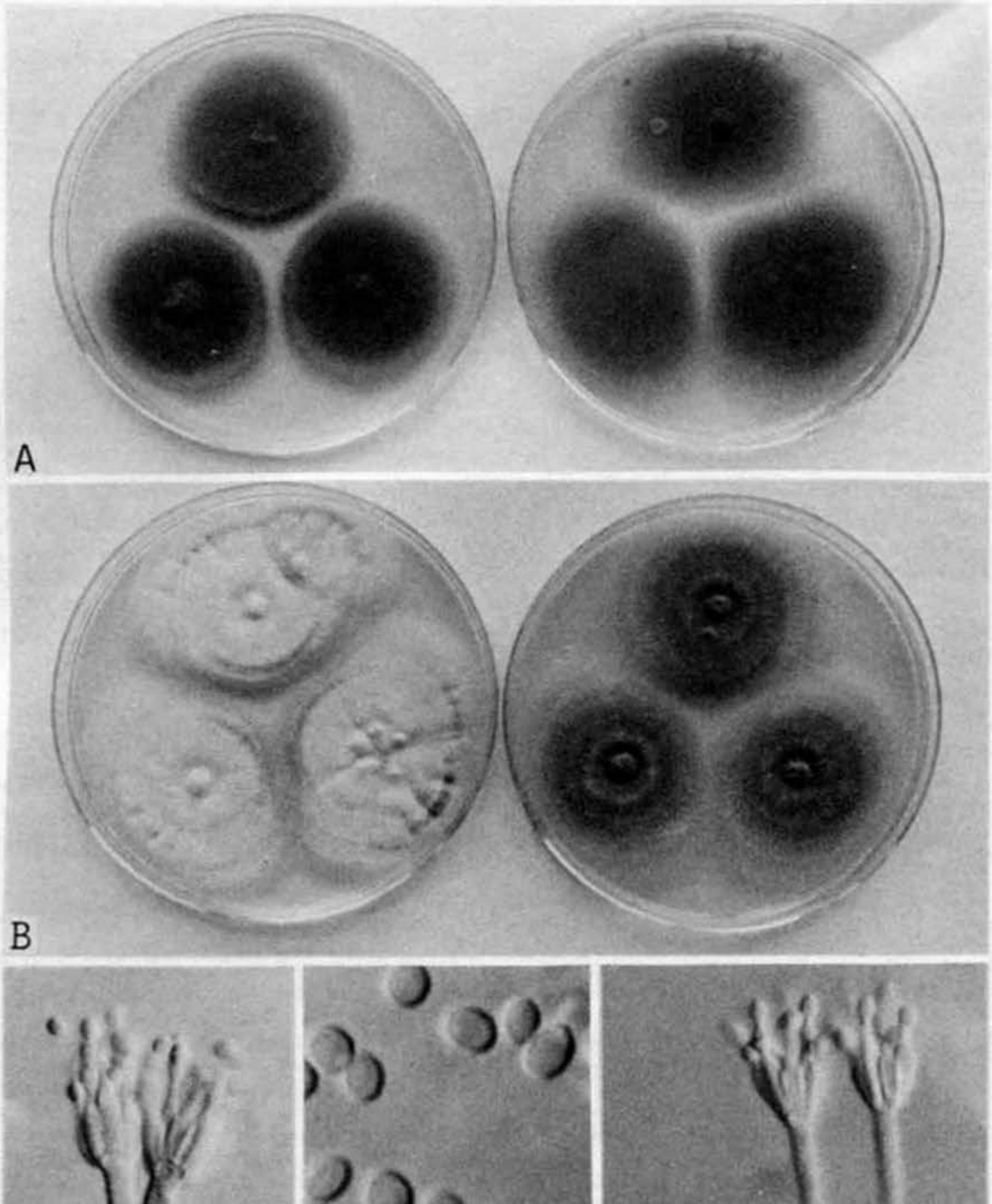

Fig. 4. Penicillium chalybeum and P. patens. A, C, D, P. chalybeum; A, colonies on CYA and MEA, 7 days, 25°; C, penicillus, X750; D, conidia, X1875. B, E, P. patens; B, colonies on CYA and MEA, 7 days, 25°; E, penicilli, X750.

dense, surface texture velutinous; conidiogenesis moderate to heavy, Greenish Grey (27-28D-E2); reverse pale.

At 5°, CYA, 7 days, at least germination, usually microcolonies formed.

At 37°, CYA, 7 days, no growth.

Sclerotia colourless to pale brown, soft, when mature 130-200 x 130-150 µm; teleomorph not known to be produced. Conidiophores borne from subsurface or surface mycelium, stipes long, 500-800 x 2.5-3.0 µm, with walls thin and finely to conspicuously roughened, strictly monoverticillate, nonvesiculate; phialides in verticils of 4-8, ampulliform, 8-10 x 2.5-3.0 µm, with short tapered collula; conidia ellipsoidal, 3.0-3.5 x 2.0-2.5 µm, smooth walled, borne in disordered chains.

Typification. The dried herbarium specimen FRR 2661 is designated as holotype of Penicillium patens, from Indonesian dried fish, Rastrelliger kanagurta, Sydney, N.S.W., Australia, 1984, J. I. Pitt. A culture of the type isolate has been accessioned by CMI as IMI 288723 and ATCC as ATCC 56980.

Distinguishing characteristics. This species is distinguished by velutinous, rapidly growing colonies with dark brown reverse colours, by nonvesiculate, strictly monoverticillate conidiophores and long, rough walled stipes.

Taxonomy. Penicillium patens is classified in sect. Exilicaulis of subgen. Aspergilloides in the classification of Pitt (1979). It will key within that subgenus to couplet 41 (Pitt, 1979: 168) along with P. donkii Stolk. The new species resembles P. donkii in some respects, including the production of pale brown, soft sclerotia and brown reverse colours. P. patens is distinguished from P. donkii by more rapid growth on all media at 25°, absence of growth at 37°, much deeper brown reverse colours, and long, rough walled stipes. Ecologically, the two species are quite distinct: P. donkii has been recorded only from soil in Alaska (Pitt, 1979: 191) and northern Canada (R. Summerbell, pers. comm.).

Isolate examined. This species is known only from the type isolate, FRR 2661, as detailed above.

Acknowledgements

This project was partly supported by a grant from the Australian Centre for International Agricultural Research. We are grateful to Dr P.E. Doe, University of Tasmania, Hobart, Ms E. Gorczyca, Royal Melbourne Institute of Technology, and Ms A. Angawatti, Research Institute for Fish Technology, Jakarta, for supplying the fish samples, and to Dr J. Bissett, Biosystematics Research Institute, Agriculture Canada, who checked the Latin descriptions. We acknowledge Ms L. Sigler, University of Alberta, Edmonton, for the initial suggestion that Scopulariopsis halophilica might belong in Basipetospora.

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