MYCOTAXON

Vol. XXV, No. 1, pp. 1-10 January-March 1986

NOTES ON ENTOMOPHTHORALES (ZYGOMYCOTINA) COLLECTED BY T. PETCH: *ERYNIA ANGLICA* COMB. NOV. AND *ERYNIA COLEOPTERORUM*

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ABSTRACT

Entomophthora anglica, a little known entomopathogen of *Agriotes sputator*, was found to possess uninucleate, bitunicate conidia and is herein transferred to the genus *Erynia* as *Erynia anglica* comb. nov. Furthermore, the morphology and dimensions of its conidia, resting spores and pseudorhizomorphs were found to coincide with those of a more recently discovered entomopathogen of *A. sputator*, *Erynia elateridiphaga*. The latter is herein considered as a junior synonym of *E.anglica*. The conidia of *Erynia coleopterorum*, another entomopathogen of Coleoptera, were also found to be uninucleate and bitunicate, thus ascertaining its place in this genus.

T. Petch surveyed for and collected numerous entomogenous fungi, most of which were described in his series "Notes on entomogenous fungi" published for almost three decades until 1948. During that time and until recently, entomogenous Entomophthorales were classified in three genera: *Entomophthora* Fresenius, 1856; *Empusa* Cohn, 1855, *sensu stricto* Nowakowski, 1883; and *Massospora* Peck, 1879.

The description of *Entomophthora anglica* Petch (1943) included only conidial dimensions and general shape, and the possession of rhizoids and conidiophores coalescing over parts of the host's body. Generic features such as the detailed morphology of conidiophores, number of nuclei in conidia and the conidial wall structure were not mentioned. Unmentioned as well were the structure of rhizoids and the presence or absence of capilliconidia, resting spores and pseudocystidia. The type occurred on an unidentified beetle "?*Plateumeris*", while other hosts were adults of *Agriotes sputator*, *Lochnoea suturalis*, and *Cantharis* sp.

Petch described in the same article (1943) the conidial stage of what he assumed to be another entomogenous fungus originally described

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by him earlier from resting spores and rhizoids only, *Entomophthora coleopterorum* Petch (1932). The conidial stage was characterised by long, narrow oval conidia, tapering cystidia, and a number of pseudorhizomorphs ("fascicles of rhizoids"), and attacked a coleopterous larva and *Sitones flavescens* adults. Petch's assumption about the conspecificity of the two stages was based on the similarity of the pseudorhizomorphs and attack of coleopterous hosts.

Recent classifications of the Entomophthorales follow the Batkoan classification in using generic-level criteria such as the structure and function of conidiophores, and the conidial nuclear number and conidial wall structure (for a review of Batkoan classifications see Ben-Ze'ev and Kenneth, 1982a). *Entomophthora anglica* could not be accommodated in any of the genera accepted by recent classifications (Remaudière & Hennebert, 1980; Remaudière & Keller, 1980; Humber and Ben-Ze'ev, 1981) due to lack of relevant characters in its description. Ben-Ze'ev and Kenneth (1982a) placed this species in *Entomophthora sensu lato*, a group devoid of generic status, proposed especially for such incompletely described species. *E.coleopterorum*, however, despite missing information on its conidial nuclear number and wall structure, was tentatively transferred to the genus *Erynia* Nowakowski, 1881, emend. Humber & Ben-Ze'ev (Humber and Ben-Ze'ev, 1981). Its transfer was based on the conjecture of characters described by Petch (1943) and known as characteristic of *Erynia* only.

This study, based on a reexamination of Petch's specimens of *E.anglica* and *E.coleopterorum*, aims to clarify the taxonomic position of the first fungus and to ascertain that of the second.

MATERIALS AND METHODS

The following specimens from the T. Petch collection were kindly lent by The Herbarium, Royal Botanical Gardens, Kew: R 1224 (*Entomophthora anglica* Petch, TYPE, coll. H. Barnes per W.G. Branley, Pickering, 6 June, 1938); R 775 (*Entomophthora anglica* Petch, on a beetle, Hornsea, 14 July, 1931); R 1228 (*Entomophthora anglica* Petch, on *Lochnoea suturalis*, Edinburgh, R.W.G. Dennis, 3 June, 1939); R 1039 (*Entomophthora anglica* Petch, on *Agriotes*, Canbs., Summer 1933); R 748 (*Entomophthora anglica* Petch, on *Agriotes*, Canbs., 3 May, 1931); R 757 (*Entomophthora coleopterorum* Petch, TYPE, on beetle {slide only} Holt House Wood, 12 June 1931); R 993 (*Entomophthora coleopterorum* Petch, Lartington, 16 September, 1933); R 1038 (*Entomophthora coleopterorum* Petch, on *Sitona flavescens*, Wick., 10 October, 1927 {specimen and slide}). All of Petch's specimens, unless otherwise stated, were packets containing dried insect and fungal material.

Another specimen containing dried insect and fungal remnants, including elytra of *Agriotes sputator*, was sent by Prof. G. Turian of the University of Geneva, Switzerland, at the request of the author to examine material of *Entomophthora carpentieri* Giard (as described by Turian, 1957).

Microscope slides were prepared from small pieces dissected from dried specimens. Mounting and staining media were lacto-phenol, lactophenol cotton blue (LPCB) and Zirkle's acetocarmine (Lee, 1950) for staining nuclei. Conidial measurements were accomplished with a divided ocular, calibrated with a stage micrometer so that each division

= 2.3µm, with an objective magnifying X 40 and ocular X 15.

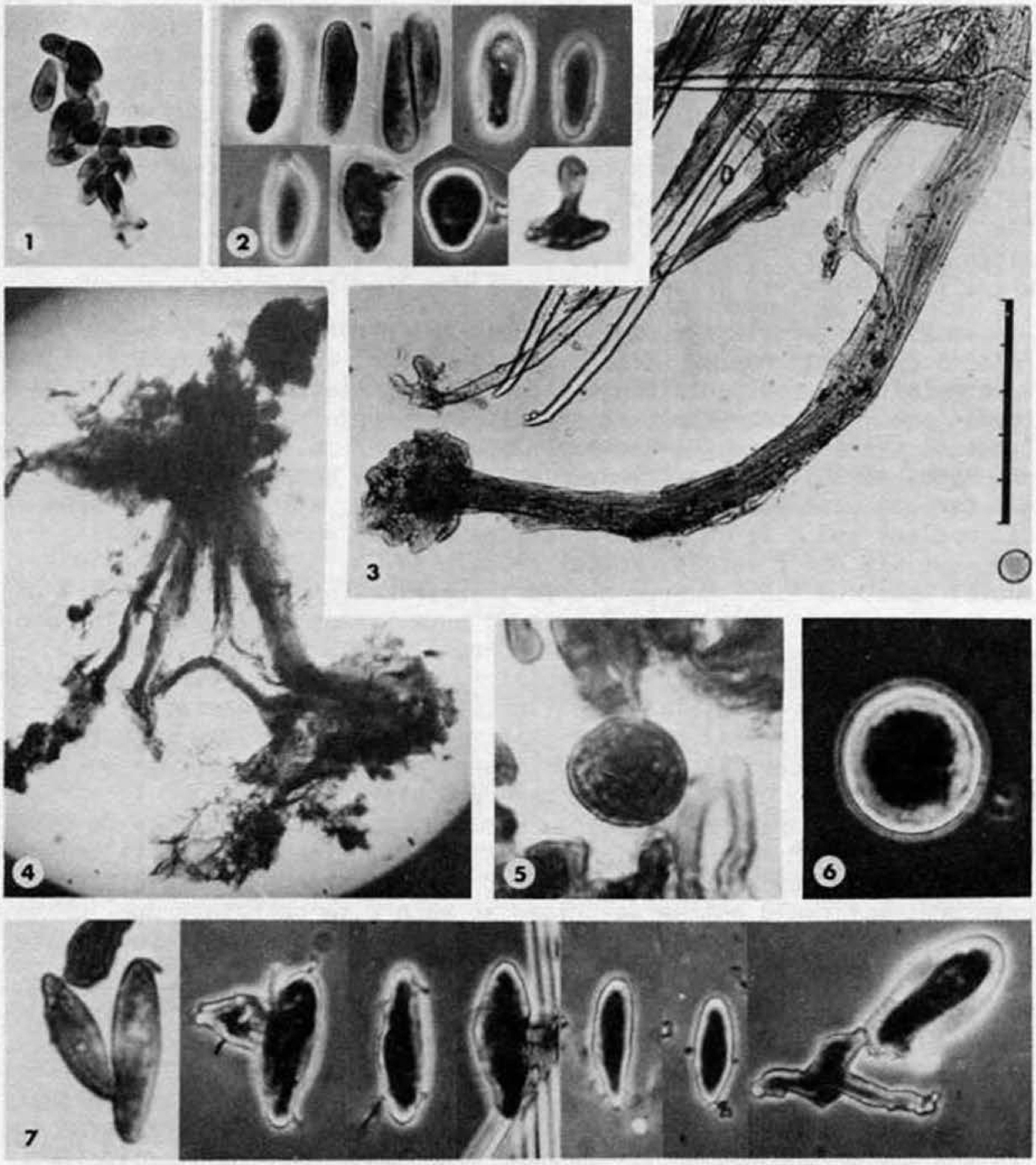
RESULTS

Two different species of *Erynia*, as defined by Humber and Ben-Ze'ev (1981), were found in Petch's *"Entomophthora anglica"* material. Conidia in the TYPE, R 1224, and in exsiccata nos. R 748 and R 1039 annotated *Agriotes* (*sputator*, as identified in Petch, 1943) resembled in shape *Erynia radicans* (Brefeld) Humber, Ben-Ze'ev & Kenneth in Humber and Ben-Ze'ev (1981) (Figs. 1,2). This fungus will be referred to below as *Erynia anglica*. Conidia in exsiccatum R 775 annotated "beetle" resembled in shape *Erynia nouryi* Remaudière & Hennebert (1980). This second species, which was absent in the type material of *E.anglica*, and did not match Petch's (1943) description of the latter, will be described elsewhere (Ben-Ze'ev, in preparation) as a new species, *Erynia suturaliis*.

In microscope slides (deposited at Kew) prepared by the author from Petch's exsiccata nos. R 1224 (*E.anglica* TYPE), R 748 and R 1039, there were relatively few conidia and the dried material was in a rather poor condition. Measurements of 72 conidia (combined from slides prepared from all three exsiccata) gave a total range of 16.7 - 33.4 X 8.0 - 13.8 µm. Some of the conidia observed had partially detached outer walls. All conidia observed had one, centrally located, ellipsoidal or spherical nucleus and a large vacuole located between nucleus and papilla — some conidia had a second, apical vacuole as well. Most ellipsoidal nuclei measured 4.6 X 6.8 µm and most spherical ones were 4.6 - 6.8 µm in diameter (stained with LPCB, viewed under phase contrast). The proportional papillar width of conidia (papillar width X 100/ conidial width) averaged 67%. Absolute papillar width was 5.2 - 7.5 µm ($\bar{x}$=6.4µm, s= 0.6 µm, n= 31). Absolute papillar length was very variable: 1.2 - 4.6 µm, and the longest papillae appeared to be associated with the less -well preserved conidia. It seems, therefore, that an average would be meaningless. One of the conidia observed was broad-pyriform (Fig. 2, lower row), uncharacteristic, and resembled *Erynia neopyralidarum* Ben-Ze'ev (1982). In some conidia the papilla was excentrically tilted (Fig. 2, upper left corner). Conidiophores appeared to be digitately branched, but could not be described as such with certainty due to their poor preservation. Pseudocystidia and capilliconidia, both unmentioned by Petch (1943), were not found.

Resting spores, unmentioned by Petch as well, were nevertheless found in his exsiccata nos. R 1224 (TYPE) and R 748. They measured 27.6 - 34.5 µm in diameter, with a wall thickness of 1.2 - 2.3 µm (Figs. 5,6). The shape, dimensions and length/ width (L/W) ratio of the largest conidia of *E.anglica*, as well as the dimensions of its resting spores and the morphology of its pseudorhizomorphs (Figs. 3,4) coincided very well with those of a well-described fungal pathogen of *Agriotes sputator*, *Erynia elateridiphaga* (Turian) Humber, Ben-Ze'ev & Kenneth in Humber and Ben-Ze'ev (1981). Conidial and resting spore dimensions of these species are compared in Table 1.

The *Entomophthora coleopterorum* material examined was found in very poor condition. Slides prepared from exsiccatum R 1038, as well as a slide prepared some years ago by S. Keller, contained no conidia or other recognizable structures except for disintegrating pieces of pseudorhizomorphs and mycelial debris. Shrunken and otherwise distorted conidia were present in slides prepared from exsiccatum R 993, together



Figs 1-6: Erynia anglica (=E.elateridiphaga) *from T. Petch's exsiccata. Figs 2-6 stained with LPCB. Bar (in fig.3) represents 50 µm in Figs 2, 5 and 6; 100 µm in Fig.1; 200 µm in Fig.3; and 500 µm in Fig.4.*

1. *Group of conidia, primary and secondary (acetocarmine).*
2. *Primary conidia (upper row) and secondary ones (lower row). The third conidium in the lower row has an aberrant shape, the extreme right one produces a tertiary conidium.*
3. *Pseudorhizomorph with discoid holdfast and scattered resting spores, one in the lower right corner.*
4. *Group of pseudorhizomorphs with holdfasts pointing downward.*

with many large pieces of pseudorhizomorphs and what could be imagined as ramified conidiophores. Seven conidia were in better shape than others and could be measured and photographed (Fig.7). The dimensions of these conidia were 27.6 - 41.4 X 9.2 - 15.0 µm, the most frequent length and width (3 out of 7) being 38.8 and 10.4 µm respectively. One of these conidia was clearly bitunicate (Fig.7, extreme right), and a few conidia were observed, under phase contrast optics, to be uninucleate (slides were stained with LPCB). Cystidia, as described by Petch (1943) were not observed, probably due to the condition of the material.

DISCUSSION

Entomophthora sphaerosperma Fresenius (now *Erynia radicans*) was recorded on *Agriotes obscurus* and *A.sputator* in the Soviet Union (Durnovo, 1935) without a description of its conidia. Turian (1957) described an attack of *E.sphaerosperma* Fres., subsp. *elateridiphaga* Turian on *A.sputator* in Switzerland. He proposed this subspecies on the grounds that its conidia were substantially larger than those of *E.sphaerosperma* found on leafhoppers (Homoptera) and on lepidopteran larvae. Remaudière et al.(1976) described in detail an attack of Turian's subspecies on *A.sputator*, and concluded that it deserved a full specific status, as *Entomophthora elateridiphaga*, which they left for Turian (1978) to propose formally. With the growing acceptance of the genus *Zoophthora* Batko (1964), *E.elateridiphaga* Turian became *Zoophthora elateridiphaga* (Turian) Ben-Ze'ev & Kenneth (1980). The realization that *Zoophthora* Batko, 1964, is a junior synonym of *Erynia* Nowakowski, 1881 (Remaudière & Hennebert, 1980) caused yet another transfer: *Erynia elateridiphaga* (Humber and Ben-Ze'ev, 1981).

Since its description by Turian (1957), *E.elateridiphaga* was compared to and found different from all known species of *Erynia* subgen. *Zoophthora* (Batko) Ben-Ze'ev & Kenneth (1982b)(=*Zoophthora* Batko, *sensu* Remaudière & Hennebert, 1980), and from *E.coleopterorum*, by various authors (Turian, 1957; 1978; Remaudière et al., 1976; MacLeod et al., 1979; Remaudière & Hennebert, 1980; Ben-Ze'ev, 1980; Ben-Ze'ev and Kenneth, 1980; 1981a; 1981b; Keller, 1980; Humber and Ben-Ze'ev, 1981). None of these authors mentioned *Entomophthora anglica*. From the rather large list of literature examined for classification purposes by the author (Ben-Ze'ev and Kenneth, 1982a; 1982b) it appears that the *E.anglica* material was largely ignored since Petch (1943) published its description. Waterhouse (1975) and Waterhouse and Brady (1982) mentioned this species and added information about "...cystidia ? long, narrow", undescribed by Petch (1943). As cystidia are absent in *E.elateridiphaga* and were not seen by me in Petch's *E.anglica* material on *Agriotes sputator*, the cystidia seen by Waterhouse (1975) match and were probably those of *Erynia suturaliis*(Ben-Ze'ev, in preparation) in Petch's material on *Lochnoea suturalis*.

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5. *Young resting spore produced in mycelial mat.*
6. *Mature resting spore with multiple-layered wall.*

Fig. 7: Erynia coleopterorum *from T. Petch's exsiccata. Conidia stained with LPCB. The conidium at the extreme right shows a bitunicate wall. The "germ-tube" belongs to a hyphomycetous contaminant. Bar (in Fig.3) represents here 50 µm.*

A comparison of *E.anglica* conidial morphology (Fig.2) with that of *E.elateridiphaga* (Turian, 1978, Fig.2; Remaudière et al., 1976, Fig.7) and conidial dimensions (Table 1) leaves no doubt that *E.elateridiphaga* should not have been described and classified as a new species if the authors involved had been familiar with *E.anglica*.

Most of Petch's descriptions of Entomophthorales lacked any figures (drawings or photographs), and he apparently did not consider conidial dimensions as important enough. As a result, several of his descriptions had been found to be incorrect: *Entomophthora aprophorae sensu* Petch (1934) turned out to be a new species, *Erynia petchii* (Ben-Ze'ev & Kenneth) Ben-Ze'ev & Kenneth (1981b; 1982b). *Entomophthora pyralidarum* Petch (1937) turned out to have been described from two different species mixed in his material: *Conidiobolus apiculatus* (Thaxter) Remaudière & Keller (1980) and *Erynia neopyralidarum* Ben-Ze'ev (1982). The present study of the collection of *E.anglica* found it containing two different species as well.

When comparing (in Table 1) the dimensions of primary conidia attributed by Petch (1943) to *E.anglica* with those of *E.elateridiphaga*, and when comparing the dimensions of secondary conidia in the two descriptions, no clear similarity between the two is apparent. However, it is this author's opinion that Petch (1943) decided arbitrarily that conidia of *E.anglica* up to 21 µm long were secondary, and that those over 22 µm long were primary. For those familiar with the genus *Erynia* it is a well known fact that primary conidia and secondary ones of type Ia (as defined in Ben-Ze'ev and Kenneth, 1982a and b) overlap in their dimensions, e.g. the dimensions of primary and secondary conidia of *E.elateridiphaga* cited in Table 1 (rows 1 and 5). When comparing the total range found in this study for *E.anglica* (which accounts for primary, secondary and very probably tertiary conidia as well) with the total range given for *E.elateridiphaga*, (primary + secondary conidia), the similarity becomes difficult to ignore. As an exercise, the measurements of *E.anglica* were divided into "mostly primary conidia" and "mostly secondary conidia" (Table 1, rows 4 and 7, respectively) by applying the lower limits of length and L/W found in primary conidia of *E.elateridiphaga* by Remaudière et al.(1976)(Table 1, row 1). The obtained group of "mostly primary conidia" contained 36 of the 72 conidia measured, and its dimensions fit rather well those of *E.elateridiphaga*. The slightly larger width and consequently smaller L/W ratio are attributed to some secondary conidia included inevitably, because of their overlapping length. The group of "mostly secondary conidia" (row 7) fits only partly the dimensions of secondary conidia of *E.elateridiphaga* (row 5). Here the discrepancy is caused by the presence of smaller conidia, with smaller L/W ratios, assumed to be tertiary conidia. Such a conidium, apparently being produced by a secondary one, is photographed in Fig. 2 (lower right corner). Resting spores found in this study agree perfectly in their dimensions (Table 1, row 10) and appearance with those of *E.elateridiphaga* (rows 8 and 9). Consequently, the following new combination and synonymy are proposed:

ERYNIA ANGLICA (Petch) Ben-Ze'ev, emend. et comb. nov.

Basionym: *Entomophthora anglica* Petch, 1943, Trans. Br. mycol. Soc. 26:89.

Synonyms: *Erynia elateridiphaga* (Turian) Humber, Ben-Ze'ev & Kenneth in Humber and Ben-Ze'ev, 1981, Mycotaxon 13: 509.

Zoophthora elateridiphaga (Turian) Ben-Ze'ev & Kenneth 1980, Entomophaga 25:181.

Table 1. *Comparison of conidial and resting spore dimensions (in µm) of fungi considered as synonyms of* Erynia anglica.

SOURCE	LENGTH (L) (min)- $\bar{x}$ -(max)	WIDTH (W) (min)- $\bar{x}$ -(max)	L/W RATIO (min)- $\bar{x}$ -(max)
	PRIMARY CONIDIA		
(1) *Remaudière et al.(1976)* (E.elateridiphaga)	(24)-29.2 -(36) >27	(7)-8.7-9.7-(10) >8.5	(2.4)-3.2-(4.4) 3.0 - 3.6
(2) *Turian (1978)* (E.elateridiphaga)	(?)- 29-32 -(?)	(?)- 9-10 -(?)	
(3) *Petch (1943)* (E.anglica)	(22) - (27)	(11) - (13)	
(4) *Present study: "mostly primary conidia" from Petch's material* (E.anglica)	(25.3)-27.6-(33.4)	(8.0)-9.8-(13.2)	(2.5)-2.9 -(3.5)
	SECONDARY CONIDIA		
(5) *Remaudière et al.(1976)* (E.elateridiphaga)	(21)- 25 -(28)	(7)- 9.9 -(12)	(2)- 2.5 -(3.2)
(6) *Petch (1943)* (E.anglica)	(18) - (21)	(10) - (11)	
(7) *Present study: "mostly secondary" conidia from Petch's* E.anglica	(16.7)-22.0-(28.8)	(8.0)-10.7-(13.8)	(1.3)-2.2-(2.7)
	RESTING SPORES (DIAMETER)		
(8) *Remaudière et al.(1976)* (E.elateridiphaga)	(27)-29.4-32.3-(34)		
(9) *Turian (1978)* (E.elateridiphaga)	30		
(10) *Present study from Petch's material, n=22*	(27.6)- 31.1 -(34.5)		

Entomophthora elateridiphaga Turian, 1978, Mitt. Schweiz. Entomol. Ges. 51:398.

The emendation merely combines Petch's (1943) formal description and the detais added in the present study with the more detailed descriptions given by Remaudière et al.(1976) and Turian (1978). The last two descriptions include data about capilliconidia and resting spores, unseen by Petch (1943) and are more accurate with regard to conidial dimensions. *E.anglica* replaces the junior synonym *E.elateridiphaga* in the subgenus *Zoophthora*.

Petch (1943) compared *E.anglica* with *Entomophthora nebriae* Raunkiaer; now *Erynia nebriae* (Raunkiaer) Humber & Ben-Ze'ev (1981), which has "...conidia...28-37 X 10-13 µm, and ... pale brown, smooth, globose resting spores, 35-50 µm diameter, produced outside the body of the host." These conidial dimensions are quite close to those of *E.anglica (=E.elateridiphaga)*. *E.nebriae* differs from *E.anglica* in the different size, color and site of production of resting spores, and in having different hosts.

The transfer of *Entomophthora coleopterorum* to *Erynia* (Humber and Ben-Ze'ev, 1981) appears to be justified in the light of the present findings. A nomenclatural problem is, however, involved. Petch's connection of the resting spore stage with the conidial stage found in other, different hosts, was considered only as probable by Petch (1943) himself. No proof for this connection was ever found by Petch or others, nor could any further evidence be found in the present study, considering the condition of the exsiccata. If and when this assumed connection is disproved, the resting spore stage will retain the specific epithet *coleopterorum*, and the *Erynia* stage will have to be described as a new species.

Petch (1943) considered that *E.coleopterorum*, validly published, is probably the same as *Entomophthora carpentieri* Giard (1888), published without description and therefore invalid. Turian (1957) found and described a fungus which he also thought to be *E.carpentieri*. Giard (1888) did not describe his fungus except for the statement that it attacked *Agriotes sputator* and fixed the infected insects to the plants by means of pseudorhizomorphs emerging from the ventral junction of the protothorax and mesothorax and behind the metathoracic legs. Both Petch (1943) and Turian (1957) relied on the similarity of the pseudorhizomorphs to claim similarity or identity between the species they found and *E.carpentieri*. The examination, in the present study, of *E.carpentieri* material sent by Prof. G. Turian, revealed only resting spores, identical in morphology and dimensions with those of *E.anglica* found in Petch's material and with those described by Turian (1957; 1978)and by Remaudière et al.(1976) as *E.elateridiphaga*. If they indeed belong to *E.anglica*, their finding in material annotated by Turian "*E.carpentieri*" is understandable, considering that both fungi attack the same host during June in Switzerland, and that material with the two fungi was collected by the same person (i.e. Turian, 1957). As for the probable identity of Giard's *E.carpentieri*, the host could indicate, by conjecture, *E.anglica*, but not *E.coleopterorum*. The fungus described by Turian (1957) as *E.carpentieri*, with bifurcately branched conidiophores, pseudorhizomorphs and uninucleate, spherical conidia appears to be an unusual species of *Erynia*. The very unusual conidial shape (for *Erynia*) is no longer unique — *E.neopyralidarum* also has subglobose and globose conidia (Ben-Ze'ev, 1982, Fig.2). Turian's (1957) fungus was not reencountered since 1953 and it lacks a detailed and formal description, whether it is *E.carpentieri* or a new species.

ACKNOWLEDGMENTS

The courtesy of the Curator of The Royal Botanical Herbarium, Kew, U.K., and Prof. G. Turian of the University of Geneva, Switzerland, in lending me specimens for study is gratefully acknowledged. I also thank

Prof. R.G. Kenneth of the Hebrew university of Jerusalem for his constructive review of the manuscript.

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MYCOTAXON

Vol. XXV, No. 1, pp. 11-14 January-March 1986

A NEW ENTOMOGENOUS SPECIES OF CORDYCEPS: CORDYCEPS ITHACENSIS SP. NOV.

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ABSTRACT

A new species, **Cordyceps ithacensis**, is described in **Cordyceps** subgenus **Eucordyceps**, section **Racemella** of Kobayasi's classification. It was found on a small dipteran larva of the family Erinnidae in the litter of a moist deciduous forest in the eastern United States.

Only one tiny stroma of a new **Cordyceps**, with its well-developed fertile part, has been collected in the course of mycocoenological studies performed on permanent plots in patches of riverside forests near Ithaca. This fungus was recorded as **Cordyceps** sp. in a list of species reporting these studies (Bujakiewicz, 1985) since its morphological features did not correspond with any of the hitherto described species. After more detailed study, the authors now consider it to be a new species, with the following description.

CORDYCEPS ITHACENSIS sp. nov. (Figs. 1-4)

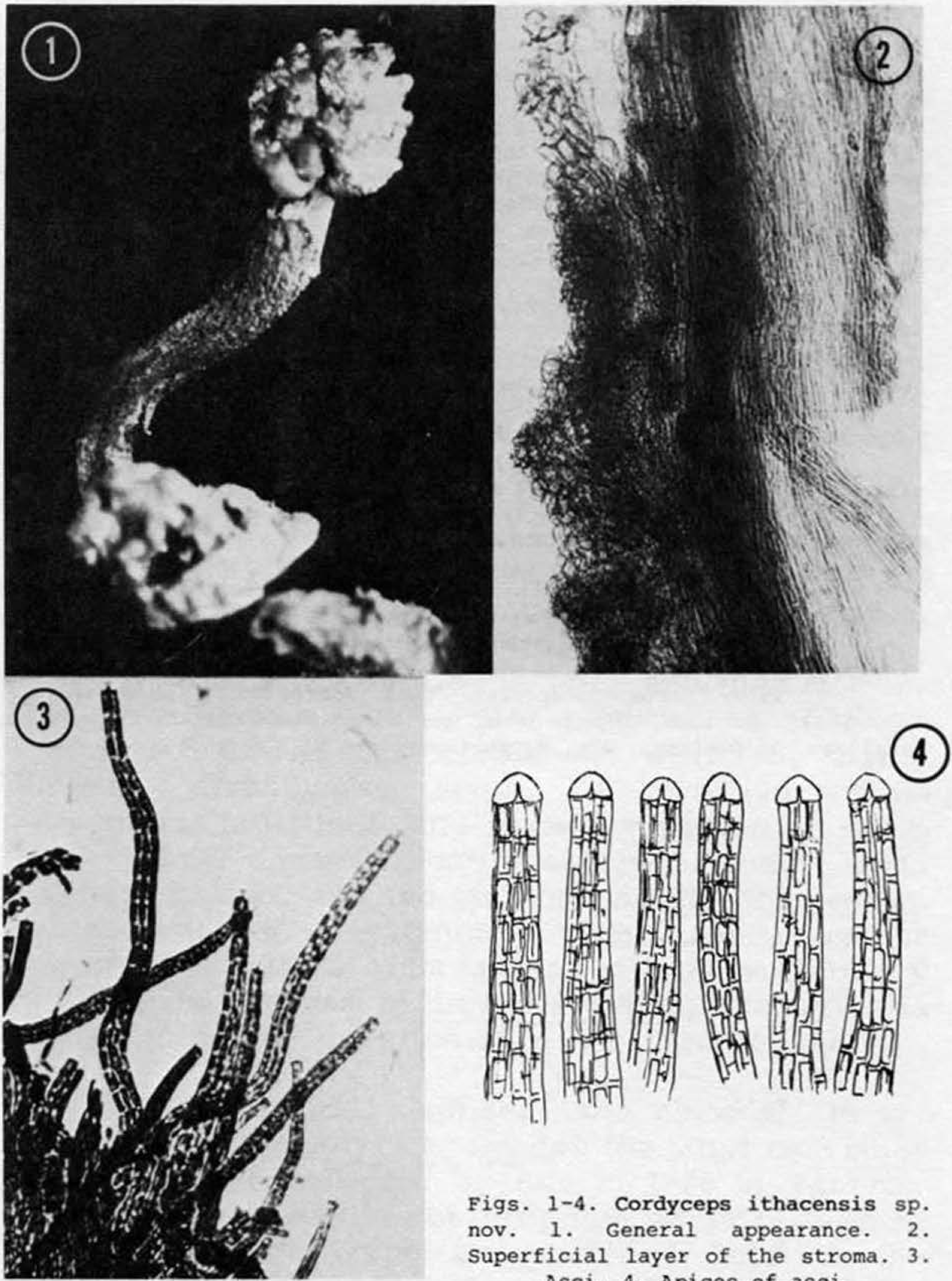
The host body filled with a pseudosclerotium composed of irregularly ramose and densely arranged hyaline hyphae rather uniformly narrow, diam 2.0-4.0 mm, with some slightly inflated segments up to 4.5 mm wide. Stroma (Fig. 1) single, helically twisted at the base, bent above, cylindrical, 4.9 mm long and 0.6 mm wide, rough over nearly the whole surface, cinnamon-brown except for a lighter, smooth, narrow ring just below the head. The internal part of the stroma formed of dense, parallel hyphae 2.0-5.5 mm diam, thinnest in the center, with septa regularly distributed at approx. 30 mm intervals, light yellow-orange in mass. Superficial layer composed of oval to subglobose cells, 6.0-12.5 X 4.0-7.0 mm, with brownish, somewhat thickened walls (Fig. 2). Fertile portion terminal, globose, 1.3 mm diam, tuberculate from radially arranged pear-shaped, orange perithecia 685-860 X 385-510 mm, a little darker in colour near the ostioles, with the bases of the perithecia immersed in the stroma up to ¼ or ½ of their total height. Perithecial walls composed of oval, globose, or obtusely multiangular cells 6.0-9.0 µm in diam with light golden-yellow contents and light orange walls. Hyphae of the subhymenial layer very thin-walled, slightly branched, 2.0-4.0 µm wide. Asci (Fig. 3) cylindrical, 260-340 X 8.6-10.0 (-10.7) µm, with domed capitula obtuse triangular in outline (Fig. 4), 4.7-5.5 µm wide at the base and 3.1-4.0 µm high. Ascospores filiform, 1.7-2.6 µm wide, multiseptate, ascospore articuli cylindric, truncate at both ends or with imperceptibly obtuse angles, (6.0-) 6.7-10.1 (-12.4) X 2.0-2.6 µm.

In a dipteran larva of the family Erinnidae in the litter of a deciduous forest (**Ulmus/Fraxinus/Carya**) in Fall Creek valley, NE of Ithaca, New York, USA, collected 29 October 1982, leg. Anna Bujakiewicz. The holotype specimen is assigned the number 542 in the Herbarium (Mycological Collection) of the Department of Plant Ecology and Environment Protection, Adam Mickiewicz University, Poznań, Poland.

Corpus hospitis mycelio composito ex hyphis hyalinis dense aggregatis, irregulariter ramosis, plus minusque aequiangustatis diametro 2.0-4.0 µm cum inflatis partibus ad 4.5 µm impletum. Stroma unum paulo flexuosum in basa heliciforme, longitudine 4.9 mm et 0.6 mm crassum, cum terminali capite globose delineato diametro 1.3 mm. Stipes cylindricus, in tota longitudine praeter minimam partem sub ipso capite asper, cinnamomeo-fulvus, in supera parte pallidior. Stratus superficialis stipitis ex ovalis vel subglobosis cellulis dimensionibus 6.0-12.5 X 4.0-7.0 µm cum incrassatis fulvis membranis compositus. Interiorem partem formant paralleliter aggregatae hyphae tenuiparietales, diametro 2.0-5.0 µm, in intervallis ca 30 µm septatae, in centro tenuissimae. Pars fertilis tuberculata, composita ex radialiter ordinatis pyriformibus peritheciis dimensionibus 685-850 X 385-510 µm, aureorufis, obscurioribus apud ostiola. Parietes peritheciorum compositae ex dense aggregatis cellulis ovalis, globosis vel obtuse-multiangulatis, diametro 6.0-9.0 µm, paulo aureo-flavis, cum fortius coloratis membranis. Hyphae partis subhymenialis tenuae, flexuosae, paulo ramosae, diametro 2.4-4.0 µm. Asci cylindracei 260-340 X 8.6-10.0 (-10.7) µm cum capitulis obtuse triangularibus vel fere subglobosis, in basa 4.7-5.5 µm latis et 3.1-4.0 µm longis. Ascosporae filiformes 1.7-2.6 µm crassae, multiseptatae; articuli ascosporarum cylindricaei utrinque truncati, raro cum paulo obtusis angulis, (6.0-) 6.7-10.1 (-12.4) X 2.0-2.6 µm.

In larva dipterorum e familia Erinnidae in silva foliacea (**Ulmus-Fraxinus-Carya**) in rivi valli Fall Creek prope urbem Ithaca in regione New York, USA, die 29 mense Octobre, anno 1982 coll. Anna Bujakiewicz. Holotypus in collectione Departamento Ecologiae Plantarum et Universitat A. Mickiewicz in Posnaniam, numero 542 designatus.

In accordance with the systematic arrangement proposed by Kobayasi (1941), the above described species should be included in the subgenus **Eucordyceps**, section **Racemella**, subsection **Confertae**. His key indicates the closest species to be **C. kirkii** Cunningham. Yet both the macro- and micromorphology and the systematic position of the host indicate that species to be remote from the fungus described here. Subsequent revisional works as well as those with descriptions of new species (Mains, 1957, 1958, 1959; Koval, 1961, 1974; Kobayasi, 1977) contain no species which would correspond with the morphology of the one described above. The only species known hitherto as infecting dipteran larvae is **C. corallomyces** Möller, reported from Brazil and the east-Asian part of the Soviet



Figs. 1-4. **Cordyceps ithacensis** sp. nov. 1. General appearance. 2. Superficial layer of the stroma. 3. Asci. 4. Apices of asci.

Union (Möller, 1901; Kobayasi, 1941; Koval, 1974). The colour of its stromata and heads resembles C. **ithacensis**, but the lateral arrangement of perithecial agglomerations, sometimes multileveled, and the dimensions of all elements of the fructification make these two species readily distinguishable.

ACKNOWLEDGEMENTS

Deepest thanks and appreciation are extended to Dr. Richard P. Korf for offering the second author such a wonderful opportunity to do research in the United States and for his generous help and invaluable assistance during these studies. Without the financial assistance of the Anna E. Jenkins Postdoctoral Fellowship from the Cornell University Plant Pathology Herbarium and the support of the Brethren Service - Polish Agricultural Exchange Program these studies could not have been effected.

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MYCOTAXON

Vol. XXV, No. 1, pp. 15-18 January-March 1986

On *Dinemasporium adeanum* Petrak.

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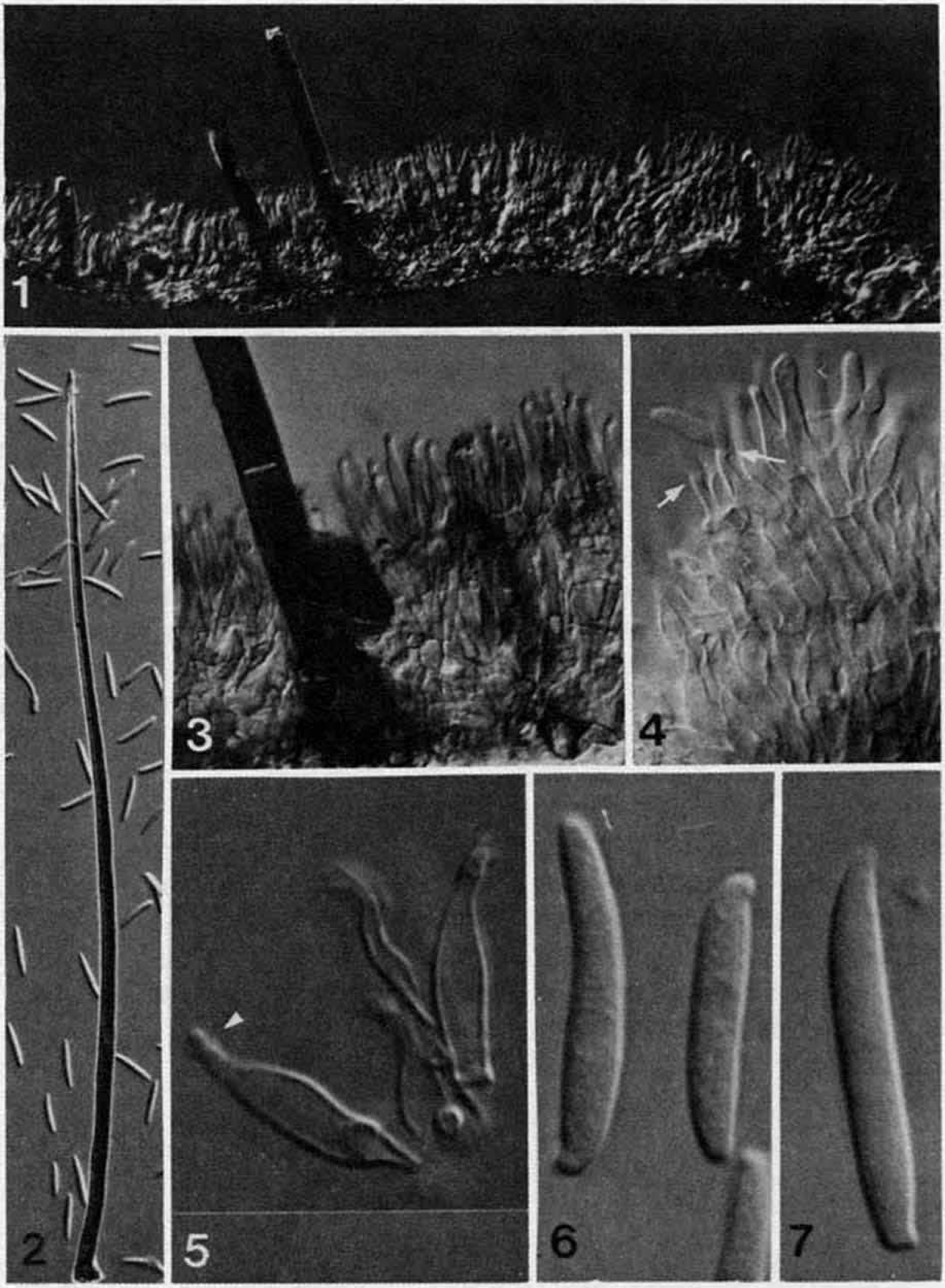
In his account of *Dinemasporium adeanum*, Petrak (1929) described the setose conidiomata as 'shallow bowl-shaped'; the conidiophores as lining the entire inner surface of the conidioma, simple, rod-shaped, more or less tuft-like at the base, strongly attenuated toward the apex and then more or less awl-shaped; and the conidia as 'narrow cylindric-fusiform, ... occasionally with 2-3, highly indistinct (transverse) septa, ... provided with a very short, indistinct, and almost evanescent, 1-2 µm long 'cilium' mostly only at one end.' Such characterization, and the fact that he did not mention the presence of an excipulum, would appear rather incongruous to those of us familiar with the morphology of a typical species of *Dinemasporium*; incongruous enough to raise a question about its correct identity.

Petrak (1929) applied the binomial to two collections, one on *Myrica faga* and the other on *Visnea mocanera*, both collected by Ade in 1926 in Tenerif, Canary Islands; he did not designate either of them as the nomenclatural type but included both in the protologue for the name. Through the courtesy of Dr. U. Passauer, we have examined both collections, distributed in 4 packets and housed in Petrak's Pilzherbarium in W. According to the labels on the packets, the 4 packets represent two sets of specimens -- one set acquired in 1971 and the other in 1973, but each packet has been labeled as type and assigned a different acquisition number. All four specimens are syntypes in the broad sense; but, as required by ICBN, we have selected the specimen on Visnea mocanera in the packet bearing the number 10366 as the 'lectotype' of D. adeanum on the basis of the abundance and good condition of the fungal material. The remaining three collections (packets No. 10358, 26911 and 29613) are 'paralectotypes'. A careful scrutiny of all four specimens revealed the same fungus which, however, did not belong in Dinemasporium Lév., as Figs. 1-7, derived from the lectotype, and the following short description, derived from a study of all specimens cited, will show.

Conidiomata sporodochial, hypophyllous, scattered to gregarious, superficial to semi-immersed, setose, covered by agglutinated, pearly white or waxy yellow masses of conidia; basal stroma of 'textura globulosa' to 'textura angularis', cells brown and thick-walled, gradually merging with a linear series of darker cells above and then with a loosely aggregated tissue of pale brown cells from which the setae and conidiophores arise. Setae unbranched, cylindrical to subulate with a slightly bulbous base, erect, dark brown and thick-walled below, lighter and thin-walled towards the apex, up to 15-septate, 300-680 µm long, 6-13 µm wide at the base. Conidiophores branched, septate, pale brown to subhyaline, smooth, up to 50 µm long. Conidiogenous cells phialidic, lageniform to subcylindrical with recurved apices and flaring collarettes, hyaline, smooth, 10-17 X 2-3.5 µm. Conidia cylindrical to naviculate, apex obtuse, base narrow and truncate, with a short papillate protuberance on one side, straight or slightly bent, unicellular, hyaline, smooth, 13-30 X 2.5-3(-3.5) ($\bar{x}$ = 22 X 2.7) µm.

The setose sporodochial conidiomata, phialidic conidium ontogeny, the lageniform to subcylindrical phialides with recurved apices and flaring collarettes, and the unicellular conidia with the



Figures 1-7. *Vermiculariopsiella immersa* ex lectotype of *D. adeanum* in W. Fig. 1. Vertical section of a conidioma. Fig. 2. Seta. Figs. 3, 4. Enlarged views of the conidial hymenium. Fig. 5. Phialides. Figs. 6, 7. Mature conidia. (Figs. 1, 2: ca X 189; Fig. 3: a X 480; Fig. 4: ca X 750; Figs. 5-7: X 2000. Arrows = phialides with developing conidia; arrowheads = flaring collarettes).

short papillate protuberance at the base marking the point of attachment, are characteristics of Vermiculariopsiella Bender. The morphological features and the quantitative characters outlined above are reminiscent of V. immersa (Desm.) Bender as redescribed and illustrated by Nag Raj (1983). The only perceptible difference between specimens typifying these two names being a slightly wider range of conidial width (2-3.5 µm) in the lectotype of D. adeanum compared to 2-2.5 µm for V. immersa isotype. Such variation could well result from ecological responses of the fungus and hence we dispose D. adeanum Petrak as a synonym of Vermiculariopsiella immersa (Desm.) Bender.

We are indebted to Dr. U. Passauer, W for the loan of the specimens cited in this study and to Dr. W. I. Illman, Carleton University, Ottawa for a critical review of this note. We are grateful to the Natural Sciences and Engineering Research Council of Canada for underwriting this research.

Nag Raj, T. R. 1983. Vermiculariopsiella Bender, an earlier name for Oramasia Urries. Mycotaxon 18(1): 159-163.

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MYCOTAXON

Vol. XXV, No. 1, pp. 19-25 January-March 1986

TAXONOMIC NOTES ON **DIATRYPELLA DISCOIDEA, DIATRYPELLA DECORATA,** AND **DIATRYPELLA PLACENTA**

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After examining type, authentic, and additional specimens **Diatrypella placenta** is neotypified and **D. discoidea** var. **alni** is considered to represent the same species. **Diatrypella discoidea** is relegated to synonymy with **D. decorata. Diatrypella decorata** and **D. placenta** were found to be distinguishable by color of entostromatic pseudoparenchyma and host. Although it eventually may prove necessary to combine the two species, it seems better at present to maintain them as distinct since these differences are fairly consistent. Ultimately, cultural studies and tests of host ranges may be useful in making a final decision regarding the status of these taxa.

Herbarium abbreviations follow Hawksworth (1974). Where no herbarium is cited the collection is in my personal herbarium.

Diatrypella placenta Rehm, **Hedwigia** 21: 117. 1882.

=**Diatrypella discoidea** Cooke & Peck var. **alni** Rav. **ex** Ell. & Everh. (as var. **alni** Cooke), **N. Am. Pyren.**, p. 587. 1892.

[≡**Diatrypella discoidea** Cooke & Peck var. **alni** Rav., in Ravenel, Fungi americani exsiccati, Century II, no. 188, 1878. **Nomen nudum.**]

Teleomorph: Stromata erumpent through bark, pulvinate, circular to oval, upper surface nearly flat to slightly convex, (1-)1.5-3(-4) mm X 0.75 mm thick, often coalescing. Surface initially tan, later reddish-brown with black stellate fissures radiating from the black perithecial ostioles, becoming black and smooth when overmature. **Perithecia** in one layer, **ca.** 0.5 mm diam. Interior region between perithecial necks occupied by mixture of white and reddish-brown pseudoparenchymatous tissue, appearing tan macroscopically. Ostioles distinctly three- to four-sulcate, circular, flattened. **Asci** spindle-shaped, long-stipitate, with refractive apical invaginations and slightly amyloid apical rings, multispored, **p. sp.** (35-)44-55(-62) X 4.4-6.6(-8) µm. **Ascospores** allantoid, slightly curved, subhyaline, (3-)4-5(-6) X 1(-1.5) µm.

Occurring on species of **Alnus.**

Anamorph: Not seen,

Comments: The type [S] apparently was immature when collected and is in very poor condition; no taxonomically significant characteristics remain. Fortunately, Rehm distributed this species in his "Ascomyceten" Exsiccati as no. 1984. Examination of specimens of that exsiccata [CUP, DAOM, K, M, MICH, NY, PAD] indicated that they are in good condition. Therefore, it seems better to regard the specimens distributed as no. 1984 of his exsiccatae as isoneotypes, rather than to attempt to fix the name for this fungus with the useless original type.

In the past, North American mycologists usually have used the above synonyms of **D. placenta** for this species. Glawe and Rogers (1984) cited Ellis and Everhart (1892) as listing Cooke as the authority for **D. discoidea** var. **alni.** As pointed out by Professor R. P. Korf (personal communication), this varietal name apparently was, in fact, first used by Ravenel for this fungus in his "Fungi americani exsiccati." Ravenel included no diagnosis on the packet label, but the name later was validated by Ellis and Everhart (1892).

The above description is based largely on one previously published for **D. discoidea** var. **alni** (Glawe and Rogers, 1984). Individual collections from throughout the world are quite similar, and as understood here, all known collections are from **Alnus** species. This fungus differs from the similar **D. decorata** in having a mixture of reddish-brown and white pseudoparenchyma within stromata, producing a macroscopically tan color rather than the usual white interiors of **D. decorata** stromata. In addition, the two fungi appear host-specific.

Specimens examined: AUSTRIA: Petrak, F., WSP 31398, VII.1939, Seehof bei Lunz, on **Alnus incana**. Rehm, H., S, TYPE, VIII.1874, Laengenthal near Kuehtai in Tyrol. (Oetz), on **Alnus viridis**. USA: COLORADO: Clements, F. E., and Clements, E. S., "Cryptogamae Formationum Coloradensium" no. 409, (ILL 10558), 17.VIII.1907, Wind River Canyon 2600 m, on **Alnus tenuifolia** [as "**Diatrypella aspera** (Fr.)

Nits."] IDAHO: Glawe, D. A., no. 79-15; no. 79-44 (WSP 66739), 79-298, 19.V.1979, Laird Park, Latah Co., on **Alnus** sp.; Rogers, J. D., WSP 56470, 16.VII.1964, farm wood lot on Rt. 95A 8 km SW intersection with Rt. 10, Kootenai Co., on **Alnus** sp. (as "**Diatrypella tocciaeanna** de Not."). OREGON: Brown, C. A., MICH, 4.XII.1925, Siskiyou Nat. Forest, Takilma, on **Alnus oregana** Nutt. (now known as **Alnus rubra** Bong.); Brown, C. A., MICH, 6.XII.1925, Siskiyou Nat. Forest, Takilma, on **Alnus oregana** Nutt. (now known as **Alnus rubra** Bong.); Denison, W. C., OSC 25088, 24.II.1968, Silver Falls, host not given, (as "**Diatrype disciformis**?"); Glawe, D. A., no. 80-229, 3.V.1980, Wildwood Recreational Area, near Sandy, Clackamas Co., on **Alnus rubra** Bong.; Glawe, D. A., no. 80-273 (WSP 66736), no. 80-315, 3.X.1980, Blue Pool Campground, near McCredie Springs, Lane Co., on **Alnus rubra** Bong.; Howell, C. R., det. S. C. Jong, WSP 57670, 23.VI.1963, 16 km NE Long Creek, Grant Co., on **Alnus** sp.; Waldron, H. M., Jr., WSP 51608, 23.VI.1963, 16 km N Long Creek, on **Alnus sinuata** (Regel) Rydb. (as "**Diatrypella discoidea** G. P. Clint. & Peck"). SOUTH CAROLINA: Ravenel, H. W., "Fungi americani exsiccati" no. 188, BPI, FH, PH, K, ISOTYPES, undated, Aiken, on **Alnus serrulata** (as "**Diatrypella discoidea** Cooke var. **alni**"). WASHINGTON: Glawe, D. A., no. 79-412 (WSP 66737), 16.IX.1979, 13 km S Forks, on Highway 101, Jefferson Co., on **Alnus rubra** Bong.; Glawe, D. A., no. 80-19, no. 80-21, no. 80-30, no. 80-43 (WSP 66738), no. 80-348, 11.VII.1979, Ike Kinswa State Park, Lewis Co., on **Alnus rubra** Bong.; Glawe, D. A., no. 79-282, 4.VIII.1979, no. 79-279, no. 80-49, no. 80-53, no. 80-92, 5.VIII.1979, Nooksack Campground, on Highway 542, Mt. Baker Nat. Forest, Whatcom Co., on **Alnus rubra** Bong.; Glawe, D. A., no. 79-311, 16.IX.1979, 3 km E Hoh, Hoh Trail, Olympia Nat. Park, Jefferson Co., on **Alnus rubra** Bong.; Glawe, D. A., no. 79-316, no. 79-395, no. 79-413 (WSP 66740), no. 80-1, no. 80-2, 15.IX.1979, North Fork Campground, Grays Harbor Co., on **Alnus rubra** Bong.; Hedgecock, C. G., det. J. Dearness, OSC 25460, 16.IV.1931, Mt. Summit to coast, Alladdin, on **Alnus tenuifolia** Nutt.; Jones, B. L., WSP 55335, 19.VII.1964, Big Spring Campground, NE 1/4 S 27 T9N R42W, Garfield Co., on **Alnus** sp. (as **Diatrypella tocciaena** de Not."); Suksdorf, W. N., WSP 27393, 21.VI.1894, White Salmon River, Klickitat Co., on **Alnus** (?) sp. USSR: Rehm, H., "Ascomycetes" no. 1984, VIII.1900, coll. Serebrianikow, CUP-F 3493, DAOM, K, M, MICH, NY, PAD, ISONEOTYPES, Schedenewo Prov., Jaroslawl., on **Alnus incana**; Tranzschel and Serebrianikow, "Mycotheca Rossica," VIII.1900, coll. Serebrianikow and Schestakow

(WIS), Schedenewo Prov., Jaroslawl., on **Alnus incana.**

Diatrypella decorata Nits., **Pyren. Germ.** p. 79. 1867.

=**Diatrypella discoidea** (Cooke & Peck) Sacc., Syll. Fung., Vol. I, p. 207. 1882.

≡**Diatrype discoidea** Cooke & Peck in Peck, **New York State Mus. Bull.**, No. 28, p. 71, 1876.

Teleomorph: Stromata erumpent through bark, pulvinate, transversely elliptical to oval, upper surfaces nearly flat, 1-2.5 mm across by 0.5-1 mm thick. Surface black to dark brown. **Perithecia** in one layer, **ca** 0.5 mm diam. Entostromatic parenchymatous region between perithecial necks usually white to yellowish white, infrequently with mixture of reddish-brown and white elements and appearing tan macroscopically. Ostioles well-developed, three- to four-sulcate, disc-shaped, flattened or rather prominent. **Asci** spindle-shaped, long-stipitate, with refractive apical invaginations and inamyloid apical rings, multispored, agglutinated; size (**p.sp.**) given by Nitschke (1867) as 40-48 X 5 µm. **Ascospores** allantoid, slightly to moderately curved, subolivaceous, 4-5.6(-6.4) X 0.8-1.6 µm.

Occurring on species of **Betula.**

Anamorph: Not seen.

Comments: This fungus is separated from **D. placenta** by its lighter-colored entostromatic tissue, and the host. Infrequently, collections of **D. decorata** contain tan-colored entostromata, resembling those of **D. placenta.** This suggests that the two species might be conspecific, or that **D. placenta** might sometimes occur on **Betula** where it can be mistaken for **D. decorata.** Further studies are needed to clarify this situation.

Petrak (1940) suggested that **Diatrypella discoidea** is a synonym of **D. decorata**, but apparently did not examine type material. Comparison of the types of **D. discoidea** and **D. decorata** leaves little doubt that the two names refer to the same fungus.

Examination of the type of **D. decorata** var. **major** Berl. [PAD] (Berlese, 1900-1905) indicated that it probably is not conspecific with **D. decorata.** The tan entostromatic pseudoparenchyma differed from that regarded herein as typical of **D. decorata**; in addition, that collection was from **Fagus.** Study of additional collections and cultural work are needed to clarify the status of **D. decorata** var. **major.**

Nitschke (1867) listed **Microstoma vulgare** Auersw. as a synonym of **D. decorata**, and listed Fuckel's "Fungi Rhenani" no. 1035 (distributed as **M. vulgare**) as illustrative material. That material is considered lectotypic of **D. decorata** but apparently does not represent **M. vulgare. Microstoma vulgare** first was described on a packet label in Rabenhorst's "Fungi Europaei" (no. 253). The name can be traced back to **Sphaeria microstoma** Pers. (Persoon, 1801), which was sanctioned by Fries (1823). The apparent Persoon type [L] appears to be a member of the Diaporthales while a second Persoon collection probably is diatrypaceous but is too decayed to be identified. A Fries specimen of **Sphaeria microstoma**, "Scleromyceti Sueciae" no. 185 [UPS], is a **Cytospora** species. The **Dictionary of the Fungi** (Hawksworth **et al.**, 1983) lists **Microstoma** Auersw. as a synonym of **Valsa.** Thus, all indications are that Fuckel's specimen was misidentified, and that **M. vulgare** cannot considered a synonym of **D. decorata.**

Specimens examined: AUSTRIA: Petrak, F., WSP 31400, IV.1928, M. -Weisskirchen, on **Betula alba**; Petrak, F., WSP 31397, Flora Moravica, VIII.1936, M.-Wesskirchen, on **Betula** sp.; Petrak, F., WSP 31399, IV.1938, M.-Weisskirchen, on **Betula** sp. CANADA: ALBERTA: Newman. J, det. Horner, R., WIS, 8.VII.1955, Kananaskis Forest Experiment Station, on **Betula glandulosa**; NOVA SCOTIA: Prince, A. R., no. 1129 (det. Wehmeyer, L. E., no. 104), MICH, 7.IX.1925, Guysboro Co., Westcooke's Grove, on **Betula** sp. (as "**Diatrypella discoidea** Cke. & Pk"); Wehmeyer, L. E., no. 477, MICH, 10.VII.1931, Colchester Co., Upper Brookside, on **Betula** sp. (as "**Diatrypella discoidea** Cke. & Peck"). ONTARIO: Dearness, J., "Fungi Columbiana" no. 1241, PH, WSP 1887, XI.1897, near Toronto, on **Betula** sp. (as "**Diatrypella discoidea** C. & P."); Horner, R., and Hill, A. W., det. Newman, J., WIS, IX.30.1950, Dorset, on **Betula lutea**; Horner, R. and Hill, A. W., det. Newman, J., no. YB 581, WIS, 2.X.1950, Dorset, on **Betula lutea**; Newman, J., Horner, R., and Hill, A. W., det. Horner, R., and Newman, J., no. YB-216, WIS, 5.X.1950, Clear Lake, Dorset, **Betula lutea.** GERMANY: Nitschke, T., "Fungi Rhenani" no. 1035, B, LECTOTYPE, date and location not given, on **Betula** (originally as "**Microstoma** [as "**Mycrostoma**"] **vulgare** Aw." sp.). ITALY: Anonymous, date and location not given, PAD, on **Betula**; Anonymous, date not given, Monte Germano, PAD, TYPE, on **Fagus** (as **D. decorata** Nits., annotated as "**D. decorata** f. **major**"). USA: COLORADO: Bonar, L, WIS, 9.VI.1923, Manitou, on **Betula fontinalis**; Clements, F. E. and Clements, E. S., "Cryptogamae Formationum

Coloradensium" no. 206, ILL 10559, 25.VI.1906, Minnehaha, on **Betula occidentalis** (as "**Diatrypella favacea** (Fr.) Ces. & De Not."). MAINE: Hansbrough, J. R, det. Dearness, J., MICH, 17.VII.1935, Norway, on **Betula lutea.** NEW YORK: Peck, C. H., "de Thuemen Mycotheca Universalis" no. 864, B, FH, K, NY (FH and K packets marked as "type"), IV.1877, Albany, on **Betula populifolia** (as "**Diatrypella discoidea** Cooke & Peck"); Peck, C. H., NY, "May," year not given, Center, host not given [as "**Diatrype (Diatrypella) discoidea** C. & P."]; Peck, C. H., NYS, TYPE, date not given, Center, on **Betula** sp. (as "**Diatrype discoidea** Cooke & Peck"); Weir, J. R., no. 19356, BPI, "May," year not given, Albany Co., Kasner, on **Betula populifolia** [as "**Diatrypella discoidea** (C. & P.)"]. WYOMING: Wehmeyer, L. E., no. 1080, MICH, 4.VII.1940, Jackson, Camp Davis, on **Betula glandulosa** (as "**Diatrypella discoidea** Cke. & Pk."). USSR: Jaczewski, Komarov, and Tranzschel, "Fungi Rossiae Exsiccati," no. 190, WIS, VI.1896, near Moscow, on **Betula alba**; Tranzschel and Serebrianikow, "Mycotheca Rossica," no. 327, VIII.1911, Berdicino, Prov. Jaroslawl., on **Betula** sp.

ACKNOWLEDGMENTS

Illinois Agricultural Experiment Station Project 68-0331. I thank the curators of the following herbaria for loaning specimens: B, BPI, CUP, DAOM, FH, ILL, K, L, M, MICH, NY, NYS, OSC, PAD, PH, S, UPS, WIS, WSP. I am grateful to Drs. J. L. Crane, Illinois Natural History Survey, R. P. Korf, Cornell University, and D. P. Rogers, Auburn, Washington for helpful comments and suggestions, and Drs. Crane, D. H. Pfister and J. Boise, Harvard University, and J. D. Rogers, Washington State University, for reviewing the manuscript.

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MYCOTAXON

Vol. XXV, No. 1, pp. 27-66 January-March 1986

THE "*PLEUROTUS SILVANUS*" COMPLEX

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ABSTRACT

Four species of fungi have been treated under the epithet *Agaricus (Pleurotus) sylvanus* Saccardo, in *Pleurotus* or *Resupinatus*. The type of *A. sylvanus* is a specimen of *Hohenbuehelia cyphelliformis* (Berk.) Miller, comb. nov. Other fungi mislabelled *sylvanus* are *Resupinatus alboniger* (Pat.) Singer, *Hohenbuehelia pinacearum* Thorn, sp. nov., and *Hohenbuehelia unguicularis* (Fr.) Miller, comb. nov. *Pleurotus atropellitus* Peck is lectotypified herein by a specimen that is *Resupinatus applicatus* (Batsch: Fr.) S.F. Gray. *Agaricus (Pleurotus) blakei* Berk. & Curt. is a synonym of *Panellus violaceofulvus* (Batsch: Fr.) Sing., and the type specimen represents the third known collection of this species from North America. The new combination *Hohenbuehelia mustaliensis* (Karsten) Thorn, based on *Agaricus mustaliensis* Karsten, is proposed.

INTRODUCTION

Agaricus (Pleurotus) sylvanus Saccardo was first described on the basis of a collection of fruit bodies on decaying stems of *Clematis*, in Selva, Italy (Saccardo, 1877). Since then, as *Pleurotus silvanus* (Sacc.) Saccardo*

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*Although the original spelling of *sylvanus* (Saccardo, 1877) must be accepted as correct, in accordance with Article 73.1 of the International Code of Botanical Nomenclature (Voss et al., 1983), most authors have followed Saccardo's later decision (1887, p. 379) to change the spelling to *silvanus*. The spelling of choice of cited authors is used thoughout this paper.

(1887) or ***Resupinatus silvanus*** (Sacc.) Singer (1951), this species has been reported to occur on a wide range of angiosperm and gymnosperm hosts in much of Europe (Pilát, 1935), the United States (Coker, 1944), Ecuador and Argentina (Singer, 1952), Morocco (Malencon & Bertault, 1975), and Tanzania (Pegler, 1977). During a study of species of ***Hohenbuehelia*** and ***Resupinatus*** in Ontario (Thorn, 1985), it became apparent that the name ***Resupinatus*** (or ***Pleurotus***) ***silvanus*** had been applied to three distinct fungi that were recognizable on the basis of morphology and habitat. None of these fungi agreed well with the description of ***Agaricus sylvanus*** Saccardo (1877). This paper interprets some of the past taxonomic confusion surrounding ***A. sylvanus***, and provides the correct names and descriptions for the species to which this name has been misapplied.

Thorn and Barron (1984) reported that ***Resupinatus silvanus*** and five species of ***Hohenbuehelia*** were nematophagous and had anamorphs belonging in the genus ***Nematoctonus*** Drechsler (1941). This report incorporated the prevailing taxonomic confusion of ***R. silvanus***. It was subsequently found that the voucher specimen (DAOM #159734) for the culture Thorn and Barron (1984) cited as ***R. silvanus*** is ***Hohenbuehelia unguicularis*** (Fr.) Miller. We now believe that all species of ***Hohenbuehelia*** Schulzer (Schulzer et al., 1866) have ***Nematoctonus*** anamorphs and are nematophagous, but that species of ***Resupinatus*** S.F. Gray (1821) do not have ***Nematoctonus*** anamorphs, and are non-nematophagous. ***Hohenbuehelia*** has traditionally been separated from ***Resupinatus*** by the presence of hymenial metuloids, which are absent in ***Resupinatus*** (Singer, 1951). This distinction still holds true, but several species of ***Hohenbuehelia*** have previously been classified in ***Resupinatus*** because their hymenial metuloids are particularly inconspicuous. The metuloids of ***Hohenbuehelia*** are metachromatic in a 0.05 % (w/v) aqueous solution of Brilliant Cresyl Blue (Donoso, 1981), and turn bright magenta in contrast to other hymenial elements that turn pale blue. Cresyl blue thus renders the inconspicuous metuloids of certain species of ***Hohenbuehelia*** clearly visible. The metuloids of these species are described and illustrated herein for the first time.

A HISTORY OF MISAPPLICATIONS

Saccardo (1877) described the fruit bodies of ***Agaricus sylvanus*** as cupulate, 5-8 mm broad, grey to black, with distant, dirty-white gills and strongly curved, cylindric spores. This description, and the occurrence of Saccardco's fungus on *Clematis*, is strongly reminiscent of *Agaricus cyphelliformis* Berkeley (1837), described from stems of *Penstemon*. Examination of the type specimen of *Agaricus sylvanus* confirmed this suspicion.

Three other species misidentified as *Pleurotus* (or *Resupinatus*) *sylvanus* are, at first glance, very similar to each other. Their fruit bodies are cupulate to flabelliform, grey to black, gelatinized, and generally less than 1 cm broad. They have grey, brown or black gills, and hyaline, inamyloid spores that are elliptical in face view and slightly concave on the adaxial face in profile view (phaseoliform). Two species form jet black or blue-black basidiomes that are nearly glabrous in age, with at most fine, white floccose tufts or wisps scattered over the surface of the cap. One of these species occurs on conifers and usually forms a conspicuous lateral pseudostipe. The other occurs on woody dicots and is sessile and dorsally attached. The third species forms flabelliform or cupulate basidiomes with a lateral pseudostipe, that are densely villose with coarse buff-coloured or greyish hairs over the disk and pseudostipe. It occurs on hardwood twigs or logs.

The species found on conifers is *Pleurotus silvanus* sensu Josserand (1933). Josserand reported that two different fungi had been treated by various authors under the name *Pleurotus applicatus* (Batsch: Fr.) Quélet: one with approximately spherical spores, and the other with elliptical spores. Josserand identified the spherical-spored species as the true *P. applicatus*, following the tradition of Massee (1902), Bresadola (1928), Lange (1930), Pilát (1930) and others. Josserand believed that the elliptical-spored species that Quélet (1888) and Rea (1922) had described under *P. applicatus* was the same species that had been collected in the Lyon area of France on *Abies* and *Picea*. Josserand called this species *P. silvanus* with some hesitation, noting the differences in habitat and spore curvature, but he could find no other species of *Pleurotus* in the literature with a description that matched his collections any better. Krieglsteiner (1979) has provided a more recent and detailed account of the occurrence in Germany of *P. silvanus* sensu Josserand (as *Resupinatus silvanus*). A collection cited by Josserand (1933) as *P. silvanus* was examined and found to be conspecific with collections seen from North America. These collections represent a species of Hohenbuehelia, but their hymenial metuloids are particularly inconspicuous and are clearly visible only in cresyl blue.

The mycological literature was searched for a valid name applicable to ***P. silvanus*** sensu Josserand. Since the coniferous habitat was considered of primary importance, the list of possibilities was rapidly narrowed to ***Agaricus* (*Pleurotus*) *blakei*** Berkeley & Curtis (1859), collected on ***Abies*** in Maine, U.S.A.; ***Agaricus mustaliensis*** Karsten (1876), on ***Pinus*** in Finland; and ***Pleurotus atropellitus*** Peck (1886), on both hardwoods and conifers in eastern U.S.A. None of the type specimens (see below) was conspecific with ***Pleurotus silvanus*** sensu Josserand. ***Agaricus blakei*** Berk. & Curt. is a synonym of ***Panellus violaceofulvus*** (Batsch: Fr.) Singer; ***Agaricus mustaliensis*** is ***Hohenbuehelia mustaliensis*** (Karsten) Thorn; and ***Pleurotus atropellitus*** Peck is a synonym of ***Resupinatus applicatus*** (Batsch: Fr.) S.F. Gray. Therefore, ***Hohenbuehelia pinacearum*** Thorn is proposed for ***P. silvanus*** sensu Josserand.

Pleurotus silvanus sensu Coker (1944) is the species with nearly glabrous, jet black, sessile basidiomes growing on hardwoods. Pilůt (1935) originally identified this fungus as ***P. silvanus***, but the specimens cited under ***P. silvanus*** in his monograph of ***Pleurotus*** included both this species ("Blake 1859, as ***P. niger***, Maine, U.S.A., in herb. Burt") plus ***H. pinacearum***, and the type of ***P. silvanus***, which is ***H. cyphelliformis***. Coker (1944) believed that he had the same concept of ***P. silvanus*** as Pilůt (1935), because he had studied the Maine specimen cited by Pilůt. ***Pleurotus silvanus*** sensu Coker is macroscopically almost indistinguishable from ***H. pinacearum***, except by habitat. Coker reported what is clearly ***H. pinacearum*** under ***P. unguicularis***, saying that, "before we had found a name for our plant we had thought to call it a variety of ***silvanus***." Coker was probably misled by Pilůt's citation of collections of ***P. unguicularis*** from ***Abies***.

Miller (in Miller and Manning, 1976; and Miller, in press) has maintained Coker's concepts of ***P. silvanus*** and ***P. unguicularis***, and provided an additional important detail about ***P. silvanus*** sensu Coker: the cuticular hyphae are brown-walled and have "staghorn branches". This species has a rameales structure in the cap cuticle, has diverticulate cheilocystidia, lacks metuloids, and the habitat differs from that of ***H. pinacearum***. In addition, a culture of ***H. pinacearum*** (R.G. Thorn #831015/04) produced conidia and adhesive nematode-trapping devices typical of the genus ***Nematoctonus*** Drechsler (1941, 1946). A culture of ***P. silvanus*** sensu Coker, received from Miller (VT #1364), produced no conidia and was not nematophagous under test conditions described by Thorn and Barron (1984). ***Pleurotus silvanus*** sensu Coker is clearly not a ***Hohenbuehelia***, but is a species of ***Resupinatus***.

Singer (1952) also studied "Blake 1859", cited by Pilát (1935) and Coker (1944) as ***P. silvanus*** and based his report of the occurrence of ***R. silvanus*** in Ecuador and Argentina on that species concept, listing "***P. alboater*** Patouillard" [sic] as a synonym. Singer (1978) later decided that the South American material was different from ***R. silvanus***, and proposed the new combination ***Resupinatus alboniger*** (Pat.) Singer (based on ***P. alboniger*** Patouillard, 1893, from Ecuador). The description of ***R. alboniger*** (Pat.) Singer (1978) matches ***P. silvanus*** sensu Coker very well. The type specimen of ***P. alboniger*** Pat. (Quito, 1 fevrier 1892, leg. Lagerheim, FH !) differs in some minor details from the few North American collections seen, but these are not considered worthy of specific distinction. The correct name for ***Pleurotus silvanus*** sensu Coker is therefore ***Resupinatus alboniger*** (Pat.) Singer.

The third species that has been identified as ***P. silvanus*** is ***Pleurotus unguicularis*** (Fr.) Quélet, as described by Lange (1937) but not Coker (1944) or Miller (in press). The fruit-bodies of ***P. unguicularis*** are brownish or black, sometimes with a silver frosting, are villose or tomentose over the disk and pseudostipe, and have grey to brown to black lamellae with white margins. Macroscopically, ***P. unguicularis*** is very similar to ***Resupinatus applicatus*** (Batsch: Fr.) S.F. Gray, in the restricted sense of Coker (1944). Microscopically, it is readily distinguished from ***R. applicatus*** by its elliptical spores and inconspicuous metuloids with brown-walled bases and crystal-encrusted apices. The bases of the basidia and basidioles of ***P. unguicularis*** are also brown, but not as dark as the bases of the metuloids. Because of its metuloids, and ***Nematoctonus*** anamorph (Thorn and Barron, 1984, as ***R. silvanus***), ***P. unguicularis*** is clearly a species of ***Hohenbuehelia***.

The following key should facilitate identification of species in this group. The character "Q" represents spore length divided by width. Spore lengths do not include the hylar appendage.

KEY TO THE SMALL, DARK, GILLED MEMBERS OF *HOHENBUEHELIA* AND *RESUPINATUS* OF CANADA

1\. Spores ovate, elliptic, cylindric or allantoid
   ($Q \geq 1.7$; Qavg usually ≥ 2.0) 2
1\. Spores globose or subglobose ($Q \leq 1.3$, Qavg near 1.1).. 9
   2. Lamellae remaining pale in age: white,
      greyish-white or yellowish 3
   2. Lamellae dark, or becoming dark by maturity 4
3\. Spores cylindric, slightly to disctinctly curved,
   8-10 (11.5) X 3.0-3.8 (4.2) µm; pileus grey to brown,
   black when dry, with fine white wisps or scales ....
   .... ***Hohenbuehelia cyphelliformis***
3\. Spores elliptic-phaseoliform, 6.5-9.0 X 3.2-4.5 µm;
   pileus pale to dark brown or blue-black, villose or
   tomentose ...... ***Hohenbuehelia atrocaerulea*** (Fr.) Singer*
   4. Metuloids present in hymenium, often inconspicuous
      except in cresyl blue mounts 5
   4. Metuloids absent from hymenium; cheilocystidia
      fusoid-ventricose to diverticulate; epicutis a
      rameales structure; on woody dicots ....
      .... ***Resupinatus alboniger****
5\. Pileus nearly glabrous, with at most fine white wisps
   or scales, jet black or blue-black 6
5\. Pileus prominently tomentose or villose;
   grey, brown, or black 7
   6. Metuloids prominently projecting, visible
      under 10X on lamellar faces; on hardwoods ......
      .... ***Hohenbuehelia nigra*** (Schw.) Singer*
   6. Metuloids not projecting prominently; lamellar
      faces at most atomate under 10X due to crystal-
      encrusted metuloid apices; on conifers ....
      .... ***Hohenbuehelia pinacearum***
7\. On conifers; pileus black, with dense pallid or
   dark tomentum; metuloids projecting prominently .....
   .... ***Hohenbuehelia mustaliensis****
7\. On hardwoods 8
   8. Metuloids projecting prominently; spores
      9-13.5 X 4.5-6 µm; pileus warm brown,
      usually with darker tomentum ....
      Hohenbuehelia reniformis (Mey.: Fr.) Sing. sensu Fr.*
   8. Metuloids not projecting prominently, with
      clavate, hyaline apices; spores 6-8.5 X 3-4 µm;
      pileus dark, often with silvery crust, and with
      buffy tomentum .... ***Hohenbuehelia unguicularis***

9. Pileus conspicuously villose or tomentose over disk and pseudostipe, cupulate to flabelliform, 5-20 mm broad; on hardwoods 10
9. Pileus glabrous to pruinose (with at most a fringe of white "tomentum" at point of attachment from basal mycelium), cupulate and dorsally attached; on hardwoods and conifers .... **Resupinatus striatulus** (Pers.: Fr.) Murr.*
   10. Pileus tomentum buffy or grey .... **Resupinatus applicatus** (Batsch: Fr.) S.F. Gray*
   10. Pileus tomentum dark brown or black, often forming a distinct mat over disk .... **Resupinatus trichotis** (Pers.) Sing.*

*Not treated   **Not known from Canada

SPECIES DESCRIPTIONS

Hohenbuehelia cyphelliformis (Berk.) Miller, comb. nov.[1]
Figures 1 A-B, 2 A-H, 10 A-C.
Basionym: *Agaricus cyphelliformis* Berkeley (1837: 511)
≡ **Pleurotus cyphelliformis** (Berk.) Saccardo (1887: 379)
≡ **Resupinatus cyphelliformis** (Berk.) Singer (1951: 253)
≡ **Geopetalum cyphelliforme** (Berk.) Kuehner & Romagnesi, nom. invalid. (1953: 68)
= **Marasmius spodoleucus** Berkeley & Broome (1859: 358), fide Singer (1975)
≡ **Pleurotopsis spodoleucus** (Berk. & Br.) Earle (1909: 412)
= **Agaricus (Pleurotus) sylvanus** Saccardo (1877: 1)
≡ **Pleurotus sylvanus** (Sacc.) Saccardo (1887: 379; as **silvanus**)
≡ **Acanthocystis sylvana** (Sacc.) Konrad & Maublanc (1937: 309 II; as **silvanus**)
≡ **Resupinatus sylvanus** (Sacc.) Singer (1951: 253; as **silvanus**)
≡ **Geopetalum sylvanum** (Sacc.) Kuehner & Romagnesi, nom. invalid. (1953: 68; as **silvanum**)

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[1] This and other new combinations by Miller are also proposed in the proceedings of the 1984 Tricholomataceae symposium (Miller, in press), the publication of which has been delayed. These combinations are duplicated herein, to ensure the priority and valid publication of Miller's combinations.

= ***Marasmius broomei*** Berkeley (in Berkeley and Broome, 1879: 209), fide Singer (1975)
= ***Pleurotus campanulatus*** Peck (1891: 131), fide Smith (1934)
≡ ***Resupinatus campanulatus*** (Peck) Murrill (in Murrill et al., 1915: 241)
= ***Urceolus sambucinus*** Velenovský (1939: 44), cf. Horak (1968)

SELECTED DESCRIPTIONS AND ILLUSTRATIONS: North America: Peck (1891: 131, pl. 2 fig s. 13-15; as ***P. campanulatus***), Smith (1934: 482, pl. 10, fig. 2). Europe: Berkeley (1837: 511, Tab. 15, fig. 3), Saccardo (1877: 1-2; as ***A. sylvanus***) Pilát (1935: 71, Tab. 21, figs. 2, 3, 6).

DESCRIPTION OF CANADIAN COLLECTIONS: Fruit Bodies cupulate, pendent or conchate, 2-6 mm diam., dorsally or laterally attached, greyish brown to almost black (6D-F3; Kornerup and Wanscher, 1978), appearing glabrous and translucent-striate when fresh and moist (lines one unit darker), drying black, opaque, with fine white floccose bits or wisps over surface. Margin even or slightly wavy. Gills radiating from a near central point on underside, stark white, becomimg faintly greyish, narrow to moderately thick, distant, occasionally becoming slightly tortuous-anastomosing, smooth or finely frosted under 10X. Cuticle 15-20 µm deep, black or dark brown in KOH, a repent tangle of heavily spiral-encrusted brown hyphae, (1.5) 2-5 (6) µm diam., with a few fine, loose ends 1.5-2.0 µm diam. terminating in small hourglass-shaped cells 3-4.5 X 1.5-1.7 µm, surrounded by a mucoid ball 3-4 (6) µm diam. All hyphae with single clamps. Gelatinous Zone hyaline, 220-300 µm deep, hyphae in a loose tangle, 1-4 (5) µm diam., most smooth, but a few near cuticle finely spiral-encrusted. Trama 30-50 µm deep, densely tangled, clay brown (in KOH), becoming paler toward the gill trama; hyphae mostly parallel, radially arranged, (1) 3-7 µm diam.,

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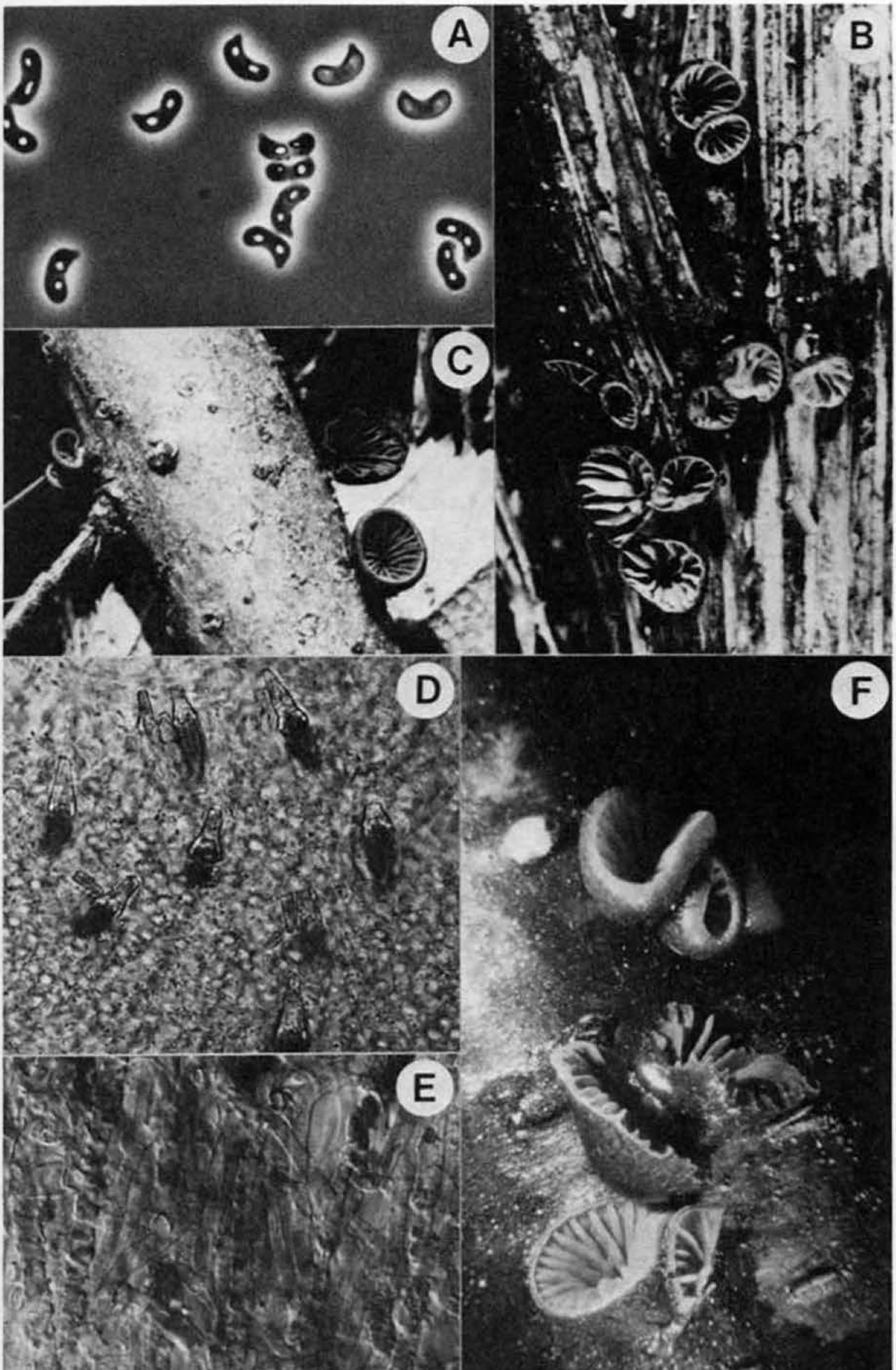
Figure 1 A-B: ***Hohenbuehelia cyphelliformis***. A) Basidiospores of RGT # 841117/02, X 750; B) basidiomes of RGT #841013/01, X 1.8. C-E: ***Hohenbuehelia pinacearum***. C) Basidiomes of RGT #831015/04, X 1.8; D) metuloids of Peck s.n., Bennetts, N.Y., 1884 (NYS), stained in cresyl blue, X 300; E) cuticle of Peck s.n., Bennetts, N.Y., 1884, showing smooth and coarsely spiral-encrusted hyphae, X 500. F: ***Hohenbuehelia unguicularis***, basidiomes of DAOM #191960, X5 (photograph courtesy of J. Ginns, DAOM).


A
B
C
D
F
E

smooth or finely encrusted, thin-walled. Gill Trama quite interwoven, pale beige (KOH) above, becoming hyaline near gill margins. Subhymenium indistinct, blending in colour from trama to hymenium, medium brown (interstices) to subhyaline (gill edges), 5-10 µm deep, hyphae 1.5-3.0 µm diam. Hymenium 25-37 µm deep, hyaline at gill edges, with hyaline apices and brown bases in interstices. Basidia 4-spored, clavate, (21) 26-30 X 6.2-8 µm. Cheilocystidia fusoid-capitate, with well-formed or poorly formed hour-glass, occasionally branched, 18-38 X 4-7 µm, hour-glass 4-6.5 X 1.2-2.0 (2.5) µm, mucoid ball 5-8 µm diam. Metuloids clavate or fusoid, thin-walled (up to 0.5 µm thick), not projecting (resembling basidioles), bases pale brown, 21-40 X 4.5-7.0 µm, brilliant magenta in Cresyl Blue, apices entirely obscured by conical or ovoid crystalline masses that are 8-12 (16) µm diam. X 12-20 µm tall. Spores white in print, hyaline, inamyloid, smooth, broadly allantoid, (7.5) 8-10 (11.5) X 2.8-3.8 (4.2) µm.

HABITAT: On dead twigs, or stems of woody biennial or perennial dicots in rich, moist environments. Ontario specimens were found on ***Arctium*** and ***Heracleum*** in moist "old fields". Host plants reported in the literature include ***Anethum***, ***Angelica***, ***Arctium*** (Pilat, 1935), ***Clematis*** (Saccardo, 1877), ***Morus*** (Peck, 1891), ***Penstemon*** (Berkeley, 1837), ***Sambucus*** (Pilat, 1935; Velenovský, 1939), ***Solanum*** (Smith, 1934), ***Thapsia*** (Malencon and Bertault, 1975) and ***Ulmus*** (Berkeley and Broome, 1859).

DISTRIBUTION: Reported from Czechoslovakia, England, Hungary, Italy and Yugoslavia in Europe, Morocco in North Africa, Michigan and New York in the United States, and now found in Ontario, Canada.

SPECIMENS EXAMINED: Canada: Ontario: Dennison Farm, Opeongo Lake, Algonquin Park, R.G. Thorn #841013/01, on ***Arctium minus*** & #841013/11, on ***Heracleum maximum***; Conc. #3 Eramosa

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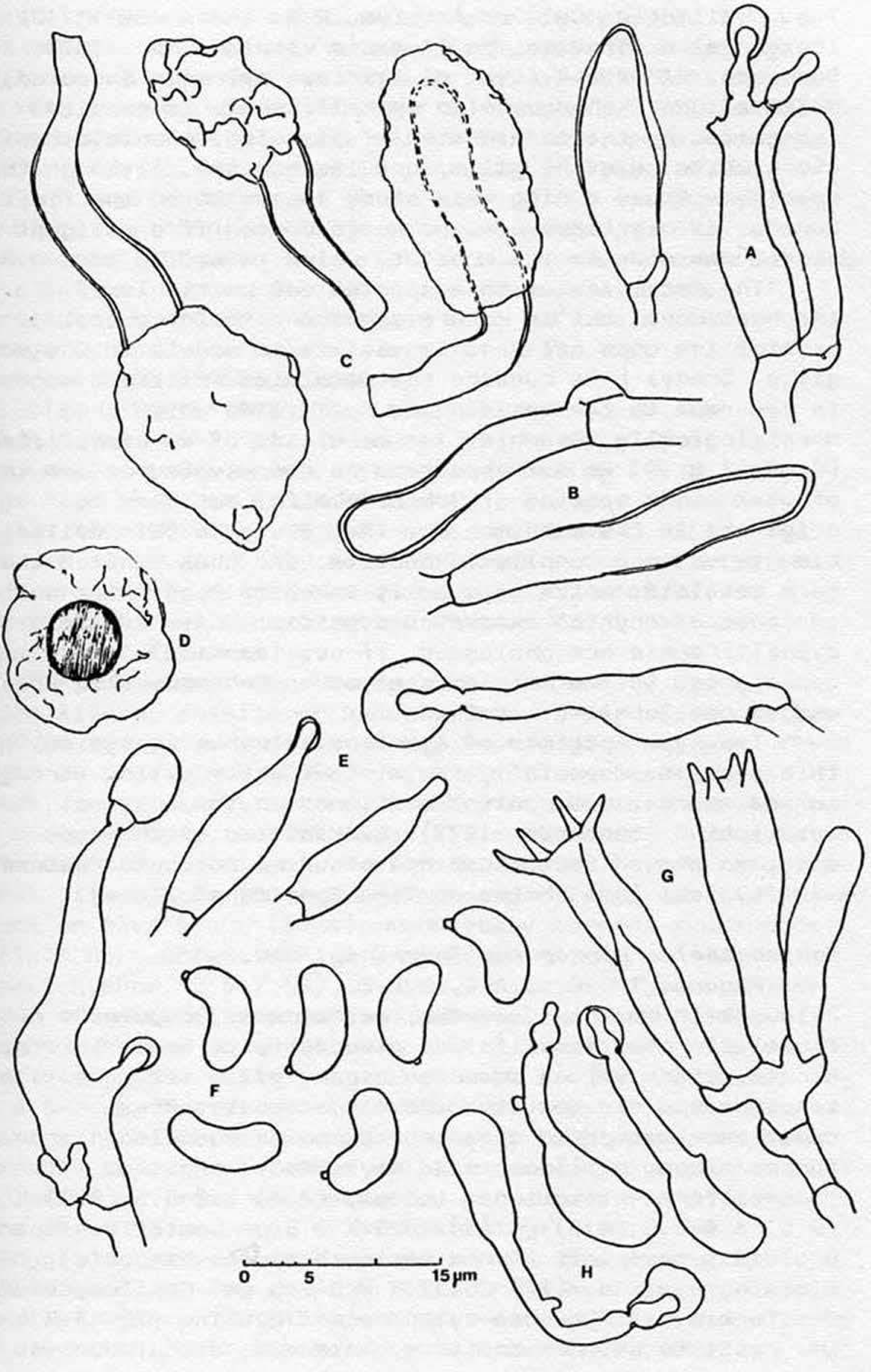
Figure 2 A-H: ***Hohenbuehelia cyphelliformis***. A-C: RGT #841117/02. A) A cheilocystidium and basidioles; B) three metuloids with crystalline caps dissolved away; C) three metuloids with crystal-encrusted apices. D-H RGT #841013/01. D) Looking down on a metuloid stained in cresyl blue; E) four cheilocystidia; F) allantoid basidiospores; G) basidia and basidiole; H)basidiospores germinating on water agar in the presence of nematodes to form adhesive knobs at the end of a germ tube.


A
B
C
D
E
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G
H
0
5
15 µm

Twp., Wellington Co., on ***Arctium***, R.G. Thorn #841117/02. Italy: Selva, Treviso, on ***Clematis vitalba***, Mar. 1877, P.A. Saccardo, PAD #3644 (type of ***Agaricus sylvanus*** Saccardo).
OBSERVATIONS: ***Hohenbuehelia cyphelliformis*** is readily recognised by the combination of its size, cupulate habit, stark white, distant gills, and its habitat. Although the specimens found during this study appear to be the first for Canada, it might prove to be quite common if a diligent search was made in its habitat, which is easily passed by.

The metuloids of this species are particularly inconspicuous, but in mature specimens their conical crystalline caps are readily visible in mounts of whole gills. Cresyl blue renders the metuloids brilliant magenta in contrast to the basidia and basidioles which they morphologically resemble. The metuloids of ***H. cyphelliformis*** (Figs. 2 B, C) do not appear to be deep-seated as are those of most other species of ***Hohenbuehelia***, but seem to originate in the subhymenium. They are also thin-walled, and clavate or occasionally lanceolate, and thus stretch the term metuloid, which is usually taken to mean thick-walled, lanceolate, crystal encrusted cystidia. These cystidia in ***H. cyphelliformis*** are analogous, if not identical in appearance, to the metuloids of other ***Hohenbuehelia*** species, and so are labelled metuloids.

The type specimen of ***Agaricus sylvanus*** is typical of this species, especially the distant white gills, strongly curved spores, and habitat mentioned in the original description (Saccardo, 1877). Examination of the type specimen showed that these and other microscopic features were typical (see "Notes on Type Specimens", later).

Hohenbuehelia pinacearum Thorn, sp. nov.
Figures 1 C-E, 3 A-G, 4 A-E.

Pileus 4-10 mm latus, lentus, gelatinosus, cupulatus aut flabelliformis, sessilis aut pseudostipite brevi laterali cernuo, niger vel ex caeruleo niger, pilis vel squamis albis tenuibus sparsis vestitus. Lamellae subdistantes, crassiusculae, primo argenteae demum ex caeruleo nigrae. Sporae albae, hyalinae, haud amyloideae, anguste phaseoliformi-ellipticae, laeves, (6.0) 6.2-8.5 (9.0) X (2.5) 3.0-3.8 (4.2) μm (ad 10.5 X 5.5 μm basidiis bisporis). Basidia tetrasporis (forma rarior basidiis bisporis), clavata, hyalina, (22) 25-32 X 6.0-7.5 μm. Cheilocystidia fusiformia vel flexuoso-cylindracea, hyalina, 22-45 X 4-8 μm, capitata aut non capitata, interdum ramosa, duobus capitulis praedita; cellulae secretoriae apicales 5-8 X 2-3 µm, mediis constrictae. Metuloidis hymenii inconspicuae, hyalinae, fusiformes vel lanceolatae, 37-50 X 6-11 µm; pariete praeter apices tenuiter tunicatos 1-2 µm crasso, in solutione azureae cresylii metachromaticae, purpureoroseae; apices crystallinis hyalinis incrustati. Pilocystidia hyalina, cylindracea, ad 50 µm longa X 3-7 µm diam., tenuiter tunicata; cellulae apicales longae, mediis constricae (interdum constrictionibus duabus praeditae), 12-25 X 5-7 µm. Hyphae fibulatae. Ad truncos et ramos corticatos coniferos. Holotypus leg. R.F. Cain, Lake Temagami, Ontario, Canada, July 18, 1938, TRTC #13200; isotypus DAOM #50083 & #80600.

SELECTED DESCRIPTIONS AND ILLUSTRATIONS: North America: Coker (1944: 78-9, pl. 42 lower, pl. 49 figs. 6-8; as ***Pleurotus unguicularis***), Miller and Manning (1976: 320-321, Figs. 2 n-p, 5; as ***P. unguicularis***). Europe: Josserand (1933: 360-364, Figs. 9 B-C; as ***P. silvanus***), Pilát (1935: Tab. 20, figs. 3, 5, 7; as ***P. silvanus*** - the description much confused), Konrad and Maublanc (1937: 309 II; as ***Acanthocystis silvanus***), Krieglsteiner (1979: 43; as ***Resupinatus silvanus***).

DESCRIPTION: Fruit Bodies cupulate to conchate or flabelliform, sessile or pendent from a short pseudostipe, 4-10 mm diam., surface moist and mostly glabrous when fresh, black or blue-black (20F4), with a few scattered white wisps, particularly toward the margin; margin incurved, even or becoming wavy, not striate. Gills radiating from point of attachment or a central or excentric point on underside, at first silver-grey (B1), becoming deep olive brown (4-5F4) to black or blue-black (20F4); moderately narrow, subdistant. Cuticle dark brown (KOH), 10-25 µm thick, of densely woven repent hyphae, 2.5-7 (9) µm diam., many with broad spiral bands of encrusting pigmented material; with hyaline tomentum hyphae up to 50 µm tall X 3-7 µm diam., tipped with long hour-glass cells (sometimes with 2 constrictions), 12-25 X 5-7 µm. Gelatinous Zone black in mass, hyaline in section, 250-500 µm thick, of loosely tangled hyphae with strongly gelatinised outer walls and refractive lumens, 2-3 (5) µm diam. Trama composed of a pale brown (KOH), compact zone about 50 µm deep, of hyphae 2-3 µm diam., the subhyaline, less dense lower zone extending into gills, hyphae tangled, 3-5 µm diam. Gill Trama hyaline, of nearly parallel hyphae 3-8 (12) µm diam., with gelatinised wall up to 3.5 µm thick. Subhymenium pale brown (KOH), thin.

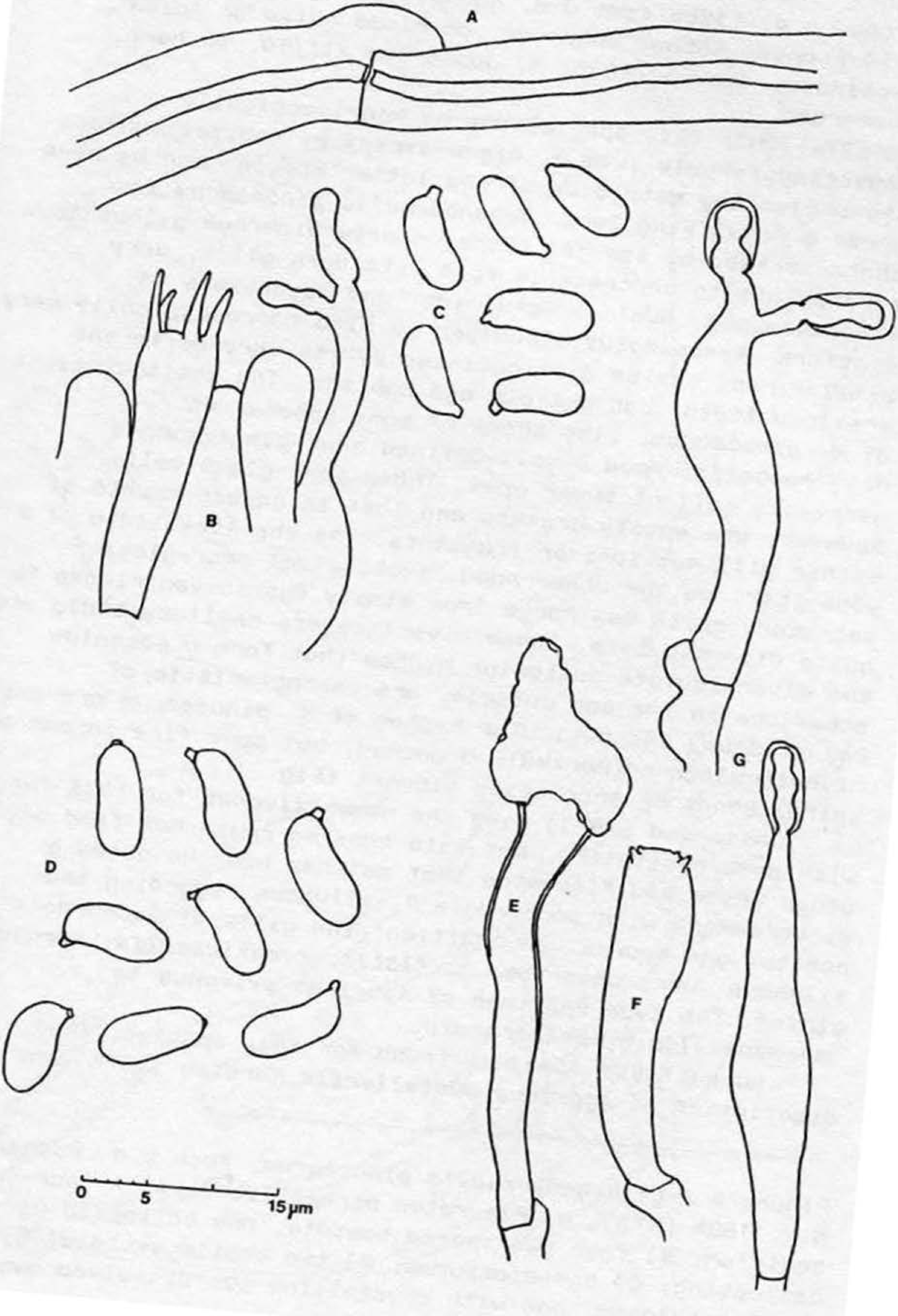
Hymenium hyaline, about 30 µm deep. Basidia (2-) 4-spored, clavate, hyaline, (22) 25-32 X 6-7.5 µm. Cheilocystidia fusoid or flexuous-cylindric, capitate or not, 22-45 X 4-8 µm, with 1 or 2 hour-glass secretory cells 5-8 X 2-3 µm. Metuloids deep-seated, flexuous, hyaline cells 37-50 X 6-11 µm, with walls up to 2.0 µm thick, except at the apex where they are thin-walled and collapsing, metachromatic in cresyl blue, capped in age with a cone of hyaline, crystalline encrusting material 15-20 (30) µm tall X 8-15 µm diam. Spores white in print, hyaline, inamyloid, smooth, narrowly elliptic-phaseoliform, (6.0) 6.2-8.5 (9.0) X (2.5) 3.0-3.8 (4.2) µm from 4-spored collections and 7.5-10.5 (11.0) X 4.4-5.5 (5.7) from 2-spored Peck collection (Bennetts, N.Y., in NYS)

HABITAT: On bark of conifers; on dead, standing trunks, fallen logs and branches, and dead branches on live trees.

DISTRIBUTION: Pilat (1935) listed collections on conifers from Belgium, Czechoslovakia and France. Josserand (1933) and Pilat believed that ***P. applicatus*** sensu Rea (1922), from England, was this species. The report by Krieglsteiner (1979) of ***Resupinatus silvanus*** in W. Germany represents this species. In North America, it is known from North Carolina (Coker, 1944, as ***P. unguicularis***) and New York in the United States, and from Ontario, Quebec and New Brunswick in Canada. Other published reports of ***Pleurotus*** or ***Resupinatus silvanus*** that have been seen refer to ***Resupinatus alboniger*** or ***Hohenbuehelia cyphelliformis***.

SPECIMENS EXAMINED: Canada: New Brunswick: Kouchibouguac National Park, on ***Abies*** (not ***Betula*** as stated on label), May 16, 1977, R. Milliken, DAOM #165824. Ontario: Maple, on ***Tsuga canadensis***, May 5, 1936, J.W. Groves, TRTC #9470; Lake Temagami, on ***Abies balsamea***, July 18, 1938, R.F. Cain, TRTC #13200, holotype (isotypes as DAOM #50083 and 80600); Petawawa, on ***Pinus strobus***, Sept. 6, 1943, J.W. & E. Groves, DAOM #11428; Petawawa, on ***Abies***, Sept. 20, 1945, J.W. Groves, DAOM #16436; Wolf Howl Pond, Algonquin Provincial Park, on ***A. balsamea***, Oct. 15, 1983, R.G. Thorn #831015/04. Quebec: Percé, on ***A. balsamea***, Aug. 14, 1959, W.B. & V.G.

Figure 3 A-G: ***Hohenbuehelia pinacearum***. A-C: DAOM #11428. A) Hypha from gill trama with thickened, gelatinised walls; b) a basidium, basidioles, and cheilocystidium. D) DAOM #84313, basidiospores. E-G: TRTC #13200. E) A metuloid; F) a basidium; G) two cheilocystidia.


A
B
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15 µm

Cooke, DAOM #84313. United States: New York: Bennetts, on *Picea*, n.d. (1884 fide J.H. Haines, pers. comm.), C.H. Peck, NYS. France: Rhône: Chansaye, on *Picea abies* or *Abies pectinata*, Jan. 3, 1933, M. Josserand XII/10, in herb. Josserand.

OBSERVATIONS: This species may be macroscopically indistinguishable from *H. nigra* except by habitat, unless the projecting metuloids of the latter species can be seen under a magnifying lens. *Hohenbuehelia pinacearum* is characterised by its jet black, nearly glabrous pileus that is cupulate to conchate in form, its dark gills, very inconspicuous, hyaline metuloids, and occurrence on conifers. *Resupinatus alboniger* is also macroscopically very similar, but can be distinguished by its very different cheilocystidia, cap cuticle and habitat. The cheilocystidia of *H. pinacearum*, like those of many species of *Hohenbuehelia*, have a well-defined hour-glass-shaped secretory cell at their apex. These hour-glass cells, however, are easily crushed and lost in squash mounts of either gill sections or fragments. The cheilocystidia of *R. alboniger*, on the other hand, lack apical hour-glass secretory cells and range from simply fusoid-ventricose to quite diverticulate. These diverticulate cheilocystidia and the diverticulate cuticular hyphae that form a rameales structure in the cap cuticle, are characteristic of *Resupinatus*. The cuticular hyphae of *H. pinacearum* are not diverticulate or markedly branched, but have fine to coarse spiral bands of encrusting pigment (Fig. 1 E).

Josserand (1933) used the name *silvanus* for this fungus with some hesitation, but said that he could not find any other described *Pleurotus* that matched his. He noted a disagreement with Saccardo's *P. silvanus* regarding the habitat and spores. In addition, the gills of Saccardo's *P. silvanus* were described as "*latis, remotiusculis, sordide albis*". The type specimen of *Agaricus sylvanus* is *Hohenbuehelia cyphelliformis*.

No suitable name was found for this species. The description of *Agaricus mustaliensis* Karsten (1876) was

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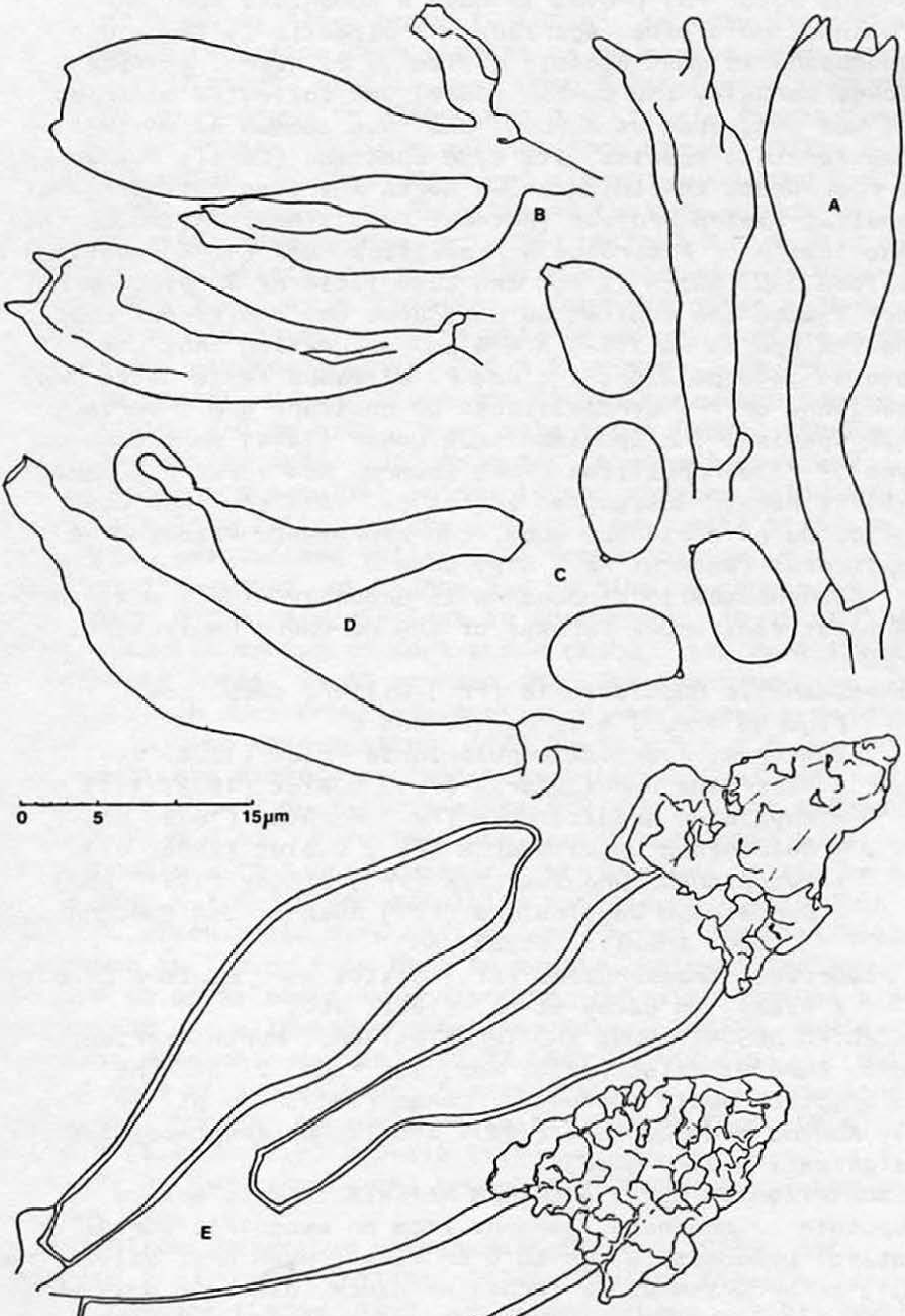
Figure 4 A-E: *Hohenbuehelia pinacearum*, Peck s.n. Bennetts, N.Y. 1884 (NYS), as *Pleurotus atropellitus*. A) A four-spored basidium; B) four two-spored basidia, one collapsed and two collapsing; C) basidiospores; D) two cheilocystidia; E) three metuloids, one with crystalline cap dissolved away.


B
A
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0
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15µm
E

suggestive of this species, but the type specimen (Fungi fenniae #605, FH) proved to have a tomentose cap, and prominent metuloids. ***Agaricus mustaliensis*** is therefore a ***Hohenbuehelia*** most closely allied to ***H. nigra***. ***Agaricus blakei*** Berkeley and Curtis (1859) was collected on ***Abies***, but was described as rufous, and thus seemed an unlikely name for this species. Its type specimen (Curtis #6289, FH, K) represents the third known North American collection of ***Panellus violaceofulvus*** (Batsch: Fr.) Singer. Although the description of ***Pleurotus atropellitus*** Peck (1886) mentions a villose cap, which is not characteristic of ***H. pinacearum***, Peck listed the habitat as deciduous and coniferous wood, and the spores as 7.5-9 X 4-5 µm, suggesting that his species concept might include ***P. silvanus*** sensu Josserand. Specimens of "***P. atropellitus***" on conifers are invariably this species. The specimen that Coker (1944) mentioned as type of ***P. atropellitus*** (Fort Edward, New York, E.C. Howe, NYS) is herein designated lectotype. This specimen was collected on deciduous wood, and represents ***Resupinatus applicatus*** (Batsch: Fr.) S.F. Gray.

Hohenbuehelia pinacearum is probably widely distributed in moist coniferous forests of the northern hemisphere.

Hohenbuehelia unguicularis (Fr.) Miller, comb. nov.
Figures 1 F, 5 A-I, 8 A-C, and E.
Basionym: ***Agaricus unguicularis*** Fries (1828: 24)
≡ ***Pleurotus unguicularis*** (Fr.) Quélet (1872: 113)
≡ ***Phyllotus unguicularis*** (Fr.) Karsten (1879: 93)
≡ ***Calathinus unguicularis*** (Fr.) Quélet (1886: 47)
≡ ***Resupinatus unguicularis*** (Fr.) Singer (1951: 253)
≡ ***Geopetalum unguiculare*** (Fr.) Kuehner and Romagnesi, nom. invalid. (1953: 68)
= ***Pleurotus atrocaeruleus*** (Fr.) Gillet var. ***minimus*** Dearness & Bisby, in Bisby et al. (1929: 104)

SELECTED DESCRIPTIONS AND ILLUSTRATIONS: North America: none. Europe: Pilát (1935: Tab. 22, figs. 2, 3 - the description badly confused); Lange (1937: 73, pl. 66, fig. C); Konrad and Maublanc (1937: 309 II, as ***Acanthocystis Leightonii*** - very good).

DESCRIPTION OF NORTH AMERICAN MATERIAL: Fruit Bodies cupulate or conchate, pendent from an excentric dorsal or lateral pseudostipe, up to 6 mm diam.; when dry, silver grey (B1) to brownish-black (6E3+) or black, glabrous only where weathered, otherwise white pruinose to finely tomentose, becoming densely strigose over pseudostipe with white to buffy (4A2) hairs; when revived margin becomes medium warm brown or slightly olive brown (5-6E3-4), faintly striate in some. Gills radiating from a point on underside, moderately narrow, subdistant, pinkish grey when fresh (notes with DAOM #191960), grey-brown to black when dry, finely frosted under 10X, margin entire. Cuticle pale to dark brown (KOH), densely tangled, 10-25 μm deep, of pigment-encrusted hyphae with clamps, 2-6 μm diam. Epicutis of hyaline or golden brown, smooth, wavy hyphae up to 200 μm tall X 2-5 μm diam., occasionally inflated to 12 μm, with scattered hour-glass cells 7-9 X 2.5-3.0 μm. Gelatinous Zone often the majority of the trama, subhyaline, with pale brown and hyaline hyphae tangled and ascendant below, 1.5-3.5 μm diam., smooth; becoming repent, deeper brown and finely encrusted toward the cuticle, 2-6 μm diam. Trama pale brown (KOH), 100-530 μm deep, darkest at upper edge adjacent to gelatinous zone, where hyphae are parallel or nearly so; tangled below and descending into gills, hyphae 3-6 μm diam., with thin, or thickened, gelatinised walls. Gill Trama pale brown, parallel-interwoven, of hyphae 3-5 μm diam. Subhymenium subhyaline and barely distinct to dark brown, 10-15 (40) μm deep. Hymenium medium to dark brown (KOH), with dark flecks of metuloid bases, 24-35 μm deep. Basidia 4-pronged, clavate, with dark brown sap that does not always extend to apices, leaving them hyaline, (22) 25-32 X 5.5-7.5 μm. Cheilocystidia clavate or fusoid-ventricose, 22-37 (60) X 4-8 μm, with 1 or 2 hour-glass cells 5-9 X 2.5-4 μm, mucoid balls 4-6 μm diam., sometimes coalescing over gill edge, or occasionally with 1 or 2 cylindric projections at tip up to 40 m long X 1.0-1.5 μm. Metuloids clavate or fusoid with rounded, often collapsing apices, dark brown and with walls thickened to 1.5 μm from base to middle, thin-walled and hyaline at apex; scarcely projecting, but with conical cap of hyaline or yellowish crystalline material 8-12 μm diam. (looking down on hymenium), 20-77 (90) X 6-12 (15) μm. Walls deep purple in cresyl blue. Spores white in print, hyaline, inamyloid, smooth, narrowly elliptic-phaseoliform, (5.0) 6.0-8.5 (9.0) X (2.8) 3.0-4.0 (4.5) μm.

HABITAT: On dead trunks and branches of hardwoods, with or without bark.

DISTRIBUTION: Described from Sweden (Fries, 1828), and reported from France (Gillet, 1876), Finland (Karsten, 1879), Denmark (Lange, 1937; Lange and Hansen, 1950), and the Carpathians in Russia (Zerov and Peresipkin, 1979). Some of the specimens cited by Pilát (1935) under this name are undoubtedly this species, but not that of Velenovský with strongly curved spores nor the collection from Germany on *Abies*. What Coker (1944) described as the first North American record of *P. unguicularis*, from North Carolina, was in fact *Hohenbuehelia pinacearum*.

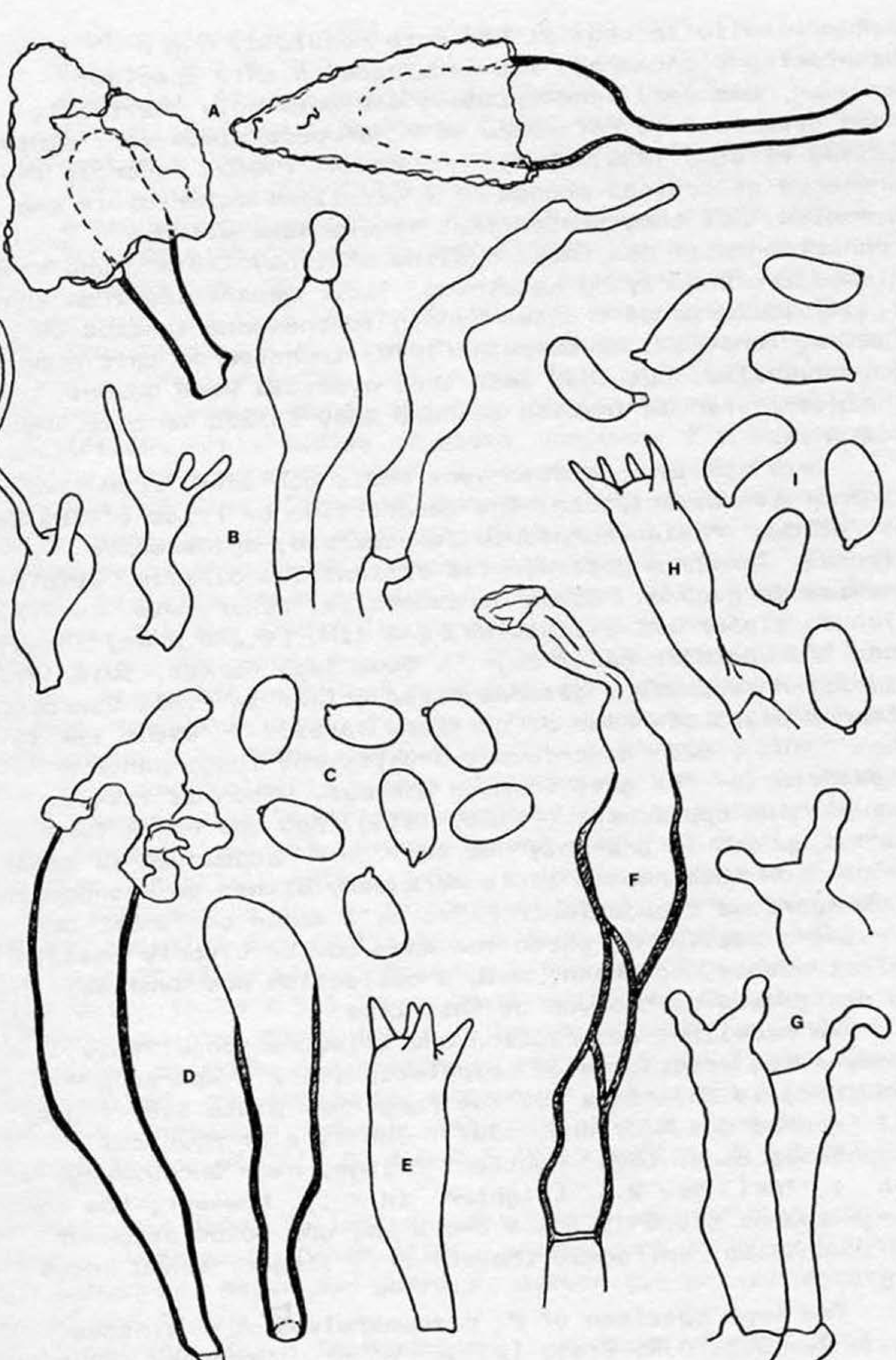
SPECIMENS EXAMINED: Canada: Manitoba: Victoria Beach, on old [decorticated dicot] wood, June 2, 1928, G.R. Bisby [#3906] et al., Dearness #6654 (lectotype of *Pleurotus atrocaeruleus* var. *minimus*; at DAOM). Nova Scotia: Highland Village, Colchester Co., on *Populus tremuloides*, June 17, 1954, A.G. Davidson, DAOM #46746. Ontario: Black Sturgeon Lake, Thunder Bay District, on *Populus*, June 11, 1976, S.A. Redhead, DAOM 159734; Dorset, Haliburton Co., on *Populus*, May 28, 1963, R.F. Cain, TRTC #40707; Lobo, on decorticated *Ulmus*, Nov. 8, 1931, J. Dearness #734 (at DAOM). Quebec: Cantley, Gatineau Co., on *Prunus serotina*, Apr. 28, 1985, J.H. Ginns, DAOM #191960; Tenaga, on *Populus*, May 1939, J.W. Groves and I. Mounce, DAOM #6998. Yukon Territory: Haines Junction, on *Populus*, Aug. 2, 1962, J. Holms, DAOM #93025. United States: New York: Knowersville [now Altamont, Helderberg Mountains], on decorticated wood, Oct. (no year), C.H. Peck s.n. (as *Pleurotus atropellitus*; NYS); Star Lake, on *Populus*, Sept. 7, 1974, J.H. Ginns, DAOM #155519.

OBSERVATIONS: *Hohenbuehelia unguicularis* is recognised by its cupulate to conchate, dark cap with silvery tomentum on its rear portion or apex, which may be drawn out into a pseudostipe, and by its gills that are silvery or pale tan when young and become dark in age. Microscopically, the peculiar, clavate metuloids that are brown in their lower portions and hyaline and thin-walled at their apices, are diagnostic. An unusual feature of this species is its occurrence in spring or early summer.

It is important to point out that *Hohenbuehelia unguicularis* (Fr.) Miller in this paper is based on *Pleurotus unguicularis* sensu Lange (1937), whereas *H. unguicularis* (Fr.) Miller (in Miller, in press) is based on *P. unguicularis* sensu Coker (1944), which is *H. pinacearum*.

Pleurotus unguicularis sensu Lange (1937) is clearly a

Figure 5 A-I: *Hohenbuehelia unguicularis*. A) Metuloids, and B) cheilocystidia of Dearness #734, 8 Nov., 1931. C-E: TRTC #40707. C) Basidiospores; D) metuloids; E) a basidium. F-I: DAOM #159734. F) A metuloid, twisted and collapsed; G) three cheilocystidia; H) a basidium; I) basidiospores.


A
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0
5
15 µm

Hohenbuehelia in that it has both metuloids and a ***Nematoctonus*** anamorph. The metuloids in this species, however, are very inconspicuous and have only previously been described in reference to ***P. atrocaeruleus*** var. ***minimus*** (Bisby et al., 1929). Lange and Hansen (1950) reported the presence of conical mounds of crystalline material in the hymenium, but they stated that "these seem without connection with the small hyaline cheilocystidia", and they missed the underlying metuloids. Their report confirms that ***H. unguicularis*** as treated herein is the same species as theirs. Zerov and Peresipkin (1979) transferred this name to ***Hohenbuehelia***, but they said that cystidia were absent. Their transfer is invalid because they failed to cite the basionym.

This species has been very badly confused, from the time of its description. The description by Fries (1828) ran as follows: "***Pileo carnosulo laeviusculo, epidermoide viscosa, lamellis determinatis distantibus albidis, stipite brevissimo glabro. Pileus horizontalis, reniformis, convexo-planus, glaber vel villosulus, 2-4 lin. [4.2-8.5 mm] latus, raro 1/2 uncialis [12.7 mm] ... Duas legi formas, suis locis fideliter redeuntes; alteram pileo griseo in rimis Quercuum, alteram pileo aterrimo ad cortices Sorbi.***" It seems likely that Fries (1828) described two different fungi under ***A. unguicularis***: the grey form on ***Quercus***, which is likely ***Resupinatus applicatus*** (Pilát, 1935), and the black form on ***Sorbus***, which is probably the same as ***P. unguicularis*** sensu Lange. For this reason it is necessary either to abandon the name ***Agaricus unguicularis*** Fries as a nomen confusum, or provide a neotype on which the name may be clearly based. Unfortunately, no fresh, mature collection was available to be designated as neotype at this time.

An excellent description and illustration of this species (as ***Acanthocystis Leightonii*** (Berk.) Konrad & Maublanc) is in Icones Selctae Fungorum, plate 309, figure III (Konrad and Maublanc, 1937). The type of ***Agaricus Leightonii*** Berk. (660. Montford Bridge, near Shrewsbury. Dec. 1, 1841. Rev W.A. Leighton, in K !), however, has the large spores (10.0-13.5 X 4.8-5.8 µm) and colouration of ***Hohenbuehelia reniformis*** (Meyer: Fr.) Singer, sensu Fries (1874).

The type specimen of ***P. atrocaeruleus*** var. ***minimus*** (June 2, 1928, G.R. Bisby [#3906] et al., Dearness #6654 at DAOM) is clearly conspecific (see Notes on Type Specimens).

Resupinatus alboniger (Pat.) Singer (1978: 17)
Figures 6 A-K, 7 A-D, 9 A-C.
Basionym: ***Pleurotus alboniger*** Patouillard, in Patouillard & de Lagerheim (1893: 126)
= ***Asterotus argentinus*** Singer, in Singer and Digilio (1953: 107), fide Singer (1978)
≡ ***Resupinatus argentinus*** (Sing.) Singer (1973: 30)

SELECTED DESCRIPTIONS AND ILLUSTRATIONS: North America: Pilát (1935: Tab. 20, fig. 1); Coker (1944: 77-78, pl. 42 centre, pl. 49, figs. 4-5); Miller and Manning (1976: 314, 317, 320, Figs. 2 k-m, 4). Europe: Kuehner (1980: Fig. 202 d) Africa: Pegler (1977: 106, Figs. 19/4 a-e). All above as ***Pleurotus silvanus***. South America: Singer (1978: 17-19).

DESCRIPTION: Fruit Bodies cupulate, pendent, 2-6 mm broad, ranging from grey-brown with glaucous or greyish fine tomentum, to flat black and glabrous, with at most a few white wisps. Lamellae radiating from centre or a point toward basal attachment, narrow, moderately spaced, dull brown, blackish brown or black, sometimes with frosted white margins. Cuticle a thin (up to 40 µm), dark brown crust, pebbly from encrusted hyphae of 2.5-6.0 µm diam., that have short, irregular knobs and branches and that become thick-walled, the walls up to 1.0 µm thick, hyaline or pale brown. Gelatinous Zone faintly brown in KOH, 80-750 µm thick (without cover-glass); hyphae pale brown, 1.2-3.0 µm diam., with clamps. Gill Trama continuous with gelatinous zone, or from narrow, less gelatinised tramal zone, of nearly hyaline, parallel, only slightly gelatinised hyphae 1-3 µm diam. Subhymenium narrow (15-20 µm thick), dark brown, of mostly parallel hyphae 1.2-2.5 µm diam. Hymenium nearly hyaline, 20-25 µm thick. Basidia 4-pronged, clavate-cylindric, 18-28 X 5.5-7 µm. Cheilocystidia variable, fusoid, clavate, lecythiform or pyriform, with or without irregular digitate projections, (11) 14-25 X 5-11 µm, most thin-walled, one with walls near apex 2.0 µm thick. Spores hyaline, inamyloid, smooth, elliptic-phaseoliform to cylindric-arcuate, (5.5) 5.8-7.5 (8.2) X (2.5) 2.7-3.5 (4.0) µm.

HABITAT: on dead, fallen branches and trunks of deciduous treees, with bark. Coker (1944) reported it on ***Liquidambar***, ***Lyriodendron***, ***Malus*** and ***Quercus***. Miller (in press) adds ***Nyssa*** and ***Prunus***.

DISTRIBUTION: Known from Alabama, Louisiana, Mississippi, North Carolina and Tennessee (Coker, 1944), Connecticut (Miller, in press) and Maine (Burt #141, FH). Singer (1978)

reported specimens from Ecuador, Venezuela, and Argentina. What appears to be this species has been reported from Tanzania (Pegler 1977) and France (Kuehner, 1980).
SPECIMENS EXAMINED: United States: Maine: Harrison, on ***Acer pensylvanicum***, Sept. 1859, Burt #141 (FH). Mississippi: Ocean Springs, on ***Liquidambar***, Feb. 1887, F.S. Earle, Ellis and Everhart's N. Amer. Fungi #2008 (at DAOM). Without source data: VT #1364 (from O.K. Miller, Jr., VPI) fruiting in culture, RGT #840810/01. Ecuador: Ravine near Quito, on [dicot] twigs, Feb. 1, 1892, Lagerheim s.n. (FH; type of ***P. alboniger***). Holland: Veere, on ***Ribes grossularia***, winter 1830, M.A. Libert, Plantae Crypt. Arduennae #19-B (at DAOM).
OBSERVATIONS: The dark, nearly glabrous or hoar-frosted pileus, and entirely resupinate, cupulate habit of this species, and its occurrence on hardwoods, eliminate all others with which ***R. alboniger*** might be confused except ***Hohenbuehelia nigra***. Microscopically, ***R. alboniger*** can be recognised by the lack of metuloids, and the presence of diverticulate cheilocystidia and diverticulate cuticular hyphae with thick, brown walls. ***Resupinatus alboniger*** shows how closely related ***Resupinatus*** is to ***Hohenbuehelia***, but its lack of a ***Nematoctonus*** state or nematophagous habit, its diverticulate cheilocystidia and cuticular hyphae indicate that it is a ***Resupinatus***, allied to ***R. applicatus*** and ***R. striatulus***.

The type specimen, and Libert #19-B, have quite strongly curved spores and apparently lack the fusoid or pyriform cheilocystidia found in the North American specimens cited. These two specimens were also conspicuously white-tomentose, as was the fruit body of VT #1364 that formed in culture. All specimens were otherwise similar and are considered to be conspecific. Singer (1978) noted that the cheilocystidia of ***R. alboniger*** are versiform, ranging from filamentous to clavate, ventricose, utriform or

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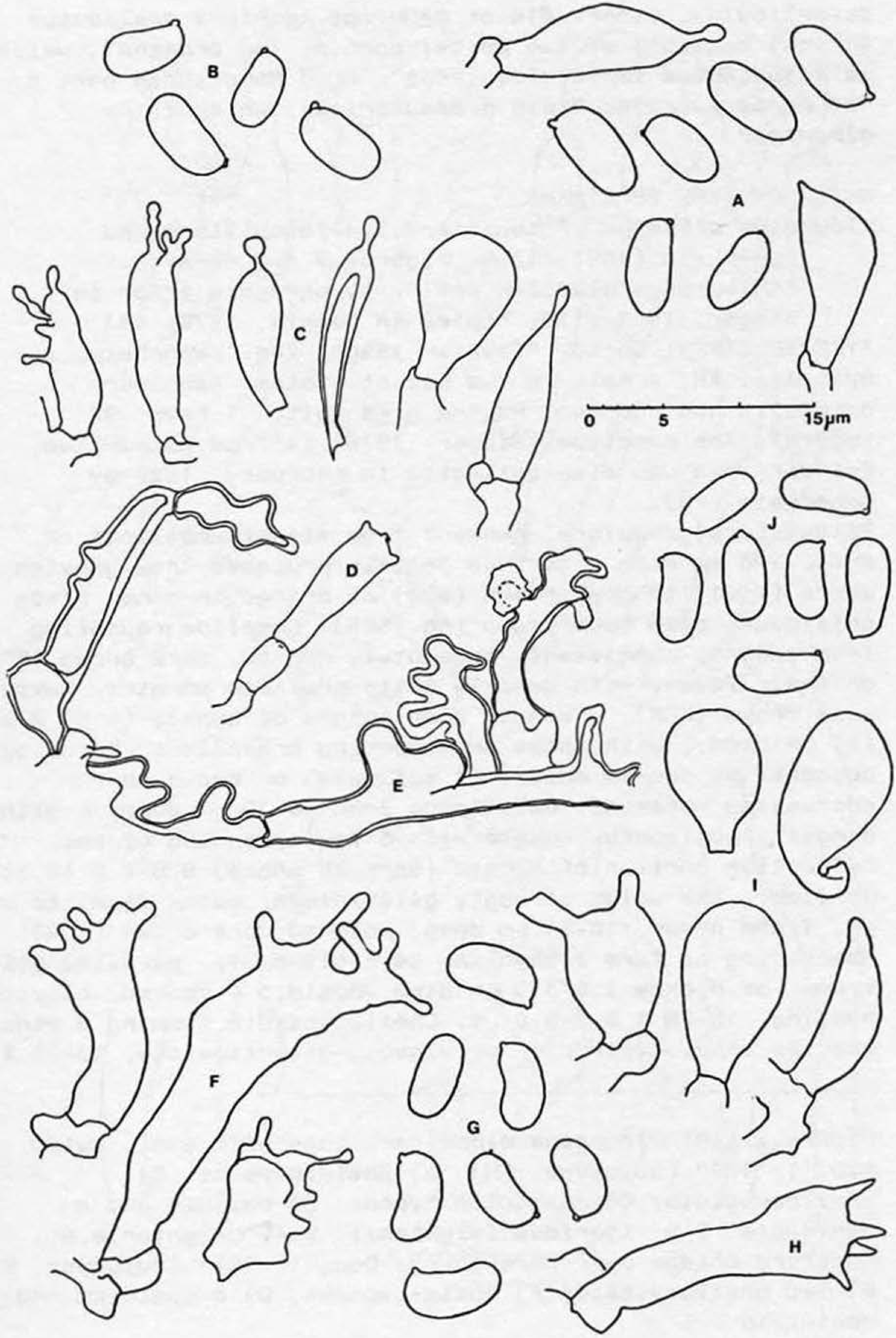
Figure 6 A-J: ***Resupinatus alboniger***. A) Blake 1859 (Burt #141, FH), basidiospores dnd two cheilocystidia. B-E: VT #1364 fruiting in culture (RGT #840810/01). B) Basidiospores; C) six cystidia, showing wide range in shape; D) a young basidium; E) diverticulate, thick-walled cuticular hyphae. F-H: Libert Pl. Crypt. #19-B (at DAOM). F) Cheilocystidia; G) basidiospores; H) a basidium. I-J: Ellis & Everhart N. Amer Fungi #2008 (at DAOM). I) Cheilocystidia; J) basidiospores.


B
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ampullaceous, and entire or with apical or lateral diverticulae. Libert #19 at DAOM (as *Agaricus applicatus* Batsch) consists of two parts: part A, *"ad truncos"*, which is *Resupinatus striatulus* (Pers.: Fr.) Murr.; and part B, *"ad ramos putridos Ribis grossulariae"*, which is *R. alboniger*.

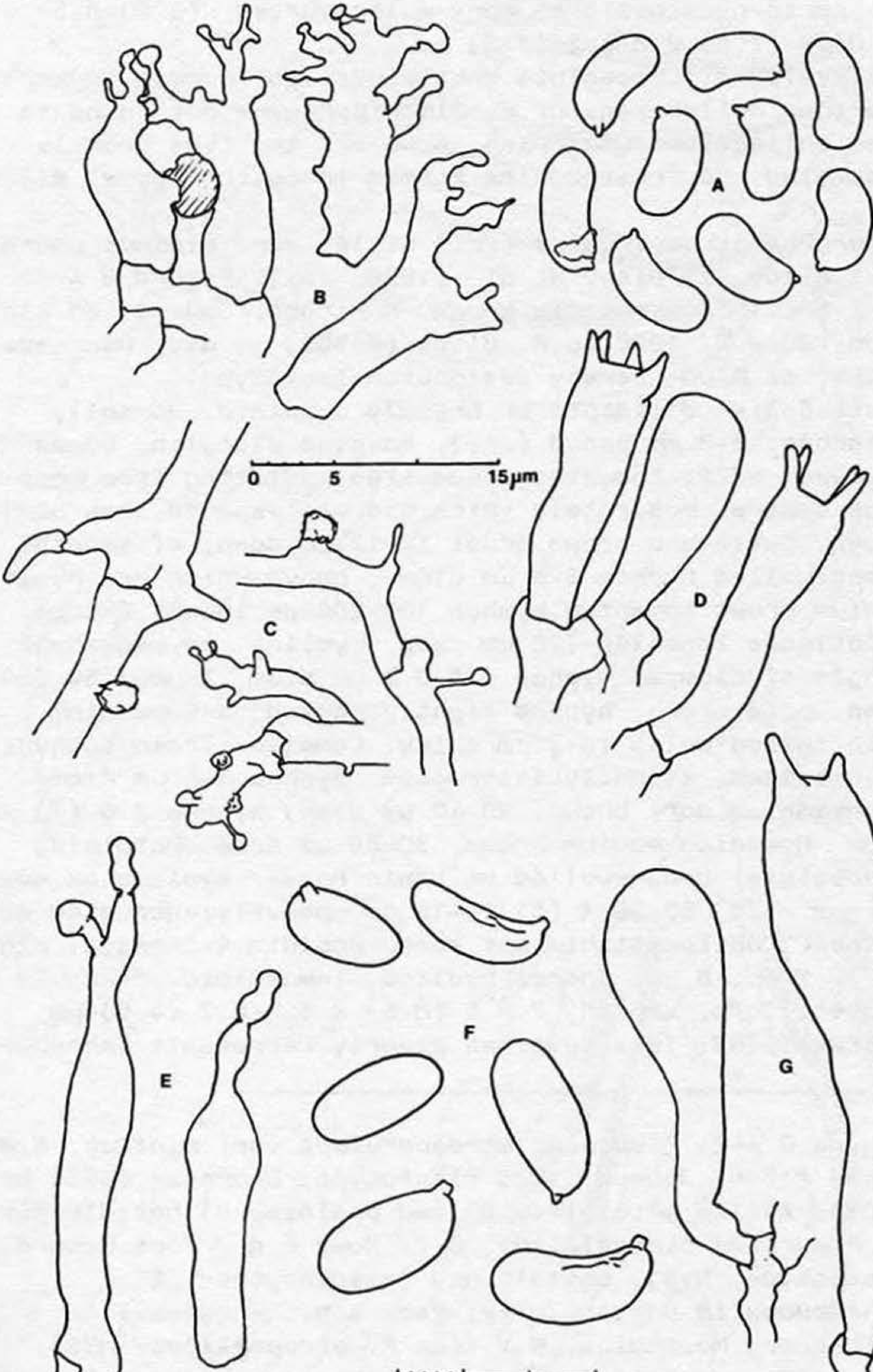
NOTES ON TYPE SPECIMENS

Pleurotus alboniger Patouillard, in Patouillard and Lagerheim (1893: 126). Figures 7 A-D, 9 A, C. (*"Pleurotus alboater* Pat.", typographic error in Singer, 1952: 178; copied in Dennis, 1970: 48)

TYPE SPECIMEN: Quito, "fevrier 1890", leg. Lagerheim, sur brindles, FH. A note in the packet states: "couleur naturelle non changée. Ravine prés Quito 1 Fevr. 92 Lagerh". The paratype (Singer, 1978) is from Cotocallao, Ecuador, and was also collected in February, 1892 by Lagerheim (FH).

Pileus (dry) cupulate, pendent from slight umbilicus on apex, 2-3 mm diam., surface heavily pruinose, now greyish white (A-B1) to grey-brown (5B2) at apices in some. Flesh chitinous, deep warm brown (ca. 5E5). Lamellae radiating from centre, subdistant, moderately narrow, dark brown (5F5) on their faces, with densely white-pruinose margins. Cuticle pale brown (KOH), a dense, deep tangle of hyphae (1.5) 2-3 (4) µm diam., with knobs and tapering branchlets, becoming obscured by coarse masses of yellowish or brownish encrusting material. Gelatinous Zone 50-70 µm deep, hyaline, a mostly-horizontal tangle with a few ascending hyphae, refractive portion of hyphae (dark in phase) 0.8-2.0 (2.5) µm diam., the walls strongly gelatinised, outer diam. to 10 µm. Trama narow, 10-25 µm deep, pale to dark brown (KOH), descending to form subhyaline to hyaline, +/- parallel gill trama, of hyphae 1.5-3.0 µm diam. Basidia 4-spored, clavate, hyaline, 18-28 X 5.5-6.5 µm. Cheilocystidia forming a wide sterile band, cylindric- or clavate-diverticulate, 13-23 X

Figure 7 A-D: ***Pleurotus alboniger***, Lagerheim s.n., Quito, Feb. 1, 1892 (holotype, FH). A) Basidiospores; B) cheilocystidia; C) cuticular hyphae; D) basidia and a basidiole. E-G: ***Agaricus leightonii***, W.A. Leighton s.n., Montford Bridge near Shrewsbury, Dec. 1, 1841 (holotype, K). E) Two cheilocystdia; F) basidiospores; G) a basidium and basidiole.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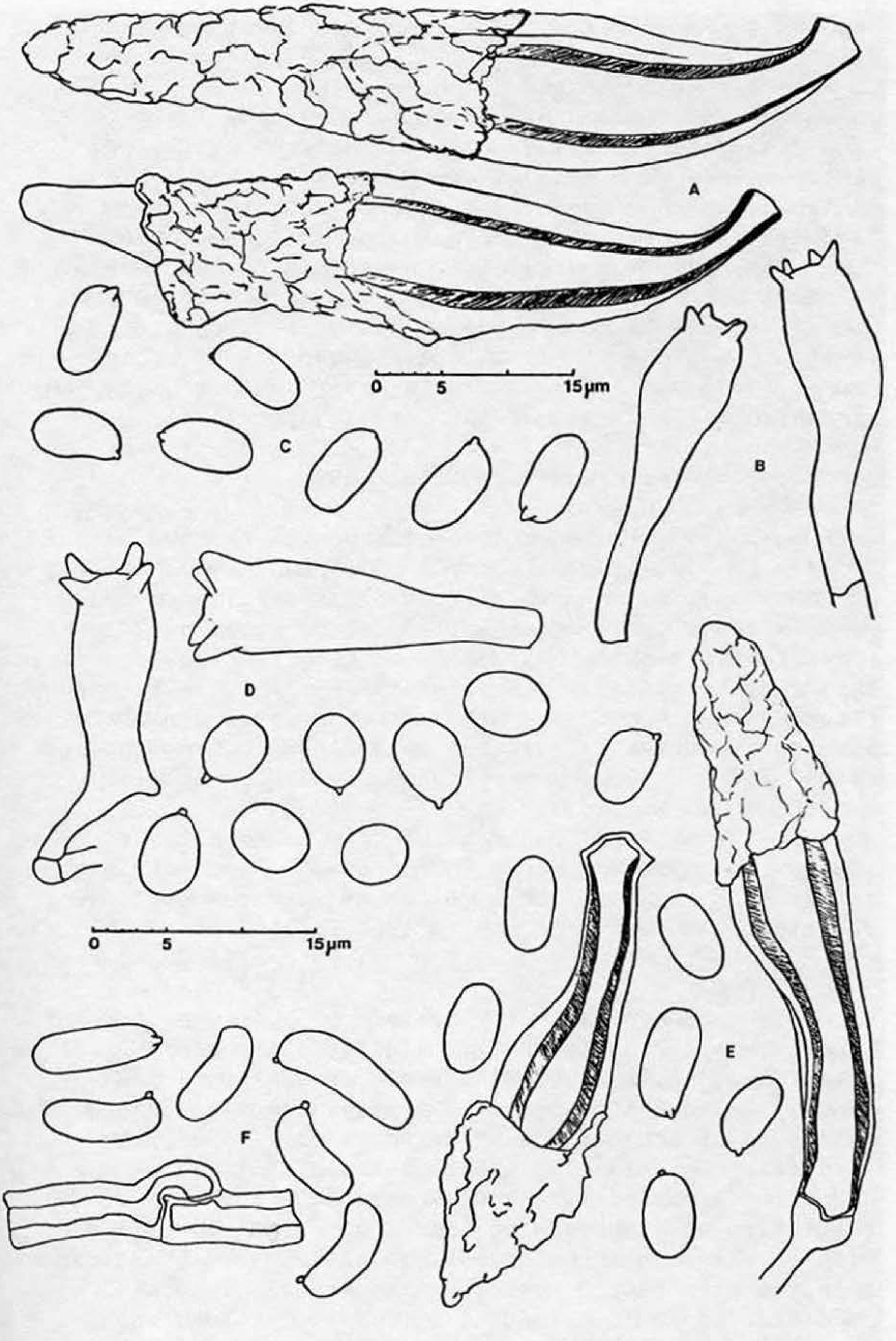
3.5-5.5 µm. Basidiospores hyaline, inamyloid, smooth, cylindric-phaseoliform, many quite curved, (5.8) 6.0- 7.5 (8.0) X (2.5) 2.8-3.2 (3.5) µm.
OBSERVATIONS: Lanceolate cheilocystidia, common in North American collections of ***R. alboniger*** were not found in the type collection. Otherwise, however, the type greatly resembled the fruit bodies formed in culture by VT #1364.

Pleurotus atrocaeruelus (Fr.) Gillet var. ***minimus*** Dearness & Bisby, in Bisby et al. (1929: 104). Figure 8 A-C.
TYPE SPECIMEN: Victoria Beach, Manitoba, Canada, on old wood, June 2, 1928, G.R. Bisby (#3906) et al., Dearness #6654, at DAOM; hereby designated lectotype.
Fruit Bodies dimidiate or broadly cupulate, dorsally attached, 3-8 mm broad (dry), margins blackish, bases somewhat buffy-tomentose. Lamellae radiating from base or near centre, moderately thick and well-spaced, now blackish-brown. Cuticle a brown crust 10-12 µm deep, of smooth, brown-walled hyphae 3-6 µm diam., above which are hyaline to medium brown tomentum hyphae 100-200 µm long X 2-4 µm. Gelatinous Zone 100-120 µm deep, hyaline, an ascendant tangle of clamped hyphae 1.5-3.5 µm diam. Trama 150-220 µm deep, pale brown, hyphae tightly packed, 3-5 µm diam., with gelatinised walls to 2 µm thick. Lamellar Trama subhyaline, gelatinised, slightly interwoven, hyphae 3-5 µm diam. Subhymenium dark brown, 20-40 µm deep, hyphae 2-6 (7) µm diam. Hymenium medium brown, 30-50 µm deep. Metuloids lanceolate, brown-walled at their bases, hyalina at acute apices, (25) 55-90 X (4) 10-15 µm, heavily encrusted at apices. Cheilocystidia not seen. Basidia 4-pronged, clavate, 28-38 X 6.5-8 µm. Spores hyaline, inmamyloid, narrowly phaseoliform, smooth, 7-8.0 (8.5) X 3.5-4.2 (4.5) µm.
OBSERVATIONS: This specimen clearly represents ***Hohenbuehelia***

Figure 8 A-C: ***Pleurotus atrocaeruleus*** var. ***minimus***, G.R. Bisby #3906, June 2, 1928 (lectotype, Dearness #6654 at DAOM). A) Two metuloids; B) two basidia; C) basidiospores. D: ***Pleurotus atropellitus***, E.C. Howe s.n., Fort Edward, N.Y. (lectotype, NYS), basidia and basidiospores. E: ***Hohenbuehelia unguicularis***, Peck s.n., Knowersville, Helderberg Mountains, N.Y. (as ***P. atropellitus***, NYS), metuloids and basidiospores. F: ***Agaricus blakei***, Curtis #6289 (isotype, FH), basidiospores and gelatinised hypha from gill trama.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unguicularis. Particularly interesting are the notes by Bisby in the specimen packet, "cystidia abundant, 10-12 X 40-60 [µm], rough [apex], dark brown base!" This is the only known previous record of metuloids in ***H. unguicularis***.

Bisby et al. (1929) reported that the spores of ***P. atrocaeruleus*** var. ***minimus*** were 7-10 X 4-5 µm, but this includes the measurements of a specimen collected June 13, 1928. This specimen (Victoria Beach, Manitoba, on old wood, G.R. Bisby [#3906a] and A.H.R. Buller, also Dearness #6654, at DAOM) was referred to by Dearness, in a note on the packet, as the "second sending". This specimen has pale lamellae, hyaline, thick-walled, lanceolate metuloids, and spores (7.2) 7.5-10 X 4.0-5.0 (5.2) µm, and is ***Hohenbuehelia atrocaerulea*** (Fr.) Singer.

Pleurotus atropellitus Peck (1886: 65)
Figures 8 D, 9 D-E.

TYPE SPECIMEN: ***Pleurotus atropellitus*** was treated as a synonym of ***Pleurotus applicatus*** (***Resupinatus applicatus***) by Coker (1944). Coker accepted the first specimen named by Peck in the original description as the type, but did not specifically designate it as lectotytpe. The box containing this specimen has been labelled "TYPE". This collection (Fort Edward, E.C. Howe, NYS) is ***Resupinatus applicatus*** and has the charactersistic subglobose spores of that species (5.5-6.2 X 4.4-5.5 µm, subglobose, hyaline, inamyloid, and smooth, Figs. 8 D, 9 E).

In the original description of ***P. atropellitus*** (Peck, 1886), the following words and phrases were printed in italics: "[pileus] villose tomentose except on the margin, ... blackish brown or black, ... [lamellae] close, blackish

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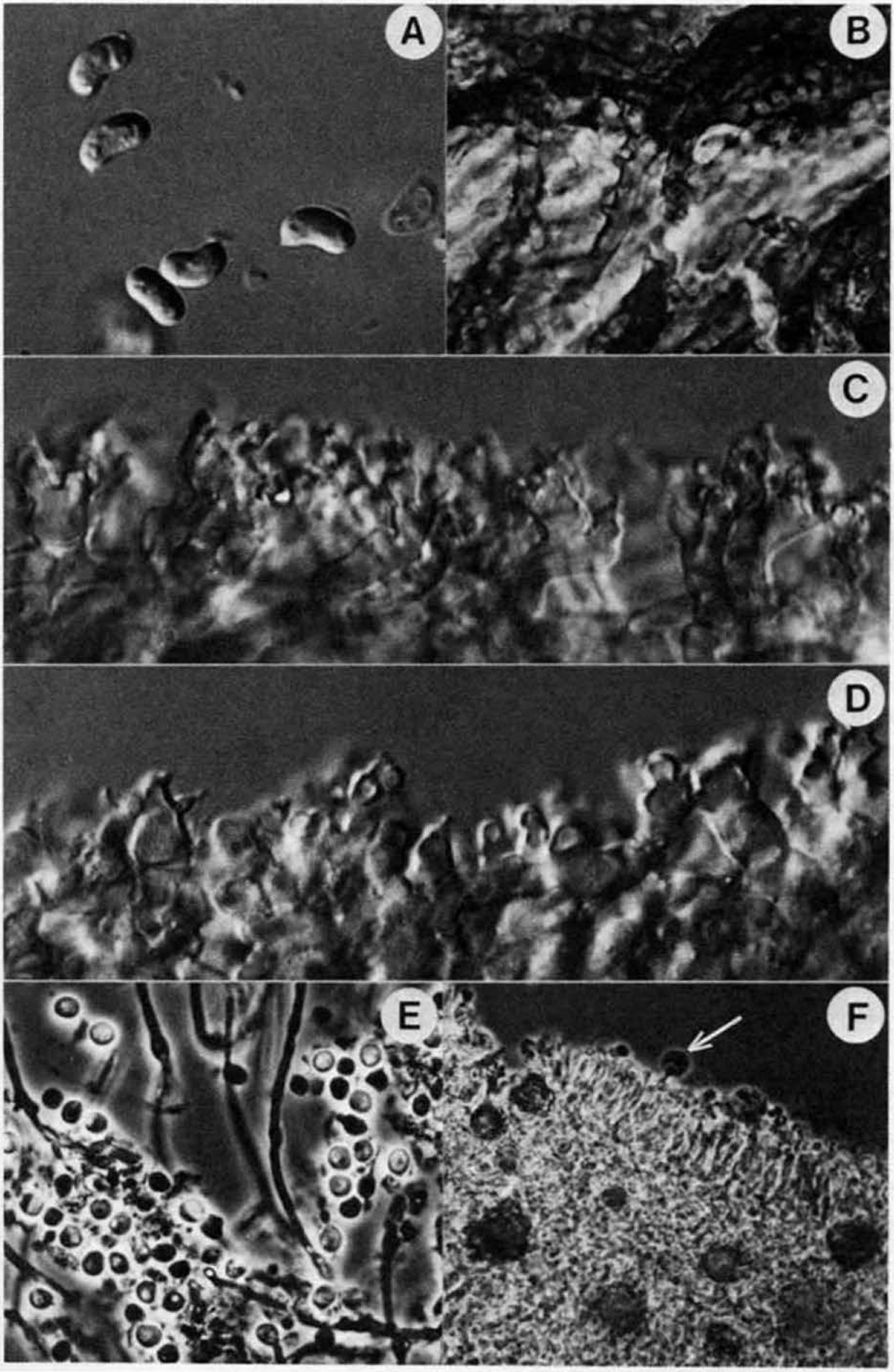
Figure 9 A-C: ***Resupinatus alboniger***. A) Basidiospores of Lagerheim s.n., Quito, Feb. 1, 1892 (holotype of ***Pleurotus alboniger***, FH), X 1250; B) cuticle of Burt #141 (FH), showing knobbed and encrusted cuticular hyphae, X 660; C) gill edge of Lagerheim s.n. Quito, Feb. 1, 1892, showing diverticulate fringe of cheilocystidia, X 1150. D-E: ***Resupinatus applicatus***, E.C. Howe s.n., Fort Edward, N.Y. (lectotype of ***Pleurotus atropellitus***, NYS). D) Gill edge with diverticulate cheilocystidia, X 1280; E) basidiospores on cuticle, X 500. F: ***Agaricus leightonii*** (type, K), gill edge showing cheilocystidium with apical mucoid ball (arrow), and crystalline caps of metuloids, X 300.


A
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brown or black, ... [spores] subelliptical". The spore size was given as ".0003 to .00035 in long, .00016 to .0002 broad" [7.6-8.9 X 4.1-5.0 µm]. No type was designated, but specimens were reported from "decaying wood and bark, both of frondose and acerose trees. Fort Edward, E.C. Howe. Buffalo, G.W. Clinton. Maryland, Helderberg and Adirondack Mountains."

Of these cited specimens, the one from the Adirondack Mountains ("Bennetts, on Spruce", NYS) can be eliminated as a choice for lectotypification, since the pileus is not at all villose-tomentose. It represents a 2-spored collection of ***Hohenbuehelia pinacearum*** (Fig. 4 A-E). Similarly, the Clinton collection from Buffalo (BUF #43355) can be rejected as a possible lectotype, since the fruit bodies are cupulate and reddish-brown, the gills are pinkish-brown, and the spores subglobose; it is a collection of ***Resupinatus striatulus*** (Pers.: Fr.) Murrill. The Fort Edward, Maryland, and Helderberg Mountains collections all match the macroscopic characters of the original description, but only the collection from the Helderberg mountains has elliptical spores (5.5-7.0 X 2.9-3.5 µm, Fig. 8 E). These spores are, however, narrowly elliptical, not subelliptical as mentioned in the original description. Since Peck regarded ***P. atropellitus*** as the North American equivalent of ***P. applicatus***, and since it is possible that he erred in transcription of the spore lengths, the Fort Edward collection by E.C. Howe is accepted as, and hereby designated, lectotype of ***P. atropellitus*** Peck. A brief description of this collection follows.

Pileus (dry) cupulate to flabelliform or dimidiate, up to 4 mm diam., vinaceous brown to blackish brown, with dense, coarse, off-white tomentum over basal area. Lamellae radiating from point of attachment, close, narrow, brownish to black, most with frosted white margins. Basidia 4-spored, clavate, 18-26 X 6-7.2 µm. Basidiospores (from gill fragments) hyaline, inamyloid, smooth, subglobose, 5.5-6.2 X 4.4-5.5 µm.

Agaricus blakei Berkeley and Curtis (1859: 288)
Figure 8 F.

TYPE SPECIMEN: United States: Maine, [1859], Rev. J. Blake #105, "Ad ramul. dej. Abietis", Curtis #6289, FH, K. One basidiocarp, in good condition, is in FH and one, poorly dried, at K.

Pileus dimidiate, (now flattened), dull magenta, white-

pruinose toward margin and with buffy tomentum over disk, stipe none. Lamellae radiating from point of attachment, narrow, subdistant, pinkish-brown, somewhat intervenose toward pileus margin. Lamellar Trama hyaline, gelatinised, of interwoven hyphae (1.5) 2-5 µm diam, with walls gelatinised to 2 µm thick, with clamps. Basidia 4-spored, hyaline, clavate, 18-21 X 5.5-6.5 µm. Cystidia none seen. Basidiospores cylindric to somewhat allantoid, amyloid, smooth, (6.6) 7.2-9.6 (10.0) X 2.2-3.4 (3.6) µm.
OBSERVATIONS: The colouration of the fruit bodies, the habitat, and the long, cylindric, amyloid spores clearly identify this collection as ***Panellus violaceofulvus*** (Batsch: Fr.) Singer. This collection represents the third known collection of ***P. violaceofulvus*** from North America. The other two collections are from Anticosti Island, Quebec, Canada (Miller, 1970) and Gros Morne National Park, Newfoundland, Canada (Sept. 24, 1983, S.A. Redhead, DAOM #187858). All collections are on ***Abies***.

Agaricus Leightonii Berkeley (1844: 343)
Figures 7 E-G, 9 F.
TYPE SPECIMEN: England: Montford Bridge near Shrewsbury, Dec. 1, 1841, Rev. W.A. Leighton, K. The substrate is corticated hardwood.
Pileus (dry) cupulate, up to 7 mm diam., dorsally attached, dark reddish brown beneath a greyish bloom at the margin, the disk entirely shaggy-tomentose with buffy hairs. Lamellae radiating from a near-central point on underside, moderately distant and narrow, deep cream to reddish, very finely frosted under 10 X. Lamellar Trama nearly parallel, hyaline, slightly gelatinised, hyphae 2-3 (4.5) µm diam. Basidia few mature; one dubiously 2-pronged, other (collapsed) apparently 4-pronged, basidioles clavate, 21-36 (48) X 6-7.2 (8.2) µm. Cheilocystidia fusoid-capitate, 32-44 X 4.0-5.5 (7) µm, with a gloeoid head 6-12 µm diam. produced by stubby hour-glass secretory cells 4-4.8 X 1.8-2.2 µm. Metuloids conical crystalline mounds clearly visible in face view, 12-18 µm diam., metuloids themselves hyaline, clavate, or with tapering necks, magenta in cresyl blue, inamyloid, in a squash mount collapsing and not distinctive, 18-36 X 5-8.4 µm. Basidiospores elliptic, hyaline, inalmyloid, smooth (many collapsed), 10.0-13.5 X 4.8-5.8 µm.
OBSERVATIONS: The metuloids and the leptocystidia with hour-glass secretory cells of this collection clearly indicate that ***Agaricus leightonii*** is a species of ***Hohenbuehelia***. The

metuloids, however, are very inconspicuous, hardly protruding from the hymenial surface. These metuloids were overlooked by Orton (1960: 181), who made the new combination ***Resupinatus leightonii*** (Berk.) Orton. This specimen has the colouration and large spores characteristic of ***Hohenbuehelia reniformis*** (Meyer: Fr.) Singer, sensu Fries (1874) and M.C. Cooke (1883).

Agaricus mustaliensis Karsten (1876: 99)
Figure 10 D-G.
TYPE SPECIMEN: Mustalia [Finland], "pa tallbark" [***Pinus sylvestris***], Dec. 8, 1865, P.A. Karsten, Fungi Fenniae Exsccati #605. A portion of this exsiccati at FH was studied.
Pileus orbicular, 7 X 6 mm, broadly attached, margin black and glabrous, entire disk covered with thick (0.5 mm deep) mat of creamy-white tomentum (probably adpressed basal mycelium). Lamellae radiating from point of attachment, narrow, subdistant, black, with white margins, finely frosted under 10 X. Cuticle a cutis of brown, smooth-walled hyphae with clamps, 2.8-8.5 µm diam., epicuticular hyphae hyaline, smooth, > 1000 µm long, (1.2) 1.8-5.0 µm diam., mostly thin-walled but some with walls up to 0.75 µm thick, with scattered hour-glass secretory cells 4-5 X 1.5-1.8 µm, producing mucoid balls 5-7.5 µm diam. Basidia 4-spored, hyaline, clavate, (21) 28-36 X 6-7 µm. Cheilocystidia numerous, clavate-capitate, 23-34 X 5-8 µm, most with a mucoid cap (before squash) 5-7.5 µm diam., the hour-glass cells 4-6 X 1.5-2 µm. Metuloids prominently projecting from hymenium, lanceolate, 42-72 X 6.6-12.3 µm, with a tri-layered wall, the middle layer dark brown (KOH) and the inner and outer layers hyaline, capped with a conical cone of hyaline crystalline material. Basidiospores hyaline, inamyloid, elliptic to elliptic-phaseoliform, 8.2-9.4 (10.4) X 4.2-5.0 µm.
OBSERVATIONS: ***Agaricus mustaliensis*** is clearly a ***Hohenbuehelia***, and is very similar to ***H. nigra*** (Schw.) Singer, from which it differs in its habitat and tomentose

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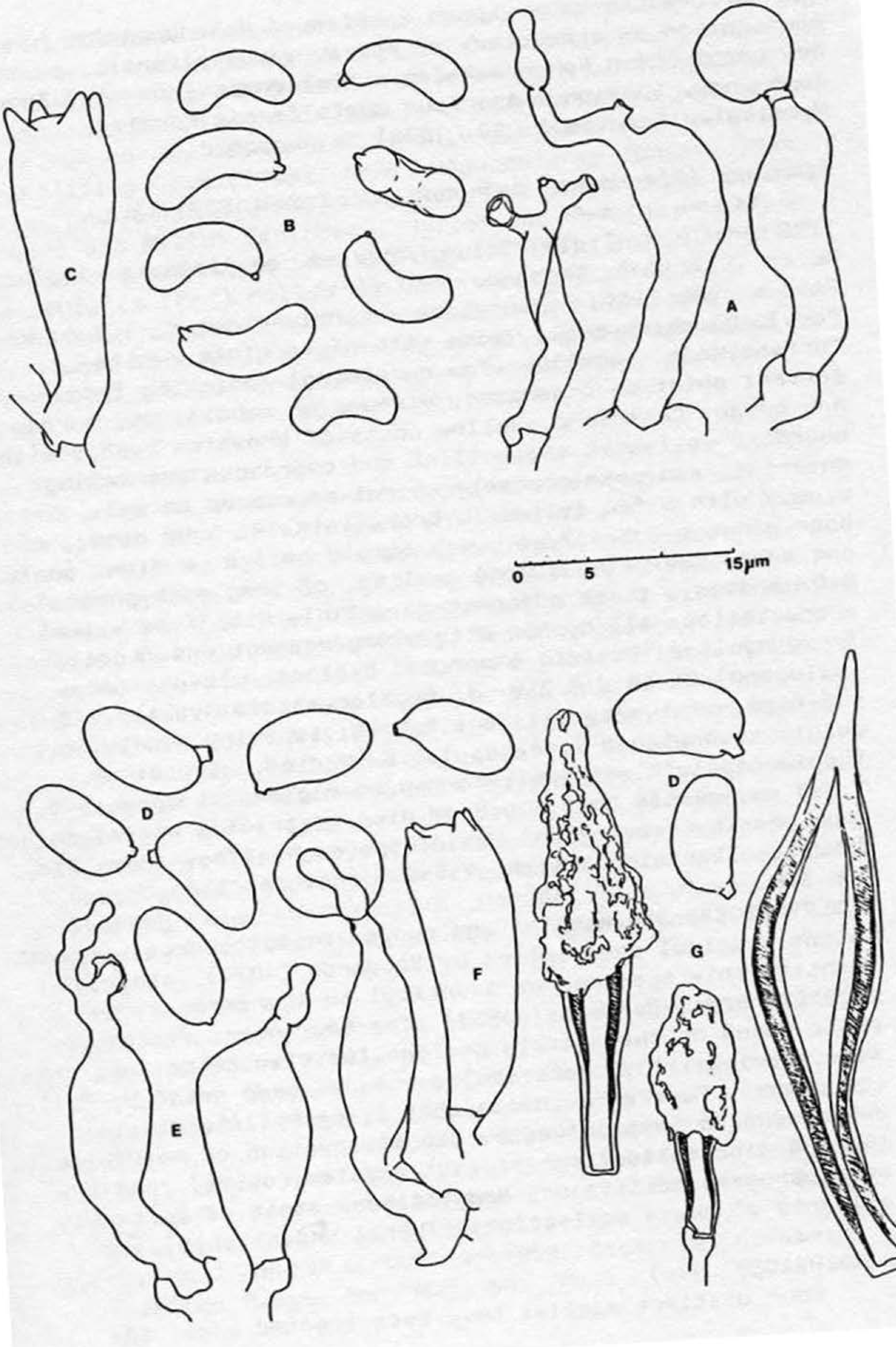
Figure 10 A-C: ***Agaricus sylvanus***, PAD #3644 (type). A) Cheilocystidia; B) allantoid basidiospores; C) a basidium. D-G: ***Agaricus mustaliensis***, Fungi Fenniae #605 (isotype, FH). D) Basidiospores; E) cheilocystidia; F) basidium; G) metuloids.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cap surface. No other known species of ***Hohenbuehelia*** has the combination of characters of ***Agaricus mustaliensis***, so the new combination ***Hohenbuehelia mustaliensis*** (Karsten) Thorn, comb. nov. (basionym ***Agaricus mustaliensis*** Karsten, Mycologica Fennica 3: 99, 1876) is proposed.

Agaricus **(*Pleurotus*)** ***sylvanus*** Saccardo (1877: 1)
Figure 10 A-C.

TYPE SPECIMEN: Italy: Selva, Treviso, on ***Clematis vitalba***, March 1877, P.A. Saccardo, PAD #3644.

Pileus cyphelloid to cupulate or conic-pendent, 1-7 mm broad (dry), blackish-brown, some with olive tints, white-furfuraceous. Lamellae (few remaining) radiating from near-central point on underside, distant or subdistant, narrow, now beige. Cuticle a shallow cutis of brownish hyphae with abundant yellowish crystalline and amorphous encrusting material, and some coarsely spiral-encrusted as well, 2-4 µm diam., with a few cylindric branchlets 1-1.5 µm diam., and hour-glass 4.5 X 1.7 µm, with mucoid ball 6 µm diam. (only one seen). Gelatinous Zone hyaline, of tangled hyphae, 1.5-4.0 µm diam., those adjacent to cuticle with fine spiral encrustation. All hyphae with clamp connections. Lamellar Trama hyaline. Basidia 4-spored, hyaline, clavate (many collapsed) 21-30 X 6.2-8 µm. Cheilocystidia hyaline, 20-35 X 4.5-6 µm, of two types - one fusoid, tapering nearly to a point, then with a fine cap 1-1.5 µm diam.; the other fusoid-capitate with well-formed hour-glass at apex, 4-5.5 X 1.5-2 µm, mucoid ball 5-6.5 µm diam. Metuloids not seen (not examined in Cresyl Blue) Basidiospores hyaline, inamyloid, broadly allantoid, smooth, 7.5-9.3 (not counting curve) X 2.8-3.6 µm.

OBSERVATIONS: The habitat and curved basidiospores, as well as the original description by Saccardo (1877), clearly identify this specimen as identical to ***Agaricus cyphelliformis*** Berkeley (1837). The hour-glass secretory cells found on the cuticle and cheilocystidia indicate that this species is a ***Hohenbuehelia***, as has been noted by Miller (in press). Further evidence that ***A. cyphelliformis*** is a ***Hohenbuehelia*** is provided by the observation of metuloids in two Canadian collections of that species (above), and the nematophagous ability and ***Nematoctonus*** state of cultures cultures of these collections (Thorn, unpublished).

CONCLUSIONS

Four distinct species have been treated under the epithet *Pleurotus silvanus* (Sacc.) Saccardo (1887). The type of *Agaricus sylvanus* Saccardo (1877) is a specimen of *Hohenbuehelia cyphelliformis* (Berk.) Miller. *Pleurotus silvanus* sensu Josserand (1933) is *Hohenbuehelia pinacearum* Thorn, which has also been commonly misidentified as *P. atropellitus* Peck (1886), or *P. unguicularis* (Coker, 1944, Miller and Manning, 1976). *Pleurotus silvanus* sensu Coker (1944), and Miller (in press; Miller and Manning, 1976) is *Resupinatus alboniger* (Pat.) Singer (1978). *Hohenbuehelia unguicularis* (Fr.) Miller has been misidentified as *Resupinatus silvanus* by Thorn and Barron (1984) and others. The elucidation of the taxonomy of this group was aided by studies on the cultural characters and biology of these fungi, which will be reported elsewhere.

ACKNOWLEDGEMENTS

I wish to thank Dr. G.L. Barron, under whose supervision much of this work was done as part of an MSc thesis project, for his encouragement and patience; Dr. J.A. Parmelee (DAOM), and Dr. J. Krug (TRTC) for the loan of specimens and for facilities provided while I visited these herbaria; Dr. J.H. Haines (NYS), Dr. M. Josserand of Lyon, France, Dr. G.G. Lorenzoni (PAD), Dr. D.H. Pfister (FH), and Dr. D.A. Reid (K) for the loan of type and authentic specimens; Dr. O.K. Miller, Jr. (VPI) and Dr. R. Singer (F) for cultures, specimens and valuable correspondence regarding *Hohenbuehelia*; and Mr. G. Whitney, superintendent of Algonquin Provincial Park, Ontario, for permission to collect there. This project was funded in part by an operating grant to Dr. Barron from the Natural Sciences and Engineering Research Council of Canada. This paper was reviewed by Dr. J.H. Ginns and Dr. S.A. Redhead (DAOM).

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MYCOTAXON

Vol. XXV, No. 1, pp. 67-83 January-March 1986

BASIDIOMYCETES THAT DECAY GAMBEL OAK IN SOUTHWESTERN COLORADO: II

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SUMMARY

Twenty additional Basidiomycetes that decay **Quercus gambelii** Nutt. in southwestern Colorado are illustrated and described.

In a previous paper (Lindsey, 1985) thirty wood-rotting Basidiomycetes in the orders Tremellales, Dacrymycetales, Aphyllophorales, and Agaricales were described. This paper continues a series which will culminate with a comprehensive key to all the species found in this area. Microscopic techniques were described in the initial paper of the series (Lindsey, 1985). Numerical color names are from Munsell's Book of Color (Munsell, 1976); descriptive names are the author's.

List of Additional Species that Decay Gambel Oak

AMPHINEMA BYSSOIDES (Fr.) John Erikss., Symb. Bot. Upsal. XVI:1, p. 112. 1958.
Basidiocarps effused-resupinate, farinaceous, separable, dull golden-brown (2.5Y 7/4); margin abrupt. **Hyphal system** monomitic; subicular hyphae thin- to slightly thick-walled, rather rigid in appearance, abundantly nodose-septate and frequently branched, some with fine regular encrustations, 2-3.5 µm diam. **Cystidia** projecting up to 80 µm, cylindric, hyphoid, with frequent clamps and fine encrustations, moderately thick-walled, up to 85 x 4-5 µm. **Basidia** cylindric to clavate, 4-sterigmate, with a basal clamp, 14-15 x 4-4.5 µm. **Basidiospores** hyaline, smooth, negative in Melzer's reagent, ellipsoid, 3-3.5 x 1.5-2.5 µm. **Voucher specimen** - JPL 1308.

ATHELIA COPROPHILA (Wakef.) Jülich, Willdenowia 7:66. 1972.
Basidiocarps very thin, pellicular, tuberculate, cracking extensively upon drying to expose the substratum, grayish-white (2.5Y 8/2); margin indistinct, thinning out. **Hyphal system** monomitic; subicular hyphae nodose-septate, thin-walled near the hymenium, becoming more thick-walled near the substratum, 2.5-3.5 µm diam. **Sterile hymenial elements** lacking. **Basidia** short-clavate, 4-sterigmate, with a basal clamp, 12-15 x 6-7 µm. **Basidiospores** globose to subglobose, strongly apiculate, hyaline, smooth, negative in Melzer's reagent, 3.5-4 x 4-5 µm. **Voucher specimen** - JPL 1290.

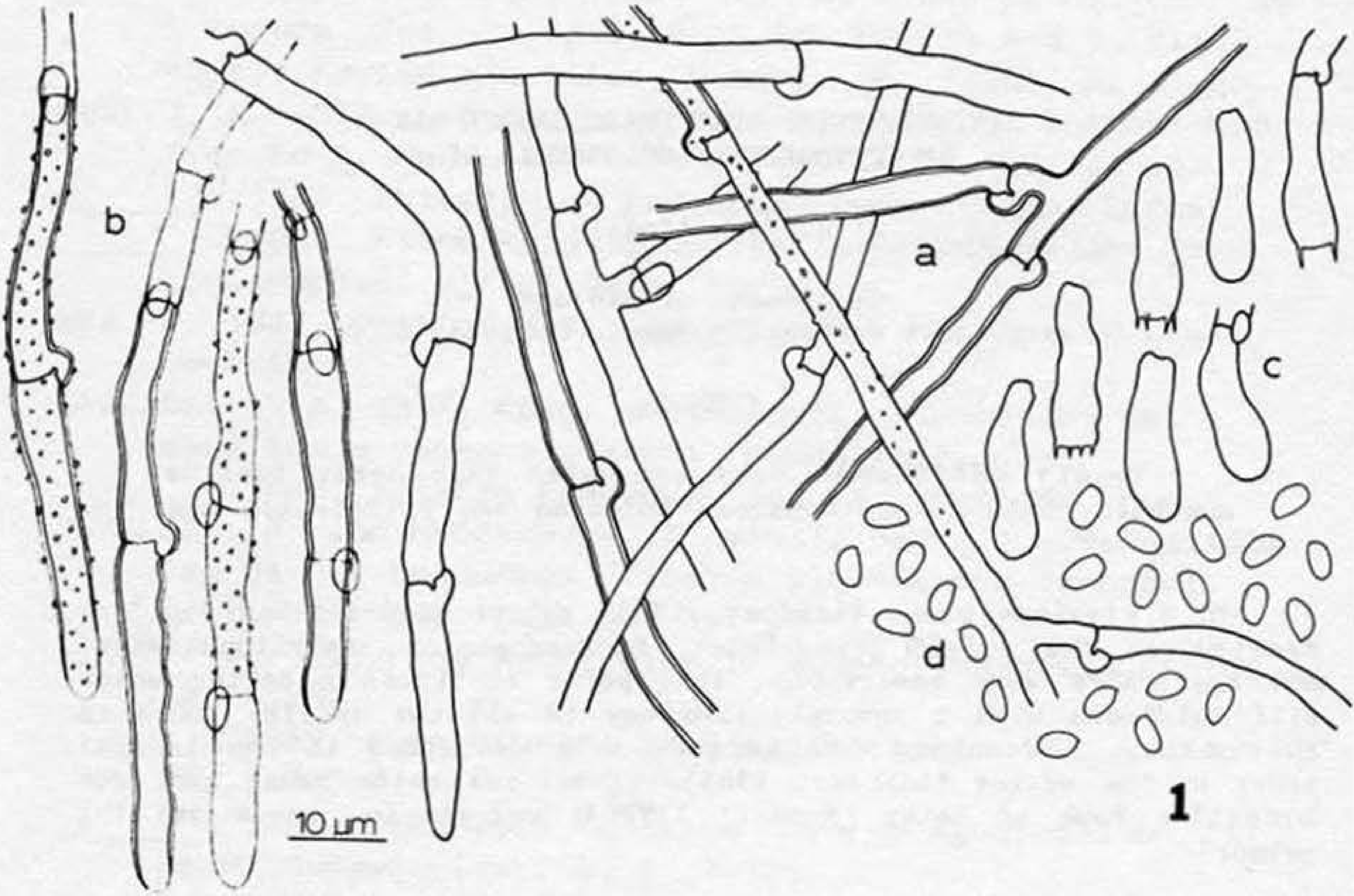

Fig. 1. **Amphinema byssoides.** (JPL 1308). a) subicular hyphae; b) cystidia; c) basidia; d) basidiospores.

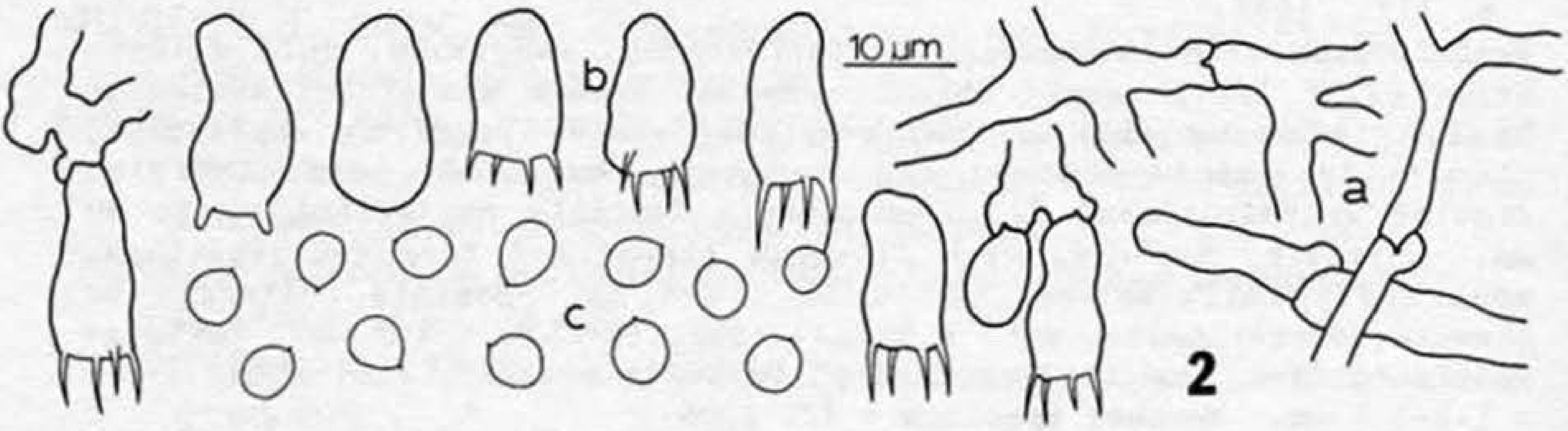

Fig. 2. **Athelia coprophila.** (JPL 1290). a) subicular hyphae; b) basidia; c) basidiospores.

CERIPORIA RETICULATA (Fr.) Dom., Acta. Soc. Bot. Pol. 32:732. 1963. **Basidiocarps** annual, resupinate, becoming effused up to 6 cm, separable, soft, drying to a pinkish orange (near 10YR 8/4); tubes 2-4 per mm, often only a shallow reticulum, with thick dissepiments. **Hyphal system** monomitic; subicular hyphae thin- to slightly thick-walled, simple-septate, with occasional right-angle branching, 2.5-5 µm. **Sterile hymenial elements** lacking. **Basidia** clavate to short-clavate, 4-sterigmate, with a simple septum at the base, 16.5-20 x 6-7 µm. **Basidiospores** hyaline, smooth, negative in Melzer's reagent, reniform to broadly allantoid, 6.5-10 x 3-4 µm. **Voucher specimen** - JPL 1121.

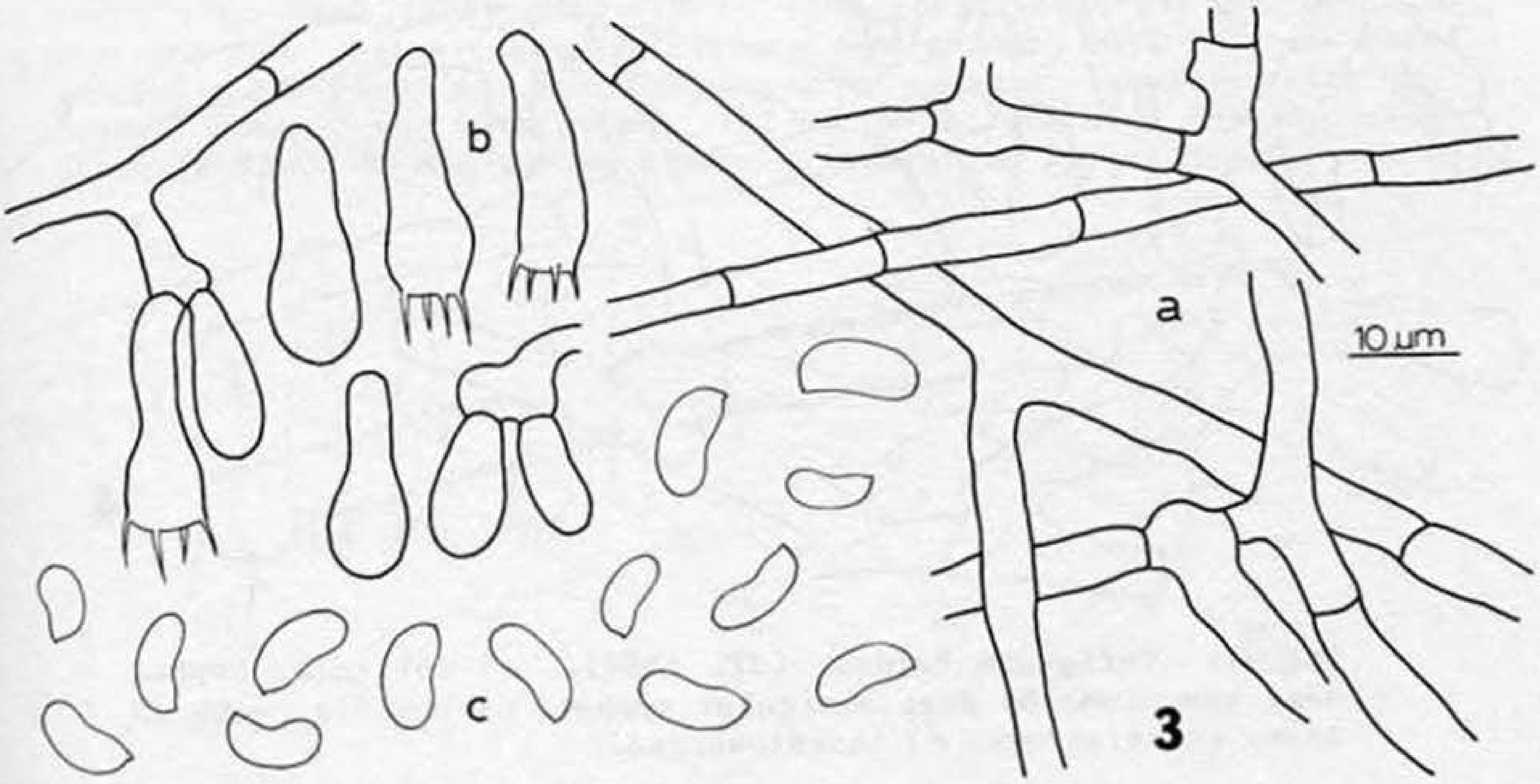

Fig. 3. **Ceriporia reticulata.** (JPL 1121). a) subicular hyphae; b) basidia; c) basidiospores.

CERIPORIA TARDA (Berk.) Ginns, Mycotaxon 21:326. 1984.
Basidiocarps annual, resupinate, effused up to 3 cm, soft, cream colored with pink areas when fresh, drying to a dull cream; pores shallow, irregular, often more of a shallow reticulum, 4-6 per mm; margin broad to abrupt, white, minutely fimbriate to floccose. **Hyphal system** monomitic; hyphae hyaline, simple-septate, thin-walled in the hymenial region, becoming slightly thick-walled and broader in the subiculum, 3-6 µm diam. **Sterile hymenial elements** lacking. **Basidia** short-clavate, 4-sterigmate, with a simple septum at the base, 12-14 x 4-6 µm. **Basidiospores** hyaline, smooth, cylindric-ellipsoid, negative in Melzer's reagent, 4-4.5 x 2-2.5 µm. **Voucher specimen** - JPL 1289.

CERIPORIOPSIS MUCIDUS (Pers.:Fr.) Gilbn. et Ryv., Mycotaxon 22: 364. 1985.
Basidiocarps annual, effused, cream colored (near 10YR 9/4); pores angular, edges becoming lacerate to fimbriate, 2-4 per mm; margin abrupt to broad, white, fimbriate, with weak rhizomorphic development. **Hyphal system** monomitic; hyphae thin- to very thick-walled, nodose-septate, frequently branched, 2.5-4.5 µm diam. **Sterile hymenial elements** lacking. **Basidia** clavate to cylindric-clavate, 4-sterigmate, 15-17 (-32) x 5-6 µm. **Basidiospores** hyaline, smooth, negative in Melzer's reagent, ovoid to ellipsoid, 3.5-4 x 2-2.5 µm. **Comments** - Basidia in this fungus often are formed directly as lateral branches on hyphae (see figure); others form at hyphal apices and become greatly elongated and distorted, having a cylindric, slender basal portion and an apex which may be at an angle to the axis of the basidium. **Voucher specimen** - JPL 1298.

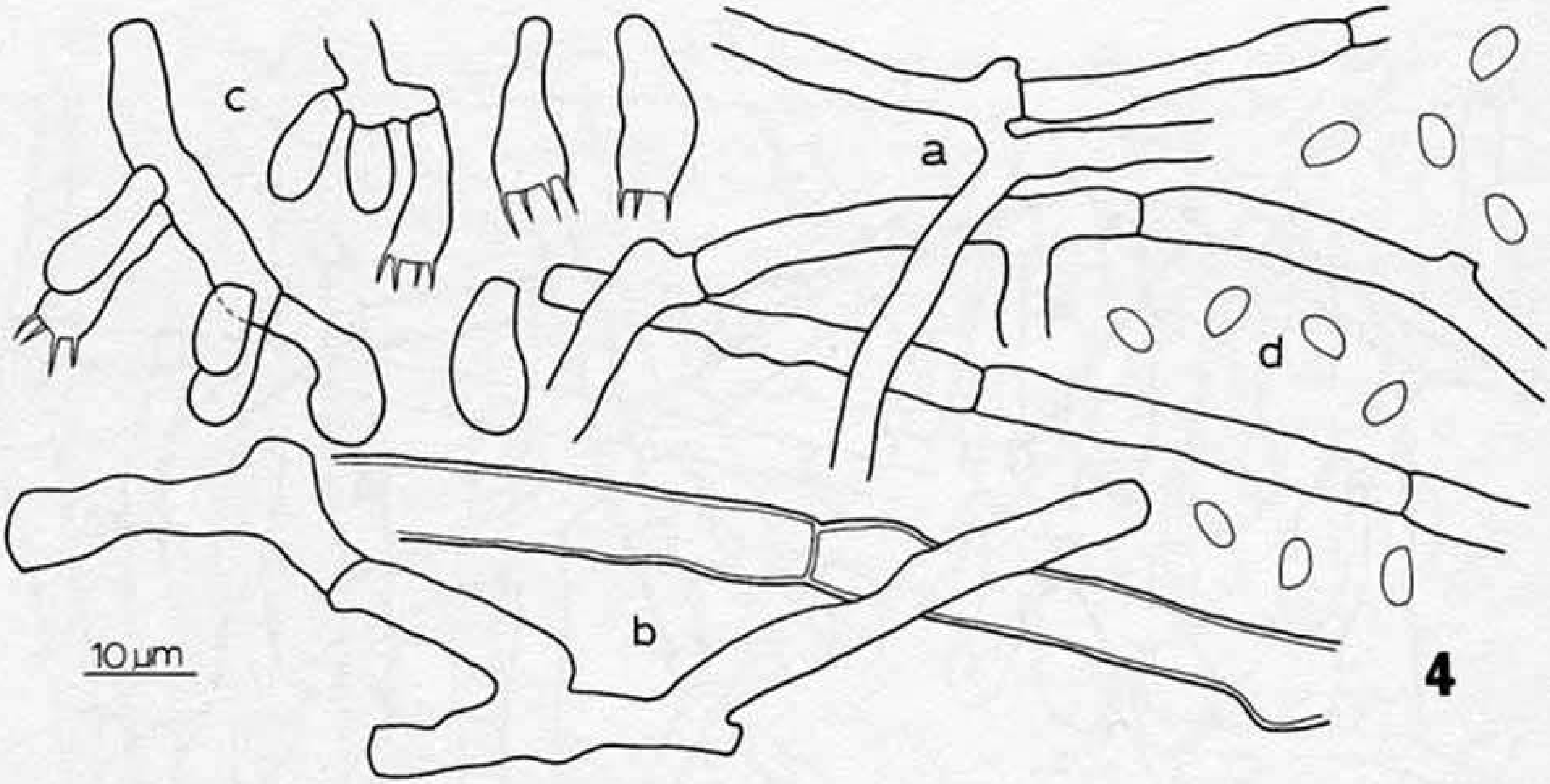

Fig. 4. **Ceriporia tarda.** (JPL 1289). a) subicular hyphae near hymenium; b) deep subicular hyphae; c) basidia, some in loose candelabrums; d) basidiospores.

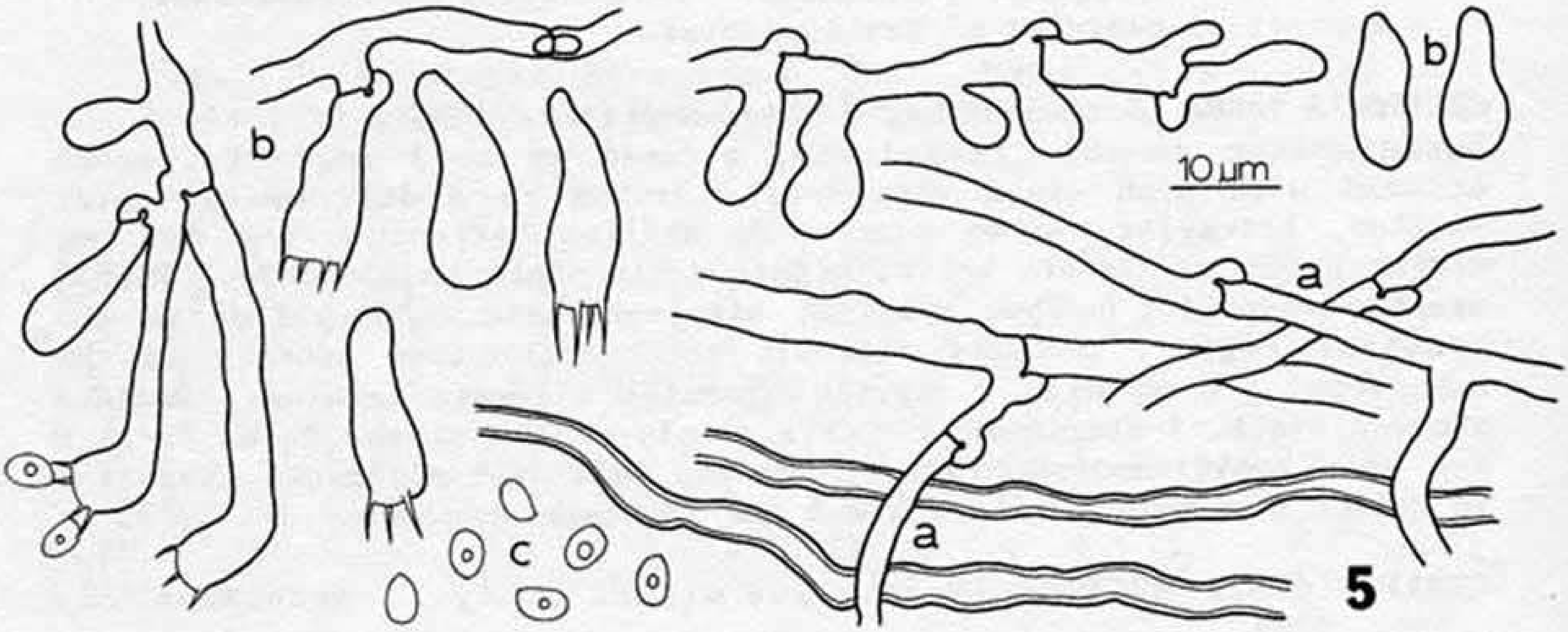

Fig. 5. **Ceriporiopsis mucidus.** (JPL 1298). a) subicular hyphae, showing thick-walled fragments without clamps that could be mistaken for skeletal hyphae; b) basidia, both laterally and terminally produced; c) basidiospores.

FIBULOMYCES MUTABILIS (Bres.) Jülich, Willdenowia 7:182. 1972. **Basidiocarps** bright white, effused, easily separable, smooth; margin white, floccose to fimbriate. **Hyphal system** monomitic; subicular hyphae nodose-septate, thin-walled near the hymenium, becoming more thick-walled near the substrate, 2-4 µm diam. **Sterile hymenial elements** lacking. **Basidia** narrowly cylindric-clavate, 4-sterigmate, with a basal clamp, 19-24 x 3.5-4.5 µm. **Basidiospores** ellipsoid, hyaline, smooth, negative in Melzer's reagent, 3.5-4.5 x 2-2.5 µm. **Voucher specimen** - JPL 1174.

GLOEOPHYLLUM TRABEUM (Pers.:Fr.) Murr., N. Am. Fl. 9:129. 1908. **Basidiocarps** annual, sessile, effused-resupinate to effused-reflexed and strongly pileate, pilei often confluent; upper surface of pileus dirty gray-brown (near 10YR 6/2 to 10YR 3/4), tomentose but becoming glabrous upon weathering; pore surface more golden, 10YR 5/4, the pores initially elongated and variable, becoming radially lamellate with age; context concolorous with pileus, 1-2 mm thick, staining dark brownish-black in KOH. **Hyphal system** dimitic; generative hyphae hyaline, thin-

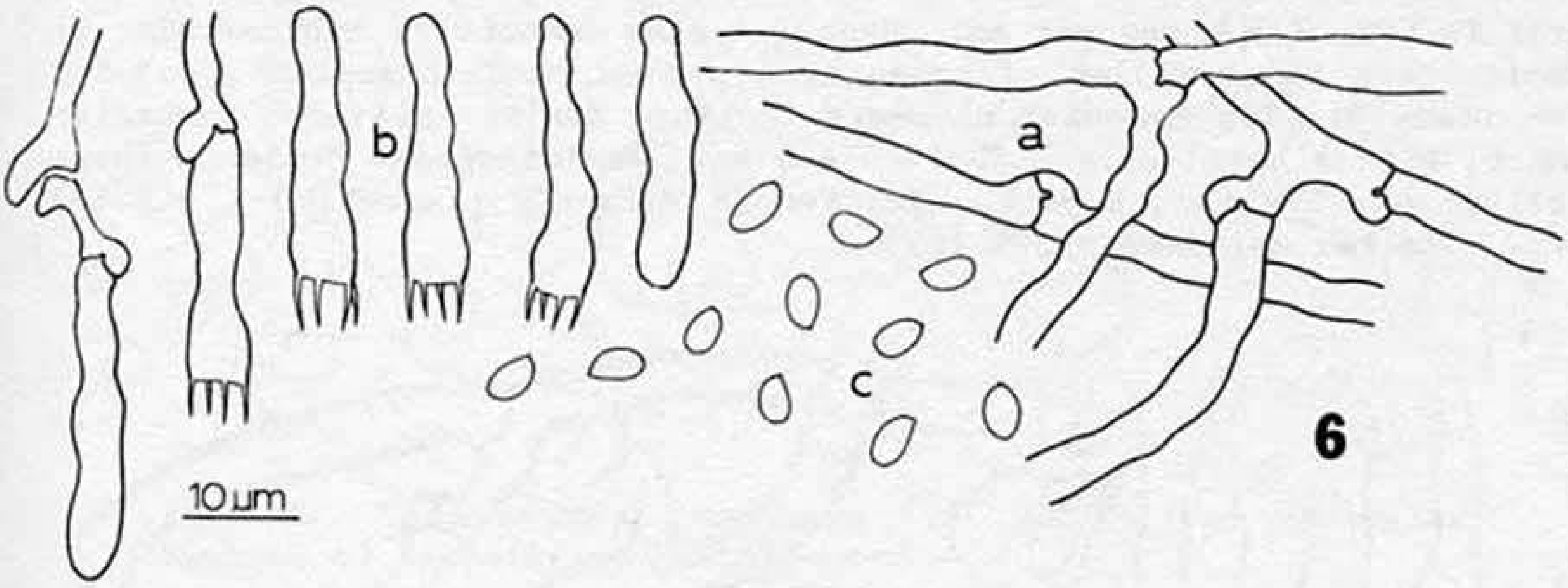

Fig. 6. **Fibulomyces mutabilis.** (JPL 1174). a) subicular hyphae; b) basidia; c) basidiospores.

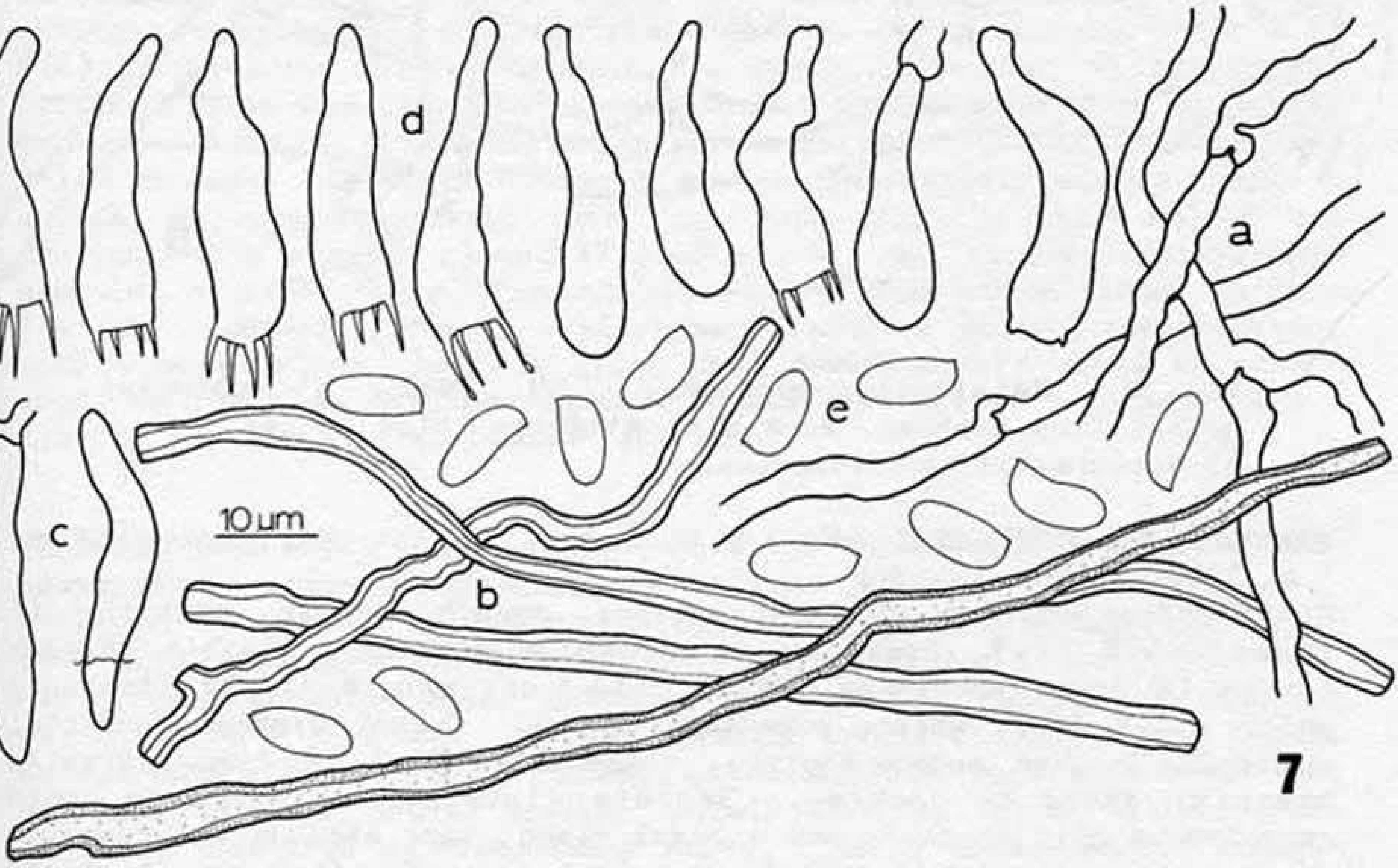

Fig. 7. **Gloeophyllum trabeum.** (JPL 1313). a) generative hyphae; b) lightly pigmented skeletal hyphae; c) hyphoid cystidia; d) basidia; e) basidiospores.

walled, nodose-septate, 2.5-3.5 µm diam; skeletal hyphae with golden pigment, thick-walled, aseptate, rarely branched, 2.5-3.5 µm diam. **Cystidia** inconspicuous, barely projecting, thin-walled and almost hyphoid, 25-30 x 3-5 µm. **Basidia** clavate, 4-sterigmate, 23-26 (-45) x 5-7 µm. **Basidiospores** hyaline, smooth, negative in Melzer's reagent, cylindric, 7.5-8.5 x 3.5-4.5 µm. **Comments** - This is the first brown-rot fungus reported on Gambel oak in this series. **Voucher specimen** - JPL 1313.

HAPALOPILUS NIDULANS (Fr.) Karst., Rev. Myc. 3:18. 1881.
Basidiocarps annual, sessile, resupinate to pileate, dimidiate; upper surface tomentose, becoming glabrous with age, reddish-brown (5YR 3/4); pore surface concolorous to golden (near 10YR 6/6), turning deep wine red in KOH, 3-5 pores per mm. **Hyphal system** monomitic; hyphae thin- to moderately thick-walled, frequently branched, nodose-septate, 3.5-5.5 µm diam. **Sterile hymenial elements** lacking. **Basidia** clavate, 4-sterigmate, with a basal clamp, 20-24 x 4-6 µm. **Basidiospores** ovoid to short ellipsoid, hyaline, smooth, negative in Melzer's reagent, 3-4 x 2.5-3 µm. **Voucher specimen** - JPL 1295.

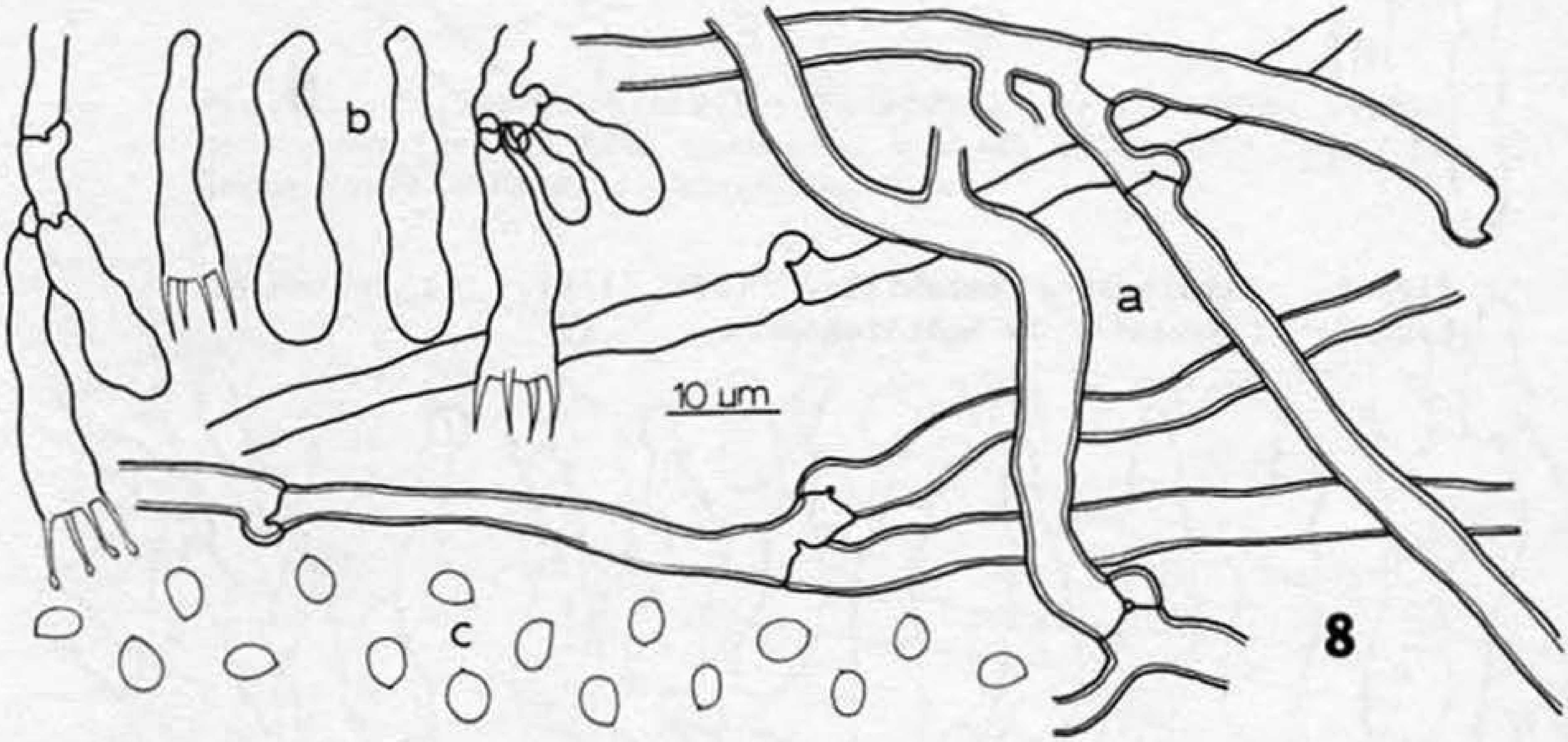

Fig. 8. **Hapalopilus nidulans.** (JPL 1295). a) subicular hyphae from context, some with slightly thick walls; b) basidia; c) basidiospores.

RADULOMYCES CONFLUENS (Fr.) M.P. Chris., Dansk Bot. Arkiv 19:2, p. 230. 1960.
Basidiocarps effused in small patches, smooth, adnate, pinkish-buff (near 7.5YR 7/4), crustaceous; subiculum sometimes visible through cracks in dried specimens, white, floccose; margin finely fimbriate under a 10X lens, white, sometimes abrupt. **Hyphal system** monomitic; subicular hyphae nodose-septate, thin-walled, 2-3 µm diam. **Sterile hymenial elements** lacking. **Basidia** clavate, 4-sterigmate, with conspicuous oily contents and a basal clamp, some sinuous and tapering to a very narrow base, 37-50 x 8.5-11 µm. **Basidiospores** hyaline, smooth, multiguttulate, negative in Melzer's reagent, varying from ovoid (6.5-7 x 5.5-6 µm) to ellipsoid-obovate, 8.5-11 x 6-7 µm. **Voucher specimen** - JPL 1301.

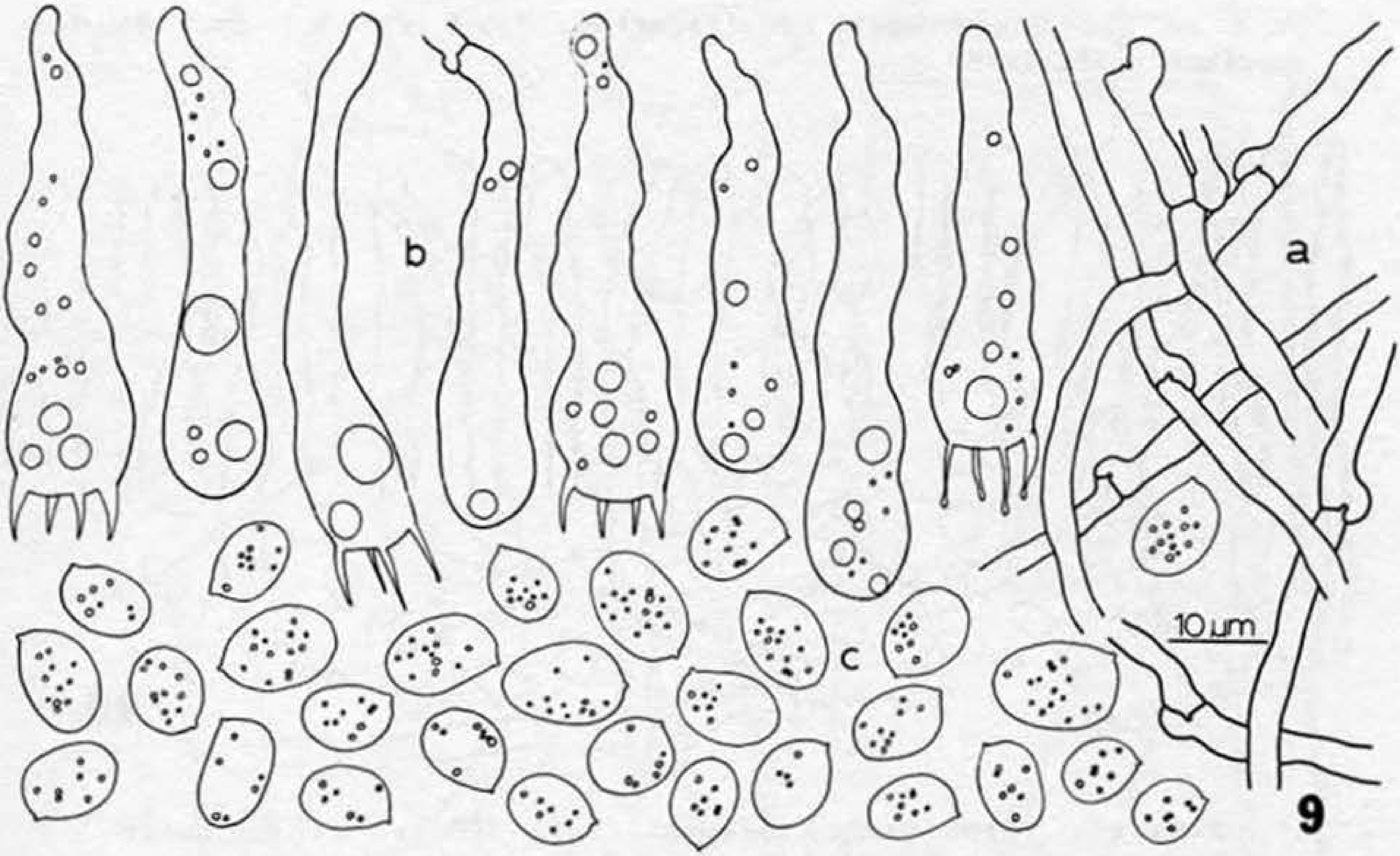

Fig. 9. **Radulomyces confluens** (JPL 1301). a) subicular hyphae; b) basidia; c) basidiospores.

HYPHODONTIA ARGUTA (Fr.) John Erikss., Symb. Bot. Upsal. 16:1, p. 104. 1958.

Basidiocarps widely effused, thin, dry, densely hydnaceous, the teeth conical to cylindric with fimbriate apices, cream colored (near 2.5Y 8/4); subiculum showing between the teeth, floccose, white; margin narrow, white, minutely fimbriate. **Hyphal system** monomitic; subicular hyphae slightly thick-walled, nodose-septate, frequently branched, 2-3.5 µm diam. **Cystidia** of two kinds; lagenocystidia with a thick-walled, tapered, encrusted apex, the base slightly thick-walled and swollen, with a basal clamp, 17.5-45 x 3-4.5 µm; thin-walled cystidia hyphoid, capitate, some flexuous, some with clamp connections, 26-38 x 3-4 µm. **Basidia** clavate, 4-sterigmate, with a median constriction, with a basal clamp, 13-27 x 3.5-4 µm. **Basidiospores** ovoid to ellipsoid, thin-walled, hyaline, smooth, negative in Melzer's reagent, 4-5 x 2.5-3.5 µm. **Voucher specimen** - JPL 1206.

INCRUSTOPORIA NIVEA (Jungh.) Ryv., Norw. J. Bot. 19:232. 1972.

Basidiocarps effused-resupinate to effused-reflexed; upper surface appressed-tomentose, becoming glabrous, turning dirty brown (near 7.5YR 5/4) with age; pore surface white to cream colored (near 2.5YR 9/4), discoloring brownish where touched; pores small, rounded to angular, glancing, 4-6 per mm. **Hyphal system** trimitic; generative hyphae nodose-septate, 2.5-5 µm diam, often heavily encrusted with fine crystals; skeletal hyphae hyaline, rarely branched, thick-walled, 3-6.5 µm diam, encrusted on dissepiment edges; binding hyphae small, irregularly branched to almost stellate, 1.5-2 µm diam. **Sterile hymenial elements** lacking. **Basidia** short-clavate, in small candelabrums, 4-sterigmate, with a basal clamp, 8-10 x 3-3.5 µm. **Basidiospores** hyaline, smooth, negative in Melzer's reagent, allantoid, very difficult to see under high magnification, 3.5-5 x 0.5-1 µm. **Voucher specimen** - JPL 1278.

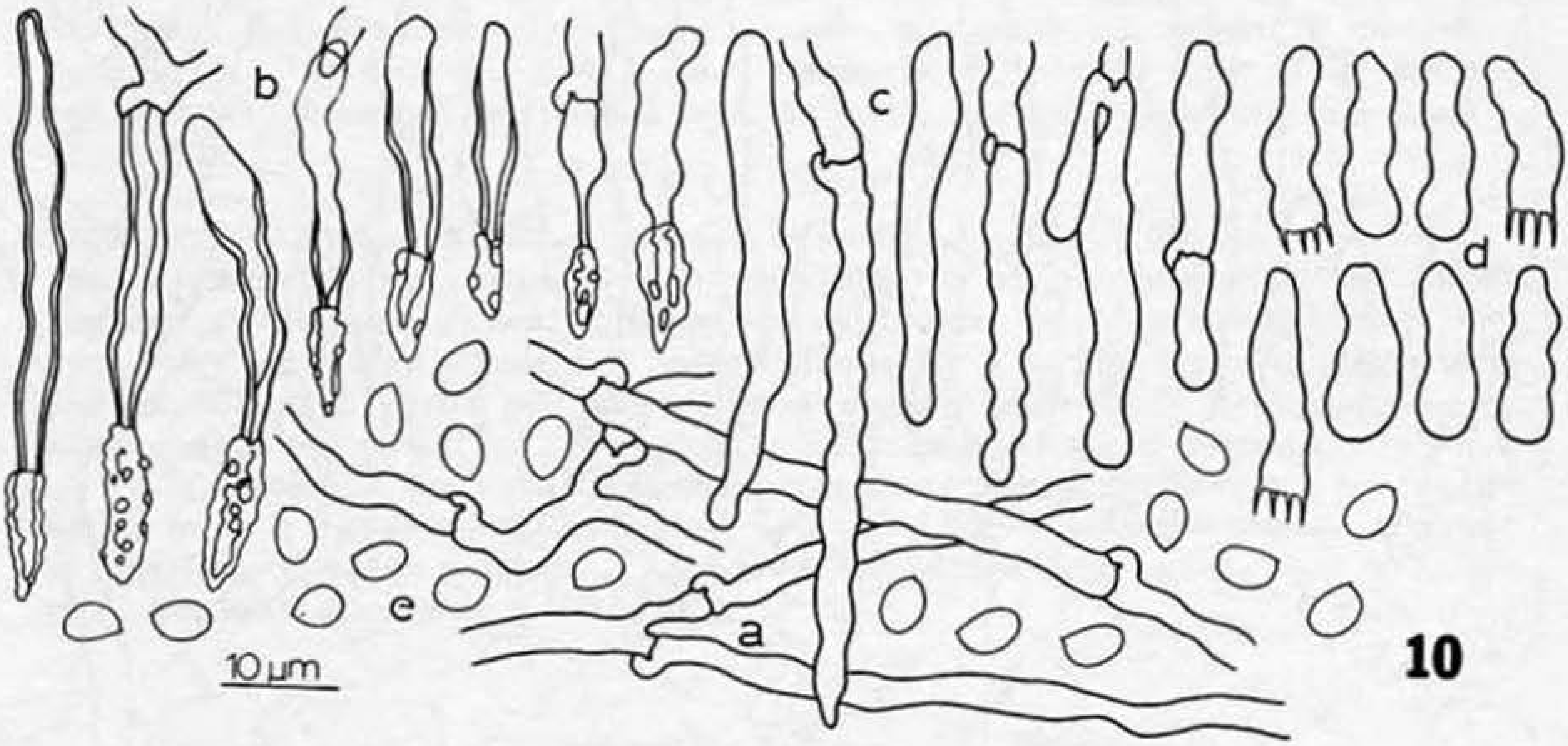

Fig. 10. **Hyphodontia arguta.** (JPL 1206). a) subicular hyphae; b) thick-walled, encrusted lagenocystidia; c) thin-walled, flexuous, capitate cystidia, some with clamp connections; d) basidia; e) basidiospores.

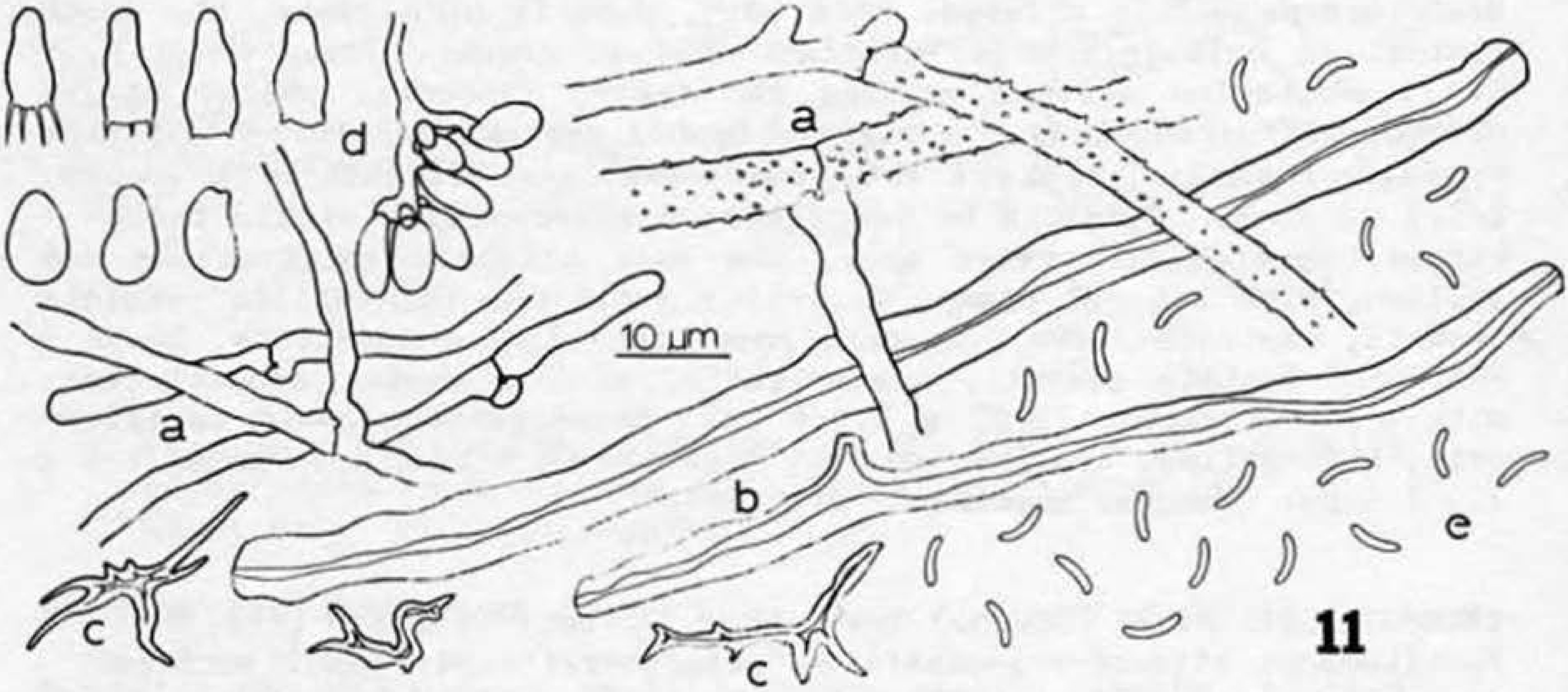

Fig. 11. **Incrustoporia nivea.** (JPL 1278). a) generative hyphae, some showing regular, fine encrustations; b) thick-walled skeletal hyphae; c) thick-walled binding hyphae; d) basidia, showing candelabrum; e) basidiospores.

OIDIUM CANDICANS (Sacc.) Linder., Lloydia 5:3. 1942.
Basidiocarps not seen. **Conidial state** grayish-yellow (near 5Y 8.5/4), floccose to mealy. **Conidiophores** thick-walled, apically branched, up to 150 µm long x 5-10 µm. **Conidia** lemon-shaped, light golden, 15-22 x 8.5-11 µm. **Voucher specimen** - JPL 1209.

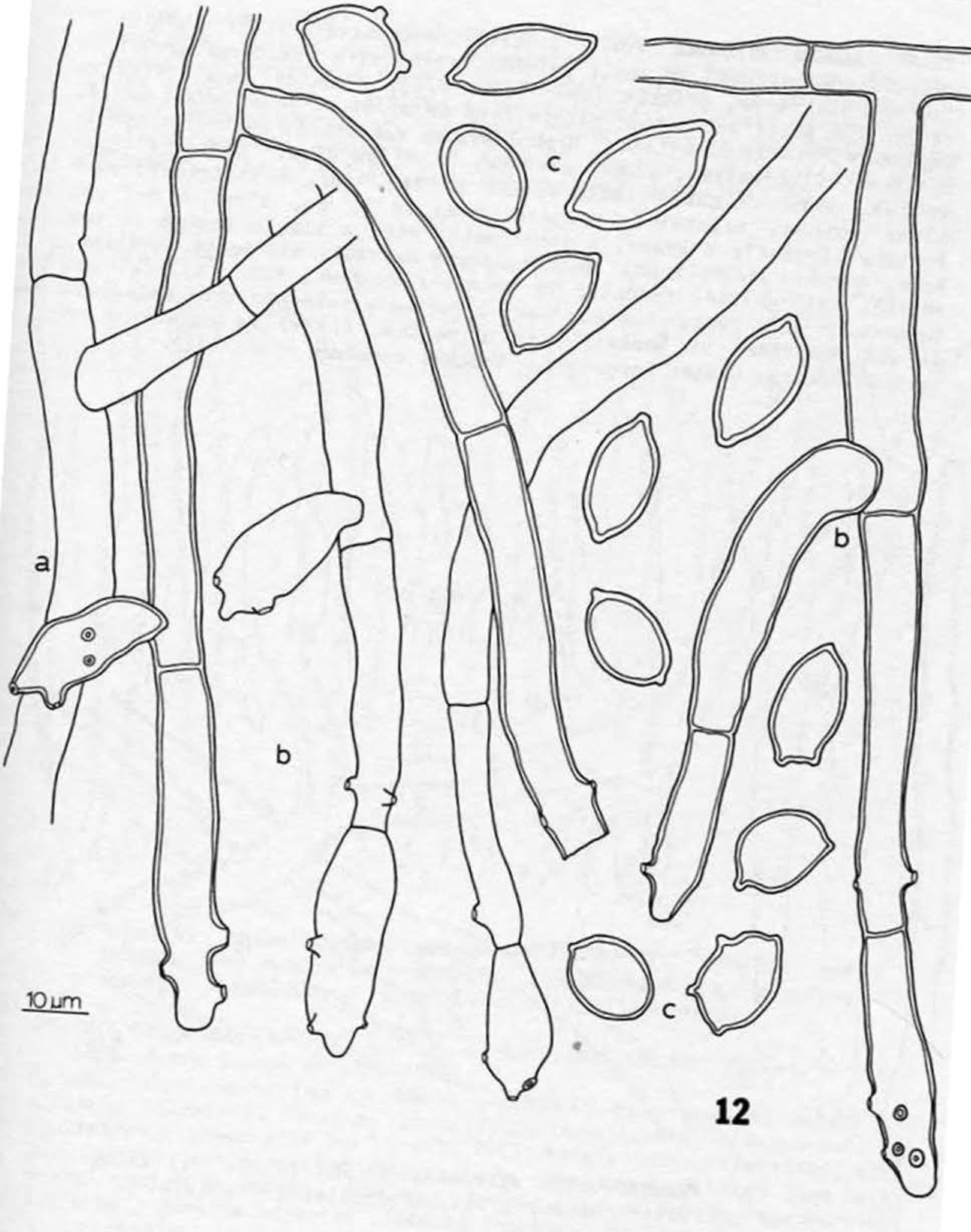

Fig. 12. **Oidium candicans.** (JPL 1209). a) subicular hypha; b) conidiophores; c) conidia.

PHANEROCHAETE ARIZONICA Burds. et Gilbn., Mycologia 66:785. 1974. **Basidiocarps** effused in small patches, thin, with scattered aculei in the hymenial area, pinkish (near 7.5YR 8/4), cracking upon drying to reveal the white subiculum; margin thin to broad in some areas, white, separable, finely fimbriate. **Hyphal system** monomitic; subicular hyphae hyaline, thick-walled, simple-septate, 3.5-7 µm diam. **Cystidia** thin-walled, very slightly thick-walled at the base, cylindrical, with blunt apices, scattered, projecting up to 25 µm, 55-90 x 5-7 µm. **Basidia** slenderly clavate, 4-sterigmate, with a simple septum at the base, 24-36 x 3.5-4.5 µm. **Basidiospores** narrowly ellipsoid, hyaline, smooth, thin-walled, negative in Melzer's reagent, 4.5-5 x 2-2.5 µm. **Comments** - This fungus has not been reported previously from Colorado. It was described by Burdsall and Gilbertson (1974) as occurring on various Sonoran Desert hardwoods. **Voucher specimen** - JPL 1223.

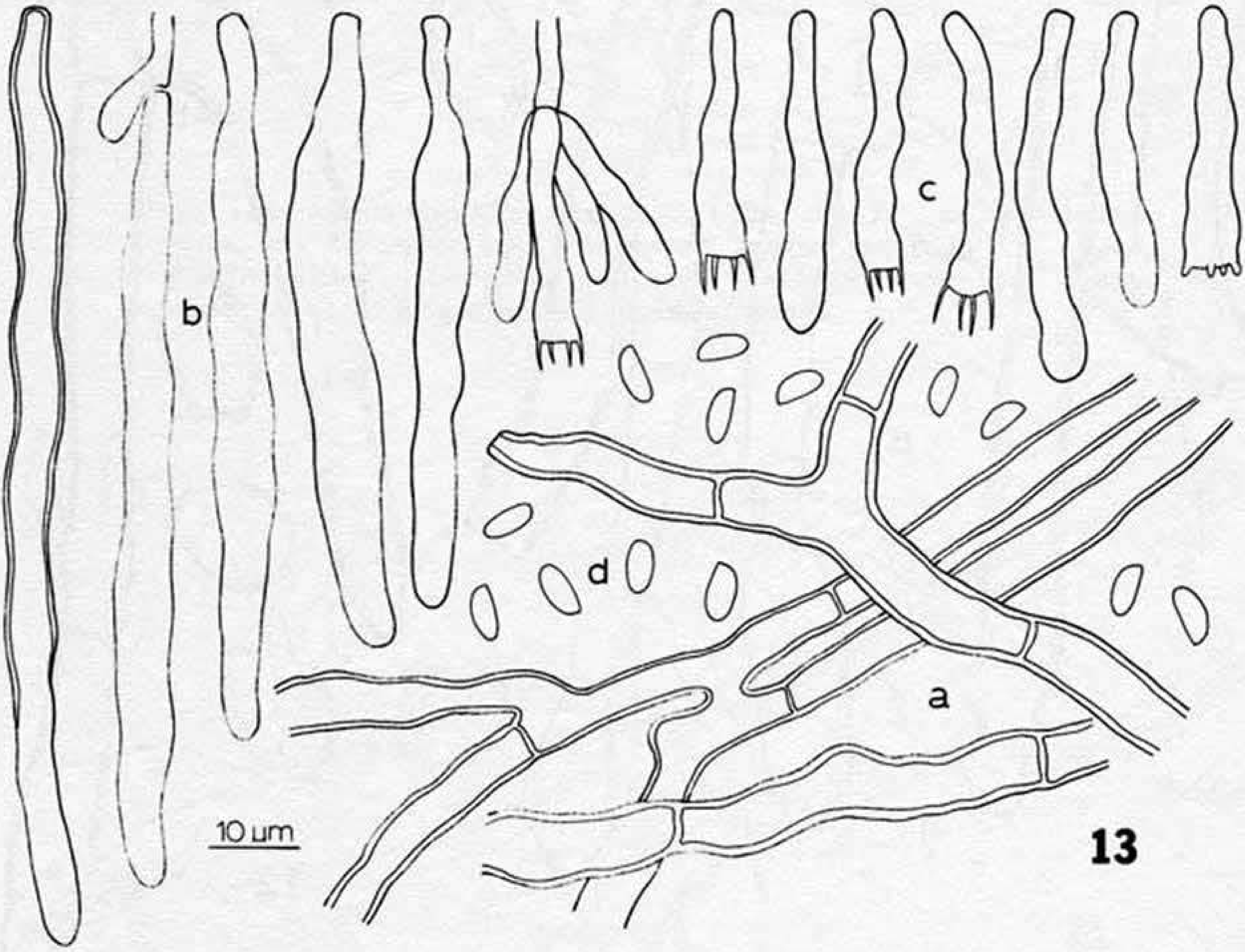

Fig. 13. **Phanerochaete arizonica.** (JPL 1223). a) thick-walled subicular hyphae; b) leptocystidia; c) basidia; d) basidiospores.

PHANEROCHAETE CARNOSA (Burt) Parm., Eesti NSV Tead. Akad. Toim. Biol. 16(4):388. 1967.
Basidiocarps widely effused-resupinate, smooth to slightly tuberculate, thick-felty, bright orangish-yellow when fresh, fading to dull yellow (near 2.5Y 9/4) to cream colored upon drying, often with orange highlights (near 7.5 YR 6/14); margin narrow, white, fimbriate, with occasional rhizomorphs. **Hyphal system** monomitic; subicular hyphae simple-

septate, thin-walled near hymenium, becoming very thick-walled near substratum, 3.5-6.5 µm diam. **Cystidia** thick-walled at base, becoming thin-walled toward the tapered apex, with a simple septum at the base, 63-78 x 4.5-6.5 µm. **Basidia** slender cylindric-clavate, 4-sterigmate, with a simple septum at the base, 28-38 x 4.5-6 µm. **Basidiospores** hyaline, smooth, negative in Melzer's reagent, ellipsoid to short-cylindric, 4-5(-6) x 2.5-3 µm. **Voucher specimen** - JPL 1200.

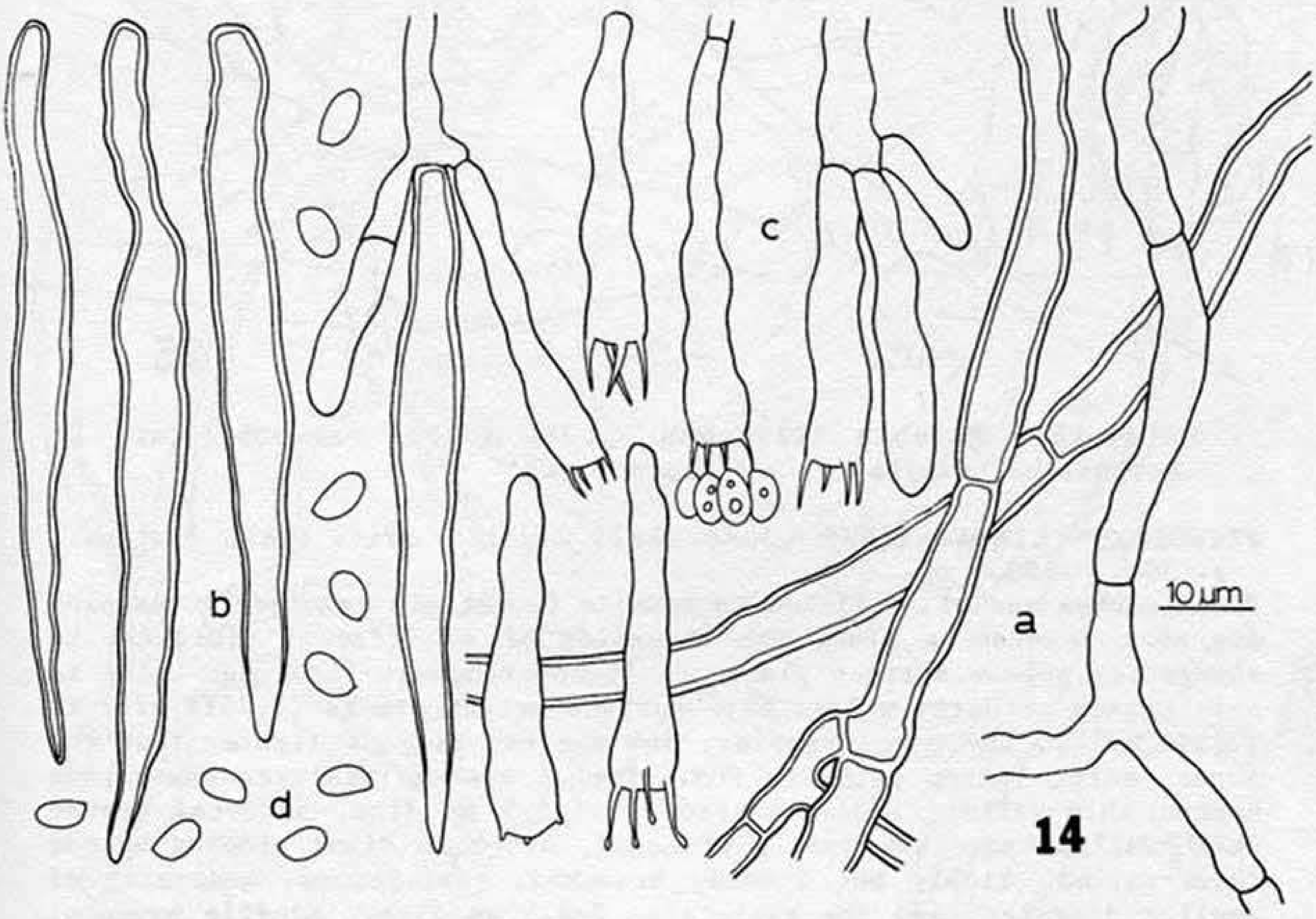

Fig. 14. **Phanerochaete carnosa.** (JPL 1200). a) thin- and thick-walled subicular hyphae; b) leptocystidia; c) basidia, showing typical loose candelabrum; d) basidiospores.

PHLEBIA LILASCENS (Bourd.) Erikss. et Hjortst., in John Erikss. et al., Cort. North Europe 6:1123. 1981.

Basidiocarps occurring on bark, effused, crustaceous, smooth to slightly phlebioid, cracking along folds upon drying, pinkish-buff to pinkish-gray (near 10YR 8/4 to 10YR 8/1); margin white, fimbriate, with pinkish to white rhizomorphs, these also present below the bark. **Hyphal system** monomitic; subicular hyphae thin-walled, nodose-septate, 2.5-6 µm. **Sterile hymenial elements** lacking. **Basidia** slender clavate, 4-sterigmate, with a basal clamp, 23-25 x 4-5 µm. **Basidiospores** short-cylindric to ellipsoid, hyaline, smooth, negative in Melzer's reagent, 4-5 x 2-2.5 µm. **Comments** - This fungus has been collected only once in this study. The hymenial surface of this specimen shows a slightly phlebioid configuration; the margin is fimbriate and sturdy white rhizomorphs are present. Eriksson et al. (1981) do not mention rhizomorphs and indicate the margin to be indeterminate. Christiansen (1960) briefly describes a fungus he refers to **Phlebia lacteola**, (Bourd.)M.P. Chris., another possible name for this fungus, but he indicates the presence of leptocystidia and does not clarify the presence of clamp connections. His macroscopic description agrees better with my collection than does that of Eriksson et al. for **P. lilascens,** however. Eriksson et al. (1981) consider recent Danish specimens determined as **P. lacteola** to be **P. lilascens. Voucher specimen** - JPL 1312.

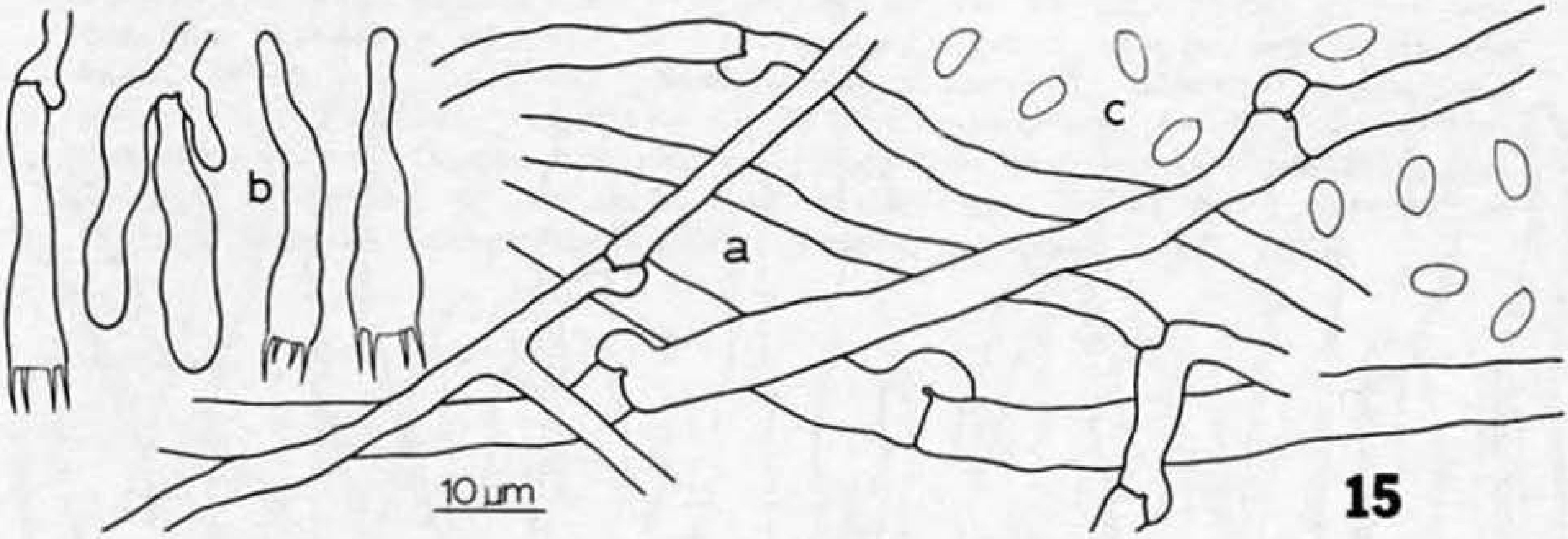

Fig. 15. **Phlebia lilascens.** (JPL 1312). a) subicular hyphae; b) basidia; c) basidiospores.

PYCNOPORUS CINNABARINUS (Jacq.:Fr.) Karst., Krit. Finl. Basidsv., p. 308. 1889.

Basidiocarps annual, reflexed to sessile (sometimes completely resupinate when developing along the underside of a surface), dimidiate to elongated; pileus surface glabrous, light orange at first but aging to pale orange or dirty white; pore surface bright orange (1.25YR 6/12 to 1.25YR 6/14), the pores angular, 3-4 per mm; context lighter than the pores, soft, losing color in KOH. **Hyphal system** trimitic; generative hyphae thin-walled, nodose-septate, 1.5-3.5 µm diam; skeletal hyphae thick-walled, aseptate rarely branched, 3.5-6 µm diam; binding hyphae thick-walled, richly but loosely branched, conspicuous, generally of smaller diameter than the skeletals, 3-4.5 µm diam. **Sterile hymenial elements** lacking. **Basidia** clavate, 4-sterigmate, with a basal clamp, 11-18 x 5-6 µm. **Basidiospores** hyaline, smooth, negative in Melzer's reagent, short-cylindric, 4-5.5 x 2-3 µm. **Voucher specimen** - JPL 1162.

RESUPINATUS APPLICATUS (Batsch: Fr. sensu Kauffman) S.F. Gray, Nat. Arr. Brit. Plants 1:617. 1821.

Basidiocarps small, 1-3 mm diam, sessile, laterally attached or dorsally attached, with margins often attached also; pileus dark grayish-blue to blackish, finely tomentose, often striate at the margins; margin inrolled; lamellae lighter than pileus, brownish, with light brown edges; context duplex, with the lower layer composed of gelatinizing hyphae, the two layers less than 1 mm thick. **Hyphal system** monomitic; hyphae nodose-septate; upper context hyphae pigmented, with normal clamps; lower contextual hyphae hyaline, contorted, often with distorted clamps. **Pleurocystidia** lacking. **Cheilocystidia** with a single attenuated tip or dendritically branched, with a basal clamp, 18-30 x 3.5-4.5 µm. **Basidia** clavate, 4-sterigmate, with a basal clamp, 23-32 x 5-7 µm. **Basidiospores** hyaline, smooth, negative in Melzer's reagent, globose to subglobose, with a prominent apiculus, 3-4 x 4-5 µm. **Voucher specimen** - JPL 1277.

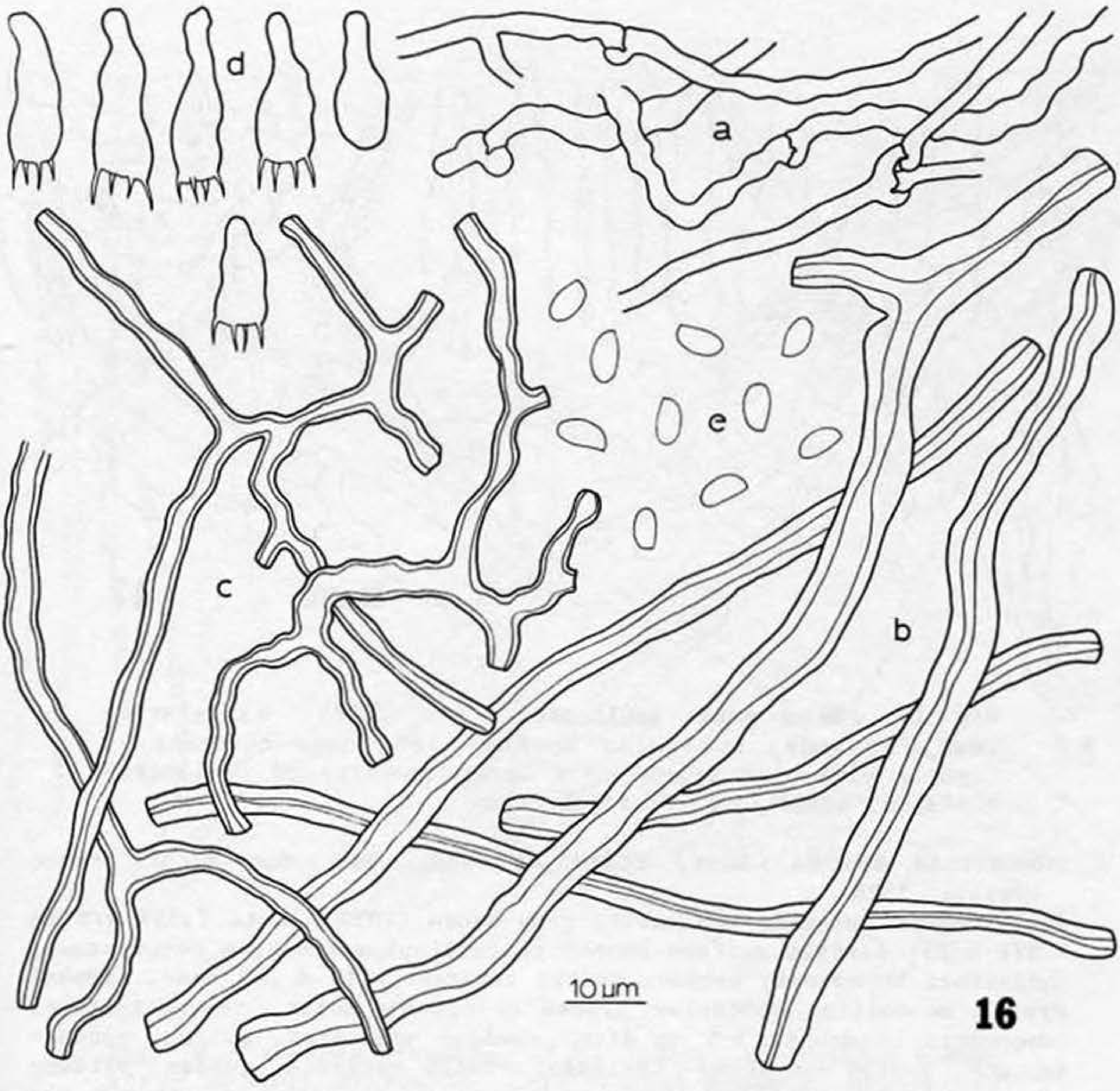

Fig. 16. **Pycnoporus cinnabarinus.** (JPL 1171). a) generative hyphae; b) thick-walled skeletal hyphae; c) thick-walled, branched binding hyphae; d) basidia; e) basidiospores.

STEREUM HIRSUTUM (Willd.:Fr.) S.F. Gray, Nat. Arr. Brit. Plants 1:653. 1821.

Basidiocarps annual, effused-reflexed; pileus matted-tomentose, golden brown (10YR 5/6 to 10YR 4/8), indistinctly zonate; hymenial surface smooth, cracking somewhat irregularly upon drying to expose a whitish subiculum; hymenial surface pinkish-gray (near 10YR 7/2 to 10YR 7/4). **Hyphal system** dimitic; generative hyphae hyaline, simple-septate, 1.5-3 µm diam; skeletal hyphae hyaline, aseptate, 3.5-7 µm diam; hyphae from pileus surface similar to skeletals but more branched and lightly pigmented, 3-5 µm diam. **Pseudocystidia** cylindric, thick-walled, slightly broader at apex with a single apical papilla, with a simple septum at the base, 63-84 x 5.5-7 µm. **Basidia** slender, cylindric-clavate, 4-sterigmate, with a simple septum at the base, 21-25 x 3.5-4.5 µm. **Basidiospores** hyaline, smooth, amyloid in Melzer's

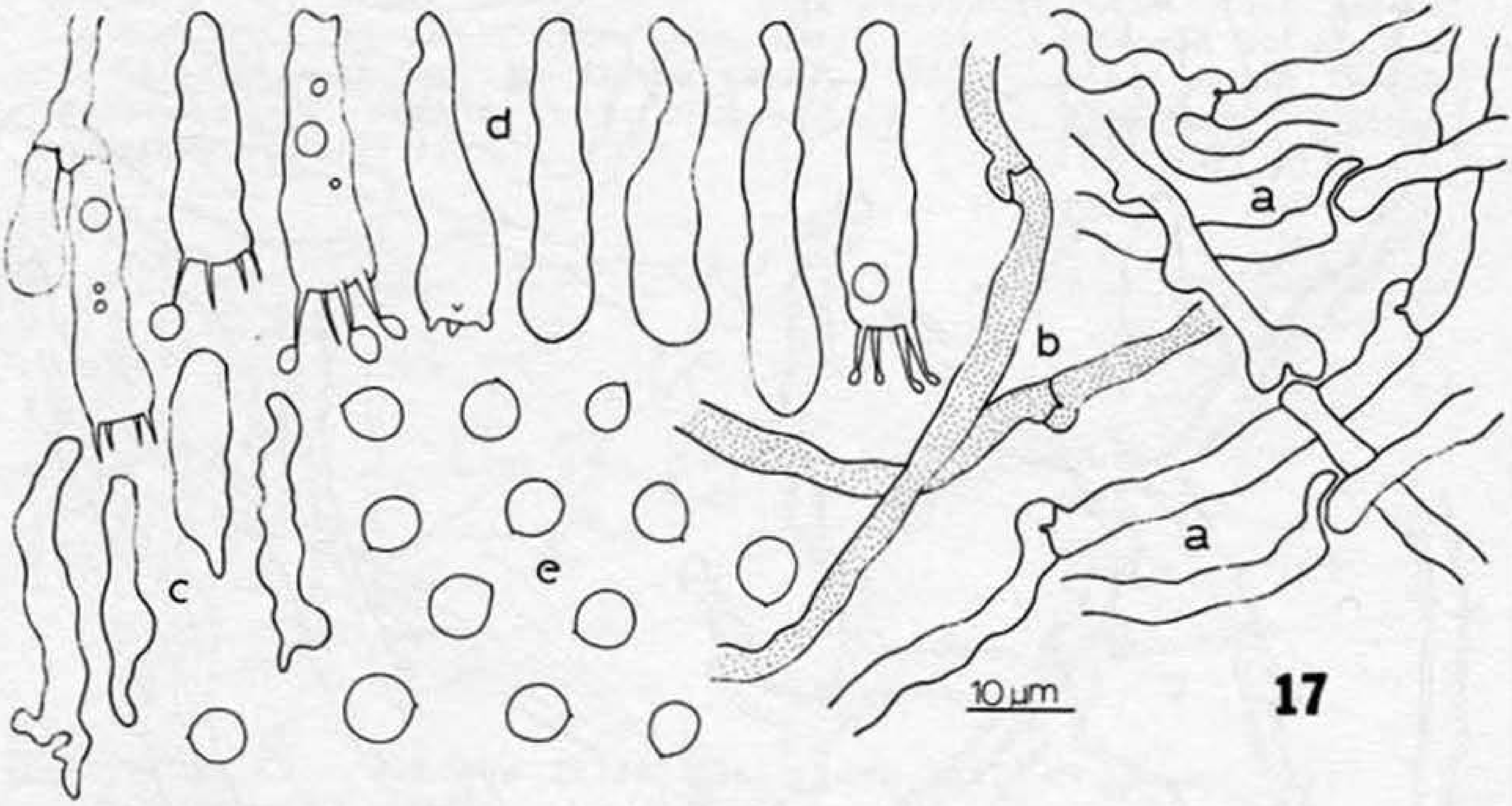

Fig. 17. **Resupinatus applicatus.** (JPL 1277). a) gelatinized, hyaline, subicular hyphae from lower context; b) lightly pigmented hyphae from upper context; c) cheilocystidia; d) basidia; e) basidiospores.

TOMENTELLA PILOSA (Burt) Bourd. et Galz., Bull. Soc. Mycol. France 40:151. 1924.
Basidiocarps byssoid, separable, gray-brown (10YR 5/2 to 7.5YR 5/2 to 7.5YR 4/2); fertile surface smooth to colliculose; margin concolorous, indistinct to abrupt; cordons barely apparent with a 10X lens. **Hyphal system** monomitic; subicular hyphae golden in color, nodose-septate, frequently branched, 3-5 µm diam; cordons scattered, golden, nodose-septate, 7.5-11 µm diam. **Cystidia** broadly capitate, golden, arising directly from subicular hyphae, with a basal clamp subtending the capitate apical cell, but with simple septa and clamps on other cells along the length of the cystidium, the apical cell 37-49 x 10-14 µm. **Basidia** stout, clavate, 4-sterigmate, with oily inclusions, with a basal clamp, 47-56 x 9-11 µm; sterigmata 4-7 µm long. **Basidiospores** irregular, echinulate, with golden-brown pigment, negative in Melzer's reagent, 6-9 x 9-10(-13) µm. **Voucher specimen** - JPL 1294.

TRECHISPORA VAGA (Fr.) Liberta, Taxon 15:319. 1966.
Basidiocarps resupinate, adnate, separable, felty, with abundant cordons over the hymenial surface, buff to drab yellow-brown (10YR 8/4 to 2.5Y 8/4 to 2.5Y 8.5/2); margin fimbriate, with scattered rhizomorphs, white. **Hyphal system** monomitic; subicular hyphae thin-walled, nodose-septate, some with ampullate septa, 1.5-5 µm diam; fiber hyphae present in abundance, aseptate, occurring in rope-like bundles, thick-walled, 1-1.5 µm diam. **Sterile hymenial elements** lacking. **Basidia** clavate, 4-sterigmate, with a basal clamp, 17-19 x 5.5-6 µm. **Basidiospores** hyaline, echinulate, negative in Melzer's reagent, obovate to ellipsoid, with a flattened adaxial face, 4.5-5 x 3-3.5 µm. **Voucher specimen** - JPL 1207.

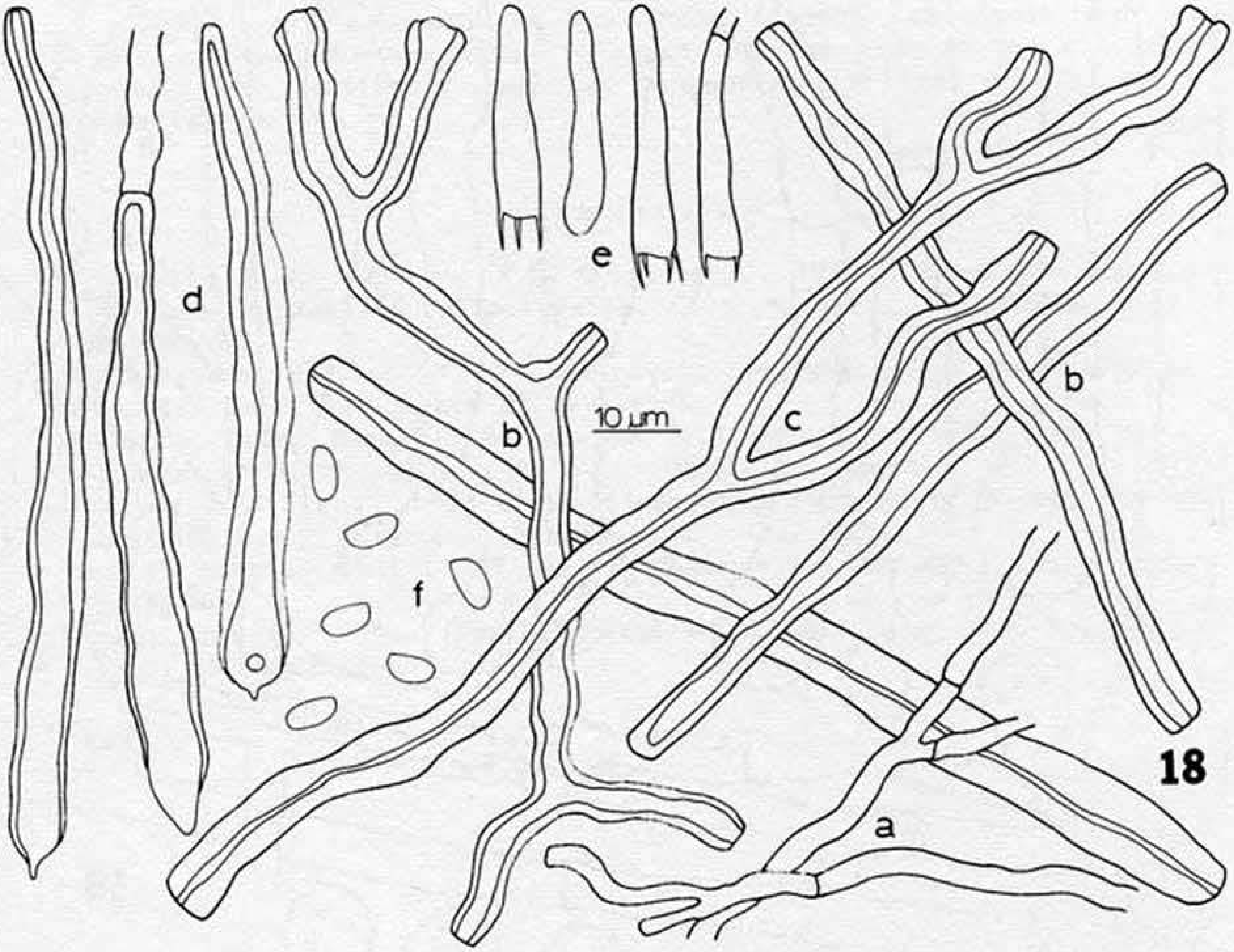

Fig. 18. **Stereum hirsutum.** (JPL 1291). a) hyaline generative hyphae; b) hyaline thick-walled skeletal hyphae; c) lightly pigmented skeletal hypha from pileus tomentum; d) pseudocystidia; e) basidia; f) basidiospores.

Discussion

Gloeophyllum trabeum is the first brown-rot fungus to be reported on Gambel oak in this series. White rot fungi still far outnumber brown rot fungi on this substratum. Shope (1931) reports **G. trabeum** on "coniferous and deciduous hosts," but does not specifically mention oak. He refers to it as "uncommon."

Oidium candicans is the anamorph of **Botryobasidium candicans** John Erikss. The teleomorph has not yet been collected on Gambel oak.

Phanerochaete arizonica is reported for the first time from Colorado. This collection extends its known range about 800 km north of the holotype collection.

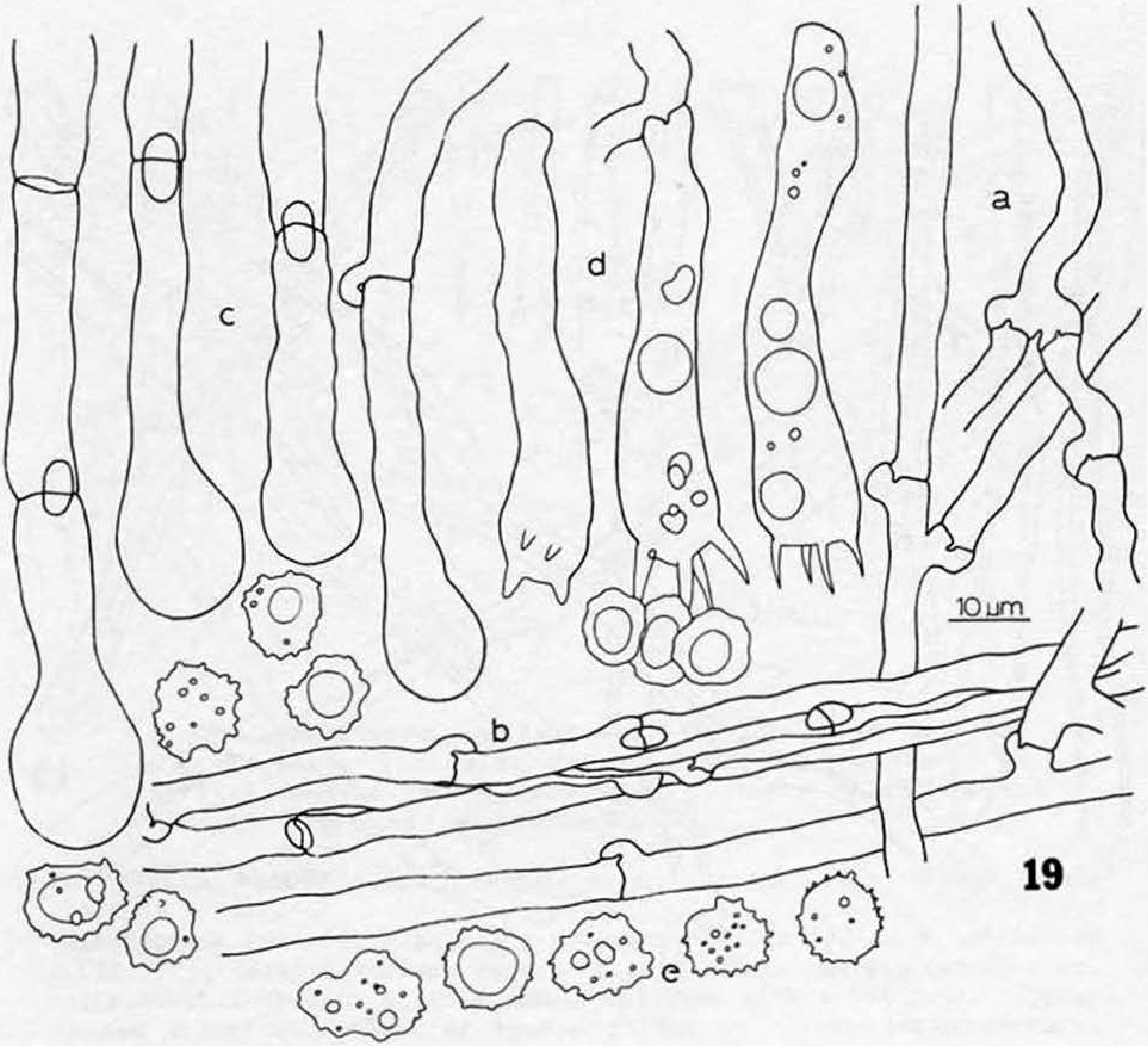

Fig. 19. **Tomentella pilosa.** (JPL 1294). a) subicular hyphae; b) pigmented cordon; c) cystidia with simple and clamped septa; d) basidia; e) pigmented basidiospores.

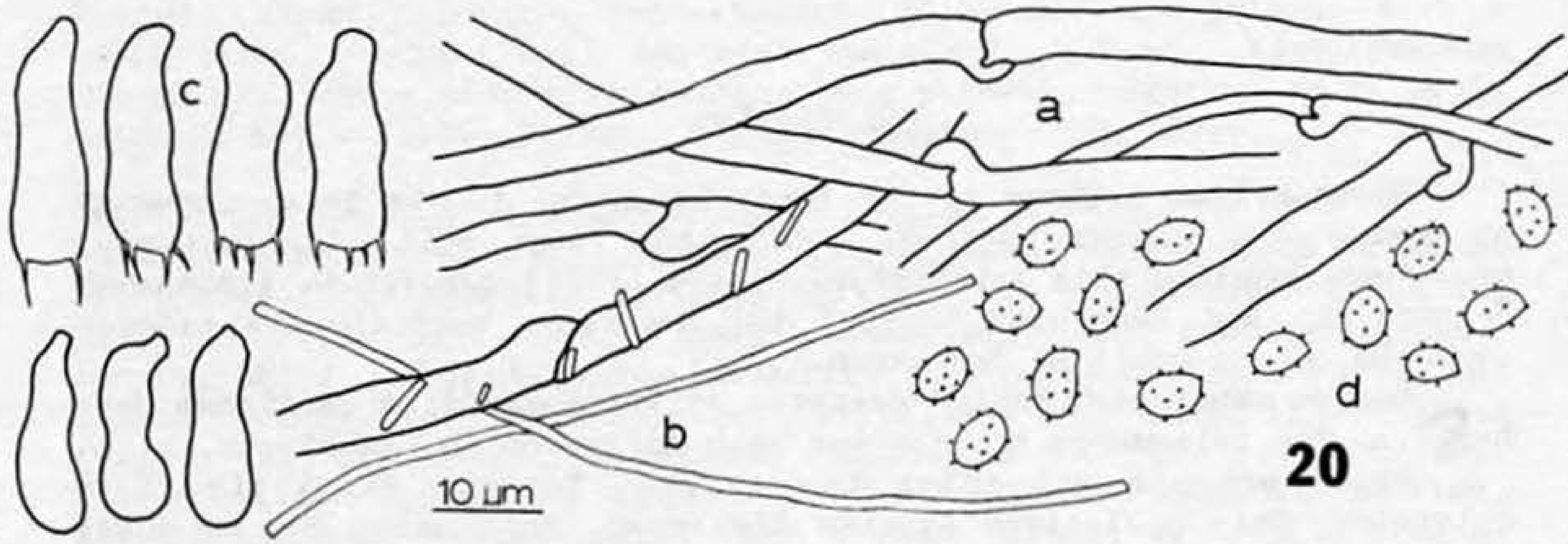

Fig. 20. **Trechispora vaga.** (JPL 1207). a) subicular hyphae; b) fiber hyphae; c) basidia; d) basidiospores.

Acknowledgments

Thanks are extended to Mrs. Donna Giersch for typing and for helpful editorial suggestions. Thanks are due also to Dr. R.L. Gilbertson, who critically read the manuscript and gave assistance on identifications.

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MYCOTAXON

Vol. XXV, No. 1, pp. 85-93 January-March 1986

NEW SPECIES IN THE LICHEN FAMILY PARMELIACEAE (ASCOMYCOTINA)

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Abstract.--The following 12 new species in the lichen family Parmeliaceae are described: Bulbothrix australiensis Hale, B. lopezii Hale, B. oliveirai Fletcher, Hypotrachyna meridensis Hale, Parmotrema betaniae Hale, P. catarinae Hale, P. fumarprotocetraricum Marcelli & Hale, P. lobulatum Marcelli & Hale, P. madilynae Fletcher, P. schindleri Hale, P. sorediiferum Hale and P. virescens Hale.

Bulbothrix australiensis Hale, sp. nov. Fig. 1

Thallus corticola, arcte adnatus, rigidulus, albido-cinerascens, 2-3 cm diametro, lobis sublinearibus, contiguis, 0.8-2 mm latis, margine bulbato-ciliatis, ciliis magnis, conspicue inflatis, superne planus, nitidus, continuus, dense isidiatus, isidiis cylindricis, simplicibus vel sparse ramosis, 0.1-0.15 mm diametro, usque ad 1 mm altis, cortice superiori 12-15 µm crasso, strato gonidiale 15-25 µm crasso, medulla alba, 80-90 um crassa, cortice inferiori 12-15 µm crasso, subtus planus, castaneus, modice rhizinosus, rhizinis castaneis, simplicibus. Pycnidia immersa, 110-130 µm diametro, conidiis cylindricis, 1 X 5-6 µm. Apothecia rara, adnata, ca 1 mm diametro, sporis evolutis.

Chemistry: Atranorin, salazinic acid.

Holotype: Observation Point, Ku-Rin-Gai National Park, New South Wales, Australia, M. E. Hale 59360, 20 Jan. 1982 (US; isotype in MEL).

This new species has large bulbate cilia, narrow lobes and robust cylindrical isidia. It has been collected so far only in the Ku-Rin-Gai area on roadside Casuarina. Another Australian endemic, also in coastal New South Wales, P. (Bulbothrix) subtabacina Elix, has a distinctly maculate upper surface, slender bulbate cilia and a black lower surface. While pantropical B. isidiza (Nyl.) Hale has a brown lower surface, the lobes are broader (3-5 mm wide) and weakly white maculate.

Bulbothrix lopezii Hale, sp. nov. Fig. 2

Thallus corticola, arcte adpressus, fragilissimus, pallide albido-cinerascens, 3-5 cm latus, lobis sublinearibus, contiguis vel imbricatis, dichotome ramosis, 1-3 mm latis, margine conspicue bulbato-ciliatis, superne nitidus, planus, continuus vel leviter albo-maculatus, dense lobulatus, lobulis dorsiventralibus, dichotome divisis, margine bulbato-ciliatis, 0.2 mm latis, usque ad 1 mm longis, cortice superiori 10-12 µm crasso, strato gonidiale 10 µm crasso, medulla alba, 30-35 µm crassa, cortice inferiori 9-10 µm crasso, subtus planus, niger, nitidus, modice rhizinosus, rhizinis pallido-castaneus, dense ramosis. Pycnidia non visa. Apothecia adnata, 0.5-1 mm diametro, disco pallido, amphithecio ecoronato; hymenium 60 µm altum; sporae male evolutae, 3 X 6 µm.

Chemistry: Atranorin, traces of unidentified substances (fatty acids?) or nothing present.

Holotype: Near El Carrizal, Sierra Nevada de Mérida, Estado Mérida, Venezuela, elev. 1400 m., M. López and M. E. Hale 20087 (MERF; isotype in US).

Specimens examined. Venezuela: Same locality as the holotype, López and Hale 20103, 20141, 20349 (US).

This species is unique in having dense, procumbent, dorsiventral lobules and lacking distinctive chemistry. The only possible relative is B. viridescens (Lynge) Hale, a rare species in southern Brazil and Uruguay which has coronate apothecia and lacks lobules. Bulbothrix lopezii is known only from the type locality.

Bulbothrix oliveirai Fletcher, sp. nov. Fig. 3

Thallus corticola, arcte adnatus, fragilis, albo-cinereus, 2-3 cm latus, lobis sublinearibus, contiguis, dichotome divisis, 0.6-1.2 mm latis, margine aetate sublobulatis, bulbato-ciliatis, ciliis apice dense ramosis, superne planus, nitidus, apicem loborum versus pustulatus, pustulis erosis, subsorediatis, cortice superiori 14-16 µm crasso, strato gonidiale ca 15 µm crasso, medulla alba, 60-70 µm crassa, cortice inferiori 12-14 µm crasso, subtus niger, dense rhizinosus, rhizinis dichotome ramosis. Pycnidia et apothecia non visa.

Chemistry: Atranorin and gyrophoric acid.

Holotype: Base aerea de Cachimbo, 20 km N of border with Mato Grosso on Cuiaba-Santarem highway, Pará, Brazil, elev. 480 m, L. Brako and M. J. Dibben 5804, 25 April 1983 (NY; isotype in US).

Specimens examined. Brazil: Pará, Brako and Dibben 6012, 6716, 6861 (NY, US); São Paulo, Fletcher 10031 (US).

This species is unusual in having subapical, eroded pustules. The floor of the pustular areas where the medulla is exposed turns black, and rather sparse coarse soredia form around the rim. It is common in forests in the sandstone areas in the state of Pará but also occurs near sea level in São Paulo. The only other pustulate species in the genus, the African B. pustulata (Hale) Hale, is broader lobed with extensive laminal pustules and salazinic acid.

Hypotrachyna meridensis Hale, sp. nov. Fig. 4

Thallus saxicola, laxe adnatus, rigidulus, albido-cinerascens, 5-8 cm latus, lobis sublinearibus, dichotome lobatis, subimbricatis, margine integris, 1.5-3 mm latis, superne nitidus, continuus, planus, modice isidiatus, isidiis cylindricis, 0.06-0.09 mm diametro, usque ad 1.5 mm altis, simplicibus vel ramosis, cortice superiori 12-15 µm crasso, strato gonidiale 15-20 µm crasso, medulla alba, 80-100 µm crassa, cortice inferiori 15-16 µm crasso, subtus planus, niger, modice vel dense rhizinosus, rhizinis dichotome ramosis. Pycnidia non visa. Apothecia adnata, 2-7 mm diametro, amphithecio isidiato; hymenium 45-50 µm altum; sporae male evolutae, 5 X 6-8 µm.

Chemistry: Atranorin, alectoronic acid and α-collatolic acid.

Holotype: On rock along forested trail above fish hatchery, Mucuy, Estado Mérida, Venezuela, elev. 2300 m, M. E. Hale 43030, 4 Feb. 1974 (US; isotype in MERF).

Specimens examined. Guatemala: Baja Vera Paz, Hale 38331 (US). Panama: Chiriquí, Hale 46107, 46111, Scholander s.n. (US). Venezuela: Mérida, Hale 42928 (US).

Hypotrachyna meridensis appears to be or at least approximates the isidiate morphotype of H. protenta Hale. Both species are saxicolous, occurring on open outcrops in pastures at 1500-3400 m elevation. The only other isidiate, alectoronic acid-containing Hypotrachyna is H. ensifolia (Kurok.) Hale, a more fragile, corticolous or terricolous lichen with cylindrical, procumbent isidia.

Parmotrema betaniae Hale, sp. nov. Fig. 5

Thallus corticola, laxe adnatus, membraneus, pallide stramineo-albicans, usque ad 14 cm diametro, lobis ambitu rotundatis, 8-12 mm latis, eciliatis, superne continuus, aetate rugosus, isidiis sorediisque destitutus, cortice superiori 10-12 µm crasso, strato gonidiale ca 20 µm crasso, medulla superne alba, subtus flavicans vel pallide aurantiaco-salmonea, 150-200 µm crassa, cortice inferiori 15 µm crasso, subtus planus, niger, centrum versus dense rhizinosus, ambitu nudus, castaneus. Pycnidia numerosa, immersa, 130-150 µm diametro, conidiis sublageniformibus, 1 X 5-6 µm. Apothecia numerosa, subpedicellata, urceolata, 3-6 mm diametro, disco imperforato, amphithecio crenato; hymenium 75-80 µm altum; sporae 11-12 X 22-24 µm, episporio 1-1.5 µm crasso.

Chemistry: Atranorin, protocetraric acid, entothein and unidentified pigments.

Holotype: Via Villa Paez-Betania, valley of Paramó de Tamá, Estado Táchira, Venezuela, elev. 2300 m, M. E. Hale 45106, 25 March 1975 (US; isotype in MERF).

This unique species has very conspicuous medullary pigmentation, most of the medulla, except for the upper part, being pale orange or salmon red to yellow. It is known only from the type collection.

Parmotrema catarinae Hale, sp. nov. Fig. 6

Thallus corticola, laxe adnatus, rigidulus, albido- vel pallide stramineo-cinereus, 6-12 cm latus, lobis rotundatis, subadscendentibus, margine late dissectis, 6-10 mm latis, margine crebre ciliatis, ciliis 2-4 mm longis, superne nitidus, planus, albo-maculatus, sorediis isidiisque destitutus, cortice superiori 18-20 µm crasso, strato gonidiale ca 15 µm crasso, medulla alba, 90-110 µm crassa, cortice inferiori 16-18 µm crasso, subtus centrum versus niger, sparse rhizinosus, ambitu nutus, albus vel albo-variegatus. Pycnidia numerosa, 90-120 µm diametro, conidiis cylindricis, 0.5 X 5-7 µm. Apothecia substipitata, 8-15 mm diametro, margine lobulato-dissecta, ciliata, amphithecio valde albo-maculato, disco castaneo, plano, imperforato; hymenium 130-150 µm altum; sporae 14-16 X 24-28 µm, episporio 2 µm crasso.

Chemistry: Atranorin and gyrophoric acid.

Holotype: Santa Cecilia, Santa Catarina, Brazil, Reitz & Klein 12975 9 July 1962 (US).

Specimens examined. Brazil: Santa Catarina, Reitz & Klein 15901 (US); São Paulo, Kalb & Plöbst 79 (Kalb herb.).

This conspicuous species appears to be a chemotype of the well-known P. melanothrix (Mont.) Hale, which contains protolichesterinic acid and has a broader range, from Santa Catarina north to Paraná and Minas Gerais in Brazil.

Parmotrema fumarprotocetraricum Marcelli and Hale, sp. nov. Fig. 7

Thallus corticola, adnatus vel laxe adnatus, subrigidus, pallide stramineo-albicans, 8-12 cm latus, lobis rotundatis, 8-15 mm latis, margine sparse ciliatis, ciliis 0.5-1 mm longis, superne nitidus, albo-maculatus, aetate irregulariter reticulato-fissus, modice isidiatus, isidiis congestis, 0.06-0.09 mm diametro, usque ad 0.4 mm altis, cylindricis vel pro parte granulatis, cortice superiori 15-18 µm crasso, strato gonidiale ca 20 µm crasso, medulla alba, 130-160 µm crassa, cortice inferiori 9-10 µm crasso, subtus omnino castaneus, dense rhizinosus, rhizinis brevibus, ambitu papillatus. Pycnidia nec apothecia visa.

Chemistry: Atranorin, fumarprotocetraric and protocetraric acids.

Holotype: On mangrove trees near bridge over Itanhaem River, km 112 of the BR-101 hwy, Itanhaem, São Paulo, Brazil, Marcelo Pinto Marcelli 8 (US).

Specimens examined. Brazil: Bahía, *Blanchet* in 1867 (G); São Paulo, same locality as holotype, *Marcelli* 4, 7 (US); Santa Catarina, *Reitz & Klein* 13322a (US).

Fumarprotocetraric acid is rare in *Parmotrema*. Out of about 228 species in this genus, only this one and two sorediate Old World species, *P. pardii* (Krog & Swins.) Krog & Swins. and *P. pseudograyanum* (Hale) Hale, contain it. Morphologically *P. fumarprotocetraricum* is very close to *P. subtinctorium* (Zahlbr.) Hale and related species, *P. recipiendum* (Nyl.) Hale, *P. subsumptum* (Nyl.) Hale, etc., which have salazinic acid or norlobairdone. The three localities for this species are widely separated in Brazil, ranging from mangrove in São Paulo to forests at 800 m in Santa Catarina.

Parmotrema lobulatum Marcelli and Hale, sp. nov. Fig. 8

Thallus corticola, fragilis, albo-cinereus, 5-7 cm latus, lobis subirregularibus, apice rotundatis, congestis, 3-6 mm latis, margine lobulatis, lobulis sublinearibus, 0.2-0.4 mm longis, sparse ciliatis, ciliis 0.5-1.5 mm longis, superne planus, continuus, crasse isidiato-lobulatus, lobulis procumbentibus, cortice superiori 9-10 µm crasso, strato gonidiale ca 15 µm crasso, medulla alba, 60-70 µm crassa, cortice inferiori 10-12 µm crasso, subtus centrum versus niger, sparse rhizinatus, ambitu nudus, castaneus. Pycnidia numerosa, ca 100 µm diametro, conidiis cylindricis, 0.7 X 7-9 µm. Apothecia non visa.

Chemistry: Atranorin, stictic acid and constictic acid.

Holotype: On mangrove trees near Guaratuba River, Bertioga, São Paulo, Brazil, Marcelo Pinto Marcelli 38 (US).

This mangrove species is apparently related to *P. crinitum* (Ach.) Choisy but there are no isidia, only small procumbent lobules. It is known only from the type locality.

Parmotrema madilynae Fletcher, sp. nov. Fig. 9

Thallus corticola, adnatus vel laxe adnatus, mollis, albido- vel stramineo-cinereus, 6-10 cm latus, lobis rotundatis, 4-7 mm latis, margine sparse vel modice ciliatis, ciliis 0.5-2 mm longis, superne planus vel valde rugosus, opacus, reticulato-fissus, submargine pustulatus, diffuso-sorediatus, cortice superiori ca 15 µm crasso, strato gonidiale ca 15 µm crasso, medulla alba, 90-110 µm crassa, cortice inferiori 13-16 µm crasso, subtus niger, modice rhizinosus, ambitu anguste nudus, castaneus. Pycnidia numerosa, conidiis non visis. Apothecia rara (ex *Marcelli* 6) substipitata, 3-6 mm diametro, amphithecio rugoso, sorediato, eciliato, disco castaneo, imperforato; hymenium 95-100 µm altum; sporae 14-15 X 23-25 µm, episporio 2 µm crasso.

Chemistry: Atranorin and protocetraric acid.

Holotype: Ilha Comprida, 4 km SSE of Cananeia, São Paulo, Brazil, elev. s.l., G. Eiten and W. D. Clayton 6132-b, 16 Feb. 1965 (US).

Specimens examined. Brazil: São Paulo, *Eiten and Clayton* 6133, *Fletcher* 10210, *Marcelli* 5, 6 (US).

Another member of the *P. gardneri* (Dodge) Serus. group, *P. madilynae* has extensive sorediate pustules in a broad submarginal zone. A related species in the Pacific area, *P. setchellii* (Vain.) Hale, also has a rugose-pustulate surface but soredia are poorly developed and the thallus is more coriaceous. *Parmotrema madilynae* occurs at low elevations in São Paulo.

Parmotrema schindleri Hale, sp. nov. Fig. 10

Thallus saxicola, membraneus, cinereo-albus, 6-8 cm latus, lobis ambitu rotundatis, 4-7 mm latis, aetate sparse laciniatis, axillis loborum ciliatis, ciliis sparsis, 0.5-1 mm longis, margine et submargine sorediatis, soraliis crassis, fere subfatiscentibus, superne planus, opacus, continuus, demum rugulosus, cortice superiori 14-16 µm crasso, strato gonidiale ca 15 µm crasso, medulla alba, 60-90 µm crassa, cortice inferiori 9-11 µm crasso, subtus niger, sparse rhizinosus, ambitu nudus, pallide castaneus. Pycnidia nec apothecia visa.

Chemistry: Atranorin, protocetraric acid and gyrophoric acid.

Holotype: An Sandsteinfelsen in Vila Velha, Curitiba, Est. Paraná, Brazil, elev. 800 m, H. Schindler 4666a, 27 Aug. 1973 (US).

Specimens examined. Brazil: Paraná, same locality as the holotype, *Schindler* 4666, 4667 (US).

This Brazilian species is also in the protocetraric acid-containing *P. gardneri* complex. It is differentiated by the coarse, subfatiscent soralia produced mostly on secondary laciniae and by the co-occurrence of gyrophoric acid. It also seems to be strictly saxicolous. Only one other species, the African *P. umbrosum* (Krog & Swins.) Krog & Swins., has these two acids, but the soralia are powdery and marginal.

Parmotrema sorediiferum Hale, sp. nov. Fig. 11

Thallus saxicola, laxe adnatus, membraneus, stramineo- vel albido-cinereus, 12-18 cm latus, lobis rotundatis, 10-18 mm latis, modice ciliatis, ciliis 2-4 mm longis, simplicibus vel furcatis, superne planus, nitidus, continuus, cortice ad marginem fissurino, pustulascenti, aetate crasse sorediato, lobis sorediatis plus minusve subrevolutis, cortice superiori 16-18 µm crasso, strato gonidiale ca 20 µm crasso, medulla alba, 110-130 µm crassa, cortice inferiori 18-20 µm crasso, subtus niger, nitidus, modice rhizinosus, ambitu nudus, castaneus vel anguste albo-variegatus. Pycnidia non visa. Apothecia bene evoluta, substipitata, suborceolata, 3-15 mm diametro, amphithecio diffuso-sorediato, eciliato, disco castaneo, imperforato. hymenium 85-90 µm altum; sporae 12-15 X 22-24 µm, episporio 1.5 µm crasso.

Chemistry: Atranorin, alectoronic acid and α-collatolic acid.

Holotype: Open rocky pasture, Via Villa Paez-Betania, valley of Paramó de Tamá, elev. 2300 m, Estado Táchira, Venezuela, M. Hale and M. López 45164, 25 March 1975 (US; isotype in MERF).

This conspicuous species is closest to *P. mellissii* (Dodge) Hale, which has submarginal isidia or sorediate isidia, sometimes becoming quite dense. *Parmotrema sorediiferum* initially has marginal soralia but soon develops a broad submarginal zone of soralia and open sorediate pustules which form dense masses. The cortex is rather fragile and flakes off in places. The cilia are much longer than in *P. mellissii*. The species is known only from the type locality.

Parmotrema virescens Hale, sp. nov. Fig. 12

Thallus corticola, laxe adnatus, pallide viridi-flavicans, 8-15 cm latus, lobis ambitu rotundatis, 5-10 mm latis, axillis ciliatis, ciliis 1.1.5 mm longis, margine sorediatis, soraliis linearibus, plus minusve subrevolutis aetate, superne opacus, continuus vel tenuiter reticulato-fissus, cortice superiori 13-15 µm crasso, strato gonidiale 15-20 µm crasso, medulla alba, 90-130 µm crassa, cortice inferiori 15-18 µm crasso, subtus planus, niger, centrum versus sparse vel modice rhizinosus, margine nudus, castaneus, laciniis secundariis albo-variegatis. Pycnidia non visa. Apothecia rara (ex *Hale* 45134a), stipitata, urceolata, ca 2 mm diametro, amphithecio sorediato, eciliato, disco imperforato; hymenium 60 µm altum; sporae non evolutae.

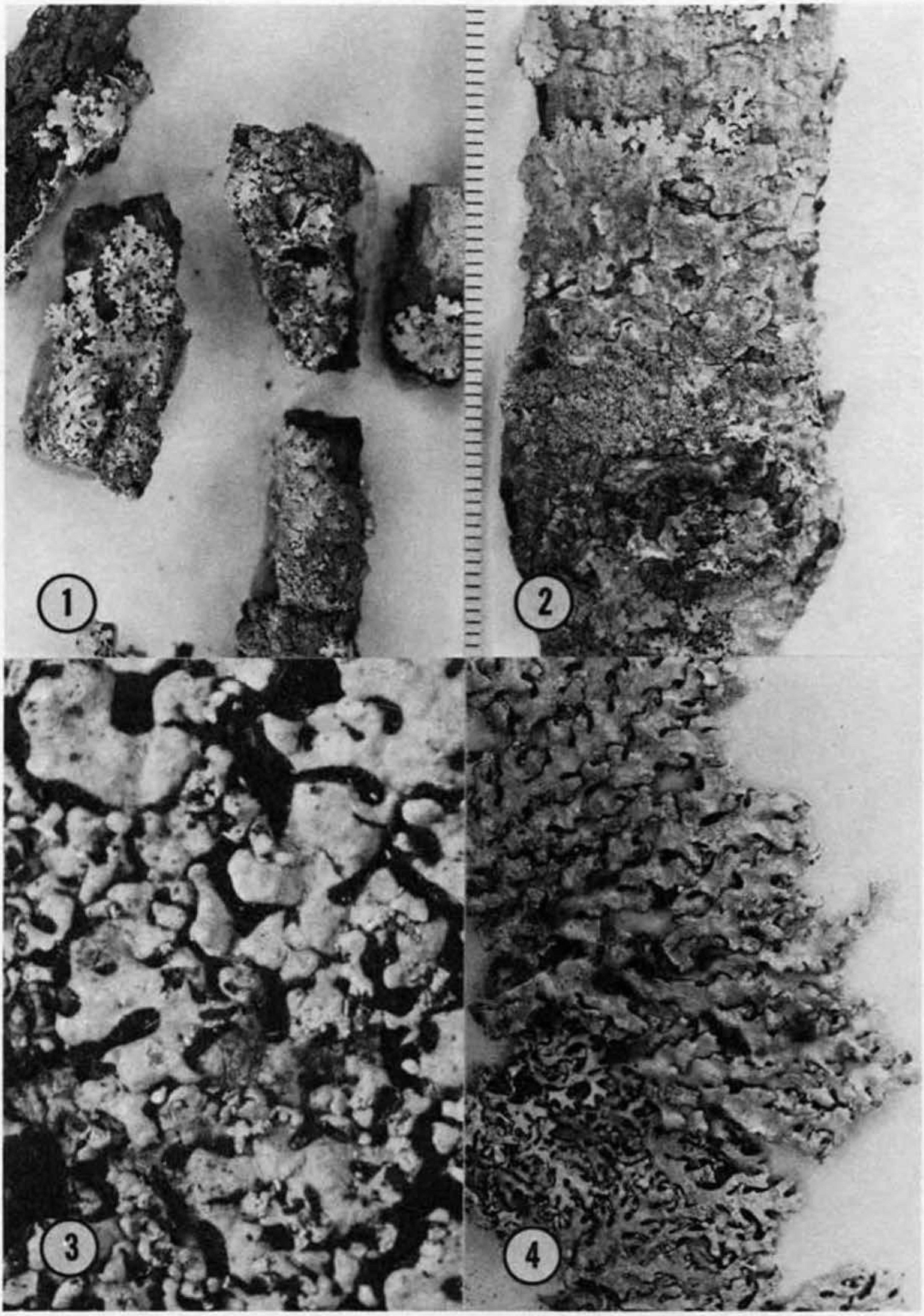
Chemistry: Usnic acid, atranorin, protocetraric acid.

Holotype: El Cobre Chiquito, Paramó de Tamá, Estado Táchira, Venezuela, elev. 2700 m, M. E. Hale and M. López 45557, 28 March 1975 (US; isotype in MERF).

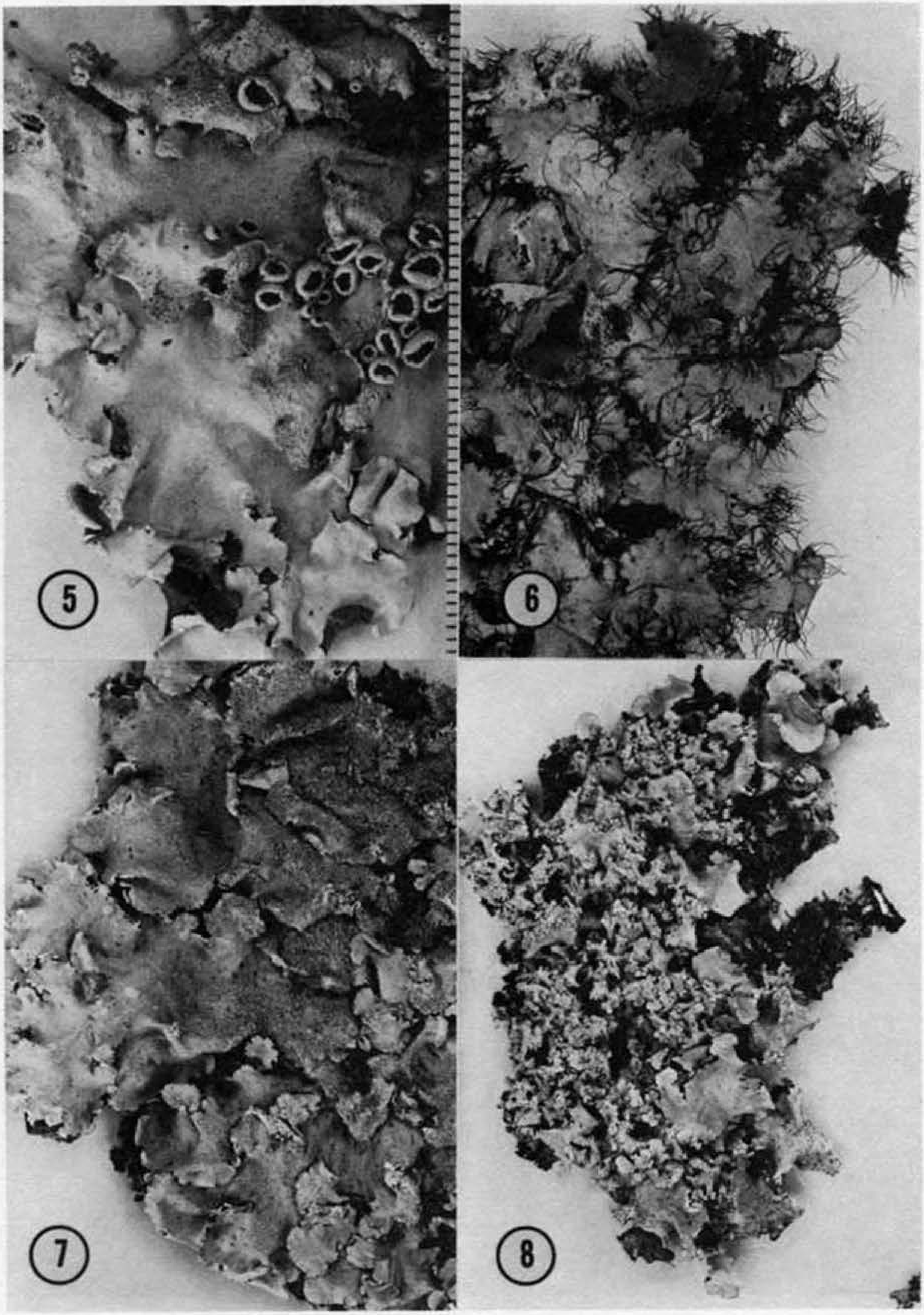
Specimens examined. Ecuador: Azuay, *Arvidsson and Nilson* 1111 (GB, US). Venezuela: Merida, *López and Hale* 20302, 20307, 20335, *Hale and López* 42016a, 42017, 42026, 42028, 42104, 42383, 42650, 42691, 42693, 42830, 43243, 45216, 45134a, 45280, 45547 (MERF, US).

This species belongs to the ill-defined protocetraric acid-containing group. The closest usnic acid-deficient species would be widespread *P. gardneri*. Closely related *P. dilatatum* (Vain.) Hale also contains echinocarpic acid and often traces of usnic acid, although the thallus is never as distinctly yellow as in *P. virescens*. Two other usnic acid-containing species lack cilia: *P. apricum* (Krog & Swins.) Krog & Swins. from Africa and *P. dominicanum* (Vain.) Hale from the West Indies. *Parmotrema virescens* seems to be restricted to the Andes at an elevation of 2400 to 3500 m.

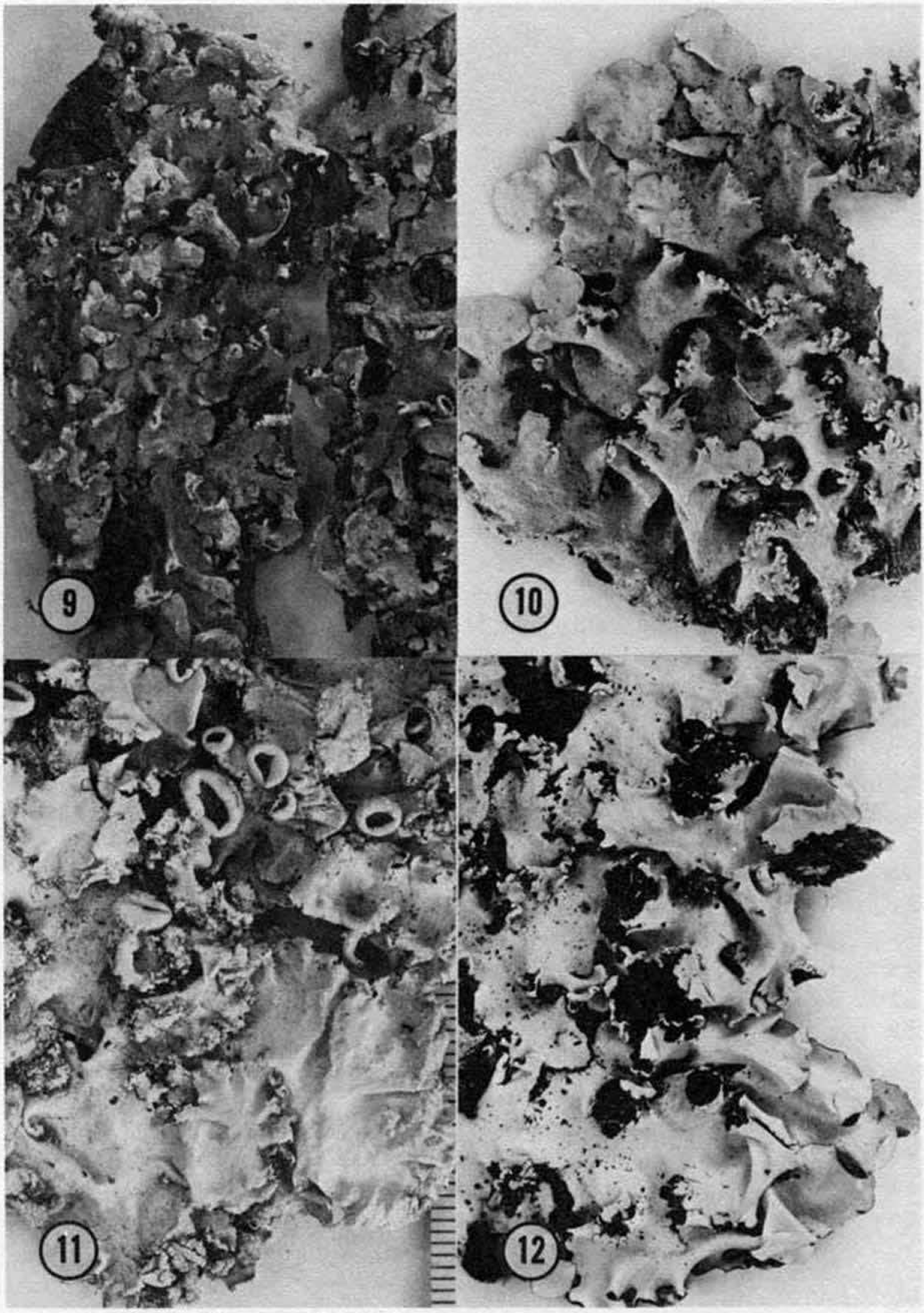
I wish to thank Dr. Anthony Fletcher and Marcelo Pinto Marcelli for specimens which they describe in this paper.



Figs. 1-4. Holotypes of Bulbothrix and Hypotrachyna. 1, Bulbothrix australiensis; 2, B. lopezii; 3, B. oliveirai (X10); 4, Hypotrachyna meridensis (for all except Fig. 3 scale = mm).



Figs. 5-8. Holotypes of *Parmotrema*. 5, *P. betaniae*; 6, *P. catarinae*; 7, *P. fumarprotocetraricum*; 8, *P. lobulatum* (scale for all = mm).



Figs. 9-12. Holotypes of Parmotrema. 9, P. madilynae; 10, P. schindleri; 11, P. sorediiferum; 12, P. virescens (scale for all = mm).

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Vol. XXV, No. 1, pp. 95-99 January-March 1986

TAXONOMIC CONCEPTS IN THE ENDOGONACEAE: II. A FIFTH MORPHOLOGICAL WALL TYPE IN ENDOGONACEOUS SPORES

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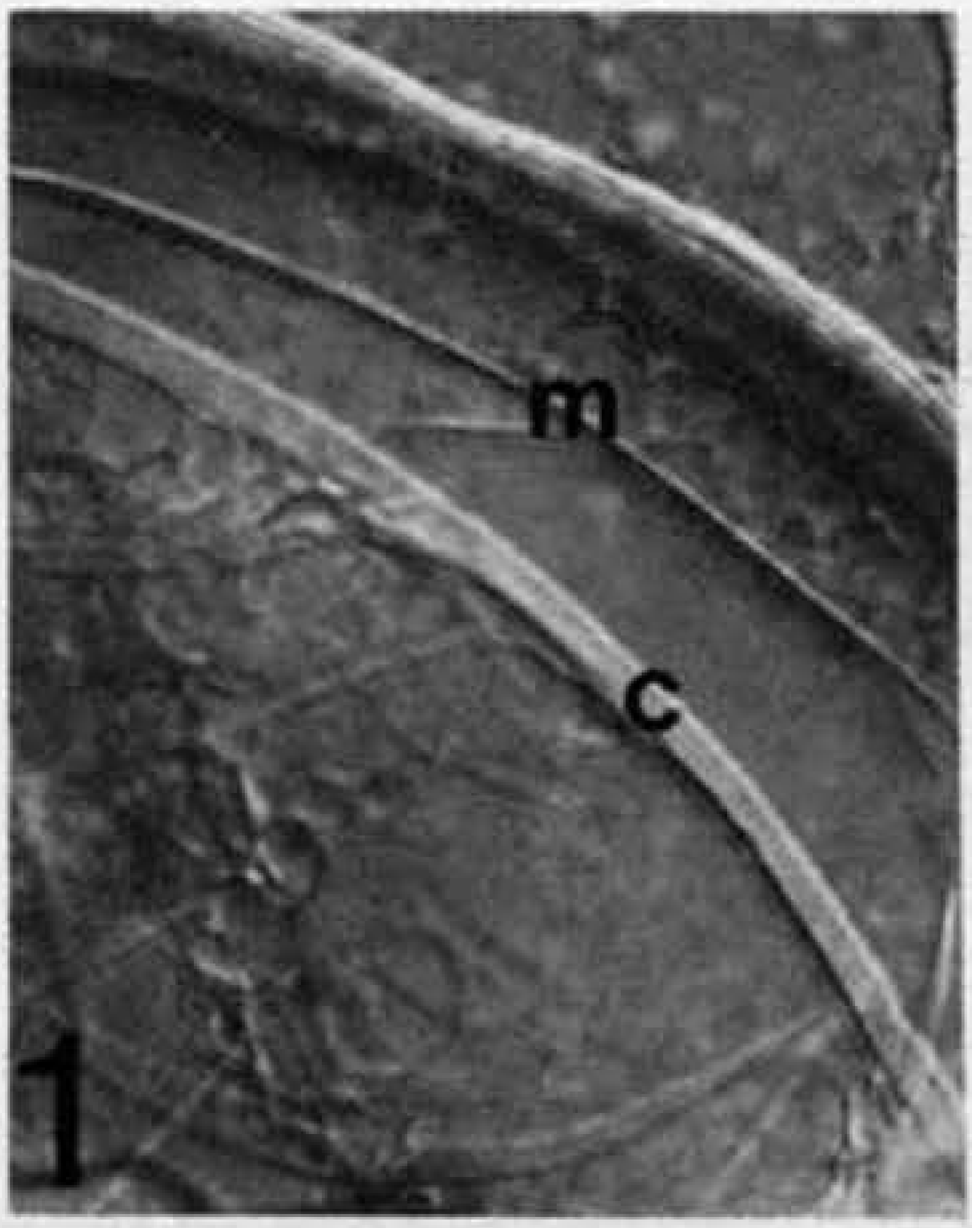
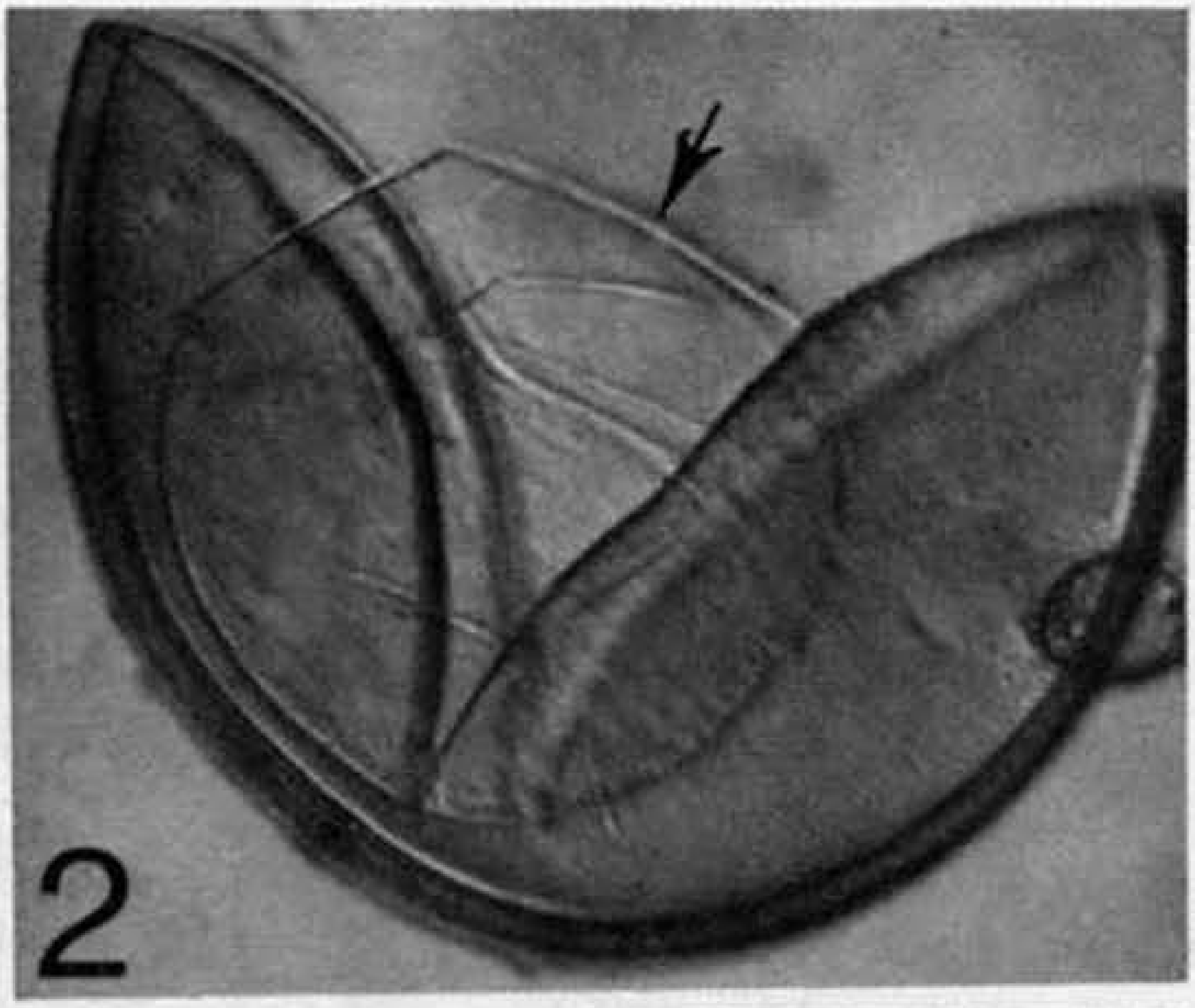
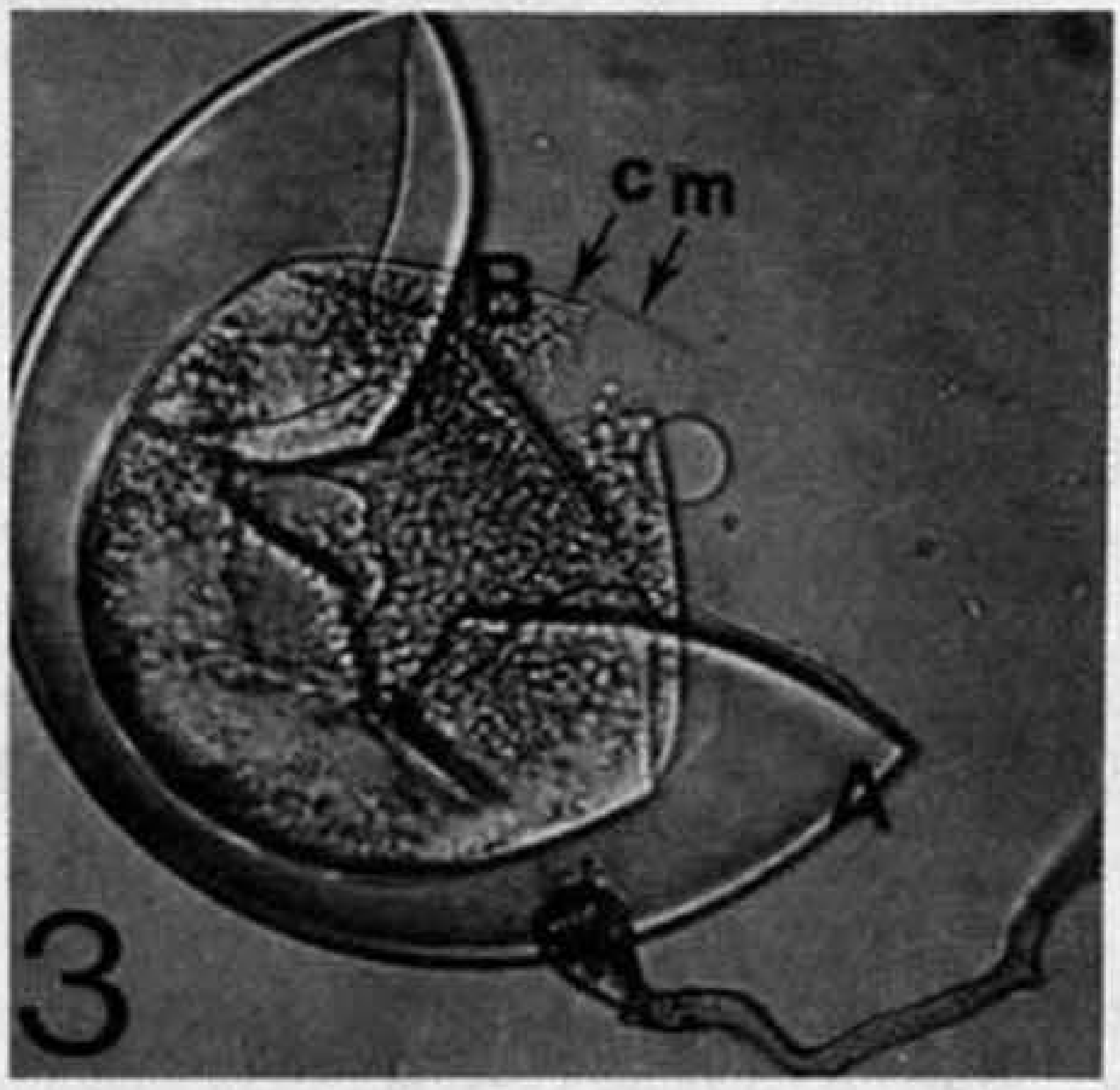
Many Endogonaceae are known only from preserved collections of spores formed either ectocarpically or in sporocarps in soil. Their taxonomy is therefore necessarily based on the microscopic features of such spores, among which, details of wall construction are particularly useful. In a recent paper (Walker 1983), I described and illustrated four wall types that can be found surrounding the contents of spores in the Endogonaceae, and proposed a standardized form of graphical illustration, the murograph. This system has found some acceptance among other authors (Rothwell and Victor 1984, Schenck et al. 1984). Since that paper was written, a further wall type has been discovered that does not fit well into the categories already established.

The new wall type, which has some characteristics of both membranous and unit walls, was brought to my attention by Dr R. E. Koske, University of Rhode Island, and was originally found in some undescribed species of *Gigaspora* Gerd. and Trappe and an undescribed *Glomus* Tul. and Tul. species. The characteristics of the wall type are as follows:

- It is generally rather robust, being between 2 and 5 µm in thickness (Figure 1, c). This contrasts with the normal membranous wall, which is usually no more than 1 or 2 µm thick, and often much less than 1 µm (Figure 1, m).
- It is rather tough and flexible. Unlike the unit or laminated wall, it does not fracture readily when a spore is crushed (Figure 2), although, as with a







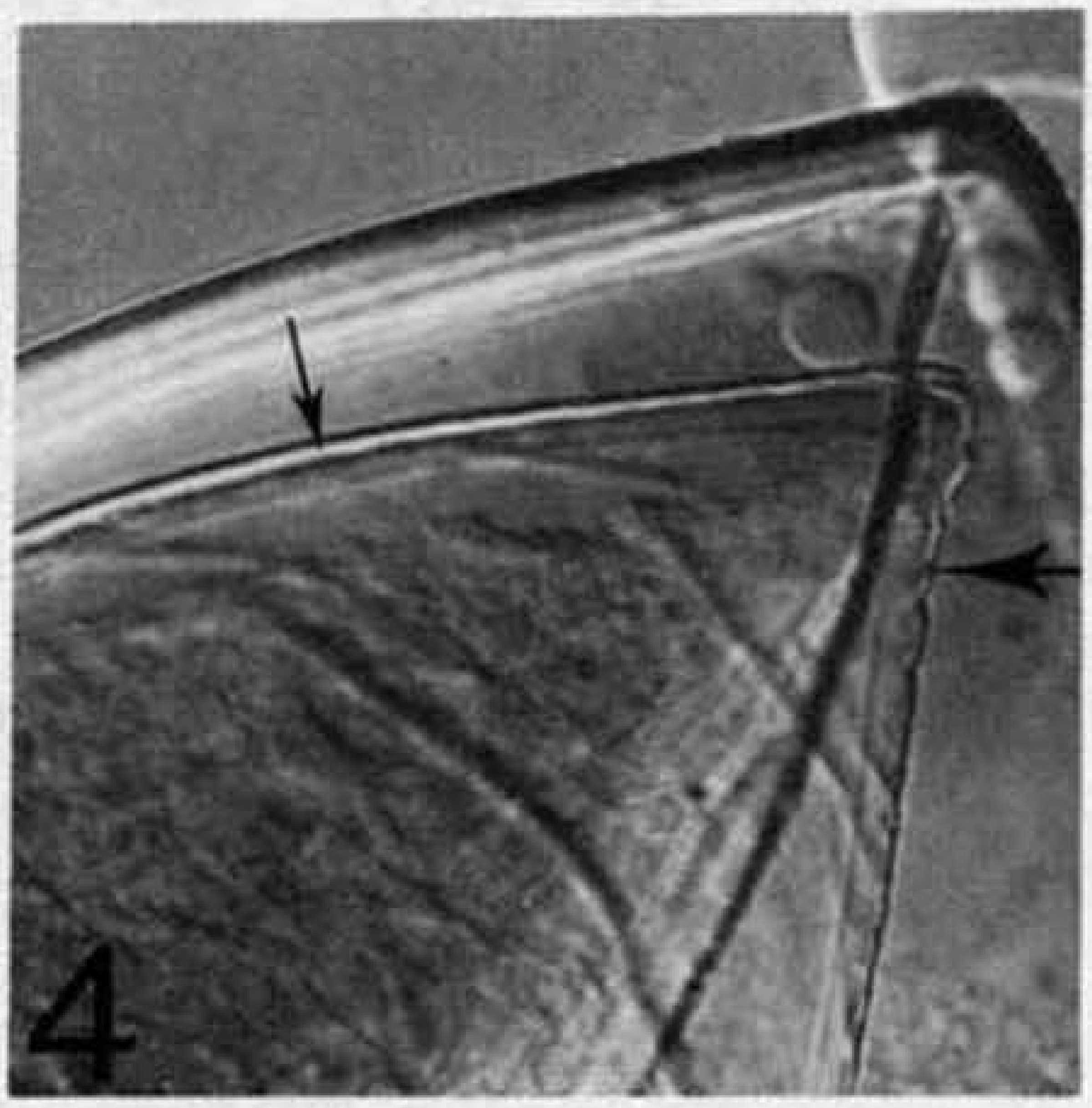


Figure 1. Crushed spore indicating the relative dimensions of membranous (m) and coriaceous (c) wall types.

Figure 2. Spore gently crushed showing the relatively tough, flexible nature of the coriaceous wall (arrowed) which remains unbroken.

Figure 3. Severe crushing in this specimen has fractured not only the outer wall group (A) but both membranous (m) and coriaceous (c) walls in the inner wall group (B).

Figure 4. Crushed spore showing the wrinkling of the outer surface that can occur with a coriaceous wall (large arrow). Optical interference has created an artefact which makes the wall appear laminated in this photograph (small arrow).

membranous wall, if excessive pressure is applied, it will break open (Figure 3).

- In hypertonic mounting media, the outer surface of the wall tends to wrinkle, and the whole wall shrinks as plasmolysis takes place. This gives the wall the appearance of old leather, smooth on the inner surface, but wrinkled externally (Figure 4). The wrinkling on the outer surface does not always occur, but the flexible nature, seen when a spore is crushed on a microscope slide or mounted in a hypertonic medium, and the dimensions of the wall serve to identify its nature even when this feature is absent.

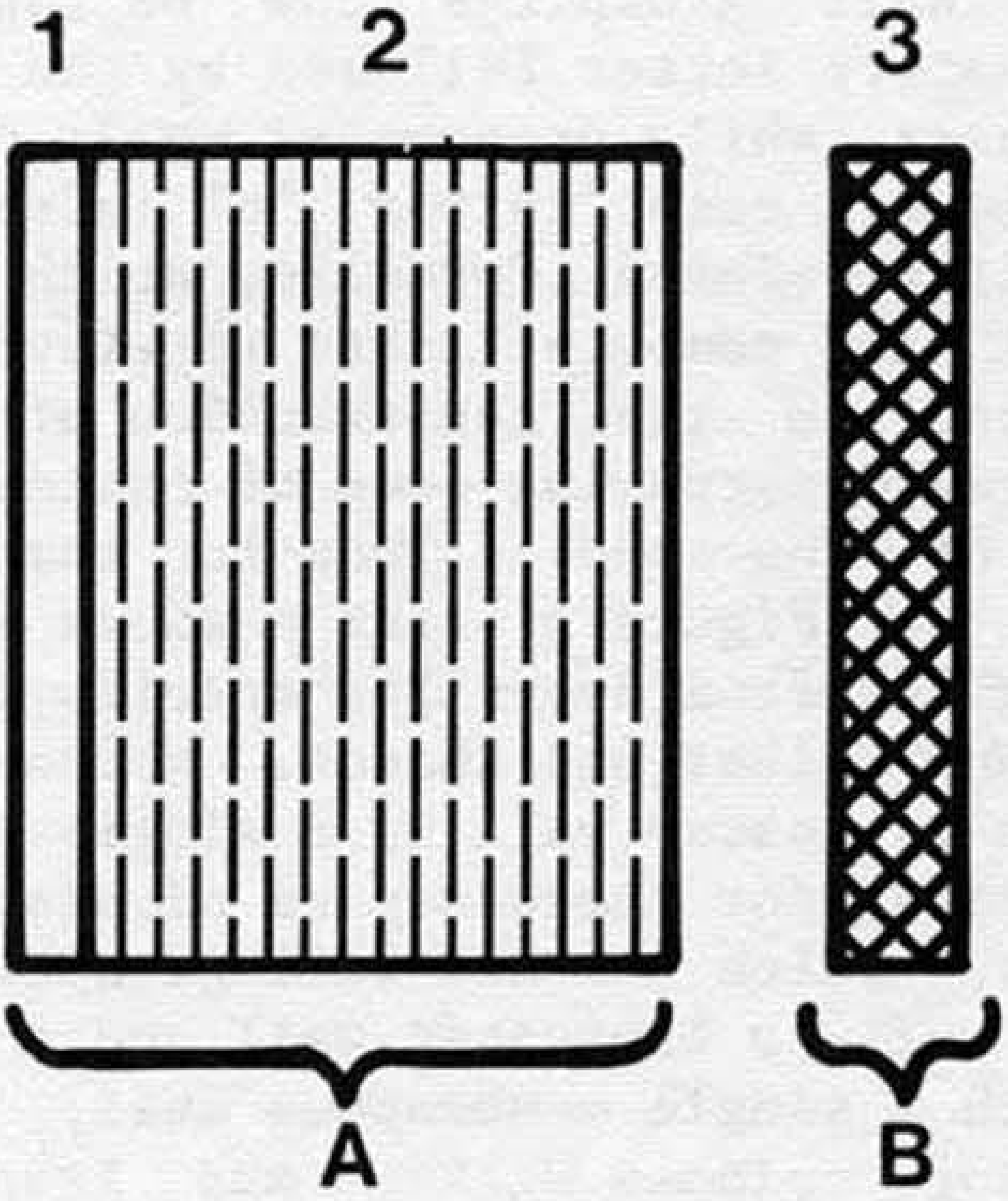


Figure 5. Murograph of a hypothetical endogonaceous spore with a unit wall (1) and a laminated wall (2) in an outer wall group (A) (after Walker 1983) and a coriaceous wall (3) in an inner wall group (B). The cross-hatching is suggested as a standardized representation of a coriaceous wall.

Because of the thick, leathery nature of this wall type, I propose to call it a CORIACEOUS wall. In construction of murographs, I suggest the use of 45° cross-hatching running in both directions (Figure 5).

Particular care should be taken to distinguish between laminated walls and coriaceous walls. In some species, the former occur among the walls of the inner wall group, and in such instances they may be more flexible than those found in the outer group. The rather thick nature of the coriaceous wall may cause refractions that create the impression of laminations when viewed through a light-microscope (Figure 4).

In using murographs for the study of endogonaceous spores, I have found that a formula consisting of writing down the initial letters of the walls in sequence from outer wall to inner wall provides a useful descriptive shorthand. Wall groupings can be represented by use of their designatory letter followed by the wall-type initials in parentheses, while ornamented walls can be indicated by adding a lower case letter 'o' after the appropriate initial letter. These formulae, which I term 'muronyms', are helpful in computer data retrieval systems, and can also be used in the construction of artificial keys to allow the rapid narrowing down of choice of species within a section of the key. Thus for the hypothetical spore illustrated in Figure 5, the muronym would be A(UL)B(C). To give examples from described species in the Endogonaceae *Glomus albidum* Walker and Rhodes, which has an evanescent wall and a laminated wall in a single group has a muronym A(EL), whereas for *Acaulospora nicolsonii* Walker, Reed and Sanders, which has two wall groups, the first with an evanescent wall, a laminated wall and a unit wall, and the second with a single membranous wall, it is A(ELU)B(M). For *Acaulospora spinosa* Walker and Trappe, which has its walls in two groups, with an ornamented unit wall attached to a laminated wall in group A, and two membranous walls in group B, it is A(UoL)B(MM).

ACKNOWLEDGEMENTS

I would like to thank Dr Rick Koske, University of Rhode Island for drawing my attention to the new wall type, and for his review of the manuscript. I would also like to thank Dr S. C. Gregory, Forestry Commission, for his helpful comments. Thanks also to Shiela Swan, Forestry Commission, for typing the camera-ready copy.

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MYCOTAXON

Vol. XXV, No. 1, pp. 101-110 January-March 1986

MARINE PYTHIACEAE FROM DECAYING SEAWEEDS IN THE NETHERLANDS

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ABSTRACT

From decaying seaweeds collected in and near the salt lake Grevelingen (The Netherlands), several isolates of two species of Pythium and one species of Phytophthora were obtained. Pythium grandisporangium Fell & Master was isolated for the first time in Europe. Pythium chondricola sp. nov. is described, illustrated and compared with related species. The isolates of Phytophthora sp. did not develop oogonia. This species is described, illustrated and its probable taxonomic status is discussed.

INTRODUCTION

A number of Pythium and Phytophthora species have been isolated by different investigators, from marine habitats, mainly mangrove swamps, estuaries and salt marshes: Pythium aquatile Hohnk, P. grandisporangium Fell & Master, P. marinum Sparrow, P. porphyrae Takahashi & Sasaki, P. salinum Hohnk (see Van der Plaats-Niterink, 1981), Phytophthora vesicula Anastasiou & Churchland (1969), Ph. bahamensis , Ph. epistomium, Ph. mycoparasitica and Ph. spinosa vars. spinosa and lobata (all described by Fell and Master, 1975), Ph. operculata Pegg & Alcorn (1982) and Ph. avicennae, Ph. batemanensis and Ph. polymorphica (Gerretson-Cornell and Simpson, 1984).

Although most of the marine Pythiaceae were found in the last two decades, the results of Anastasiou and Churchland (1969), Fell and Master (1975) and Gerretson-Cornell and Simpson (1984) indicate that at least some species are quite common. In order to investigate marine Pythiaceae along the Netherlands coast, I collected and examined, a number of decaying seaweeds (including Chondrus crispus and Ulva lactuca) and leaves of Zostera marina, in 1983 and 1984. Isolates of two species of Pythium were found and they are described below. One of the species turned out to be identical with P. grandisporangium Fell & Master, and the other differs from any known species. In addition a heterothallic species of Phytophthora was isolated.

MATERIAL AND METHODS

Both apparently healthy and decaying seaweeds and seagrass leaves were collected in October 1983 and September 1984 in Lake Grevelingen (a former estuary, now enclosed, salinity about 3.6%), in the south-western part of the Netherlands, and in two other localities, close to this lake, viz. the Oosterschelde estuary and in the North Sea. Collected material was transported in seawater in plastic bottles to the laboratory, where it was stored overnight at 5°C.

Isolations were made on cornmeal agar, prepared with half strength artificial seawater (salinity 1.8 %) (Hw-Meeressalz, H. Wiegandt, Krefeld, in tap water). This medium was used with and without penicillin and/or benomyl, to suppress bacteria and other fungi respectively. Small pieces of thallus or leaves were rinsed in sterile, artificial seawater, blotted on filter paper and put on the agar. After a few days at 17.5°C the resulting pythiaceous mycelium was subcultured. If necessary, the mycelium was purified on cornmeal agar containing penicillin and streptomycin.

The isolates were grown on cornmeal agar prepared with both tap water and artificial seawater at salinities of 1.8 and 3.6 %, to study mycelial growth and oogonium production. Growth was also observed on potato-carrot agar. For preparation of the agar media see Van der Plaats-Niterink (1981). For studies of sporangium development water cultures were used: colonized grass leaves (for Pythium) or hemp seeds (for Phytophthora) in the soil extract described below, and in artificial sea water at salinities of 0.036, 1.8 and 3.6%, prepared with distilled water. Soil extract was prepared by shaking 400 g of sandy soil with 1 l of distilled water and then filtering and autoclaving the extract. Water cultures were kept at room temperature (20 ± 3°C).

DESCRIPTION OF THE SPECIES

Pythium chondricola De Cock sp. nov. (fig. 1)

Species homothallica. Coloniae in agaro farina maydis confecto submersae, indistincte rosulatae. Hyphae radiantes 2.5-6 µm, vulgo 4 µm latae. Intumescentiae intercalares, raro terminales, globosae vel subglobosae, 10-29 µm diam. Sporangia filamentosa, non-inflata; tubi evacuationis longissimi, 2-3 µm lati, apicem versus ad 7-8 um dilatati. Zoosporae in aqua marina normali vel diluta circa 20°C formatae, cystides 10-15 µm diam. Oogonia saepe conglomeratae, plerumque intercalaria, nonnumquam terminalia, (sub-)globosa, saepe partem hyphae originalis comprehendentia, levia plerotica vel aplerotica undulata, (14-)16-24(-34) µm diam. Antheridia 1-3(-4), diclina, stipites nonnumquam furcata, cellulae antheridiales saccatae vel claviformes, apices oogonio fere late adnati. Oosporae pleroticae vel nonnumquam apleroticae, parietibus ad 1.5 µm crassis.

Typus CBS 203.85, vivus et exsiccatus, isolatus e Chondro crispo putrido, ad Lacum Grevelingen, prope Grevelingendam, in Neerlandia, A.W.A.M. de Cock, 1983.

Homothallic species. Colonies on cornmeal agar submerged with a vague, irregularly rosette/chrysanthemum pattern. Main hyphae 2.5-6 µm , mostly 4 µm wide. Hyphal swellings present in agar cultures, intercalary, occasionally terminal, (sub-)globose, 10-29 µm diam. Sporangia filamentous, not inflated; discharge tubes very long, 2-3 µm wide, widening at the tip to 7-8 µm. Zoospores formed at room temperature in artificial sea water at salinities between 0.036 and 3.6 %. Encysted zoospores 10-15 um diam. Oogonia formed on cornmeal agar with tap water or 1.8% seawater agar, often concentrated in macroscopically visible white groups, mostly intercalary, occasionally terminal, (sub-)globose, often including a part of the subtending hypha, colourless, smooth or, if aplerotic oospores are present, with undulate wall, (14-)16-24(-34) µm diam. Antheridia 1-3(-4) per oogonium, diclinous, antheridial stalk sometimes branched, antheridial cell sac-like to club-shaped, tip rather broadly attached. Oospores plerotic, occasionally aplerotic, wall to 1.5 um thick. Cardinal temperatures for growth: minimum 3°C, optimum 24°C, maximum 31°C. Daily growth rate on cornmeal agar at 24°C: 5 mm, on cornmeal/1.8% seawater agar 5.5 mm, on cornmeal/3.6% seawater agar 3.5 mm, on potato-carrot agar (after a lag period of some days) 3-4 mm.

Material examined: CBS 203.85, type strain, isolated from decaying Chondrus crispus in Lake Grevelingen, near the Grevelingendam, 1983. CBS 204.85 and CBS 205.85 from the same origin and locality; CBS 206.85 from decaying Ulva lactuca, CBS 207.85 from decaying leaf of Zostera marina, both in Lake Grevelingen, 1983; CBS 208.85 from decaying unidentified red alga, CBS 209.85 from decaying Ulva lactuca, both in the Oosterschelde estuary, near Colijnsplaat, 1984; CBS 210.85, single zoospore isolate from CBS 208.85, and some more isolates not maintained.

Discussion.

Pythium chondricola is a species with some highly variable characters. The oospores may be distinctly plerotic as well as aplerotic. Some isolates have both types, whereas others may have nearly 100% of one type.

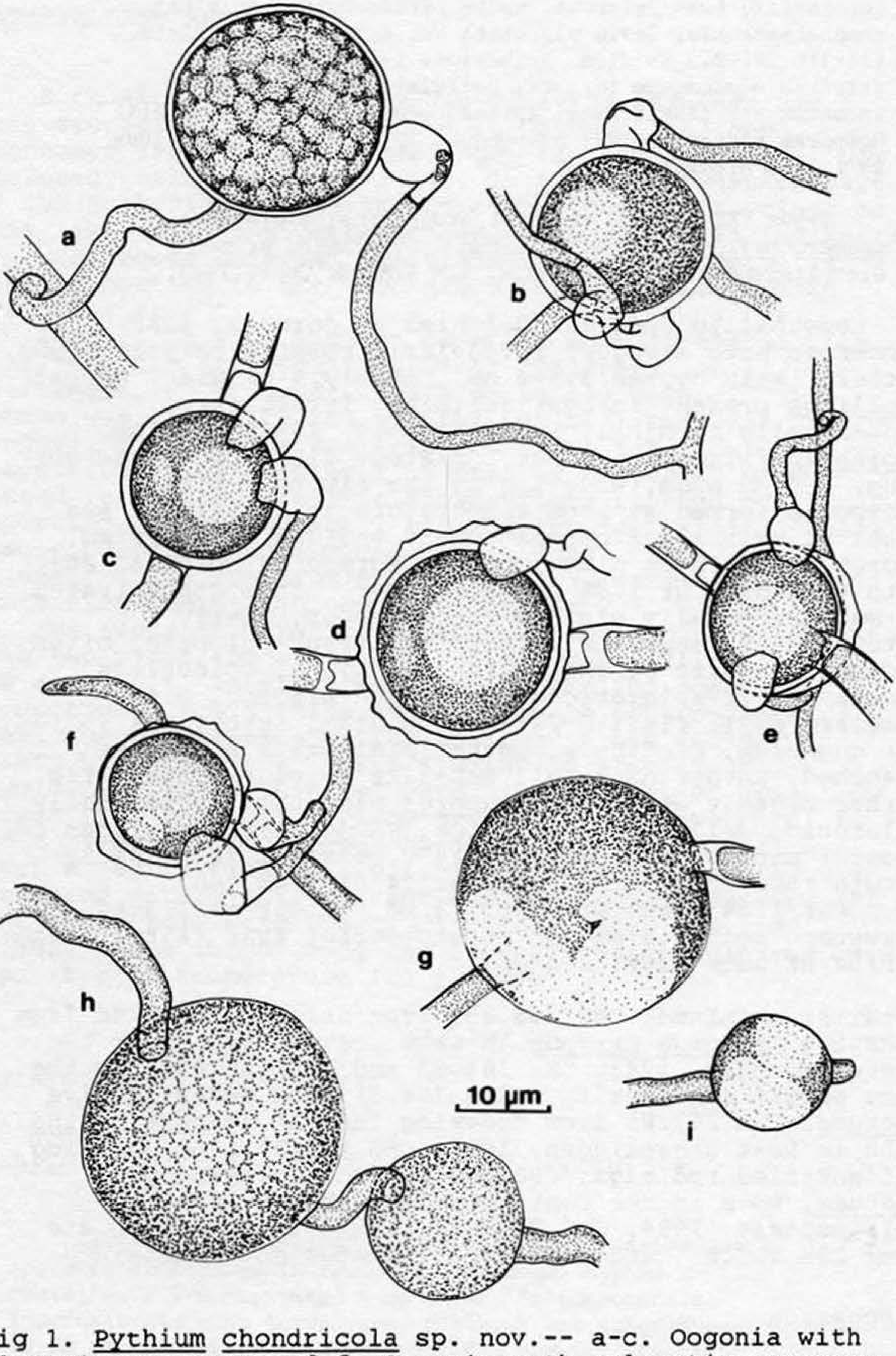

Fig 1. Pythium chondricola sp. nov.-- a-c. Oogonia with plerotic oospores.--d-f. Oogonia with aplerotic oospores and undulate wall.--g-i. Hyphal swellings.

Rarely two oospores are present in an oogonium. In some isolates oogonia that failed to develop mature oospores often had a larger diameter than oogonia with well developed, mature oospores. Moreover, the number of antheridia present on these oogonia was sometimes quite high: up to and even more than ten, whereas the normal number of antheridia on well-developed oogonia was one to four. Antheridia are sometimes also present on hyphal swellings.

Pythium chondricola belongs to the group of species with filamentous, non-inflated sporangia. In this group three species with hyphal swellings occur: *P. porphyrae* Takahashi & Sasaki, *P. perniciosum* Serbinow and *P. sulcatum* Pratt & Mitchell. *P. chondricola* is closely related to *P. porphyrae*: besides the sporangium type, common characters are the presence and position of hyphal swellings, position of oogonia, type and number of antheridia and hyphal diameter. *P. chondricola* differs from *P. porphyrae* in having also aplerotic oospores, larger oogonia, thinner oospore walls and considerably lower cardinal temperatures. Unfortunately the CBS strains of *P. porphyrae* are in a degenerate condition: 367.79 did not form well-developed, mature oospores and 517.82 only a few. The thickness of the oospore wall in both isolates was 1-4 µm, mostly 2-2.5 µm. In *P. chondricola* the oospore wall is mostly less than 1.5 µm (rarely up to 2 µm). The wall of plerotic oospores is often even less than 1 µm thick. *P. perniciosum* has catenulate hyphal swellings that are easily shed and differs in almost every other character from *P. chondricola*; *P. sulcatum* has monoclinous antheridia, longitudinally appressed to the oogonium. Among species lacking hyphal swellings *P. chondricola* differs from *P. aquatile* Hohnk, *P. tenue* Gobi, *P. monospermum* Pringsh., *P. dissotocum* Drechsler, *P. coloratum* Vaartaja and *P. angustatum* Sparrow in having strictly diclinous antheridia and plerotic oospores, from *P. adhaerens* Sparrow by antheridia borne on mainly unbranched stalks, not encircling the oogonium, and by thinner oospore walls, from *P. marinum* Sparrow by intercalary oogonia and the presence of mostly more than one antheridium, from *P. diclinum* Tokunaga and *P. apleroticum* Tokunaga by the mainly intercalary oogonia, higher number of antheridia, lower cardinal temperatures and slower growth rate. It is also distinct from *P. papillatum* Matthews as this species lacks antheridia completely and may have papillae on the oogonia.

Pythium grandisporangium Fell & Master - Can. J. Bot. 53: 2920-2921. 1975 (fig. 2).

Colonies on cornmeal agar submerged, without a recognizable pattern, becoming yellowish with age, due to the development of oogonia. Main hyphae up to 7.5 µm wide. Hyphal swellings and appressoria not observed. *Sporangia* developing in 3.6% sea water only, terminal, the long axis occasionally perpendicular to the subtending hypha, most typically globose with a beak (fig. 2 f-h), but many sporangia irregularly obclavate, 55-165 x 25-88 µm.

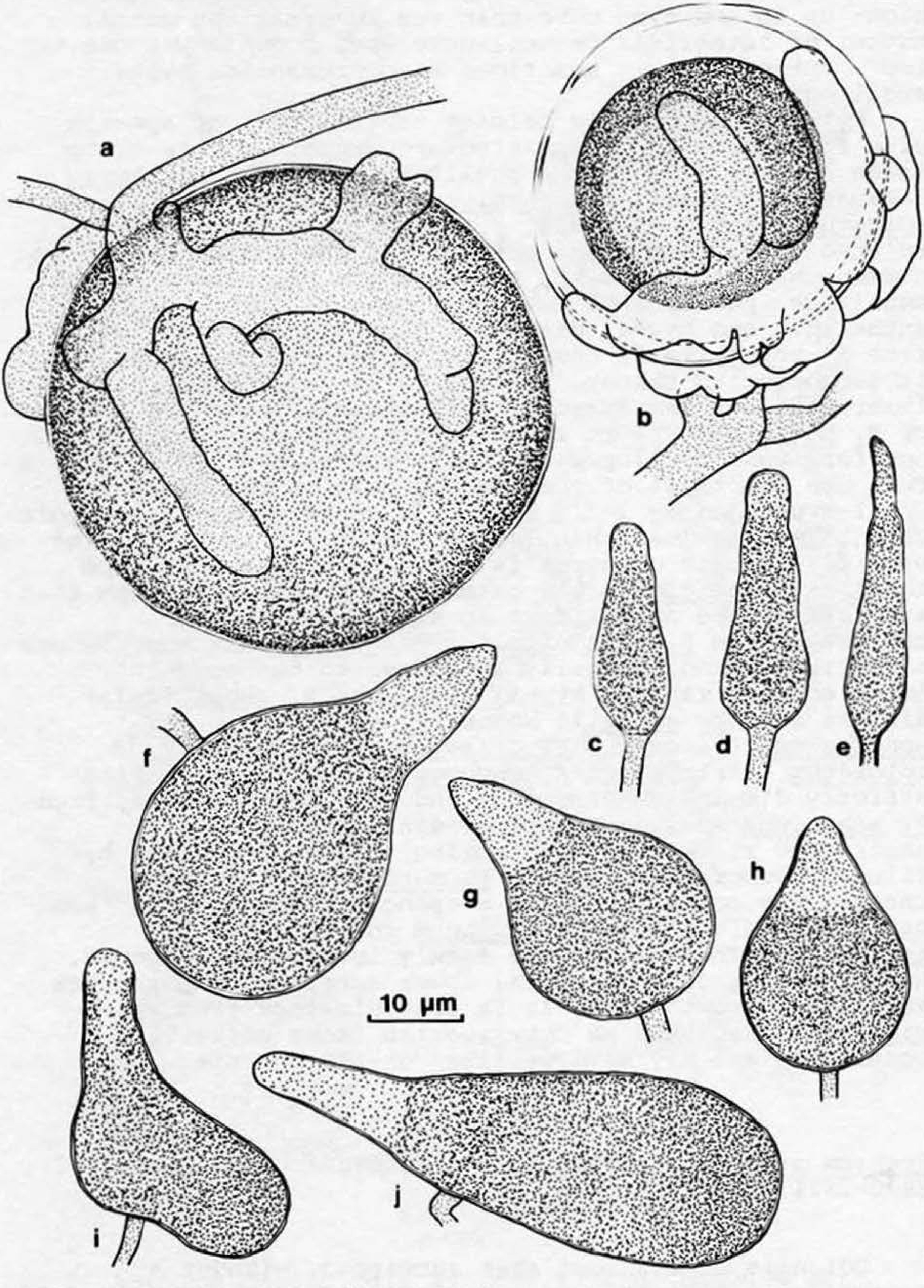

Fig 2. Pythium grandisporangium Fell & Master.-- a, b. Oogonia.--c-e. Young, developing sporangia.--f-j. Mature sporangia.

Oogonia terminal, globose, smooth, rarely with a single finger-like projection, (21-)27-48(-60) µm diam. Antheridia 1(-2, possibly 3) per oogonium, antheridial cell irregularly lobed and branched, broadly appressed to the oogonium, close to the oogonial stalk. Origin of the antheridia difficult to trace, probably both monoclinous and diclinous types occurring. Oospores single, slightly aplerotic, globose, 20-56 um diam, wall (2-)4-6(-7) µm thick. Cardinal temperatures for growth: minimum below 0°C, optimum 27°C, maximum about 30°C. Daily growth rate on cornmeal agar at 24°C 10 mm, on cornmeal/1.8% seawater agar 20 mm, on cornmeal/3.6% seawater agar 16 mm.

Material examined: CBS 211.85, CBS 212.85, CBS 213.85 and CBS 214.85 from decaying leaves of *Zostera marina* L., Lake Grevelingen, and several isolates from the same origin, not maintained. CBS 286.79, type strain, isolated from leaves of *Distichilis spicata* submerged in 3% seawater in a salt-marsh, dwarf mangrove area inland from Little Card Sound, Florida, J.W. Fell and I.M. Master, 1973; CBS 606.81, isolated from *Fucus distichus* L., near Skookumchul tidal rapids in southern British Columbia, Canada, by T.A. Thompson, 1980.

Discussion

Thus far *P. grandisporangium* was known in the literature only from its original isolate from Florida. A secundary isolate from Canada, maintained at CBS, agrees with the type strain. The isolates from Lake Grevelingen show only slight differences from the type strain: the maximum size of oogonia is somewhat larger, the oospores are slightly aplerotic and the oospore walls may be somewhat thicker. The growth rate on cornmeal/1.8% seawater agar is considerably higher. Examination of the type strain showed that this isolate also develops many slightly aplerotic oospores.

Phytophthora sp. (figs. 3, 4)

On cornmeal agar colonies coarsely radiate, submerged or with thin aerial mycelium; amount of aerial mycelium decreasing with increasing salinity of the medium. On agar only mycelium with occasionally inflated hyphae and hyphal knots are developed. Hyphae 5 µm wide in water, up to about 8 um on agar. Soil extract and 1.8% seawater proved to be the best media for development of sporangia and hyphal swellings. In both media zoospore release and cyst germination were observed. Large complexes of irregularly inflated hyphae developed in these media. Hyphal swellings (sub-)globose, intercalary and terminal, single, occasionally catenulate and often in complexes together, (22-)30-50(-70) µm diam. Sporangia terminal, internally proliferating, ovoid to obturbinate, non-papillate, with a slight apical thickening, 45-80 x 30-52 um, apical opening 12-17 um wide. Zoospore discharge directly or by a vesicle, cyst diameter 13 um. Oogonia and antheridia absent from both agar cultures and water cultures. Cardinal temperatures for growth: minimum below 0°C, optimum 27°C and maximum 34°C. Daily growth rate on cornmeal agar at 24° 10-8 mm (decreasing in time), on cornmeal/1.8% seawater agar 12.5 mm, on cornmeal/3.6% seawater agar 14.5 mm.

Material examined. CBS 215.85, CBS 216.85, CBS 217.85, isolated from decaying leaves of Zostera marina and CBS 218.85, from decaying Chondrus crispus, all in Lake Grevelingen, Near the Grevelingendam, 1983; CBS 268.85 from decaying leaf of Z. marina in the same locality, 1984.

Discussion

The Phytophthora isolates from Lake Grevelingen are probably identical to the marine Phytophthora isolates of Hohnk (1953). They are easily to be distinguished from Ph. bahamensis, Ph. epistomium, Ph. mycoparasitica, Ph. spinosa var. spinosa, Ph. spinosa var. lobata, Ph. vesicula and Ph. operculata as all these marine species have unique methods of zoospore release; the Dutch

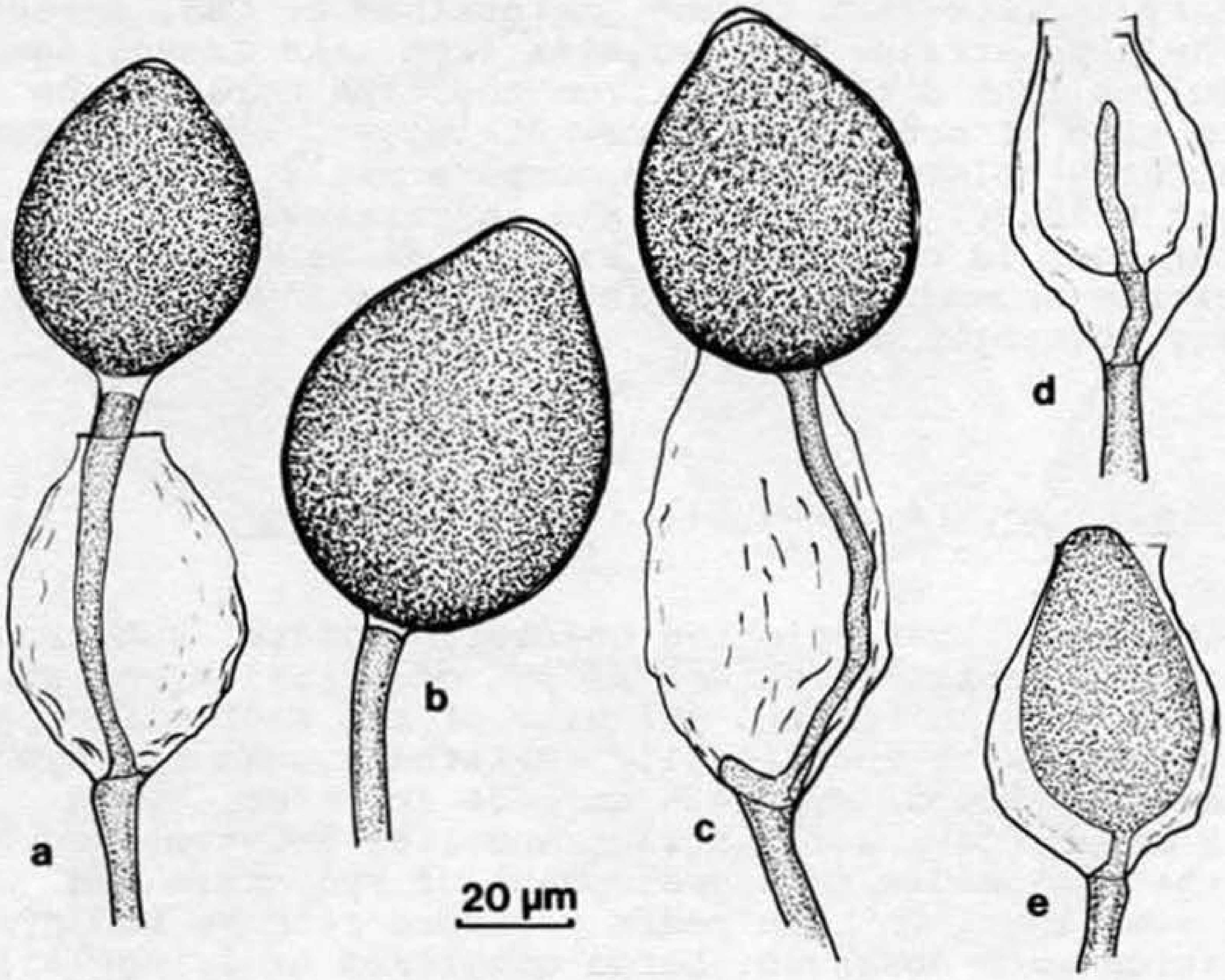

Fig 3. Phytophthora sp.--a-e. Sporangia in various stages of development and proliferation.

isolates differ from Ph. avicennae, Ph. batemanensis and Ph. polymorphica by the smaller sporangia, internal proliferation and development of hyphal swellings. The Grevelingen isolates belong to the group of heterothallic Phytophthora species with internally proliferating, non-papillate sporangia. The isolates seem to be identical with Ph. japonica Waterhouse (=Pythiomorpha oryzae Ito &

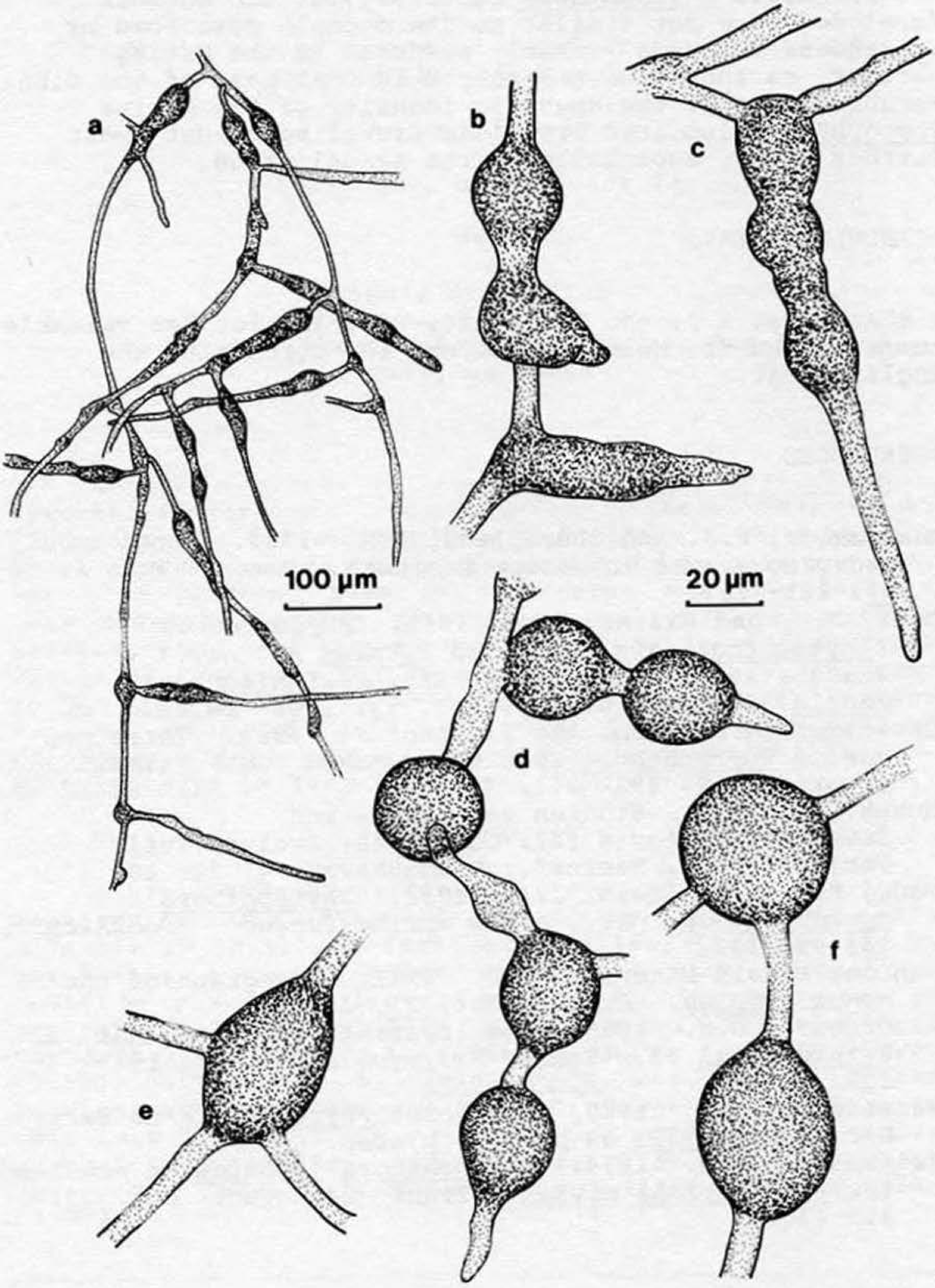

Fig 4. Phytophthora sp.-- a. Complex of inflated hyphae.-- b-f. Inflated hyphae and globose hyphal swellings.

Nagai); the original description by Ito and Nagai (reproduced in Waterhouse, 1970) fits the marine isolates perfectly, even in the absence of a sexual stage. Only the differing origins of Ph. japonica and the marine isolates raise questions. Waterhouse (1958) succeeded in culturing oogonia in Ph. japonica; the marine isolates gave positive results in mating experiments with some other heterothallic Phytophthora isolates, but the oogonia developed were not similar to the oogonia described by Waterhouse and were probably produced by the mating partner, as they always appeared in that half of the dish. Establishment of the specific identity of the marine Phytophthora isolates from Lake Grevelingen must await further study, especially of the sexual stage.

ACKNOWLEDGEMENTS

I thank Mrs. A.J. van der Plaats-Niterink for her valuable comments and Mr. Keith A. Seifert for correcting the English text.

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MYCOTAXON

Vol. XXV, No. 1, pp. 111-117 January-March 1986

A NEW SPOROCARPIC SPECIES OF ACAULOSPORA (ENDOGONACEAE)[1]

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ABSTRACT

A new species of Acaulospora, A. myriocarpa, a mycorrhizal-forming fungus in the Endogonaceae (Endogonales, Zygomycetes) is described. This hyaline, small-spored species forms spores singly in soil and roots but also produces them in sporocarps and sporulates in soil crevices, within empty seed teguments, cast insect exoskeletons, and empty spores of other Endogonaceae. Spores of A. myriocarpa are of similar size and appearance to A. trappei. Spores detached from the hyphal terminus can be confused possibly with Glomus occultum, G. diaphanum and G. microcarpum. The known distribution of A. myriocarpa is restricted to Colombia and Peru.

INTRODUCTION

A small-spored, hyaline, sporocarp-forming species of Acaulospora was observed first in Carimagua, Meta, Colombia in 1981. On first examination, this species was perplexing because spores associated with this fungus could be placed in the genera Glomus, Entrophospora and Acaulospora based on their configuration with or without the hyphal terminus. In addition, until recently (Berch, 1985), no species of Acaulospora was known to form sporocarps. The purposes of this paper are to describe this new fungus, compare it to species of similar morphology and size and discuss some of its unique features. Spore wall terminology follows that of Walker (1983).

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[1] Florida Agriculture Exper. Stat. Jour. Series No. 6687

ACAULOSPORA MYRIOCARPA Spain, Sieverding et Schenck (Figs. 1,2 and 3)

Sporae singulatim in terra vel in sporocarpiis efformatae; sporocarpia irregularia, hyalina,parva,725 X 525 µm vel magna 22 X 8 mm, sine periodio; sporae penduculo gestae vel sporae sessiles, in subattenuata hypha cum terminatione inflata globosa. Sporae hyalinae, globosae vel subglobosae, 32-90 µm diam., vel irregulares, 28-95 X 28-80 µm. Tunicae sporarum 1.5-3.5 µm crassae; tunica exterior rigida, hyalina, 0.75-2 µm crassae, secundo interior rigida, hyalina, 0.3-1.5 µm crassae, tertio membranaceo (<0.3 µm crasso) inseparabili e tunica secundo. Sporae cum pedicellibus aliquando. Formans mycorrhizas sed sine vesiculis vel arbusculis.

Spores formed singly in the soil and adjacent to roots or in irregular-shaped small, 725(-1050) X 525(-906) µm, to occasionally large, upto 22 X 8mm, sporocarps without a peridium; spores frequently formed within soil crevices and inside roots, empty spores of other Endogonaceae, within insect carapaces, and old seed testa. Spores borne on a short pedicel, 2.8-12 long X 2.7-8 µm wide, or sessile on a slightly tapering hypha, 5-8 µm wide, terminating in a globose to ovoid terminus, 25-100 X 30-95 µm; hyphal terminus contents hyaline to subhyaline, granular to reticulate; terminus wall 0.5-0.75 µm thick; as the spore forms the terminus empties, collapses and the terminus hypha proximal to the pedicel may attenuate. Spores hyaline, mostly globose to subglobose, (22)32-90 µm, or cylindrical, ovoid, pyriform to irregular, (23)28-95(114) X (21)28-80(96) µm; spore contents hyaline and granular; composite spore wall hyaline, 1.5-3.5(7) µm thick, of 3 walls (1-3) in one group; wall 1 rigid, 0.75-2 µm, wall 2 rigid 0.3-1.5 µm; spore walls staining dull yellow in Melzer's reagent; wall 3 membranous (<0.3 µm thick) closely appressed to wall 2, seen best in stained preparations; hyphal pedicel occasionally (10-20% of spores) remaining attached to the spore after separation from the hypha and terminus. Hyphae within the root staining faintly with trypan blue and no typical vesicles or arbuscules observed.

TYPE: Obtained from a pot culture with *Pueraria phaseoloides* (Roxb.) Benth. (tropical kudzu), culture C-7 at Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia; originally collected by Joyce Spain from native grasses in an acidic loam (pH 4.5) at Reserva-Carimagua, Meta, Colombia. Holotype OSC; isotypes FLAS and FH.

SPECIMENS EXAMINED: Numerous specimens of *A. myriocarpa* were collected from several regions in Colombia. Spore sizes of pot-cultured isolates of these specimens varied considerably but because of the gradual overlap in spore diameter among the isolates on *P. phaseoloides* (Fig. 4) they were considered variants of the holotype rather than new taxa. Paratypes: (listed with CIAT pot culture numbers and followed by spore diameter measurements) C-4-10 associated with roots of *Manihot esculenta* Crantz in acid clay, Mondomito, Cauca; 27-57 µm. C-20-5 associated with roots of *M. esculenta* in acidic sand, Alegria-Carimagua, Meta; 40-90 µm. C-22-1 associated with roots of *Allium porrum* L. in red clay loam, farm of Mr. Baron, Bitaco, Valle; 51-82 µm. C-29-4 from soil for greenhouse experiments in Quilichao, Cauca; 30-61 µm. C-37-7 associated with roots of *Stylosanthes* sp. at the CIAT field station in Quilichao, Cauca; 45-75 µm. C-44-6 associated with roots of native grasses at Piragua Grande near Buenaventura, Valle; 33-65 µm. C-88-1 from soil on the CIAT station at Popayan, Cauca, collected by J. Haanschoten; 31-51 µm. C-94-3 associated with roots of *M. esculenta* at site D-4 on the CIAT station, Quilichao, Valle; 33-50 µm. C-98-2 from a pot culture (Car-45) of *Acaulospora appendicula* Spain, Sieverding & Schenck on *P. phaseoloides* at CIAT, Cali, Cauca; 41-64 µm. C-100-3 from a pot culture (Car-29) of *A. appendicula* on *P. phaseoloides* at CIAT, Cali, Cauca; 30-45 µm. Sporocarps were not found with all the above isolates but all spores had two walls. All the paratypes have been sent to the OSC herbarium. Also observed in Tarapoto, San Martin, Peru at two locations associated with roots of tropical grasses and legumes (pot culture C-46-7) and with roots of *Brachyaria* sp. (pot culture C-47-6).

ETYMOLOGY: *Myriocarpa* (Gr. *Myrio* = innumerable; L. *carpa* = fruit) referring to the abundance of spores and sporocarps produced by this species.

MYCORRHIZAL ASSOCIATIONS: Known to form mycorrhizal associations with *Peuraria phaseoloides*, *Manihot esculenta*, *Coffea arabica* L., *Brachyaria* sp., *Stylosanthes* sp., and *Allium porrum* L.

DISTRIBUTION: Known only from Colombia and Peru.

DISCUSSION

Some spores of *A. myriocarpa*, especially those which were stained with trypan blue or cotton blue, have a separation between the inner wall and a membrane retaining the spore contents. The thickness of this membrane was not possible to determine accurately with a light microscope (X1250) in unstained spores because of its thin nature and its adherence to the inner rigid wall. In stained preparations, this membrane separated from the inner rigid wall and measured less than 0.3 µm in thickness. This increased thickness of the membrane in stained spores may have resulted from stain particle deposition. This membranous wall is included in the murograph (Fig. 2) but is labeled with an asterisk as being difficult to see.

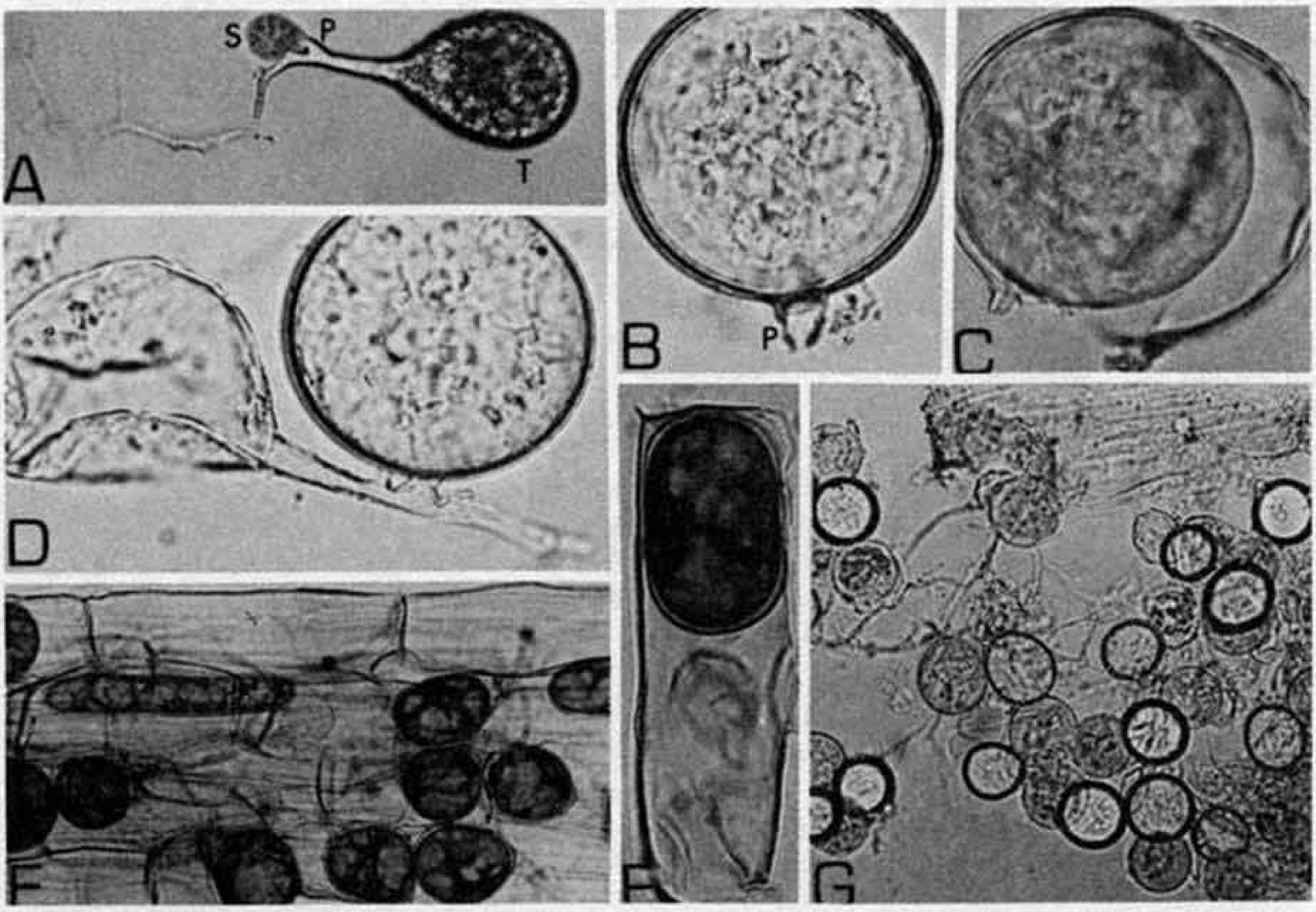

FIG. 1. Acaulospora myriocarpa. A) Initial stages of spore formation. (T=hyphal terminus; P=pedicel; S=initial spore) X250. B) Mature spore with attached pedicel (P) X400. C) Broken outer wall on mature spore, X400. D) Mature spore attached to pedicel, hypha, and collapsed terminus, X400. E) Spores (stained with trypan blue) in a root, X400. F) Mature spore (stained with trypan blue) and collapsed terminus in a single cortical cell, X400. G) Mature spores at the edge of a broken sporocarp, X250.

The only other sporocarp-forming species of Acaulospora, A. sporocarpia Berch, (Berch, 1985) can be readily separated from A. myriocarpa. Spores of A. sporocarpia are dark brown to black, are considerably larger (160-200 X 150-175 µm) than A. myriocarpa, and are formed in dark brown sporocarps. However, A. myriocarpa can be easily confused with A. trappei Ames & Linderman because both species produce spores that are hyaline, thin walled, of similar size and both form spores in roots. Spores of A. myriocarpa in sporocarps would readily be separable from A. trappei since A. trappei does not form sporocarps. In addition, spores of A. myriocarpa have two distinct walls and spores formed singly in soil frequently have a pedicel attached, features absent in A. trappei. However, many spores of A. myriocarpa lack a pedicel or the pedicel can be lost by abrasion in soil.

Single spores of A. myriocarpa with a pedicel can sometimes be confused with Glomus species (Fig. 1B), especially spores of G. occultum Walker, G. diaphanum Morton & Walker and G. microcarpum Tul. & Tul. Spores of A. myriocarpa and both G. diaphanum and G. occultum have two separable walls. Glomus diaphanum has the inner wall inserted into the hyphal attachment and this arrangement can be seen when spores are broken and the two walls disassociate. This does not occur with A. myriocarpa. Glomus occultum has a thin outer wall that is frequently associated with debris and a thicker inner wall. In A. myriocarpa the outer wall is slightly thicker than the inner wall (Fig. 2) and no debris is associated with the outer wall (Fig. 1 B,C and D). With G. microcarpum the spore wall is single, frequently has laminations, and is some what thicker (4-6 µm) than that of A. myriocarpa (1.5-3.5 µm).

As mentioned earlier, our first observations of A. myriocarpa revealed spore types that resembled three genera. Typical Acaulospora-like attachments to the spore were observed but in addition Entrophospora-like attachments were noted. These resulted from the attenuation or loss of the proximal hypha associated with the tapering hypha at the pedicel (Fig. 3). This spore-terminus conformation much resembled that of Entrophospora. The Glomus-like appearance of the pedicel attached to the spore resulted when the separation of the spore from the hypha occurred at the point where the pedicel was attached to the tapering hypha (Fig. 1B; Fig. 3).

A word of caution is appropriate regarding research with and identification of small, hyaline-spored species of Endogonaceae. These species can be easily overlooked in soils, especially if very fine sieves (25 µm diam.) are not used routinely in surveys for mycorrhizal fungi. These hyaline, small-spored species can be a problem also when inoculating "control" pots with pot culture sievings to establish similar microflora to that which occurs in mycorrhizal inoculated treatments. Many of these spores are small enough in diameter, especially without their attached hyphae, to pass through most sieves routinely used to exclude spores of mycorrhizal fungi from these sievings. This can result in "control" treatments with mycorrhizae.

Many of these hyaline, small-spored species cannot be distinguished readily from each other with a dissecting microscope (X70-X100). A species determination may be impossible even if examined with a compound microscope,

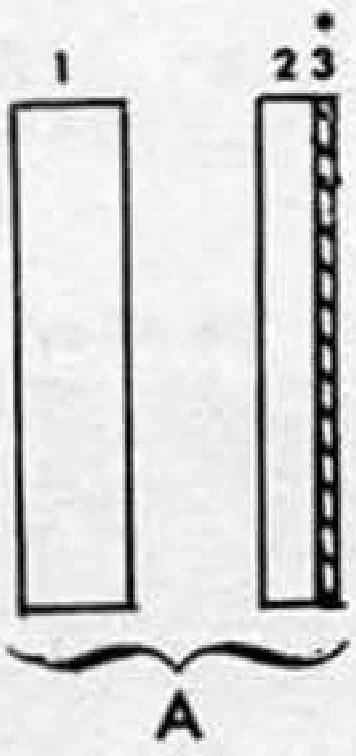

Fig. 2. Murograph of the wall structure of Acaulospora myriocarpa which consists of two unit walls and a thin membranous wall. Diagram after Walker, 1983.

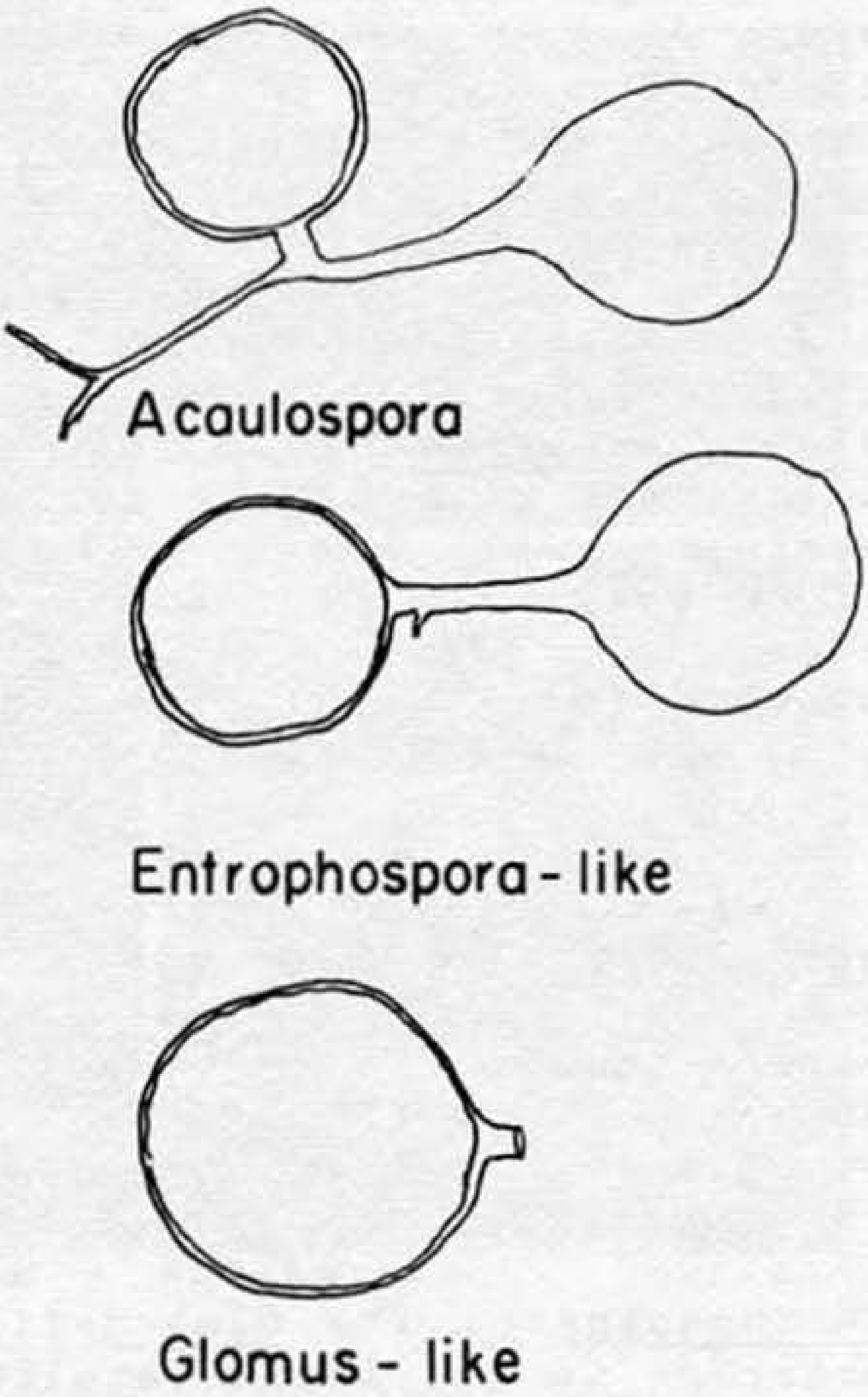

Fig. 3. Diagram of the spores of Acaulospora myriocarpa with and without the attached terminus showing the three configurations observed.

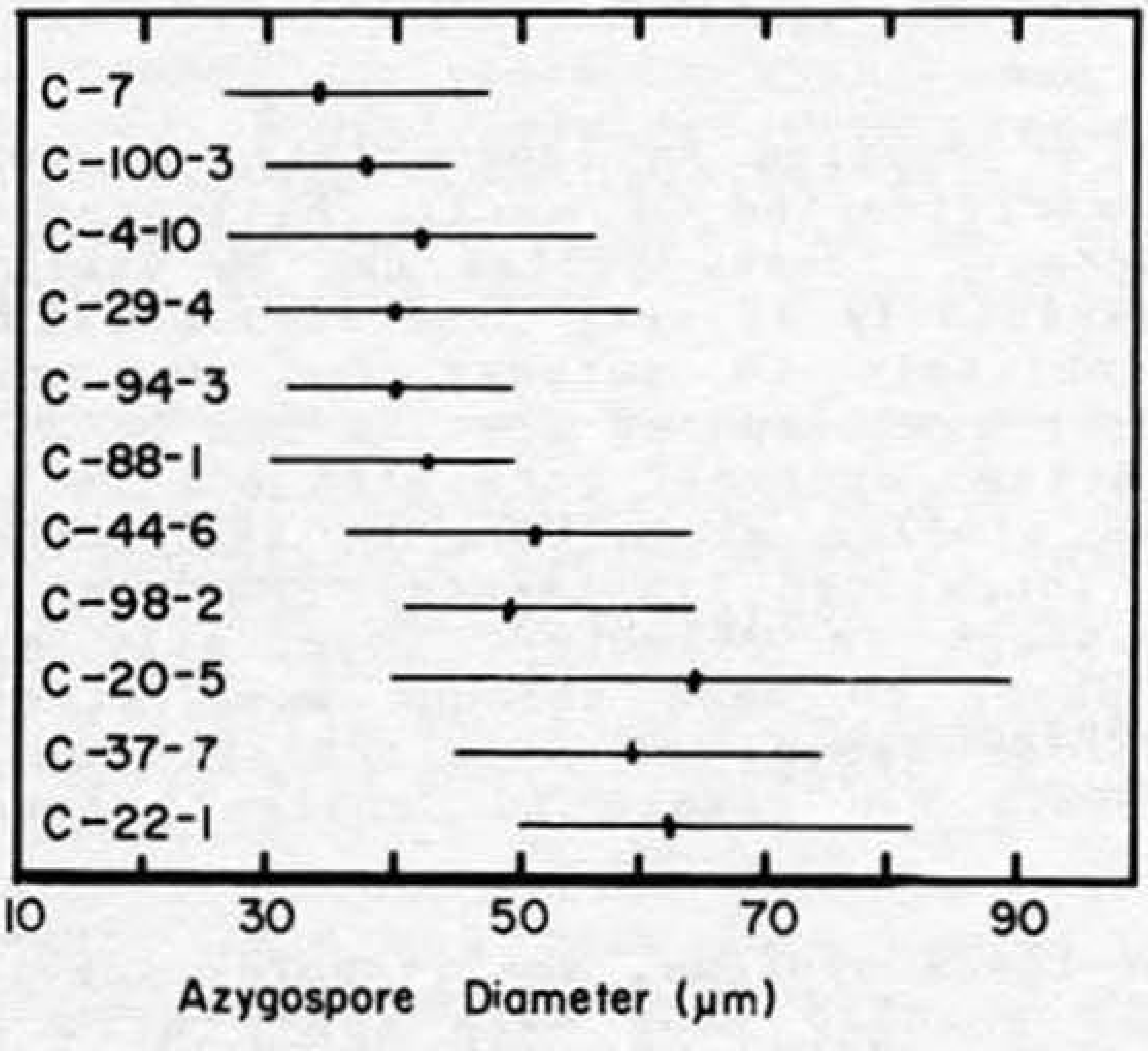

Fig. 4. Range of spore diameters of eleven isolates of Acaulospora myriocarpa. Mean spore diameter indicated by the mark on each line.

especially if hyphal attachments are missing. Therefore, we recommend establishment of pot cultures from single spores so that a positive determination can be made later on pot cultured spores with intact hyphal attachments and spores in different stages of maturity and development.

ACKNOWLEDGMENTS

We wish to thank J. B. Morton, R. E. Koske, G. W. Simone, J. W. Kimbrough, and T. Schubert for helpful suggestions and critical review of the manuscript, the laboratory staff of the Mycorrhizal Project at C.I.A.T. for their assistance, and the U.S.D.A. Title 406 Grant 58-7830-0-225 for financial assistance to the senior author.

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MYCOTAXON

Vol. XXV, No. 1, pp. 119-140 January-March 1986

SOME MORE OBSERVATIONS ON EASTERN HIMALAYAN HELOTIALES

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SUMMARY

Five new species and one new genus (Debaryoscyphus) of the Helotiales are recorded from the Eastern Himalayas. Two of the species belonq to the Leotiaceae, namely Mollisinopsis aurantiaca and Debaryoscyphus melanobasis and three to the Hyaloscyphaceae, Dendrotrichoscypha tetraspora, Hyaloscypha himalayensis and Hyaloscypha uncinata. Unguiculella eurotioides is recorded from the Indian subcontinent for the first time. There are provided keys to the known species of Mollisinopsis and to the Indian species of Hyaloscypha.

ZUSAMMENFASSUNG

Fünf neue Arten und eine neue Gattung (Debaryoscyphus) der Helotiales aus dem östlichen Himalaya-Gebiet werden beschrieben. Zwei der neuen Arten gehören zu den Leotiaceen, nämlich Debaryoscyphus melanobasis und Mollisinopsis aurantiaca und drei zu den Hyaloscyphaceen: Dendrotrichoscypha tetraspora, Hyaloscypha himalayensis und Hyaloscypha uncinata. Unguiculella eurotioides wird zum ersten Mal für den indischen Subkontinent nachgewiesen. Zur Bestimmung der bekannten Mollisinopsis- und der indischen Hyaloscypha-Arten werden Bestimmungsschlüssel gegeben.

RESUME

Voici la description de cinq nouvelles espèces et d'un nouveau genre des Helotiales trouvés dans le Himalaya oriental. Deux des espèces nouvelles font partie des Leotiaceae, c'est-à-dire Debaryoscyphus melanobasis et Mollisinopsis aurantiaca, trois des Hyaloscyphaceae: Dendrotrichoscypha tetraspora, Hyaloscypha himalayensis et Hyaloscypha uncinata. Unguiculella eurotioides (Karst.) Nannf. est documentée pour la première fois dans le sous-continent indien. On présente des clefs de determination pour les espèces publiques de Mollisinopsis et les espèces indiennes de Hyaloscypha.

This is a continuation of a series of papers about Eastern Himalayan Helotiales collected by the senior author in recent years (cf. e.g. ARENDHOLZ & R. SHARMA 1983 and 1984). The methods are the same as described there. In addition the junior author used an old threefold colouring, which was developed by GUEGEN (1906). The reagent contains SUDAN III, cotton blue and iodine, which were dissolved in pure lactic acid. SUDAN III stains fats, e.g. as oil drops in the ascospores, cotton blue tinges - among other things - the cytoplasm, and iodine shows the J+ reaction of the tips of the asci and, if present, colours reserve substances as e.g. glycogen. The colouring yields nice pictures in the light microscope, especially of the ascospores, if these contain oil drops, which stand out red against the blue coloured cytoplasm.

All collections cited in the text have again been deposited in PAN (Panjab University, Botany Department, Herbarium) and duplicates in the junior author's personal herbarium, as indicated.

MOLLISINOPSIS AURANTIACA Arendholz & R. Sharma sp. nov.

FIGS.: Plate 1: Fig. 1-6, Plate 2: Fig. 5.

Apothecia gregaria ad sparsa, sessilia ad breviter stipitata, cupulata ad plana, ad 0.25 mm diam. et ad 0.3 mm alta. Receptaculum fulvum, in sicco luteolum, subtiliter villosum, pili parvi, continua, ad 20 x 6 µm, apex simplex ad furcatus, varie curvatusque. Hymenium pallide aurantiacum, in sicco luteolum. Excipulum ectalum ex textura intricata, hyphae leptodermae, in gelatina inclusae, exciplum medullatum ex textura intricata, hyphae sicut in excipulo ectalo. Asci tetraspora, 68-81 x 10-11 µm, clavati-cylindrici, apex rotundus, poro jodo caerulescente. Ascosporae hyalinae, 11-13 x 3-4.5 µm, ellipsoideae, uniseptatae, in medio constrictae, guttulatae, ad maturitatem evanescente, involutae in tunica gelatinosa crassa, uniseritae. Paraphyses ad 2 µm latae, filiformes, simplices, ad ramosae, angustae, ascos ad 20 µm superantes.
Holotypus. - In calamo emortuo angiospermo, Chimakothi, Bhutan, September 23, 1980, R. Sharma, 17758 (PAN), isotypus 24083 (PAN); W.R.A.

Apothecia gregarious to scattered, sessile to short stalked, shallow cupulate to plane, margin finely crenate, external surface yellowish brown, drying pale luteous, minutely downy. Hymenium light orange, drying pale luteous, up to 0.25 mm in diam. and up to 0.3 mm in height, dark brown at the point of attachment with the substrate.

Ectal excipulum of textura intricata, up to 75 µm thick, glassy, hyphae thin-walled, embedded in a gelatinous matrix, up to 25 x 10 µm, outermost cells drawn out into hairs. Hairs small, smooth, up to 20 x 6 µm, one-celled, the apex of which is simple to forked and variously curved.

Medullary excipulum of textura intricata, up to 50 µm thick, hyphae thin-walled, septate, up to 2 µm wide.

Asci 4-spored, J+, 68-81 x 10-11 µm, clavate-cylindric, apex round, base stem-like.

Ascospores hyaline, 11-13 x 3-4.5 µm, ellipsoid, one-septate, constricted in the middle, filled with innumerable minute guttules, which disappear at maturity, enveloped in a thick, hyaline gelatinous sheath up to 7 µm thick, uniserate.

Paraphyses filiform, simple or branched, narrow, up to 2 µm wide at the top, projecting up to 20 µm beyond the tips of the asci.

Etymology of the specific epithet. - Refers to the colour of the hymenium in the fresh condition.

Habitat. - On dead angiosperm stem.

Type locality. - Chimakothi, Bhutan.

Holotype. - September 23, 1980, Raghunandan Sharma, PAN 17758. Specimens examined: Isotypes PAN 24083, on dead angiosperm stem, 5 km from Jamiri towards Nachephu, West Kameng, Arunachal Pradesh, September 12, 1981, Raghunandan Sharma; and in the junior author's personal herbarium (W.R.A. 1984-1020, 1984-1021).

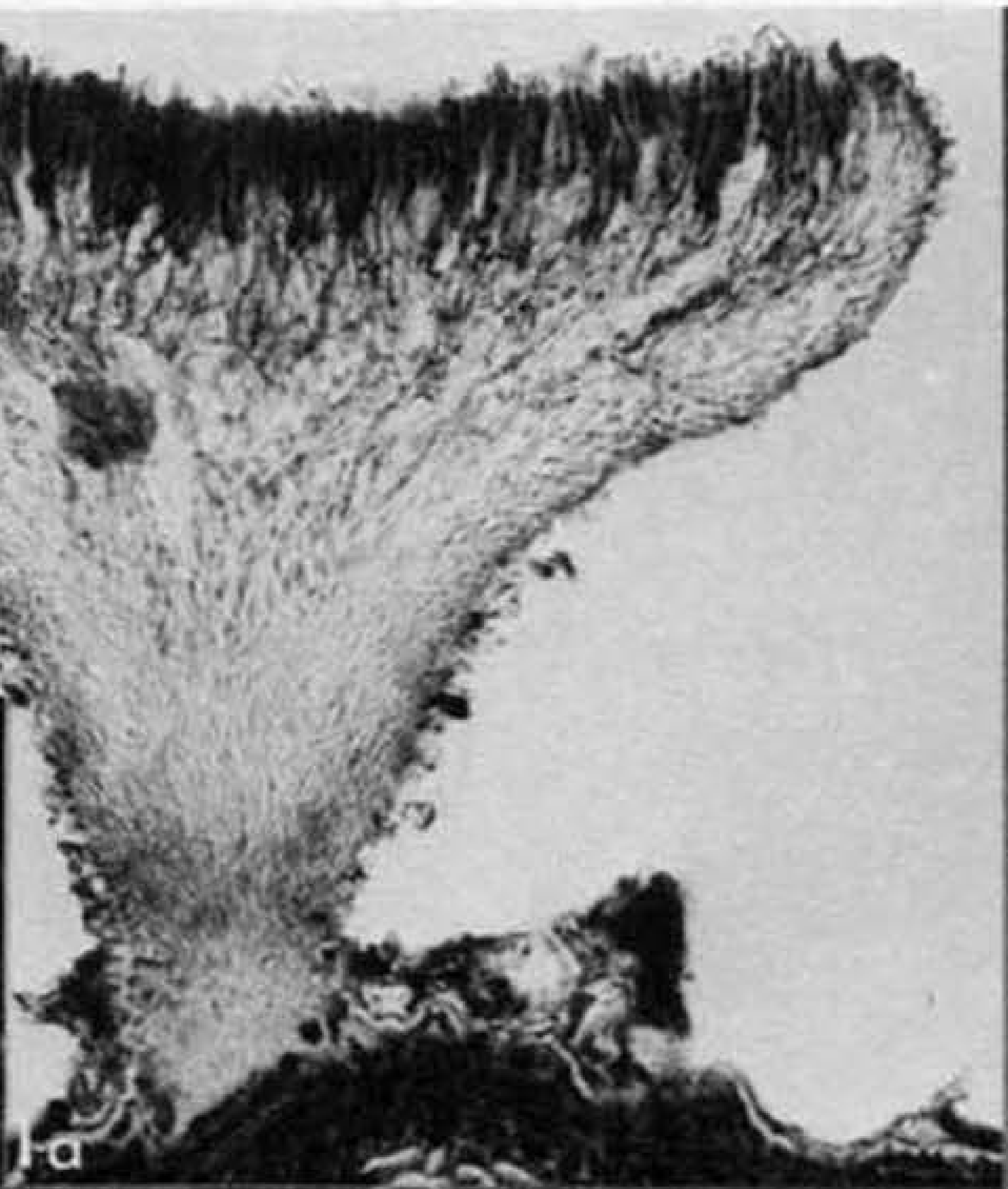
NOTES. - Because of its anatomical characters this species fits rather well into the genus MOLLISINOPSIS Arendholz & R. Sharma (ARENDHOLZ & R. SHARMA 1984), although the "branches" of the hairs show a weak striation, as revealed by SEM studies and which here is more marked than in either of the other species of MOLLISINOPSIS (M. indica and M. filicis; cf. ARENDHOLZ & R. SHARMA 1983, 1984). Whether this stritiation is an artifact or a consistant existing character has to be studied in fresh material, which is critical point dried.

Plate 1

MOLLISINOPSIS AURANTIACA Arendholz & R. Sharma sp. nov.; PAN 24083, Fig. 1-3, 5; PAN 17758: Fig. 4

Fig. 1: A group of Apothecia seen under the stereomicroscope; 47 x.
Fig. 1a:LS*) through an apothecium; 160 x, BF*).
Fig. 2, 2a: LS showing part of the ectal excipulum with hairs; 630 x DIC*).
Fig. 3: One apothecium showing downy excipulum; SEM picture, 150 x.
Fig. 4: Some hairs of the ectal excipulum showing striation; SEM picture, 7200 x.
Fig. 5: ditto; SEM picture, 5400 x.
(photos: W.R. Arendholz)

*) LS = longitudinal section; BF = bright field; DIC = Nomarski differential interference contrast.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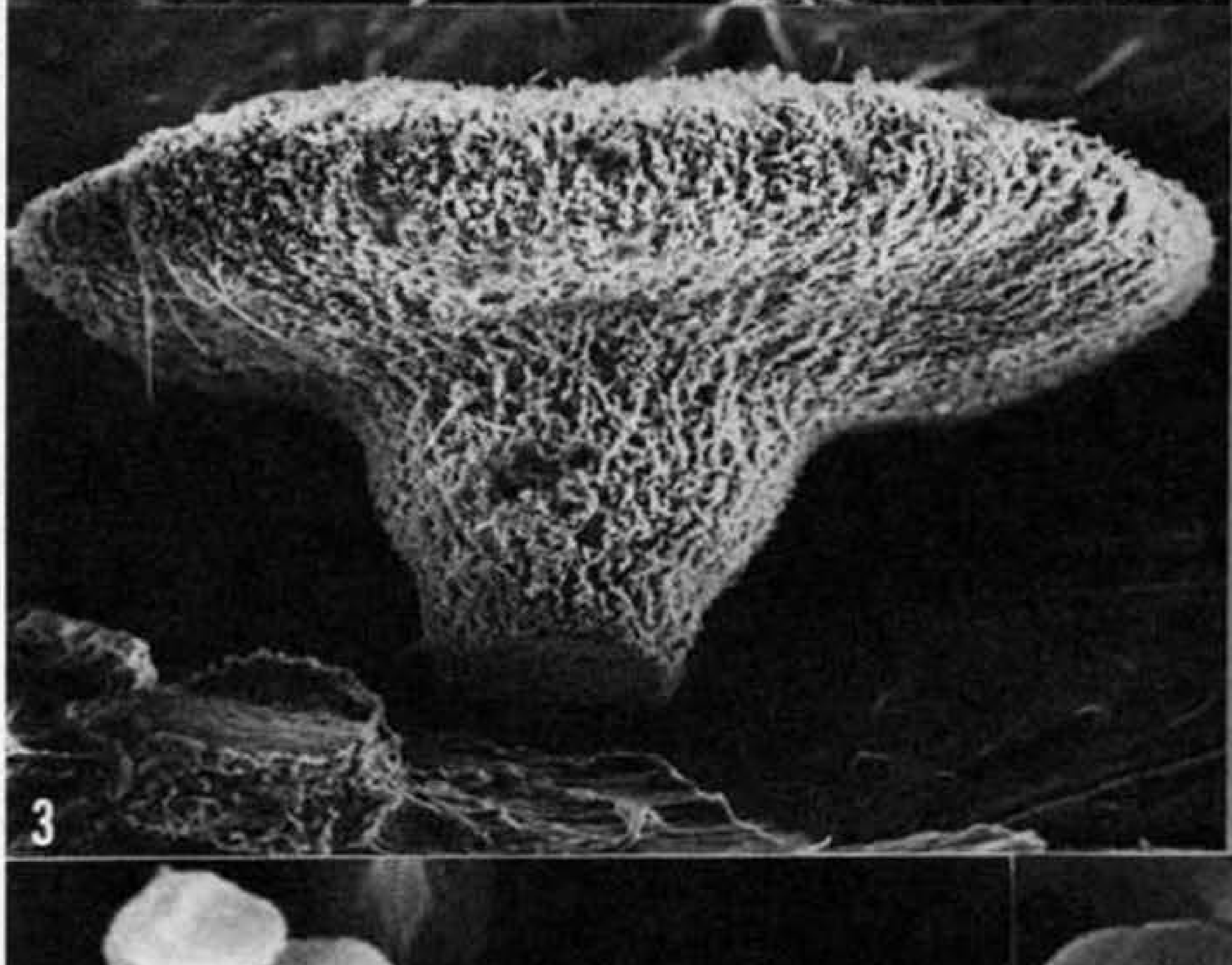
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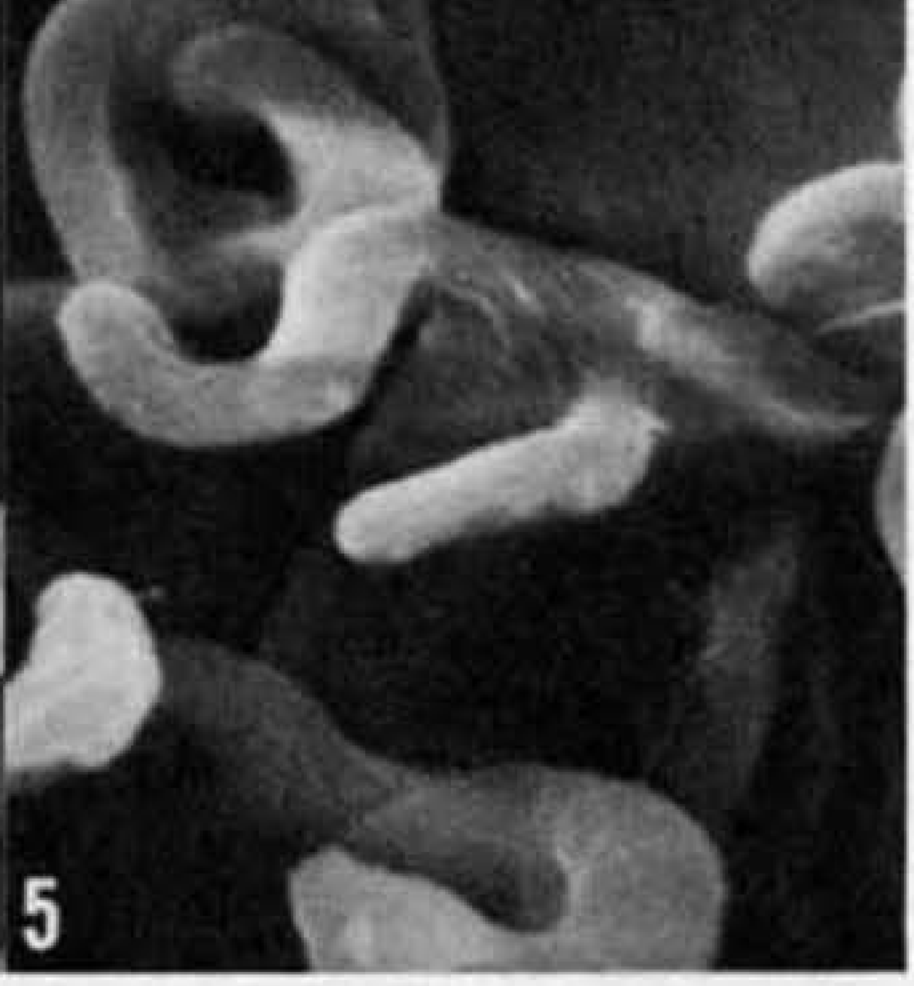
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Following is a key to the known species of MOLLISINOPSIS:

1	Ascospores more than 10 µm long, 1-septate, constricted in the middle	M. aurantiaca
1*	Ascospores shorter than 10 µm, one-celled, not constricted in the middle	2
2	Ascospores 3.5-4.0 x 1.5-2.0 µm, growing on dead, fallen leaves and culms of grasses	M. indica (Cf. ARENDHOLZ & R. SHARMA 1983)
2*	Ascospores 5.5-7 x 1-1.5 µm, growing on dead fern stipes	M. filicis (Cf. ARENDHOLZ & R. SHARMA 1984)

HYALOSCYPHA UNCINATA Arendholz & R. Sharma sp. nov.

FIGS. Plate 2: Fig. 1-4, 6; Plate 3: Fig. 5, 7

Apothecia gregaria, parva, mollia,sessilia, plana ad convexa, ad 1 mm diam. Receptaculum albidum, subtiliter villosum, pili uncinati, simplices ad furcati ad apicem, ad 30 x 3 µm. Hymenium concolorum cum receptaculo, in sicco umbrinum ad ochraceum. Ectal excipulum ex textura prismatica, excipulum medullatum ex textura intricata. Asci octospori, e uncis nati, 55-65 x 7-7.5 µm, clavati-cylindrici, apex rotundus, poro jodo caerulescente. Ascosporae hyalinae, 8.5-12 x 2-3 µm, ellipsoideae, biguttulatae, oblique uniseriatae ad irregulariter biseriatae. Paraphyses hyalinae, filiformes, ramosae, septatae, ad 3 µm latae, ascos ad 15 µm superantes. Holotypus. - In superficiebus ambabus foliourum emortuorum.

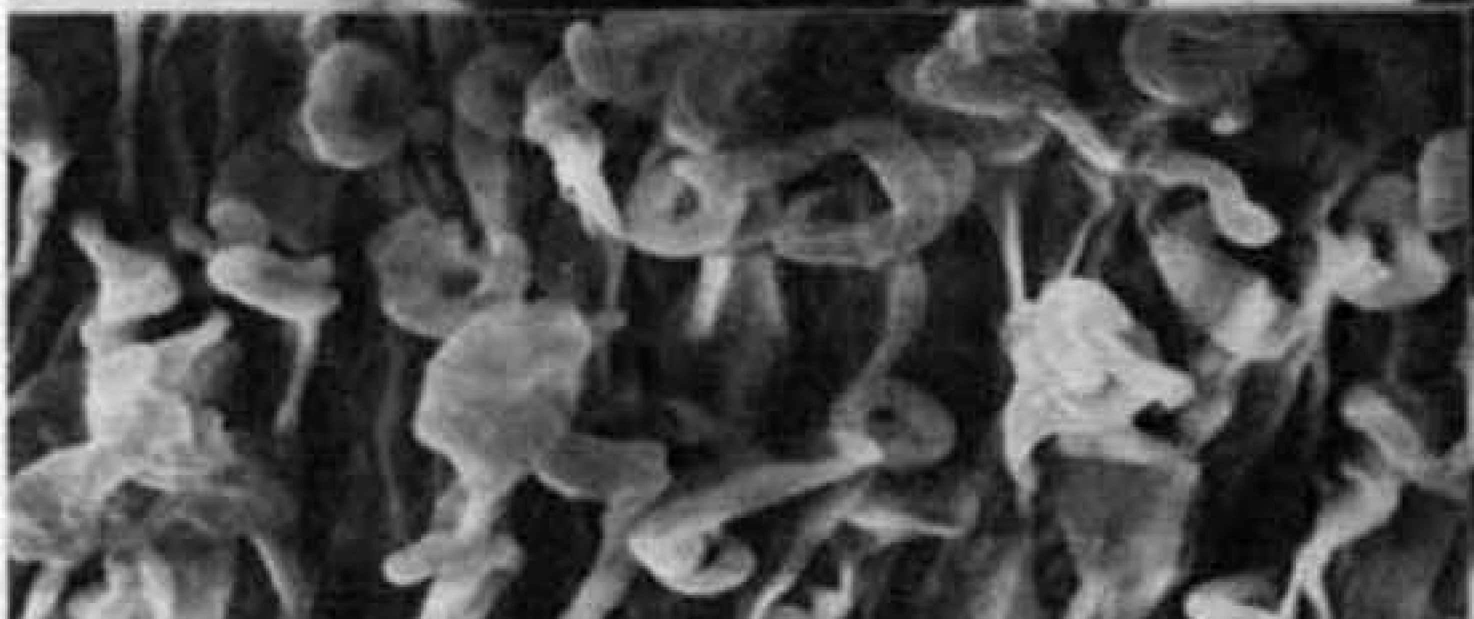
Plate 2

HYALOSCYPHA UNCINATA Arendholz & R. Sharma sp. nov.; PAN 17833: Fig. 1-4. 6; MOLLISINOPSIS AURANTIACA Arendholz & R. Sharma sp. nov.; PAN 24083: Fig. 5

Fig. 1: LS showing part of the excipulum at the margin; 1000 x, BF.
Fig. 2: ditto; 1000 x, DIC.
Fig. 3: Hairs of the ectal excipulum; SEM picture, 1500 x.
Fig. 4: Some hairs, showing "hooks"; SEM picture, 5400 x.
Fig. 5: A group of apothecia as seen under the stereo-microscope; 47 x.
Fig. 6: Two asci, one with ascospores. Note the apical apparatus and the oil drops in the spores (arrows); 1000 x, DIC.
(photos: W.R. Arendholz)


1


2

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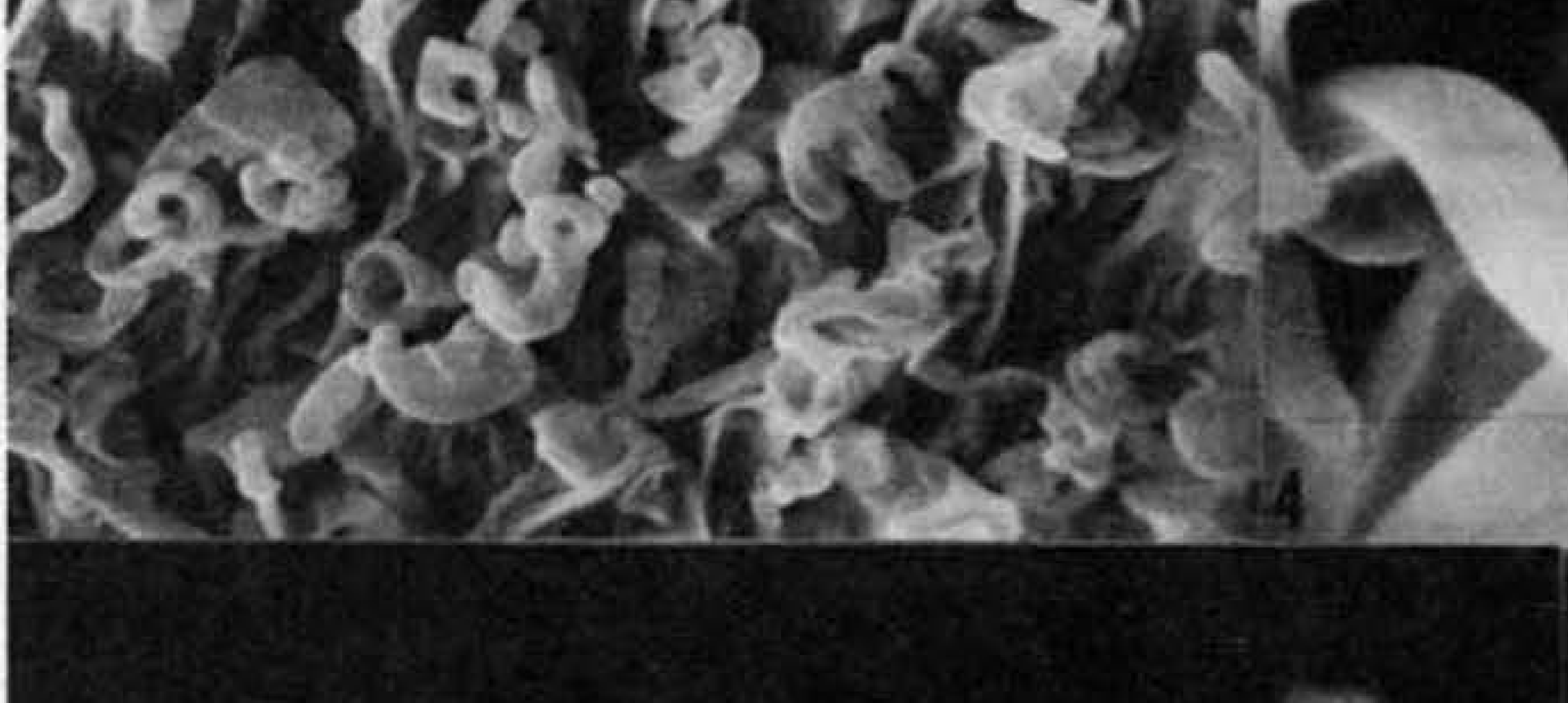
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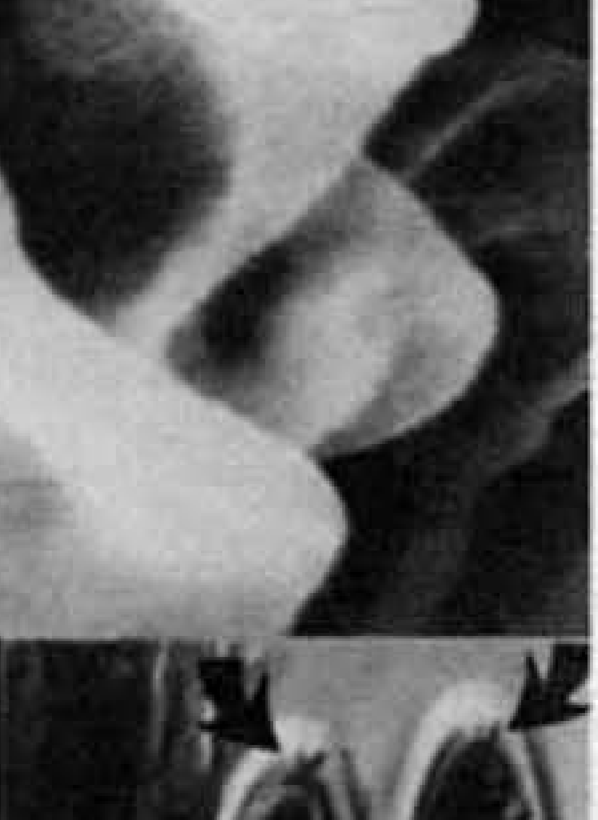
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Holotypus. - In superficiebus ambabus foliorum emortuorum angiospermorum, Bomdila, West Kameng, Arunachal Pradesh, August 23, 1981, Raghunandan Sharma, 17833 (PAN).

Apothecia gregarious, superficial, soft whitish, sessile, plane to convex, up to 1 mm in diameter, minutely downy. Hymenium whitish, drying umber to ochraceous.

Ectal excipulum of textura prismatica, cells hyaline, thin-walled, up to 11 x 5 µm, the outermost cells drawn out into smooth, thin-walled hairs. Hairs strongly curved at the tips, like a hook, simple to forked at the apices, the forked apices may point upwards or curve downwards, up to 30 x 3 µm long.

Medullary excipulum of textura intricata, hyphae hyaline, thin-walled, septate, compactly arranged, cells up to 14 x 2 µm.

Asci 8-spored, J+, 55-65 x 7-7.5 µm, clavate-cylindric, apex round, base flat, arising from croziers.

Ascospores hyaline, ellipsoid, biguttulate, 8.5-12 x 2-3 µm, obliquely uniseriate to irregularly biseriate.

Paraphyses hyaline, filiform, branched, septate, up to 3 µm wide at the top, projecting up to 15 µm beyond the tips of the asci.

Etymology of the specific epithet. - Refers to the hooked hairs.

Habitat. - On both sides of dead fallen angiosperm leaves.

Type locality. - Bomdila, West Kameng, Arunachal Pradesh.

Holotype. - August 23, 1981, Raghunandan Sharma, PAN 17833, isotype in the junior author's personal herbarium (W.R.A. 1984-1024).

NOTES. - With some hesitation we classify this specimen in HYALOSCYPHA, although many characters (excipulum, basic hair character, etc.) speak well for this classification, except for the rarely irregularly branched tips of the hairs.
This character recalls some affinity with the hair character of DENOROTRICHOSCYPHA (SVRCEK 1977). Possibly both these genera can be united, if we understood HYALOSCYPHA better. On the other hand, the hooked tips suggest a classification with HAMATOCANTHOSCYPHA (SVRCEK 1977; UNCINIELLA K. et L. HOLM 1977), but in this genus the excipulum is more of a textura angularis and the base of the hairs is not swollen.

HYALOSCYPHA HIMALAYENSIS Arendholz & R. Sharma sp. nov.

FIGS. Plate 3: Fig. 1-4. 6-6a, Plate 4: Fig. 1-6

Apothecia gregaria, mollia, sessilia, cupulata, ad 0.5 mm diam.. Receptaculum album, in sicco bubalinum, minute villosum, pili varie curvati ad circinati, ad 11 x 2 µm. Hymenium concolorum cum receptaculo. Excipulum ectalum ex textura prismatica ad textura angularis. Asci octospori, 15-25 x 5-6 µm, clavati, apex rotundus, poro jodo caerulescente. Ascosporae hyalinae, fusoideae, 5.5-8 x 0.8-1.5-(2.0) µm, in gelatina inclusae, irregulariter biseriatae. Paraphyses hyalinae, simplices, septatae, ad 2.5 µm latae, ascos parce superantes.

Holotypus. - In superficiebus ambabus foloiorum emortuorum caducorumque, Bunakha apud Chimakothi, Bhutan, July 29, 1981, Raghunandan Sharma, 17694 (PAN).

Apothecia gregarious, soft, sessile, cupulate, white, drying buff, up to 0.5 mm in diam., minutely downy. Ectal excipulum of textura prismatica to textura angularis, up to 10 µm thick.

The brick shaped, thin-walled excipular cells (up to 7 x 2 µm) are drawn out, especially at the margin, into small, variously curved to circinate, smooth and thin-walled hairs, up to 11 x 2-(3) µm long.

Medullary excipulum a rather loose textura intricata.

Asci 8-spored, J+, 15-20-(25) x 5-6 µm, clavate, apex round, base small, flat.

Ascospores hyaline, fusoid, 5.5-8 x 0.8-1.5-(2.0) µm, irregularly biseriate; spores embedded in a gelatinous sheath 0.8-1.3 µm thick, which is particularly visible in free ascospores.

Paraphyses filiform, hyaline, simple, septate, up to 2.5 µm wide at the top, slightly projecting beyond the tips of the asci.

Etymology of the specific epithet. - Refers to the locality, where the specimen was collected.

Habitat. - On both surfaces of dead fallen angiosperm leaves.

Type locality. - Bunakha, near Chimakothi, Bhutan.

Holotype. - July 29, 1981, Raghunandan Sharma, PAN 17694; isotype in the junior author's personal herbarium (W.R.A. 1984-1026); paratype Chimakothi, July 27, 1981, Raghunandan Sharma, PAN 17653; W.R.A. 1984-1027.

NOTES. - Hyaloscypha himalayensis somewhat resembles Hyaloscypha lachnobrachya (Desm.) Nannf.; the type of that was studied by one of us in a previous study (ARENDHOLZ 1979). This species grows on dead leaves of deciduous trees (e.g. Acer, Betula, Quercus), too, but has asci nearly twice as large (30-40 x 5-6 µm) with four ascospores (9-13 x 1.5-2.5 µm), which have no gelatinous sheath.

There is another collection (PAN 17653, cf. plate 4, Fig. 1-5) which has somewhat larger asci (up to 25 µm) and the ascospores are sometimes up to 2.0 broad. The hymenium is more or less flat rather than convex as in the type collection. Otherwise the remaining characters are identical (incl. the gelatinous sheath of the ascospores), so that we consider both these specimens conspecific. A statistical analysis (F- and t-test) corroborates this decision.

Following is a key to determine the species of HYALOSCYPHA known from the Indian subcontinent:

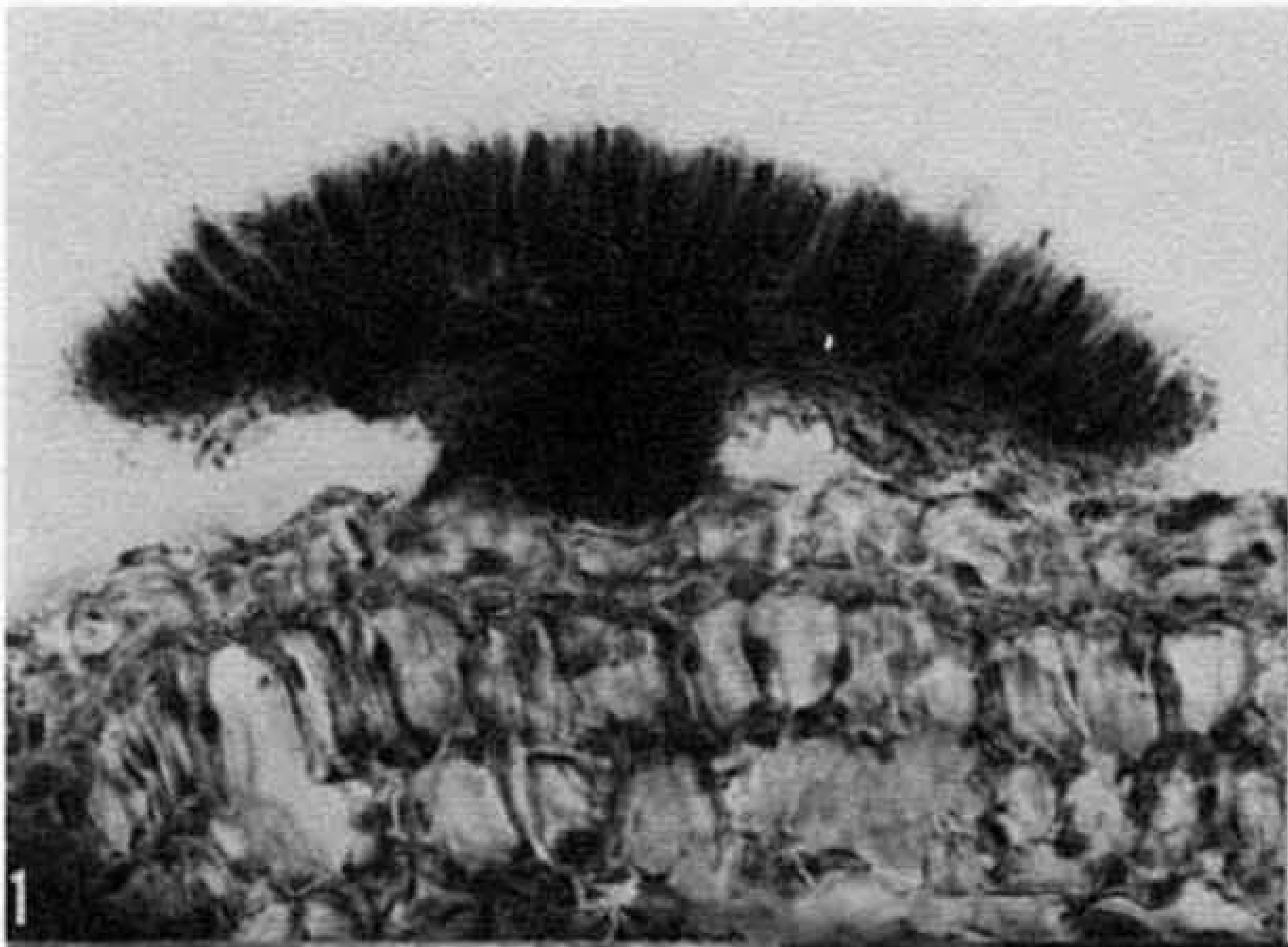
1.	Apothecia growing on fallen leaves of deciduous trees	2
1*.	Apothecia not growing on fallen leaves of deciduous trees	3
2.	Asci >30 µm, ascospores >8 µm	H. uncinata
2*.	Asci <30 µm, ascospores <8 µm	H. himalayensis
3.	Apothecia growing on dead fallen grass leaves, asci J-	H. pusilla

(Cf. ARENDHOLZ & R. SHARMA 1983)

Plate 3

HYALOSCYPHA HIMALAYENSIS Arendholz & R. Sharma sp. nov.; PAN 17694: Fig. 1-4, 6-6a; PAN 17833: Fig. 5, 7.

Fig. 1: LS showing apothecium; 400 x, BF.
Fig. 2: LS showing margin and part of the hymenium; 1000 x DIC.
Fig. 3: Part of the margin; SEM picture, 2800 x.
Fig. 4: Part of the ectal excipulum; SEM picture, 2800 x.
Fig. 5: Group of apothecia seen under the stereomicroscope; 40 x.
Fig. 6, 6a: Two apothecia, top view, seen under the stereomicroscope; 63 x, 40 x, respectively.
Fig. 7: Apothecium, top view, seen under the stereomicroscope; 63 x.
(photos: W.R. Arendholz)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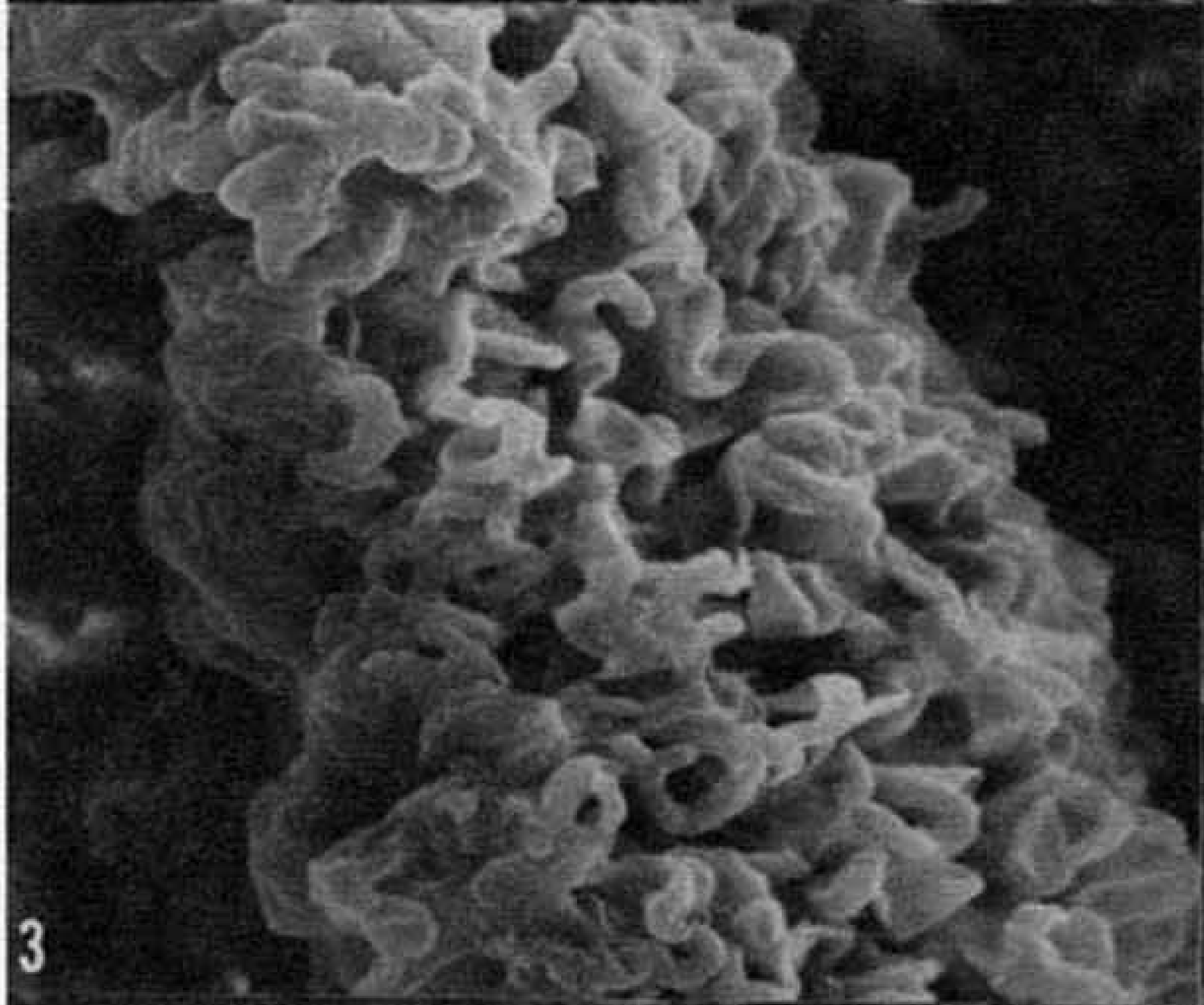
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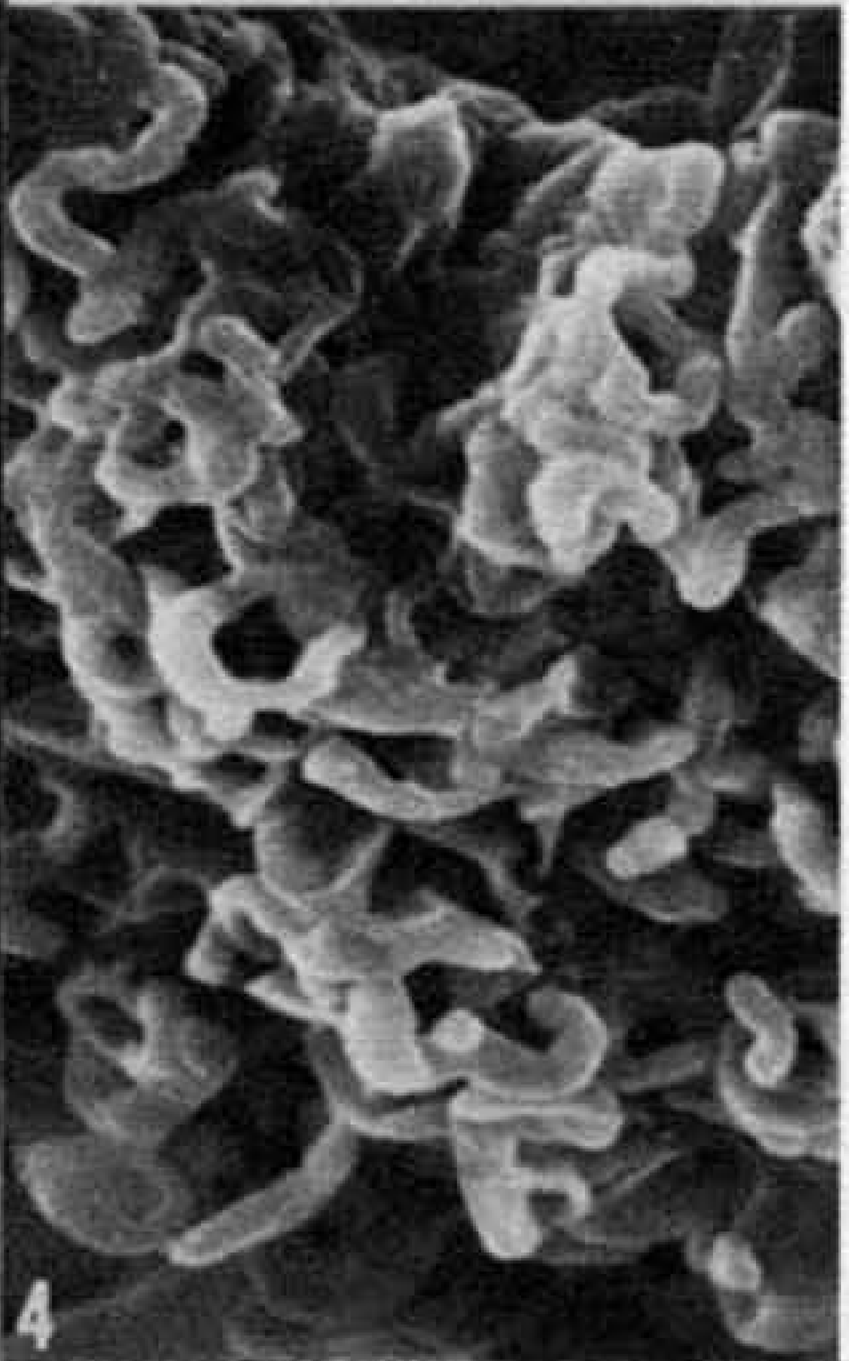
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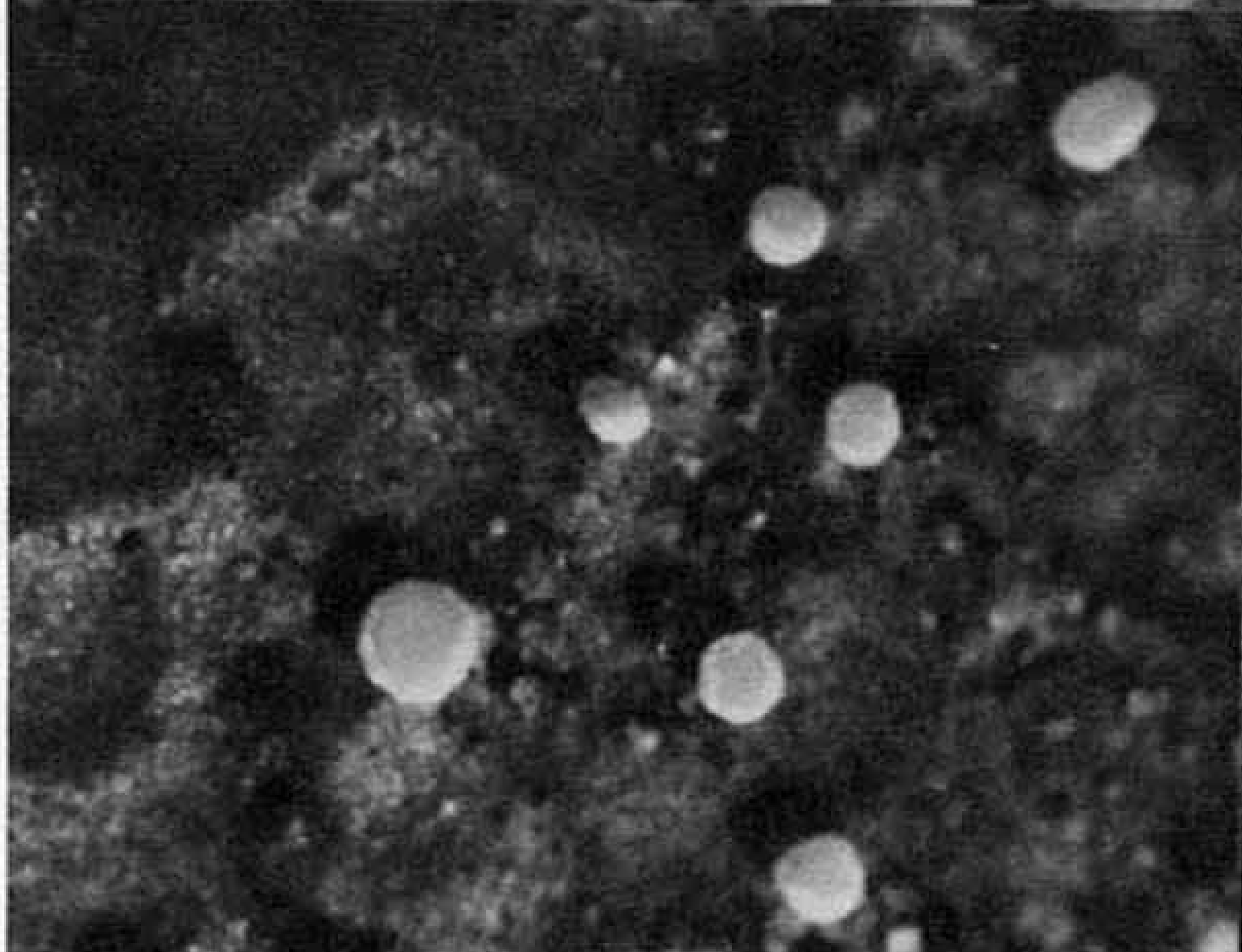
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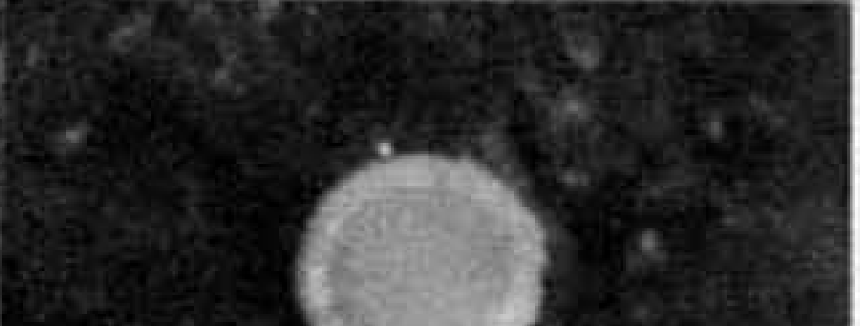
6a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3*. Apothecia not growing on dead fallen grass leaves, asci J+ or J-

4\. Apothecia up to 0.15 mm in diam., asci J+, ascospores ± allantoid, 5.5-11.5 x 1.5-2.5 µm ..... H. parvula
(Cf. ARENDHOLZ & R. SHARMA 1983)

4*. Apothecia up to 0.68 mm in diam., asci J-, ascospores elliptic-fusiform, 6-9 x 1.6-2.6 µm ..... H. cf. stevensonii
(Cf. THIND & SAINI 1967)

DENDROTRICHOSCYPHA TETRASPORA Arendholz & R. Sharma sp. nov.

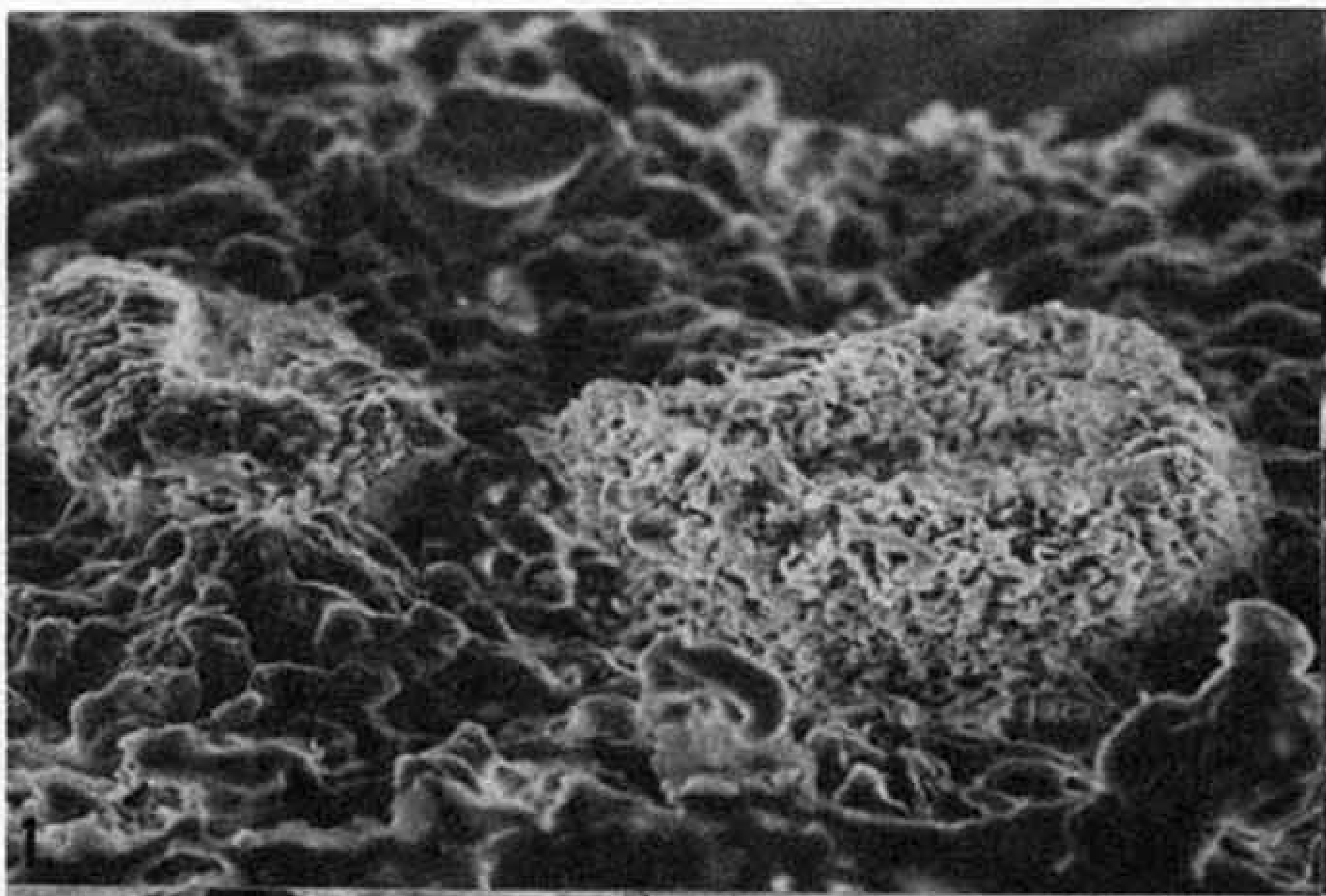
FIGS.: Plate 5: Fig. 1-7

Apothecia gregaria, sessilia, cupulata ad plana, ad 1 mm diam. Receptaculum album, in sicco ± bubalinum, subtiliter villosum, pili curvati, uncinati, ad 15 x 3 µm. Excipulum ectalum ex textura prismatica, excipulum medullatum ex textura intricata. Asci tetraspori, e uncis nati, 23-30 x 5 - 5.5 µm, clavati-cylindrici, poro jodo caerulescente.
Ascosporae hyalinae, 5.5-9 x 1.5-2 µm, elongatae ellipsoideae, biguttulatae, eseptatae, bilatae, ascos ad 10 µm superantes.
Holotypus. - In foliis caducis monocotyledonis, 5 km a Jamiri ad Nachephu, West Kameng, Arunachal Pradesh, September 12, 1981, R. Sharma, 24049 (PAN).

Plate 4

HYALOSCYPHA HIMALAYENSIS Arendholz & R. Sharma sp. nov.; PAN 17653: Fig. 1-5; PAN 17694: Fig. 6.

Fig. 1: Two apothecia, SEM picture, 400 x.
Fig. 2, 2a: Apothecia seen under the stereomicroscope, side view, top view, respectively; 63 x.
Fig. 3: Hairs of the ectal excipulum; SEM picture, 2800 x.
Fig. 4: LS of an apothecium, note the hooked hairs (arrows); 400 x, DIC.
Fig. 5: LS; part of the margin, excipulum and hymenium; 1000 x, DIC.
Fig. 6: Apothecium; SEM picture, 400 x.
(photos: W.R. Arendholz)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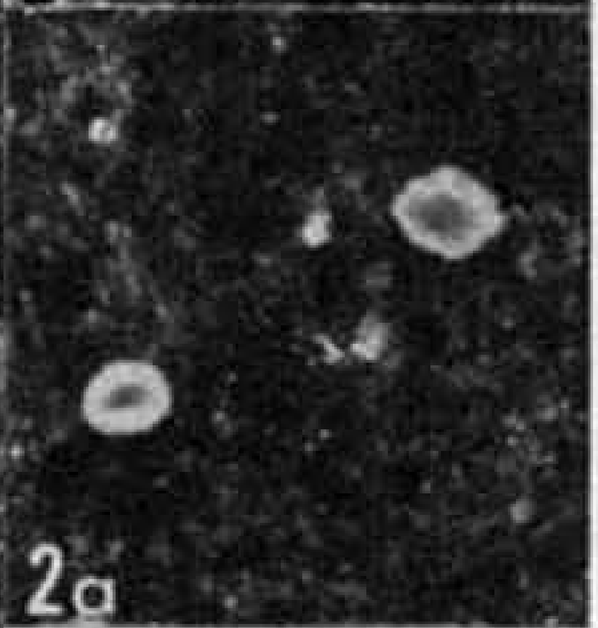
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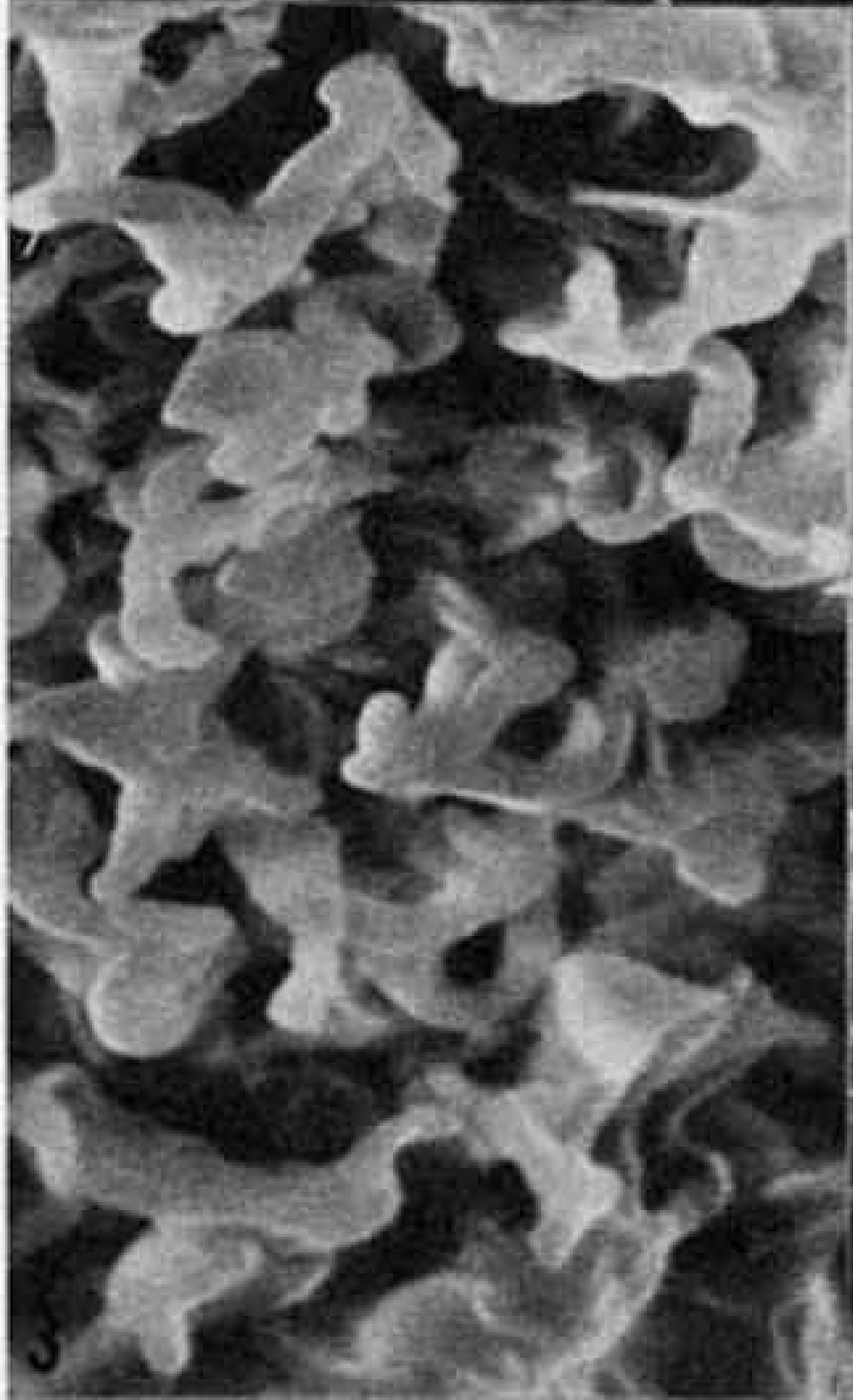
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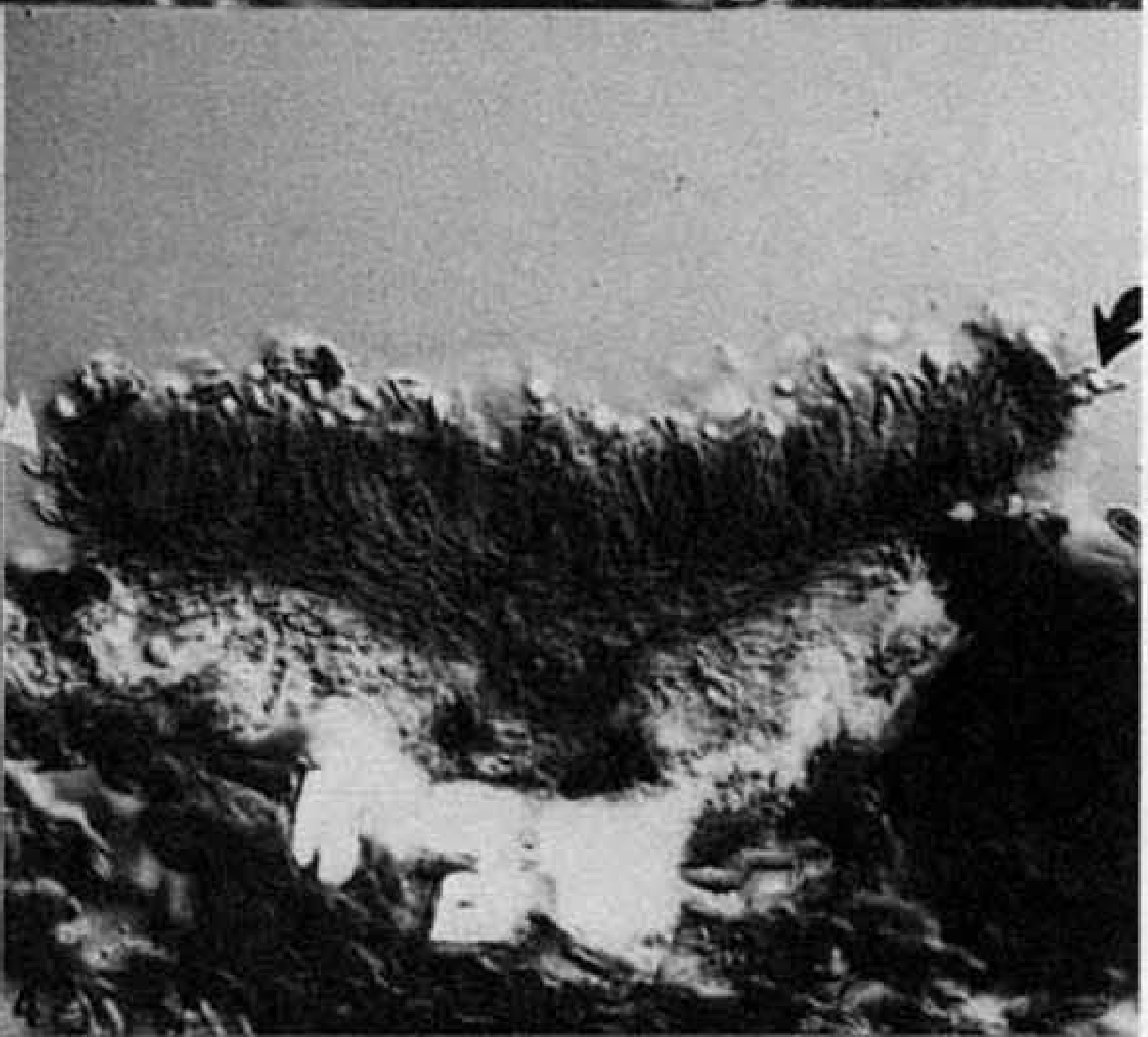

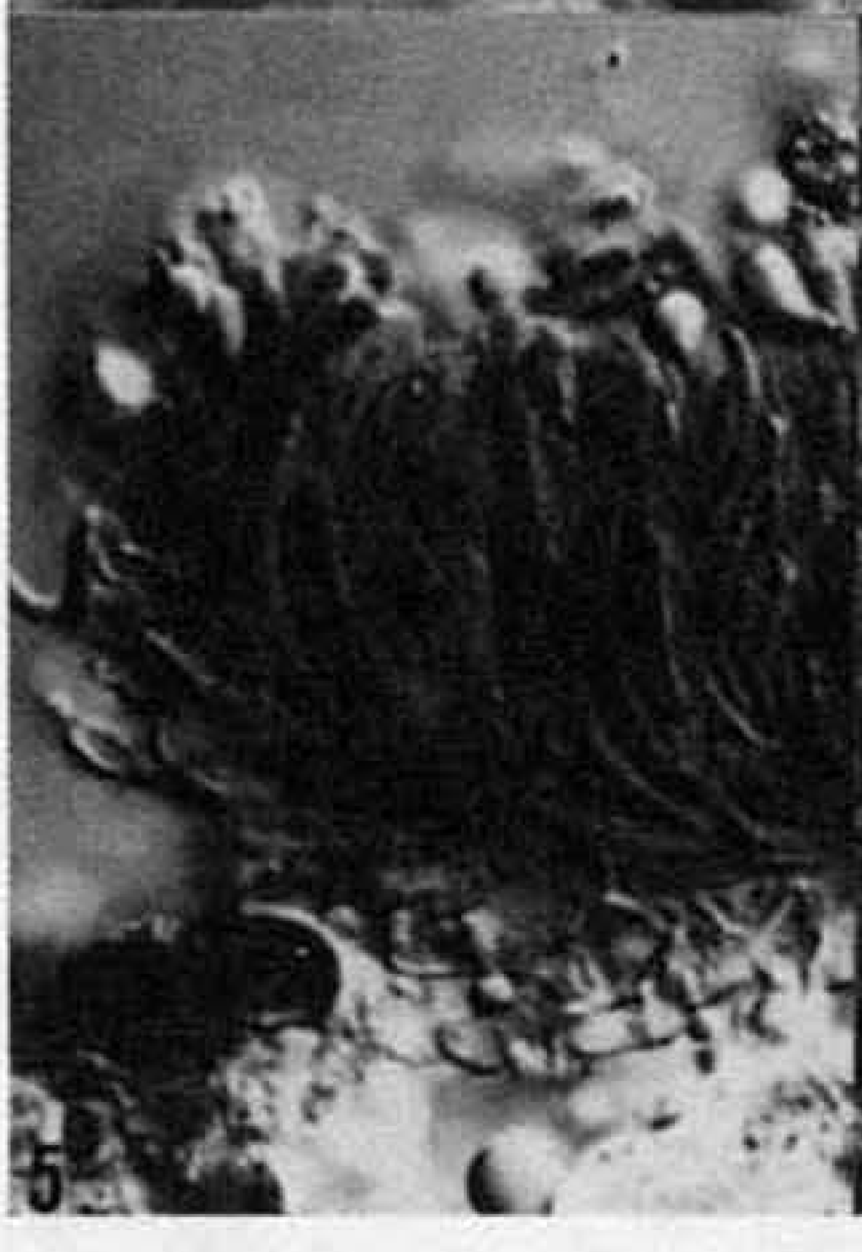
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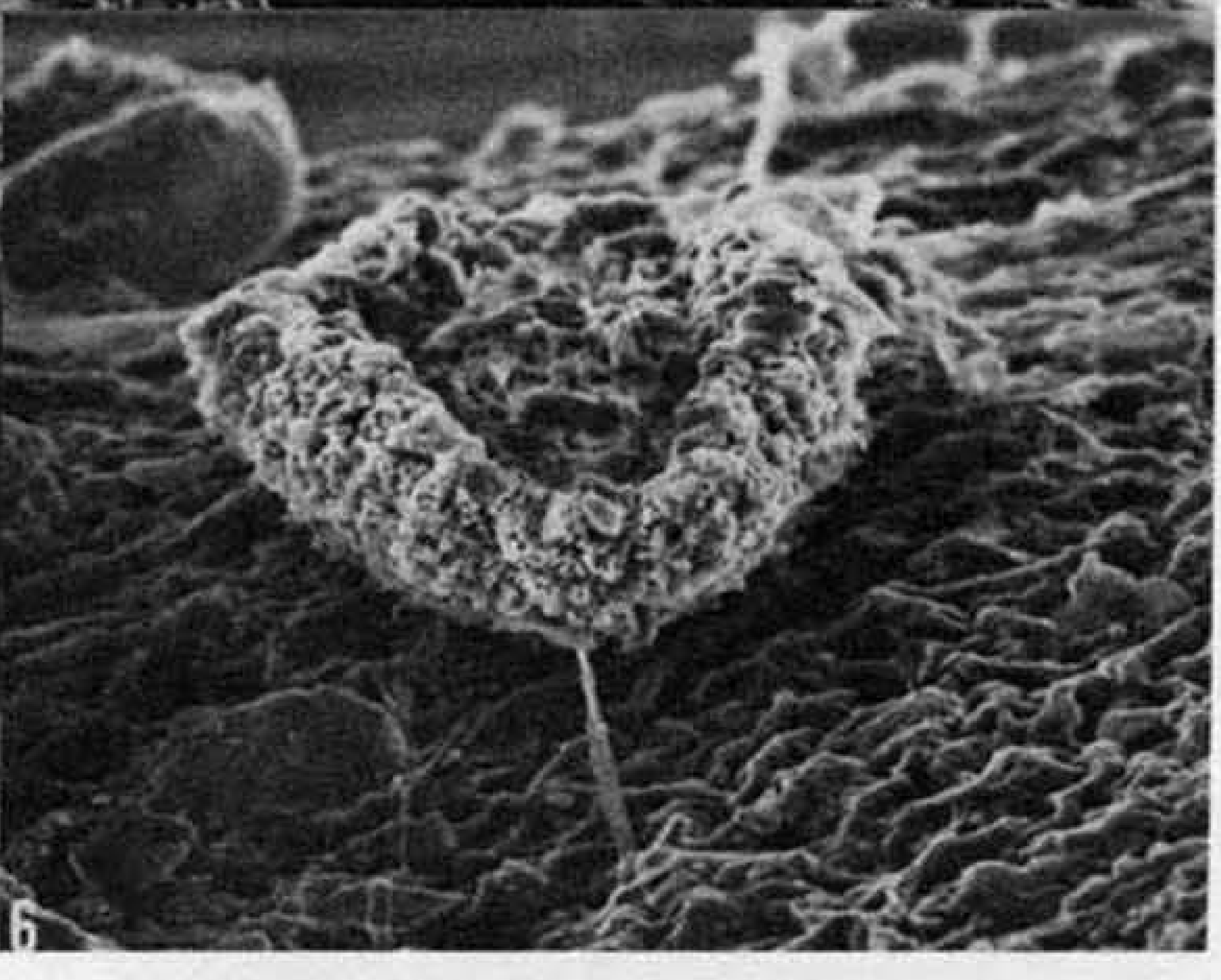
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Apothecia scattered, sessile, shallow cupulate to plane, white, drying whitish buff, up to 1 mm in diameter, minutely downy.

Ectal excipulum of textura prismatica, the brick-shaped, thin-walled, hyaline excipular cells up to 8 x 3 µm. Hairs thin-walled, smooth, irregularly branched, hooked, especially at the margin, up to 15 x 3 µm.

Medullary excipulum of textura intricata.

Asci 4-spored, J+, 23-30 x 5-5.5 µm, clavate-cylindric, apex round, base small, stem-like, arising from croziers.

Ascospores hyaline, elongate-ellipsoid, 5.5-9 x 1.5-2 µm, biguttulate, non-septate, biseriate.

Paraphyses filiform, simple, septate, up to 1.5 µm wide at the top, projecting up to 10 µm beyond the tips of the asci.

Etymology of the specific epithet. - Refers to the number of the ascospores in the asci.

Habitat. - On fallen monocotyledonous leaves.

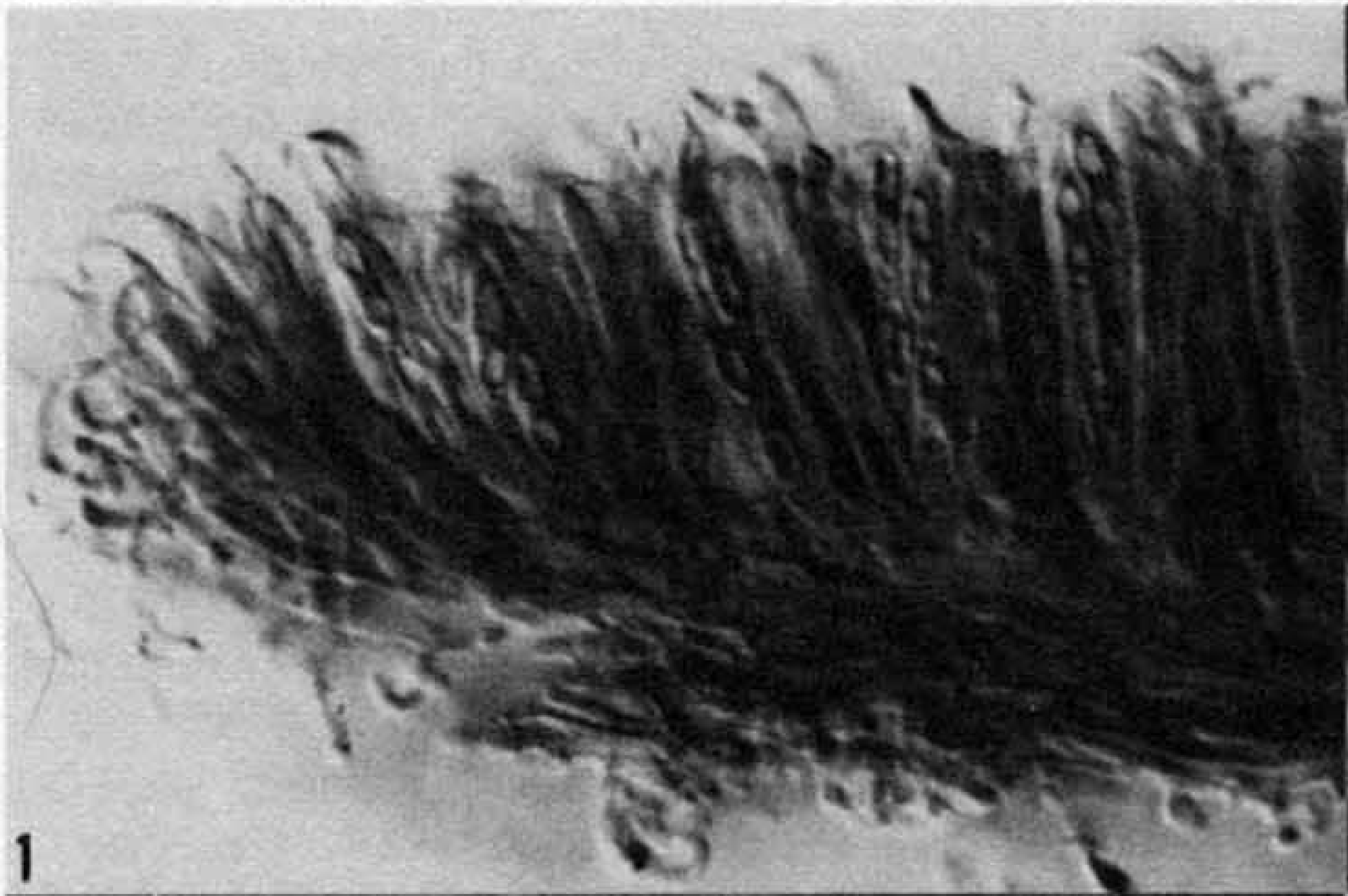
Type locality. - 5 km from Jamiri towards Nachephu, West Kameng, Arunachal Pradesh.

Holotype. - September 12, 1981, Raghunandan Sharma, PAN 24049; paratypes on dead and decaying angiosperm stem, Jamiri, West Kameng, Arunachal Pradesh, September 12, 1981, Raghunandan Sharma, PAN 24043, and in the junior author's personal herbarium (W.R.A. 1984-1022, 1984-1023).

Plate 5

DENDROTRICHOSCYPHA TETRASPORA Arendholz & R. Sharma sp. nov.; PAN 24049.

Fig. 1: LS showing margin with hooked hairs, part of the ectal excipulum and hymenium; 1000 x, DIC.
Fig. 2; 2a: Apothecia seen under the stereomicroscope, top view, side view, respectively; 47 x.
Fig. 3: Apothecium showing downy excipulum; SEM picture, 400 x.
Fig. 4: LS showing part of the hymenium with some lanceolate paraphyses; 1000 x, DIC.
Fig. 5; 6: Hairs of the ectal excipulum and at the margin, note the branches of the hairs (arrows); SEM pictures, 4000 x.
Fig. 7: LS showing part of the hymenium, of the excipulum and some hairs; 630 x, DIC.
(photos: W.R. Arendholz)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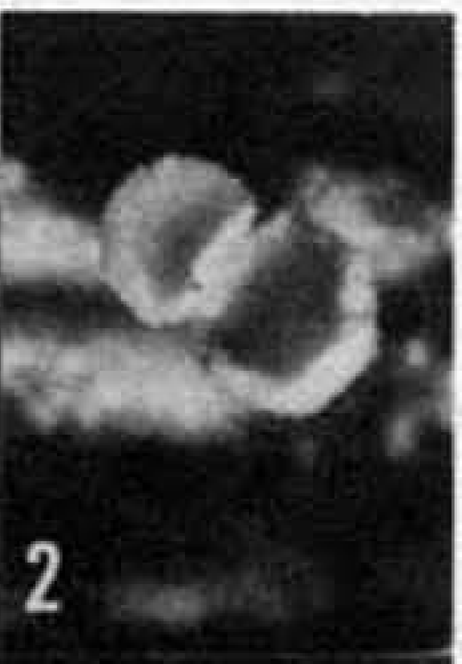
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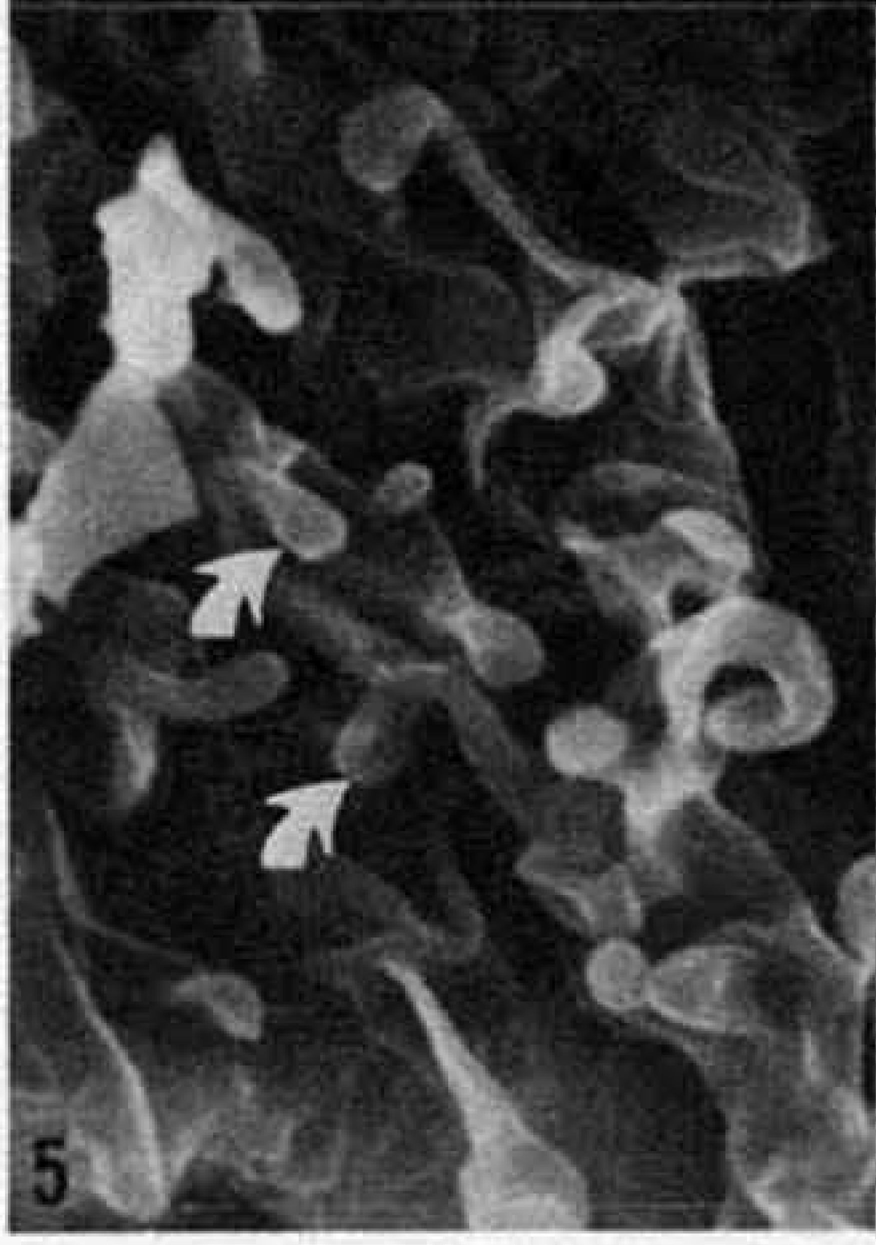
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NOTES. - Dendrotrichoscypha tetraspora shows some resemblance to Mollisina uncinata Arendholz & R. Sharma (ARENDHOLZ & R. SHARMA 1984), but in this species the apothecia are smaller (0.4 mm in diam.), and the asci and ascospores are larger (40-55 x 7-7.5, 12-16.5 x 1.5-2 µm, respectively). Whether the Chalara anamorph belongs to the Mollisina species or whether it is a parasitic hyphomycete of the Chalara-type "which is not unfrequently found in small Discomycetes" (HOLM 1977, p. 18) has to be proven by culture studies.

Our species differs from the generic type (Dendrotrichoscypha acanthopila Svrcek) by its larger apothecia, the smaller, J+ asci and the four, biguttulate ascospores.

As we stated earlier (ARENDHOLZ & R. SHARMA 1984), possibly DENDROTRICHOSCYPHA and MOLLISINA can be united, for TEM studies by one of us (ARENDHOLZ in preparation) reveal, that the hyphal processes of MOLLISINA do have a cell-lumen, as already indicated by light microscopy studies (cf. ARENDHOLZ & R. SHARMA 1984, p. 658 and p. 661 figs. 5a and 5b).

DEBARYOSCYPHUS ARENDHOLZ & R. SHARMA gen. nov.

Genus familiae Leotiaceae (Helotiales), apothecia breviter stipitata, stipes basi ater. Receptaculum minute pubescens, pili longi, hyalini, laeves et leptodermi, e- ad uniseptati, ad apicem curvati. Excipulum ectalum ex textura porrecta ad textura intricata. Excipulum medullatum ex textura intricata. Asci octospori, e uncis nati, clavati-cylindrici, poro jodo caerulescente. Ascosporea hyalinae, continuae, ellipsoideae, parvae. Paraphyses filiformes, ascos parce superantes.

Species typica generis: DEBARYOSCYPHUS MELANOBASIS Arendholz & R. Sharma sp. nov.

Etymology of the generic name. - In honour of the great German mycologist (and botanist) Anton de Bary (1831-1888).

DEBARYOSCYPHUS MELANOBASIS Arendholz & R. Sharma sp. nov.

FIGS. Plate 6: Fig. 1-6

Apothecia dense gregaria, mollia, breviter stipitata, stipes ad 0.2 x 0.1 mm, basis ater; cupulata, ad 1 mm diam. et ad 0.5 mm alta. Receptaculum aureum, in sicco bubalinum ad ochraceum, minute pubescens, pili longi, hyalini, e- ad

uniseptati, ad apicem curvati, ad 20 x 5 µm. *__Hymenium__ concolorum cum receptaculo.* *__Asci__ octospori, 30-40 x 5-6 µm, clavati-cylindrici, apex rotundus, poro jodo caerulescente.* *__Ascosporae__ hyalinae, ellipsoideae ad late ellipsoideae, biguttulatae, 3.5-6.5 x 1.5-3 µm, uniseriatae ad irregulariter biseriatae.* *__Paraphyses__ filiformes, simplices, septatae, ad 2 µm latae, ascos parce superantes.*
Holotypus. - In cortice angiospermo, Nawephu, Thimphu, Bhutan, September 26, 1980, R. Sharma, 17590 (PAN).

Apothecia densely gregarious, soft, stalked, stipe up to 0.2 x 0.1 mm, black at the base; cupulate, up to 1 mm in diameter and up to 0.5 mm in total height. Receptacle bright yellow, drying buff to ochraceous, minutely downy, hairs hyaline, smooth and thin-walled, up to 20 x 5 µm, one- to two-celled, curved at the apices.

Ectal excipulum of textura porrecta to textura intricata.

Medullary excipulum of textura intricata.

Asci 8-spored, J+, 30-40 x 5-6 µm, clavate cylindric, apex round, base small, flat.

Ascospores hyaline, ellipsoid to broadly ellipsoid, biguttulate, 3.5-6.5 x 1.5-3 µm, uniseriate to irregularly biseriate.

Paraphyses filiform, simple, septate, up to 2 µm wide at the top, slightly projecting beyond the tips of the asci.

Etymology of the specific epithet. - Refers to the dark base of the stipe.

Habitat. - On bark of some angiosperm.

Type locality. - Nawephu, Thimphu, Bhutan.

Holotype. - September 26, 1980, Raghunandan Sharma, PAN 17590; isotype in the junior author's personal herbarium (W.R.A. 1984-1028).

NOTES. - Debaryoscyphus melanobasis is a very interesting species. Nearly one half of the stipe is built up of dark-walled hyphae, but there is neither a sclerotium nor a substratal stroma. The structure of the ectal and medullary excipulum recalls affinities with HYMENOSCYPHUS, but the hooked hairs, which are not swollen or expanded at their bases are unknown in this genus. On the other hand the anatomical characters of the excipulum do not agree with those in HAMATOCANTHOSCYPHA Svrcek (hooked hairs: = UNCINIELLA Holm & Holm) or HYALOSCYPHA Boud. (straight and ± pointed hairs).

A classification in BISPORELLA or CROCICREAS is out of place, too, although in these genera we find hairs in some species, but these have an ectal excipulum of textura oblita, i.e. the hyphae are embedded in a gelatinous matrix. Due to the above diagnostic characters the erection of the new genus is justified.

UNGUICULELLA EUROTIOIDES (Karst.) Nannf. Trans. Brit. Mycol. Soc. 26: 194 (1936)

FIGS. Plate 7: Fig. 1-6

Apothecia gregarious, small, soft, shallow cupulate, subsessile, up to 0.3 mm in diameter. Receptacle light yellow, drying pale luteous to ochraceous, margin thick inrolled, deep cupulate on drying, minutely downy. Hymenium yellow, turning bright yellow, drying ± ochraceous.

Ectal excipulum of textura intricata to textura angularis, cells up to 5 x 4 µm, outermost cells drawn out into hairs, hairs tapering to fine point, strongly hooked at the apices, up to 30 x 4 µm.

Medullary excipulum of textura intricata, hyaphae septate, up to 3 µm wide.

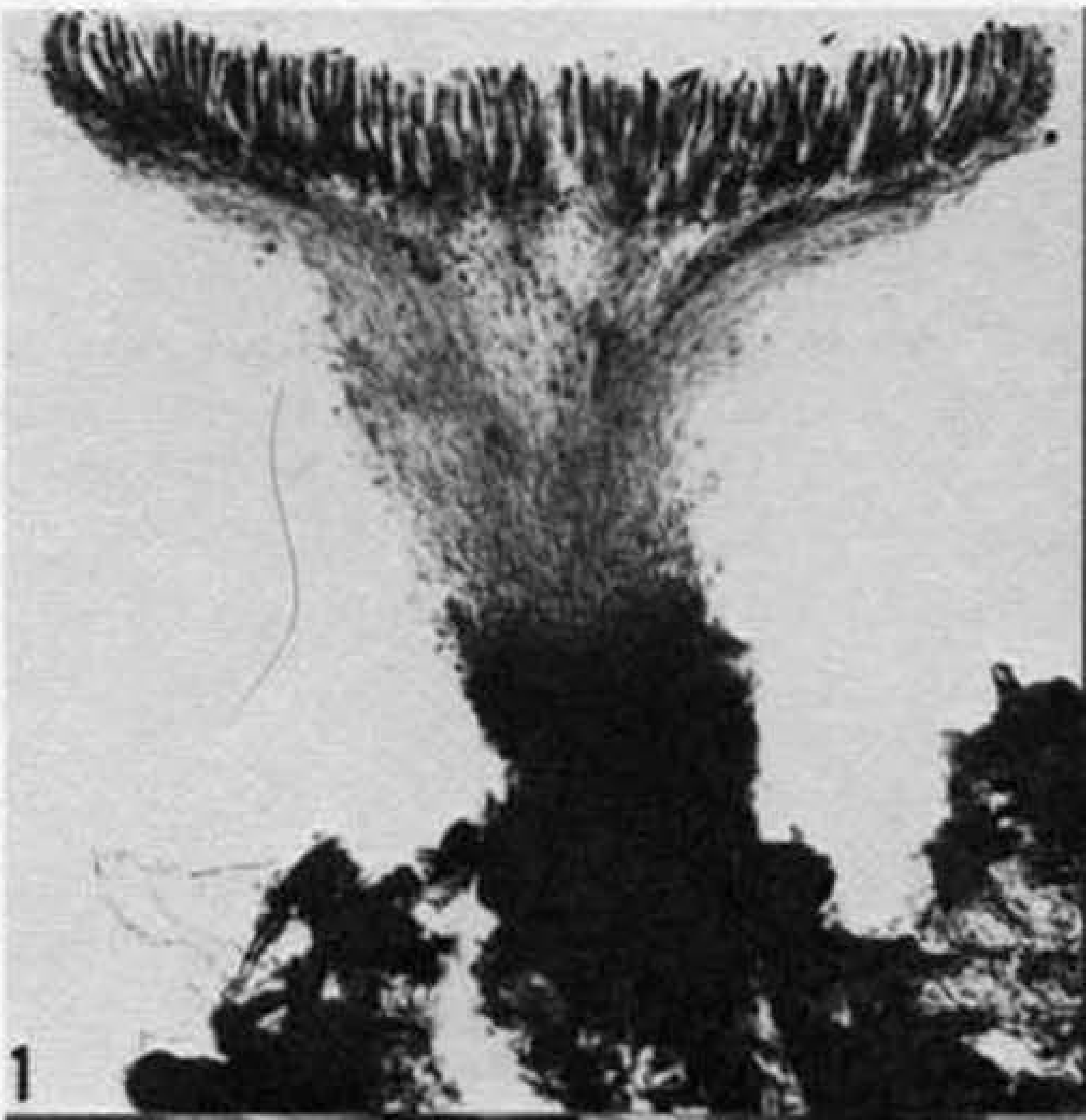
Asci 8-spored, J-, 35-45 x 4-5 µm, clavate-cylindric, apex round, base stem-like, arising from croziers.

Ascospores hyaline, ellipsoid biguttulate, 4-6 x 1.5-2.5 µm, uniseriate to irregularly biseriate.

Plate 6

DEBARYOSCYPHUS MELANOBASIS Arendholz & R. Sharma sp. nov. PAN 17590.

Fig. 1: LS through an apothecium, note the dark stipe base; 160 x, BF.
Fig. 2: Apothecium showing downy excipulum; SEM picture, 280 x.
Fig. 3: Hairs of the excipulum; SEM picture, 3500 x.
Fig. 4: Some apothecia seen under the stereomicroscope, side view; 47 x.
Fig. 5: LS showing part of the margo, excipulum and hymenium, note the hooked hairs (arrows); 400 x, DIC.
Fig. 6: LS, stipe base showing dark-walled hyphae; 1000 x, BF.
(photos: W.R. Arendholz)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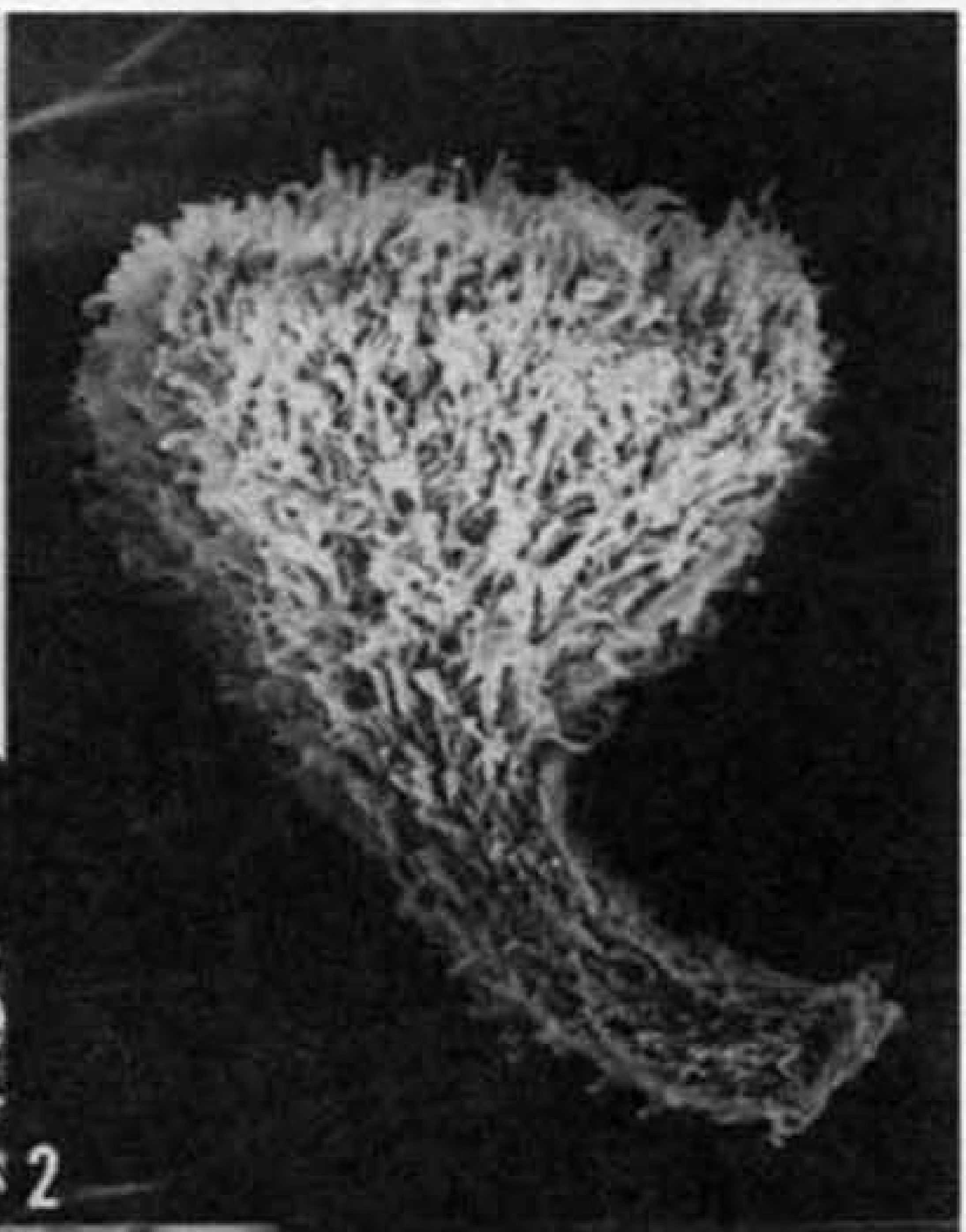
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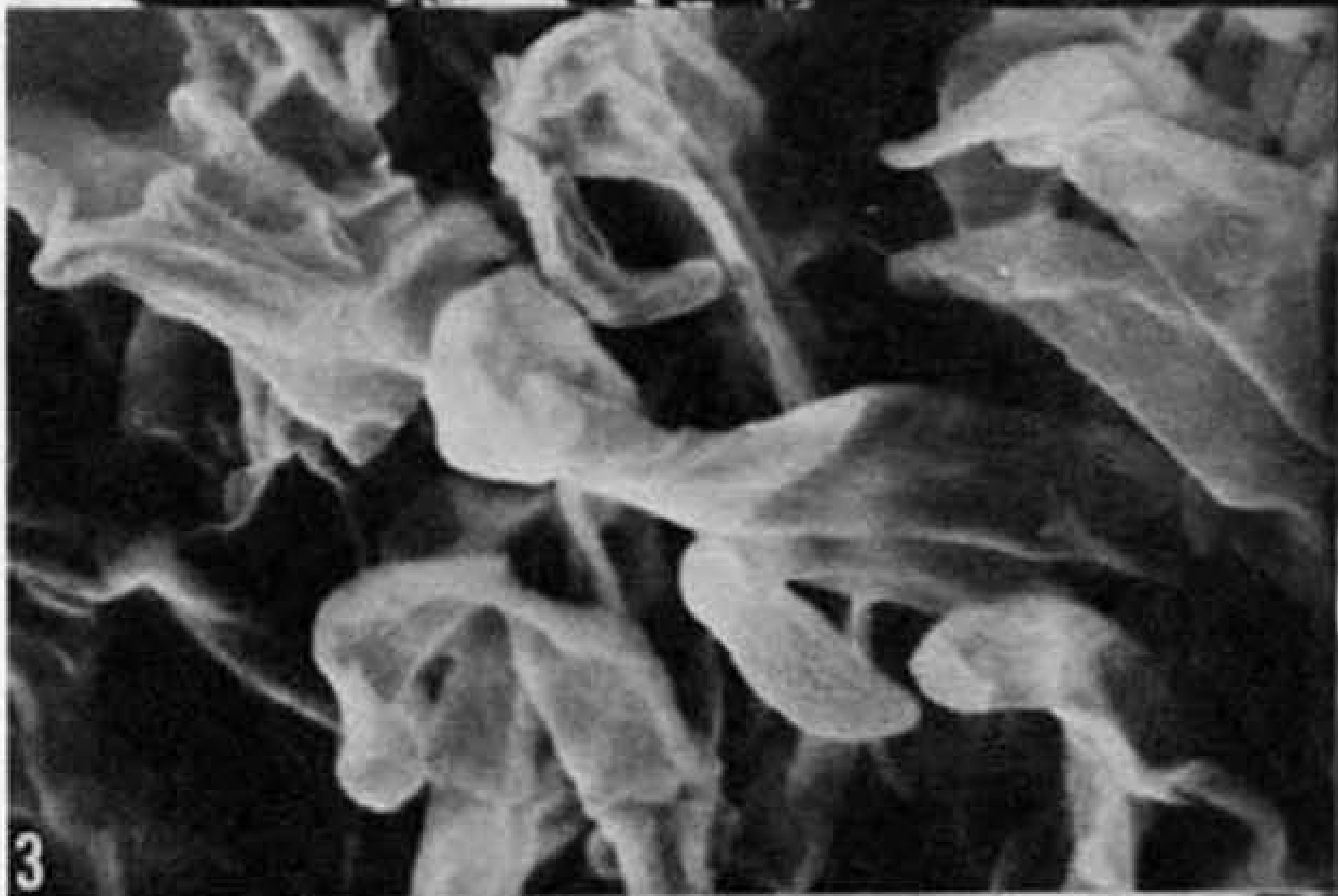
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Paraphyses pale yellow in groups, hyaline individually, filiform, wider at the base (up to 3 µm), strongly hooked at the tips, slightly projecting beyond the tips of the asci.

Habitat. - On dead, shruby angiosperm stem.

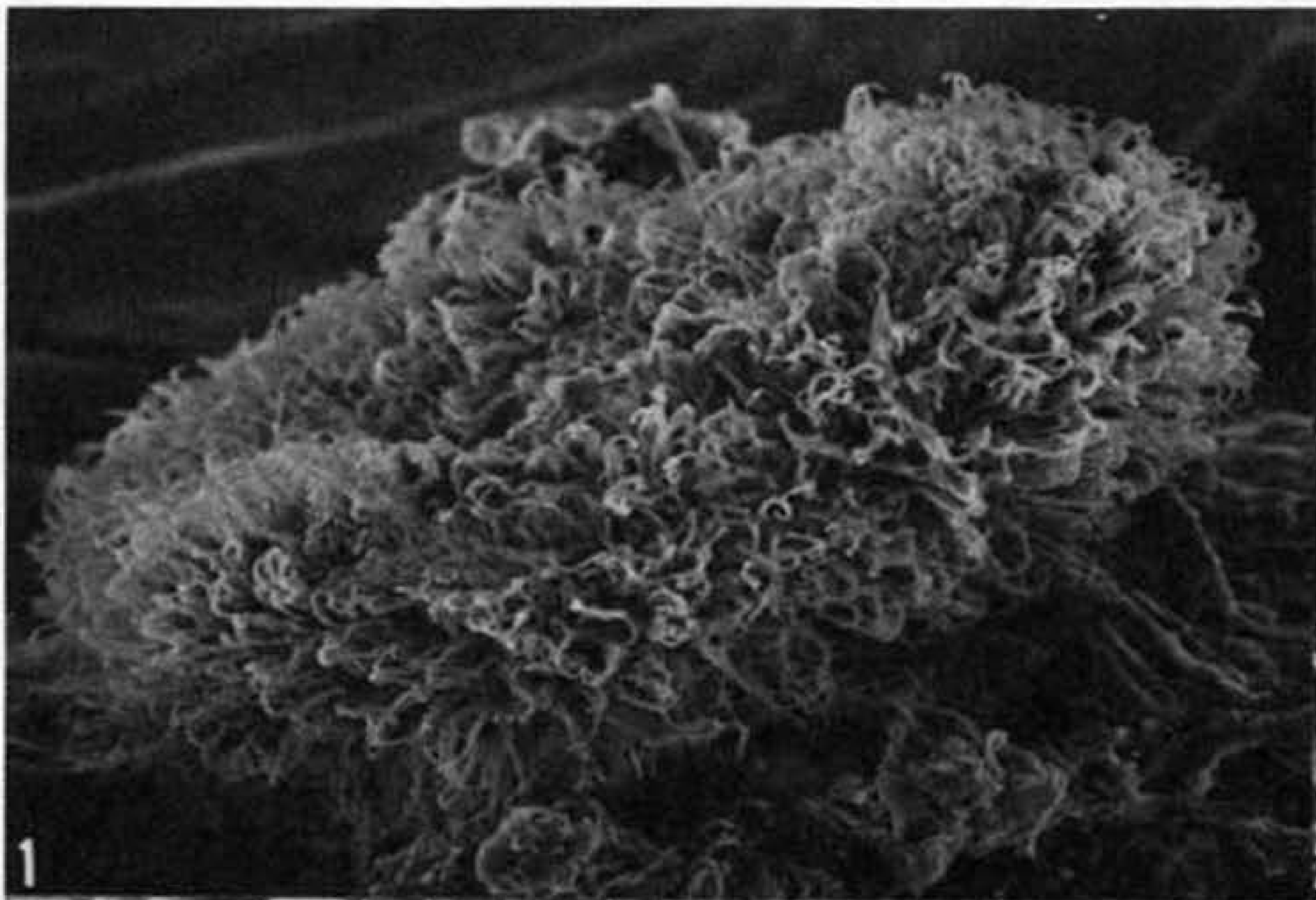
Specimens examined. - 10 km from Bomdila towards Tawang, West Kameng, Arunachal Pradesh, August 27, 1981, Raghunandan Sharma, PAN 17916; part of this collection is also deposited in the junior author's personal herbarium and at NYS. Syntype of Peziza eurotioides Karst., Fungi fenn. 652 (CUP-D 4207).

NOTES. - Our specimen seems to be identical with UNGUICULELLA EUROTIOIDES (Karst.) Nannf., although there are some differences between the Indian and the type specimen (KARSTEN 1869): In the Indian one the hooked hairs show bubbly swellings, both in the light microscope and in the scanning electron microscope. These swellings are absent in the type. Furthermore the walls of the asci of the type are somewhat thicker, but otherwise both the specimens match well with each other.

Plate 7

UNGUICULELLA EUROTIOIDES (Karst.) Nannf.; PAN 17916; Fig. 1-4, 6; Fungi fenn. 652 (CUP-D 4207): Fig. 5, syntype.

Fig. 1: Apothecium showing hairy excipulum, SEM picture; 400 x.
Fig. 2: A group of apothecia seen under the stereomicroscope, 47 x.
Fig. 3: Hairs of the ectalexcipulum, note the "bubbles" on the hairs (arrows); SEM picture, 1500 x.
Fig. 4: LS showing part of the hymenium and excipulum, note the hooked paraphyses (arrow); 630 x, DIC.
Fig. 6: LS, margo with hairs, note the "bubbles" at the hairs (arrow) as shown in the SEM picture above (Fig. 4); 1000 x, DIC.
Fig. 5: LS through an apothecium; 250 x, BF.
(photos: W.R. Arendholz)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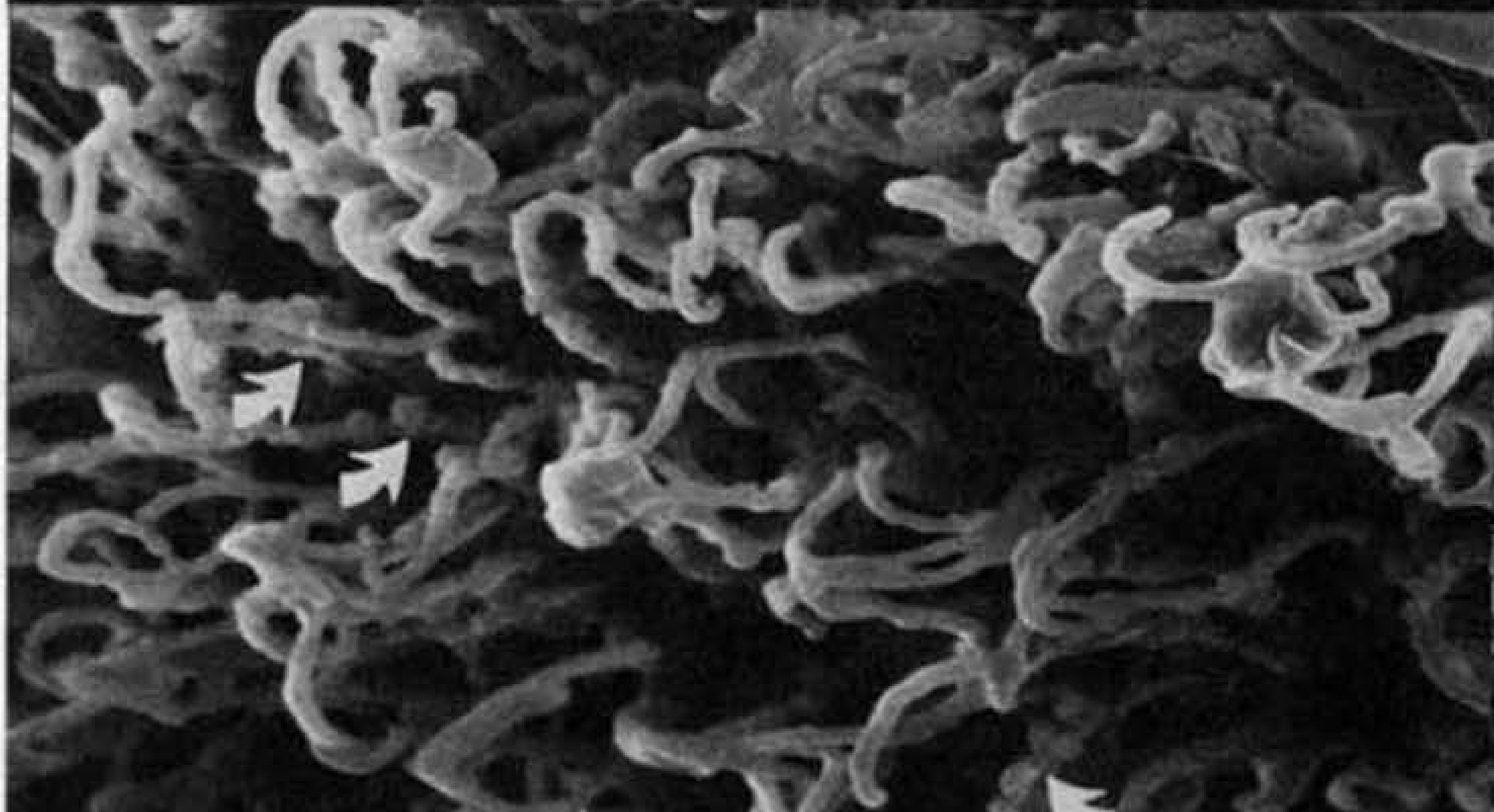
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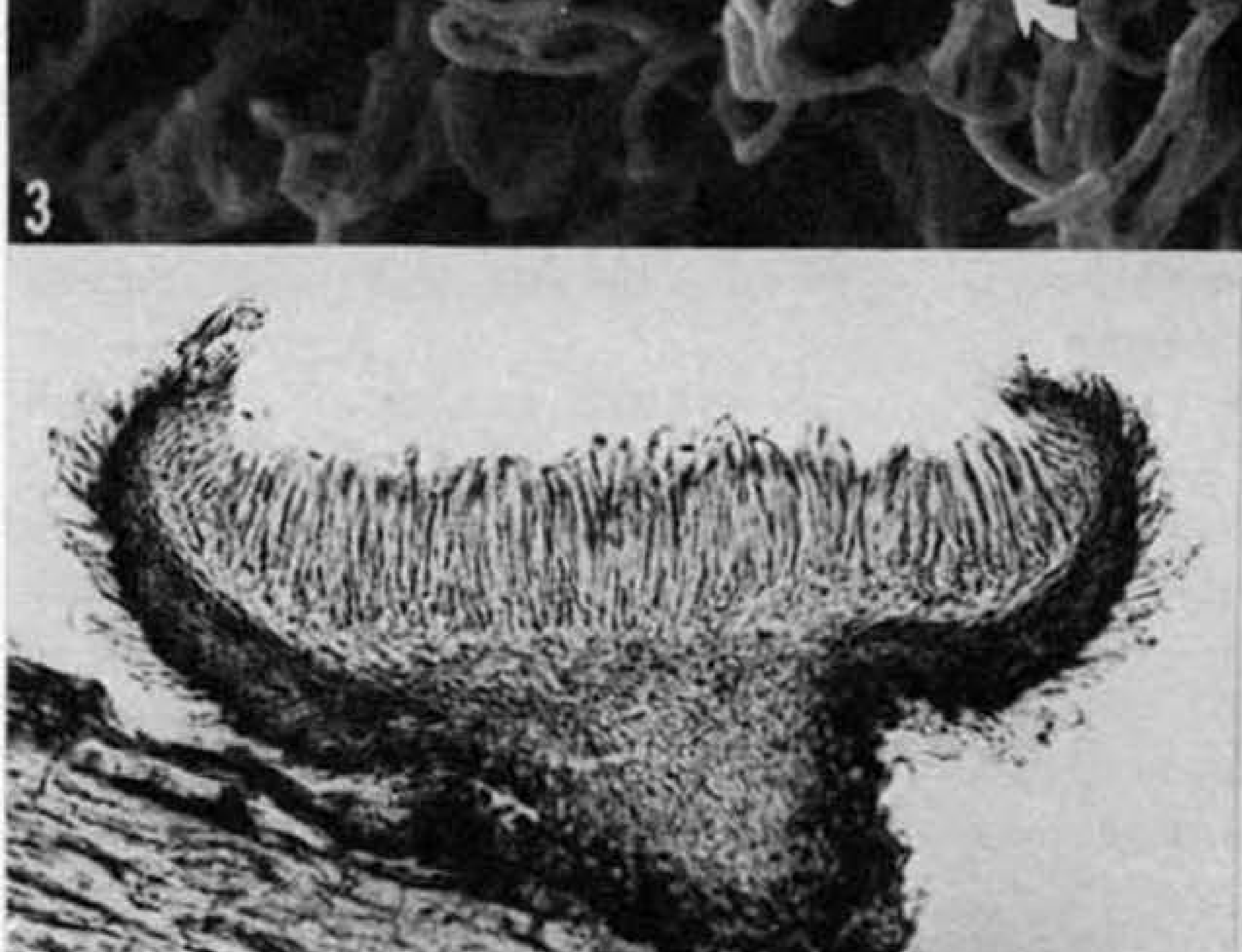
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ACKNOWLEDGEMENTS

The first and the third author are thankful to the Department of Science and Technology for the financial help. The junior author is pleased to acknowledge the valuable comments of Prof. Dr. R.P. Korf, Cornell University and Dr. J. H. Haines, New York State Museum, Albany. Furthermore he is grateful to Mrs. E. Miesel, who typed the camera-ready manuscript in a reliable manner.

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MYCOTAXON

Vol. XXV, No. 1, pp. 141-145 January-March 1986

A CORRECTED AUTHORS INDEX FOR A BIBLIOGRAPHIC ACCOUNT OF EXSICCATAE CONTAINING FUNGI

Donald H. Pfister
Harvard University Herbaria
Cambridge, Massachusetts

The index to authors of exsiccatae included in an article published earlier in this journal (Mycotaxon 23: 1-139. 1985) contains incorrect page numbers which resulted from a repagination of the final version. Though the index can be used simply by adding "5" to page numbers as printed it has seemed desirable to set the record straight by providing a proper index. A copy of this index is also available upon request from the author.

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Vol. XXV, No. 1, pp. 147-152 January-March 1986

The New Species *Dekkera naardenensis*, Teleomorph of *Brettanomyces naardenensis*

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Summary

Dekkera naardenensis sp. nov. is described to accommodate the ascogenous state (teleomorph) of *Brettanomyces naardenensis* Kolfschoten et Yarrow. ATCC 22075, the type culture of *B. naardenensis* which was isolated from aerated lemonade in the Netherlands, is designated as the type. The vitamin-enriched *Endothia* complete agar medium with a pH of 4-5 is most effective for inducing ascospore formation.

Brettanomyces naardenensis Kolfschoten et Yarrow (1970) was established on the basis of twelve strains isolated from soft drinks with a pH ranging between 2.6-3.2. The strain CBS 6042 (=ATCC 22075) isolated from aerated lemonade with a pH of 2.8 in the Netherlands is the type culture. It was distinguished from all the accepted species by assimilating soluble starch. Ascospores were not observed in any of the strains on either the normal sporulating media or media supplemented with vitamins.

In his identification key to the species of *Brettanomyces* Kofferath et van Laer, van der Walt (1984) separates the species from *B. anomalus* and *B. claussenii* by not fermenting lactose, from *B. custersii* by not assimilating lactose, from *B. intermedius* by not using sucrose, from *B. abstinens* by assimilating trehalose, and from *B. custersianus*, *B. lambicus* and *B. bruxellensis* by assimilating cellobiose. According to Barnett et.al. (1983), G + C nuclear DNA for *B. naardenensis* is 42.2-43.4 mol %.

The genus *Dekkera* van der Walt (1964), characterized by hat-shaped, easily liberated ascospores, is the perfect state of *Brettanomyces*. Members of both genera produce large amounts of acetic acid through the incomplete oxybiontic dissimilation of carbohydrate and are characterized by a so-called "negative Pasteur effect" or "Custer effect", i.e., a stimulation of fermentation of molecular oxygen and acetoin (Scheffers, 1966; Scheffers & Wiken, 1969). Although the genus *Dekkera* and its anamorphic genus

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Brettanomyces appear morphologically and physiologically to be most closely related to the genus Hanseniaspora Zikes and its anamorphic genus Kloeckera Janke (van der Walt, 1963, 1970; Fiol & Billon-Grand, 1978), the presence of the coenzyme Q-9 system in the former two genera and the coenzyme Q-6 system in the latter two genera has excluded this possibility (Yamada et.al., 1980).

In our authentication of the yeast strains maintained in the American Type Culture Collection (ATCC), we have found for the first time ascospores in the cultures of B. naardenensis ATCC 22075 (type) and ATCC 56870 (=CBS 6040) grown on vitamin-enriched media with a pH ranging between 4-5. It has therefore revealed the fungus to be a new species of Dekkera which is described herein.

Dekkera naardenensis Jong et Lee, sp. nov.
Stat. anamorphosis: Brettanomyces naardenensis Kofferoth et Yarrow, 1970.

In extracto malti post dies 5 25°C, cellulae ellipsoidae vel cylindricae elongataeque, 1.5-3 X 3.5-25 µm singulae, binae vel catenatae. Cellulae longae pseudomycelii formantur. Sedimentum Aliquando annulus, insulae aut pellicula tenuis. Cultura acclivis, superficie limitata, media subfusca alba ad marginem, cerata et nitida vel opaca. Asci e cellulis diploidis transformatis oriuntur. Ascosporae pilleiformes ad 4 in quoque asco formantur. Ascosporae maturae ex ascis celeriter liberantur et inter se agglutinant. Fermentatio, crescentia in variis substantiis carbonaceis et alliae naturae monstrantur in Tabula 1.

Typus: ATCC 22075 in collectione American Type Culture Collection, Rockville, Maryland, USA.

Growth in malt extract: After 5 days at 25°C the cells are ellipsoidal to cylindrical, rarely ogival, 1.5-3 X 3.5-25 µm, reproducing by budding and occurring singly, in pairs or short chains. Pseudomycelium may be formed. A sediment is present. After 10 days the sediment is usually floccose and a thin ring or thin pellicle may be formed. The formation of a characteristic aroma is detectable.

Growth on malt agar: After 6 weeks at room temperature the streak culture is butyrous, brownish-cream, somewhat shiny to dull, smooth to somewhat pulvinate or somewhat raised. The margin is undulating or slightly lobate.

Growth on malt agar with 2% calcium carbonate: After 6 weeks at room temperature the streak culture is cream-colored to light brown, somewhat shiny to rather dull, smooth to pulvinate. The margin is undulating to lobate. Acid production is not very pronounced.

Dalmau plate culture on corn meal agar: A ramified pseudomycelium bearing few or no blastospores is produced. It is developed better under anaerobic conditions.

<u>Physiological characteristics:</u> Fermentation and growth on various carbon compounds, growth on nitrogen sources and some additional properties are summarized in Table 1.

Table 1. Physiological Test Results

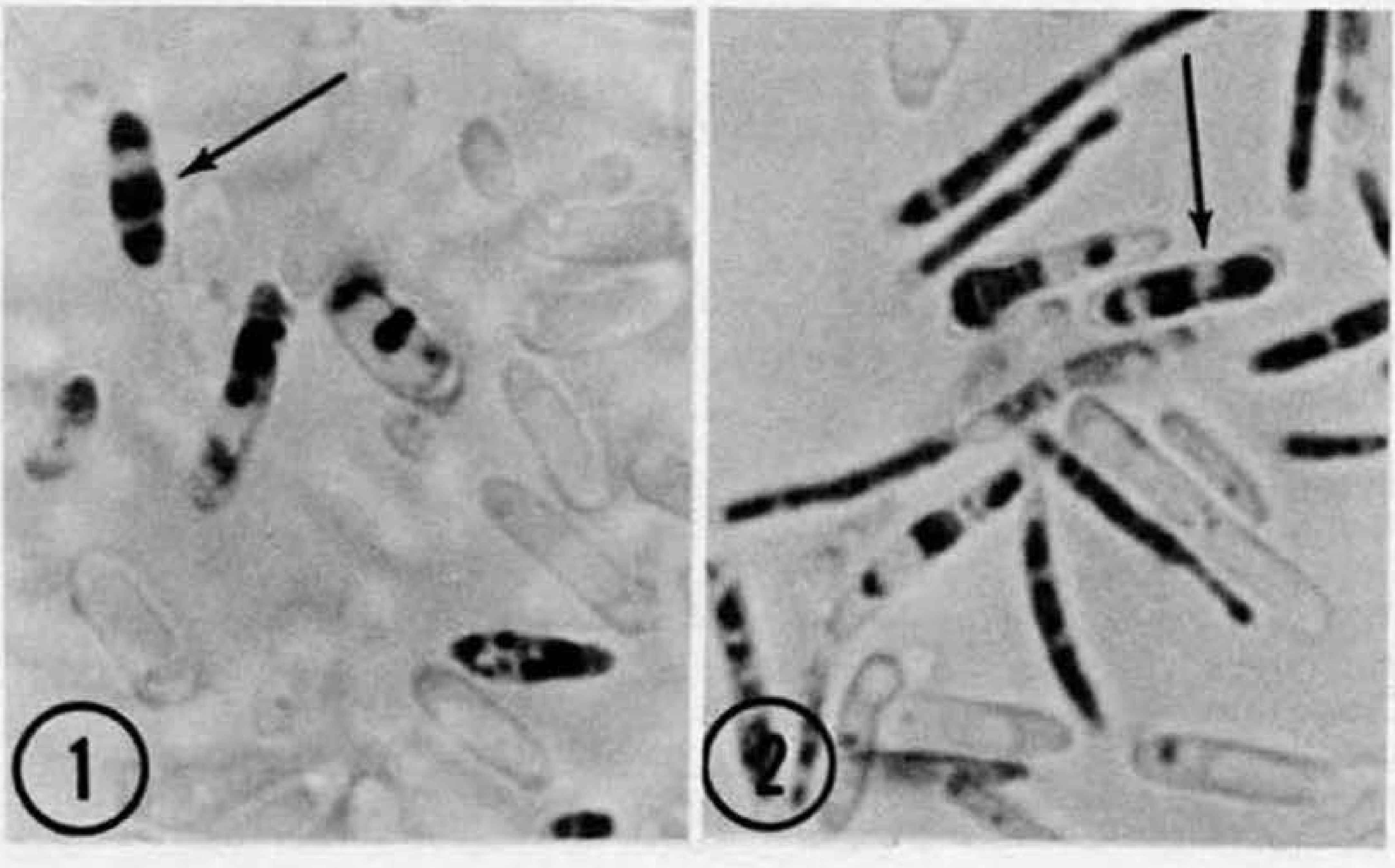
	ATCC 22075	ATCC 56870
Growth in vitamin-free medium	-	-
Growth at 37 °C	-	-
Splitting of arbutin	-	-
Urea hydrolysis	-	-
Diazomium blue B reaction	-	-
Acetic acid production	+w	+
Starch formation	-	-
Fermentation of:		
Glucose	+	+
Galactose	-	-
Maltose	-	-
Sucrose	-	-
Lactose	-	-
Raffinose	-	-
Melibiose	-	-
Inulin	-	-
Cellobiose	D	-
Melezitose	-	-
Starch	-	-
Trehalose	D	D
α-Methyl-D-Glucoside	-	-
Assimilation of:		
Glucose	+	+
Galactose	+	+
L-Sorbose	-	-
Maltose	D	D
Sucrose	-	-
Cellobiose	+	+
Trehalose	+	+
Lactose	-	-
Melibiose	-	-
Raffinose	-	-
Melezitose	-	-
Inulin	-	-
Soluble starch	+	+
D-Xylose	+	+
L-Arabinose	-	-
D-Arabinose	-	+w
D-Ribose	-	-
L-Rhamnose	+	+
D-Glucosamine	-	-
Ethanol	+	+
Methanol	-	-
Erythritol	-	-
Glycerol	-	-

Table 1. (continued)

	ATCC 22075	ATCC 56870
Adonitol	D	D
Dulcitol	-	-
D-Mannitol	+	+
D-Sorbitol	+	+
α-methyl-D-glucoside	-	-
Salicin	D	D
Inositol	-	-
Lactic Acid	+	+
Citric Acid	-	-
Succinic acid	+	D
Valine	-	-
Glycine	-	-
Proline	-	+w
Arginine	-	-
KNO_3	-	-
NO_2	-	-
Ethylamine	+	+

Code in Table: (+) positive; (-) negative; (D) delayed for longer than 7 days; (+w) weak

Formation of ascospores: Vegetative cells are transformed directly into asci, producing one to four ascospores. The ascospores are hat-shaped and can be stained with the modified Schaeffer-Fuller malachite green or Ziehl Neelsen's carbol fuchsin (Figs. 1,2). Mature ascospores tend to agglutinate when liberated. The occurrence of ascospore formation in the cultures of ATCC 22075 and ATCC 56870 depends greatly on media which have been adequately



Figs. 1-2. **Asci and ascospores of Dekkera naardenensis, stained with modified Shaeffer-Fuller malachite green. ca. X 2,000. 1. ATCC 22075 (Type). 2. ATCC 56870.**

enriched with vitamins. Sporulation is best observed in cultures at room temperature after one week on ATCC medium 686 (Cote et al., 1984), referred to as *Endothia* complete medium (Puhalla & Anagnostakis, 1971), supplemented with a vitamin solution which contains 0.2 mg biotin, 40 mg calcium pantothenate, 0.2 mg folic acid, 200 mg inositol, 40 mg niacin, 20 mg *p*-aminobenzoic acid, 40 mg pyridoxine hydrochloride, 20 mg riboflavin and 100 mg thiamine in a liter of demineralized water and sterilized by filtration (van der Walt & van Kerken, 1960).

Since the designated type culture ATCC 22075 is the type culture of *Brettanomyces naardenensis* Kolfschoten et Yarrow, the new species *Dekkera naardenensis* Jong et Lee is the perfect state (teleomorph) of *B. naardenensis.* Four species, *D. bruxellensis* van der Walt (1964), *D. intermedia* van der Walt (1964), *D. anomala* M. Th. Smith et van Grinsven (1984) and *D. claussenii* Lee et Jong (1985), are now recognized in the genus *Dekkera.* *D. naardenensis* is distinguished from the above accepted species by it ability to utilize D-mannitol, D-xylose and soluble starch and by its inability to grow at 37°C.

Dekkera naardenensis displays a rather strict habitat specificity and has thus far only been isolated from soda water and soft drinks with a pH ranging between 2.6-3.2 (Kolfschoten & Yarrow, 1970). However, it appears to constitute a well defined taxon that has been recovered in Belgium, Denmark, France, Norway, the Netherlands and the United States (Kolfschoten & Yarrow, 1970) and that has a coenzyme Q-9 system (Yamada et al., 1980) and 42.2-43.4 mol % of G + C nuclear DNA (Barnett et al., 1983).

Acknowledgments

We acknowledge with appreciation the critical review of the manuscript by Mary Jane Gantt. The work was supported in part by the National Science Foundation Grants DEB 7921031 and BSR 8413523 and by the National Institutes of Health Contract N01-RR-2-2139.

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Vol. XXV, No. 1, pp. 153-158 January-March 1986

TOLYPOCLADIUM, A SYNOMYM OF BEAUVERIA

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A comparision of their type specimes shows that Tolypocladium W. Gams cannot be satisfactorily separated from Beauveria Vuill. They have similar conidiogenous structures and similar, white, lanose or slightly fasciculate colonies. Fig. 1a shows camera lucida drawings of Beauveria bassiana (Bals.) Vuill., and Fig. 1b of Tolypocladium niveum (Rostr.) Bisset = T. inflatum W. Gams. Both fungi form botryose, swollen conidiogenous cells on short conidiophores, composed of a single swollen cell or a short row of swollen cells. Each conidiogenous cell forms a peg-like, often curved conidiogenous rhachis, which elongates sympodially or percurrently. The conidia are small (2-4 µm), obovate or spherical, aseptate, hyaline, with a minute basal scar. Supplementary ampulliform phialide-like cells are present in both species. The conidia develop in basipetal sequence and are similar to the conidia formed on scars of the elongating conidiogenous rhachis.

In B. bassiana the conidiogenous rhachis often becomes zig-zag and the scars are distinctly protuberant. In B. brongniartii (Sacc.) Petch, however, the conidiogenous rhachis is shorter, not zig-zag, and the scars of the conidia are sessile or only slightly protuberant as they are in T. niveum.

The fungus known as Acremonium arenarium Petch or Aphanocladium arenarium (Petch) W. Gams is also congeneric with B. bassiana (Fig. 1c). The conidiogenous cells often form a single conidium on a peg-like stalk, but this also may elongate sympodially, occasionally with distinct, denticle-like elongations. In older cultures, conidiogenous pegs also develop from swollen cells of the aerial hyphae.

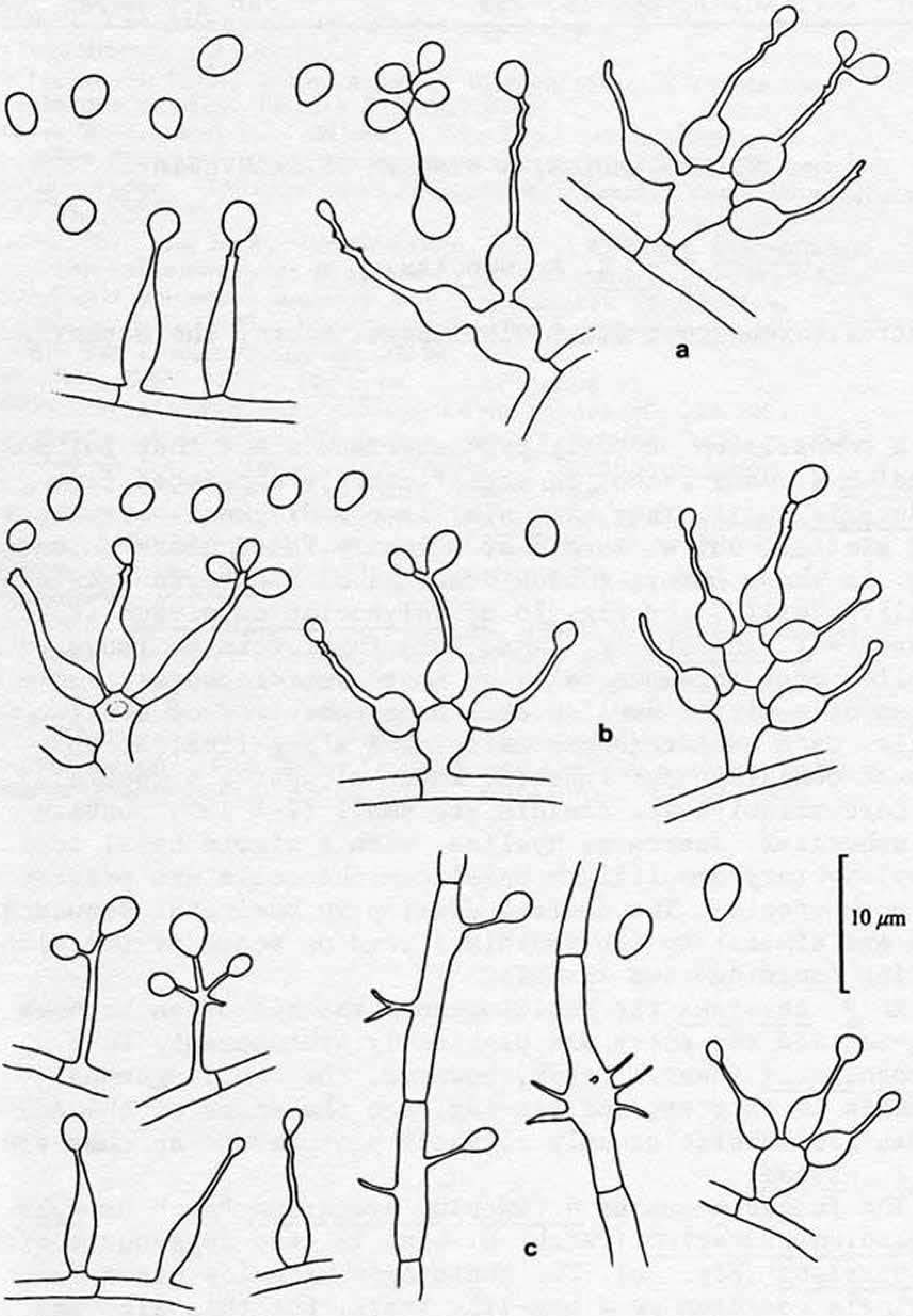

Fig. 1. a. Beauveria bassiana (fresh isolate); b. Beauveria nivea (fresh isolate); c. Beauveria arenaria (CBS 781.66).

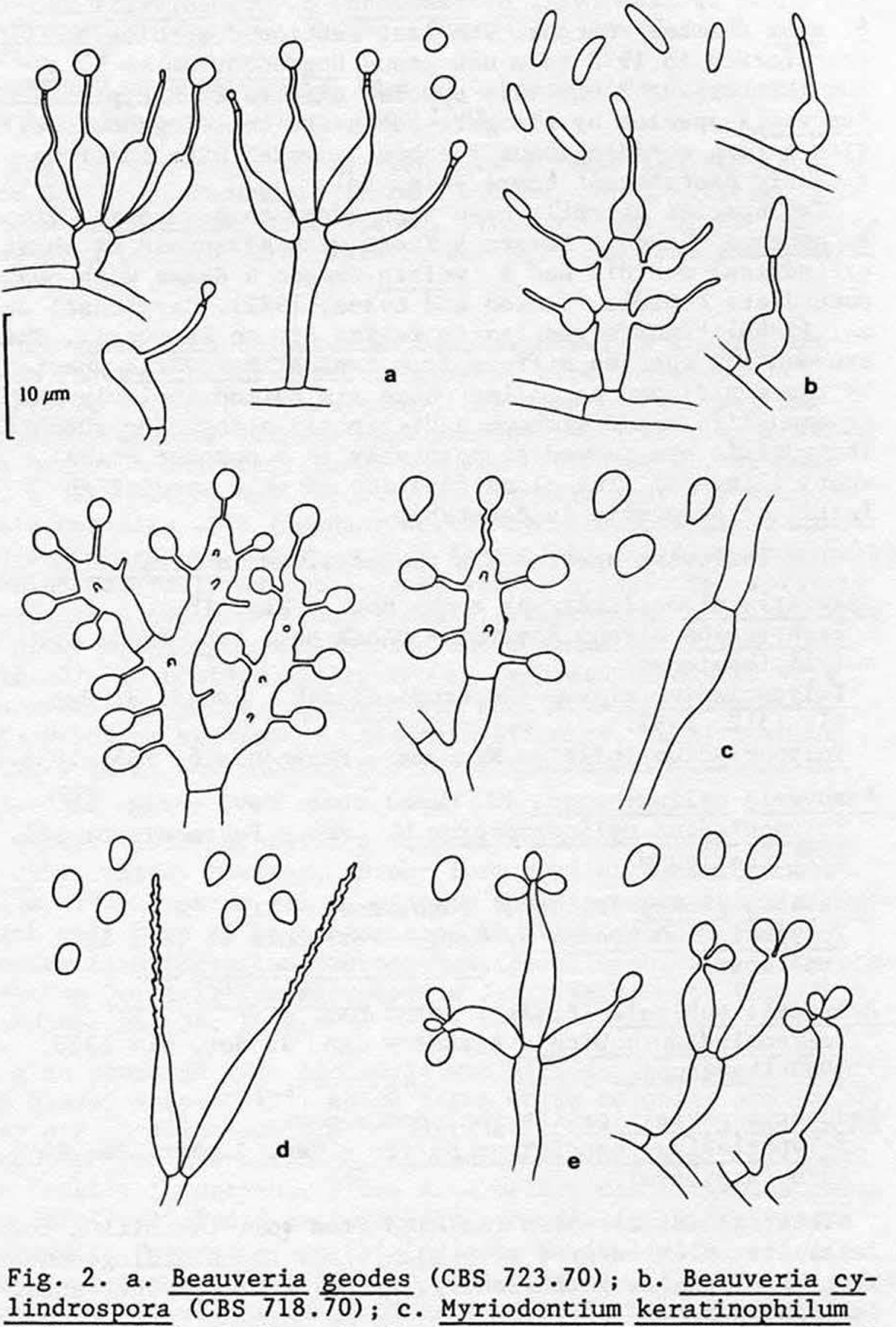

Fig. 2. a. Beauveria geodes (CBS 723.70); b. Beauveria cylindrospora (CBS 718.70); c. Myriodontium keratinophilum (CBS 974.73); d. Engyodontium album (CBS 348.55); e. Isaria felina (CBS 250.34).

Beauveria has been revised by de Hoog (1972). He accepted three species, viz. *B. bassiana*, *B. brongniartii* and *B. alba* (Limber) Saccas. The last mentioned species he transferred in 1978 to a new genus *Engyodontium* as *E. album* (Limber) de Hoog. This species differs from typical *Beauveria* species by elongate-obclavate conidiogenous cells with a long conidiogenous rhachis, covered with numerous slightly protuberant scars (Fig. 2d).

Two species recently have been added to *Beauveria*, viz. *B. amorpha* (Höhnel) Samson & Evans with allantoid or short cylindrical conidia and *B. velata* Samson & Evans with ovate, punctulate conidia (Samson and Evans, 1982). Carmichael et al. (1980) transferred *Isaria felina* Fr. to *Beauveria*. This synnematous species differs from typical *Beauveria* species by the conidiogenous cells, which are cylindrical-clavate or ampulliform and without a distinctly elongating rhachis. The conidia are formed successively in a compact apical whorl (Fig. 2e). The classification of this species in *Isaria* or *Beauveria* is debatable.

The following species are reclassified in *Beauveria*:

Beauveria nivea (Rostrup) comb. nov. - Fig. 1b.
Pachybasium niveum Rostrup - Dansk bot. Ark. 2, 5: 41. 1916 (basionym).
Tolypocladium niveum (Rostrup) Bisset - Canad. J. Bot. 61: 1312. 1983.
Tolypocladium inflatum W. Gams - Persoonia 6: 185. 1971.

Beauveria cylindrospora (W. Gams) comb. nov. - Fig. 2b.
Tolypocladium cylindrosporum W. Gams - Persoonia 6: 187. 1971 (basionym).

Beauveria geodes (W. Gams) comb. nov. - Fig. 2a.
Tolypocladium geodes W. Gams - Persoonia 6: 187. 1971 (basionym).

Beauveria nubicola (Bisset) comb. nov.
Tolypocladium nubicola Bisset - Can. J. Bot. 61: 1320. 1983 (basionym).

Beauveria parasitica (Barron) comb. nov.
Tolypocladium parasiticum Barron - Can. J. Bot. 58: 439. 1980 (basionym).

This species has been isolated from soil-inhabiting rotifers. Its colonies grow very slowly and the conidiogenous rhachis elongates percurrently, with rather distinct annellations in age.

Beauveria tundrense (Bisset) comb. nov.
Tolypocladium tundrense Bisset - Can. J. Bot. 61: 1322. 1983 (basionym).

Beauveria arenaria (Petch) comb. nov. - Fig. 1c.
Acremonium arenarium Petch - Trans. Br. mycol. Soc. 16: 242. 1932 (basionym).
Aphanocladium arenarium (Petch) W. Gams - Cephalosporium-artige Schimmelpilze p. 198. 1971.

Fig. 1c was prepared in 1966 from a fresh isolate received from Dr. M. C. Papendorf (Potchefstroom, South Africa). This strain was isolated from litter. Other strains of *B. arenaria* have been isolated from spiders and have been collected mainly in tropical areas.

The genus *Aphanocladium* W. Gams is based on *Acremonium album* Preuss, a mycoparasitic fungus, first observed on *Cribraria vulgaris* (Myxomycota). The type species was not examined. Several strains were studied isolated from *Agaricus bisporus* and other fungi and identified by Dr. W. Gams (e. g. CBS 411.34 and 798.84). On cornmeal agar all produce white colonies with abundant aerial mycelium of narrow hyphae and a red exudate. Obclavate or lanceolate conidiogenous cells develop laterally on unthickened aerial hyphae. The solitary conidia are ovate or broadly clavate, aseptate, hyaline, have an often slightly truncate base and measure 4-7 x 2.5-4 µm (Fig. 3). No conidia aggregated in droplets or chains were observed. The genus *Aphanocladium* should be restricted to this peculiar species of uncertain affinity. It also occurs on rust fungi and induces the formation of telia (Biali et al., 1972).

Bisset (1983) classified several more species in *Tolypocladium*, which, however, do not form swollen conidiogenous cells with a narrow and elongating conidiogenous rhachis and which will have to be transferred to other genera. Such a species is *Gliocladium microsporum* (Jaap) comb. nov. with the basionym *Verticillium microsporum* Jaap (Verh. bot. Ver. Prov. Brandenb. 58: 38. 1916).

Also compared with *Beauveria* was *Myriodontium keratinophilum* Samson & Polonelli, which forms white colonies and small, aseptate, hyaline conidia on distinct stalks (Fig. 2c). The conidiophores are often aggregated in sporodochial tufts and the usually integrated, often intercalary conidiogenous cells are relatively broad and elongate sympodially. Other genera related to *Beauveria* are *Phialocladus* Kreisel with a single species growing in association with termites, *Pleurodesmospora* Samson et al. with a fungicolous species forming catenate conidia in basipetal sequence, *Culicinomyces* Couch et al. with a single species parasitic on mosquito larvae, also with apparently basipetal conidia, and *Beauveriophora* Matsushima.

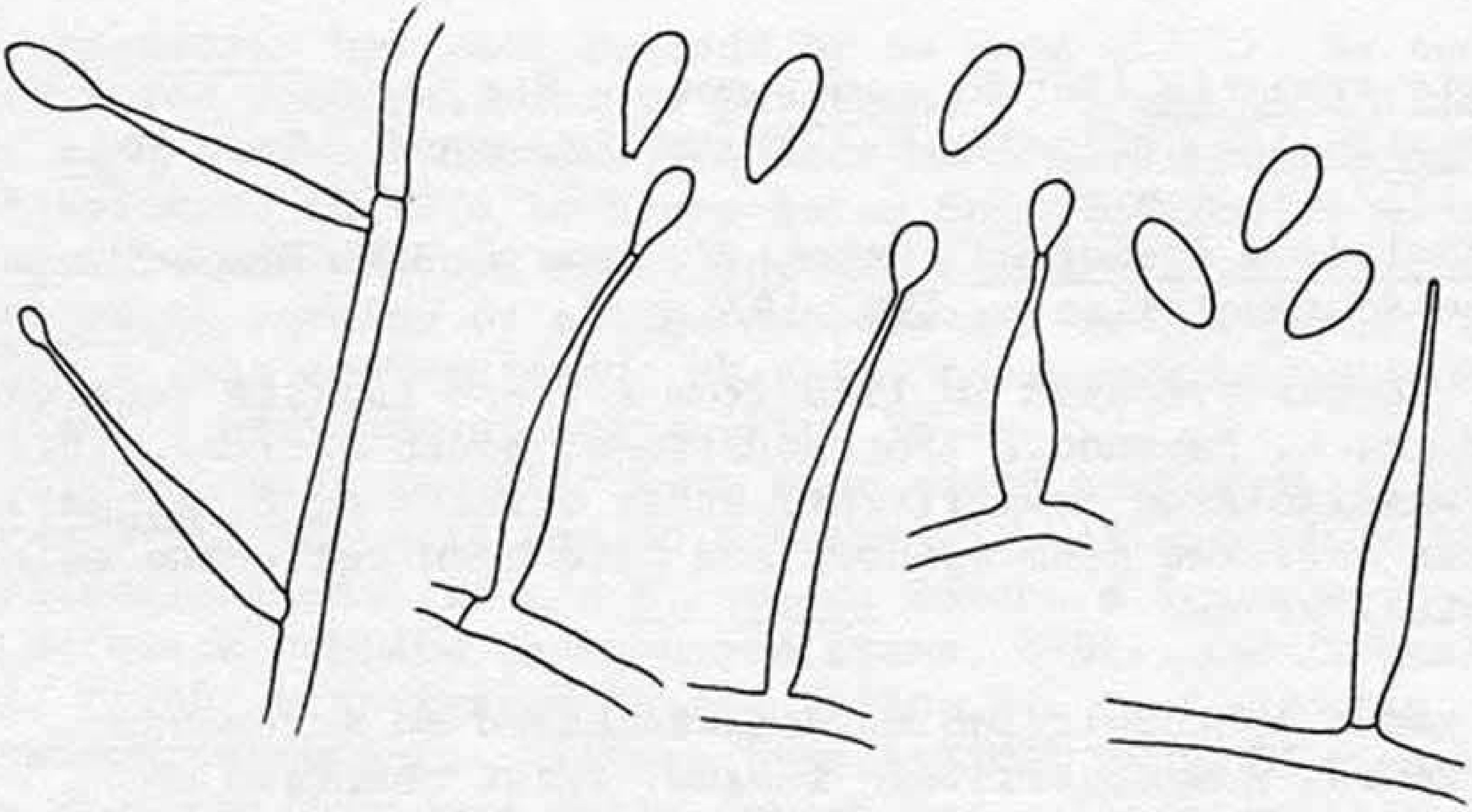

Fig. 3. Aphanocladium album (CBS 794.84).

Teleomorphs are unknown in Beauveria, but apparently would belong to the Clavicipitaceae (Cordyceps, Torrubiella and related genera). The entomogenous genus Hirsutella Pat. differs from Beauveria by larger , often sheated conidia and lanceolate, only slightly swollen conidiogenous cells (Minter and Brady, 1980).

Acknowledgements

The author thanks Prof. E. Müller, Dr. G. S. de Hoog and Dr. K. A. Seifert for useful suggestions and comments, and for reading the manuscript.

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MYCOTAXON

Vol. XXV, No. 1, pp. 159-160 January-March 1986

MODIFICATION OF NOBLES' SPECIES CODE FOR IDENTIFICATION OF BASIDIOMYCETE CULTURES

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The numerical species code developed by Nobles (1965) for identification of basidiomycete cultures has been modified and supplemented by a number of workers. These include Boidin (1966), Nobles (1967), Burdsall *et al*. (1978), Burdsall & Nakasone (1981), and Boidin & Lanquetin (1983). Two additional modifications are proposed in this paper.

1. Regarding Character No. 28

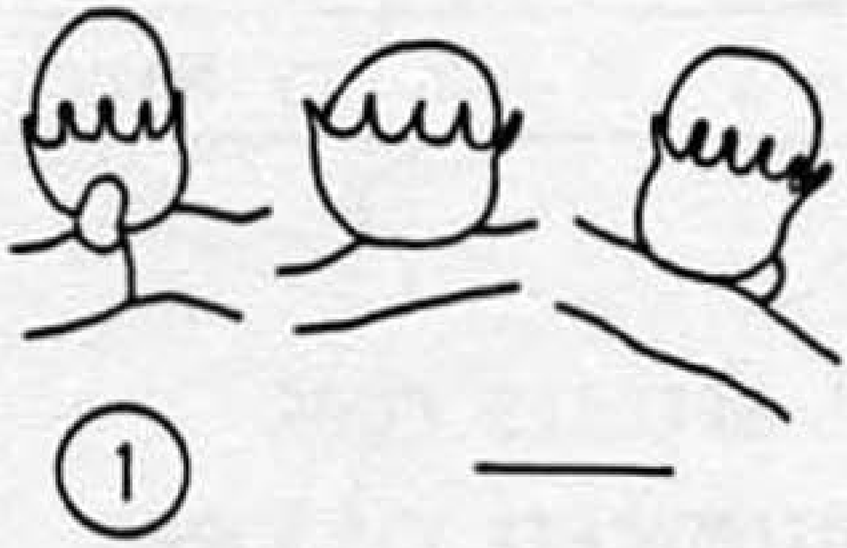
Boidin & Lanquetin (1983) used character no. 28 for "dextrinoid asterohyphidia." That number, however, was already occupied. Burdsall & Nakasone (1981) had assigned no. 28 to "capitulate spines on vegetative hyphae." I propose that the dextrinoid asterohyphidia be assigned to character no. 29.

2. Regarding Stephanocysts

Structures first called "caliciform structures" by Litschauer (1928) were later called *stephanocysts* by Boidin (1950). These are characteristic of several species of *Hyphoderma* Wallr. (Corticiaceae). Burdsall (1969) gives a detailed account of these curious hyphal modifications. Stephanocysts may be one- or two-celled and usually possess a ring of spine-like projections at the midline between the two cells (FIG. 1) or at the base of the sessile type (FIG. 2). The function of stephanocysts is unknown, but they may serve as propagules. I propose that stephanocysts be assigned to character no. 30 in Nobles' system.

<u>The following characters are assigned</u>:

28. Capitulate spines on vegetative hyphae
29. Dextrinoid asterohyphidia
30. Stephanocysts



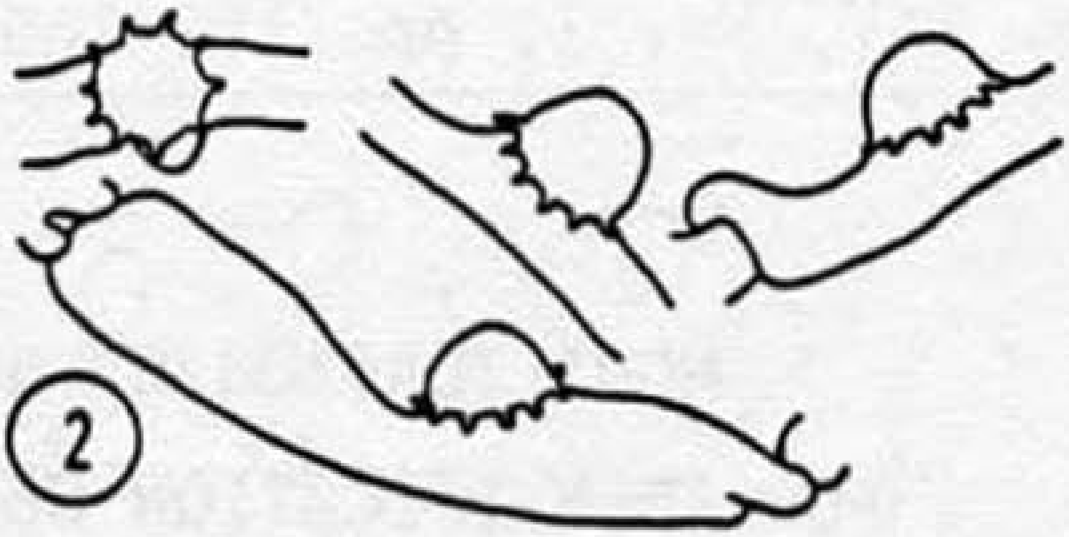


FIG. 1. Stephanocysts from culture of *Hyphoderma praetermissum* (Karst.) J. Erikss. & Strid in Erikss. & Ryv., RLG-11467-Sp. FIG. 2. Stephanocysts from culture of *H. puberum* (Fr.:Fr.) Wallr., RLG-9652-Sp. Scale bar = 10 µm. Both cultures ex USDA Forest Products Lab., Madison, Wisc.

ACKNOWLEDGMENT

Thanks to Mrs. F.F. Lombard for her comments on the manuscript.

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MYCOTAXON

Vol. XXV, No. 1, pp. 161-164 January-March 1986

DERMATISCUM FALLAX (PHYSCIACEAE), A NEW LICHEN FROM SOUTHERN AFRICA

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ABSTRACT

A new lichen, *Dermatiscum fallax* (Physciaceae), is described from southern Africa. Its relationship to *Dermatiscum thunbergii* is discussed, as is its distribution and chemistry.

DERMATISCUM FALLAX Brusse, *sp. nov.*

Thallus ut in *Dermatiscum thunbergii*(Ach.)Nyl., sed cortice superiore tenuiore et acido rhizocarpico deficienti.

Thallus cinereus, peltatus, saxicola, usque ad 3 cm diametro, 400 - 800 µm crassus. *Cortex superior* 10 - 15 µm crassus, anticlinate prosoplectenchymatus. *Stratum gonidiale* 25 - 80 µm crassum, algis *Trebouxiis*, 6 - 16 µm diametris.*Medulla* alba, 280 - 650 µm crassa. *Cortex inferior* 30 - 80 µm crassus, anticlinate prosoplectenchymatus, hyphis conglutinatis, hyalinus, sed zonis exteriore atrobadius. *Stratum epinecrale* atrobadium, irregulare. *Apothecia* lecanorina, usque ad 1 mm diametris, primum immersa deinde sessilia, leviter convexa, fuliginea. *Thecium* pallide stramineum vel hyalinum, 120 - 200 µm crassum. *Excipulum* reductum (ut in *Dermatiscum thunbergii*). *Hypothecium* pallide stramineum vel hyalinum, 70 - 120 µm crassum, J+ leviter caeruleum, paraplectenchymatum, cellulis 4 - 7 µm diametris. *Hymenium* pallide stramineum vel hyalinum, 50 - 80 µm altum, J+ caeruleum. *Epihymenium* fuscum cum hydroxido kalii non reagens, et in acidum nitricum ad rosescens mutans. *Paraphyses* capitatae, fere simplices, septatae, circa 1.5 µm crassae, capitibus 3 - 5 µm crassis, 0 - 1 septatis, cum teguminibus gelatinarum fuscus. *Gelatina* J+ caerulea. *Asci* clavati, cum tholis J+ caeruleis, ut in *Physciis*. *Ascosporae* octonae, badiae, uniseptatae, ellipsoideae, cum toris et parietibus aequis, ut in *Dimelaenis*, 8.5 - 13 x 5.5 - 7.5 µm. *Pycnidia* globosa, hyalina, immersa, 100 - 120 x 70 - 100 µm. *Pycnidiosporae* hyalinae, bacillares, rectae, 5 - 8 x 0.8 µm. *Thallus* acidum squamaticum continens.

TYPUS: South Africa, Cape Province, Pakhuis Pass near Clanwilliam, on Table Mountain sandstone boulder, *F. Brusse 1102*, 8. ii .1977 (PRE, holo- ; BM, iso-), fig. 1.

Fig. 1. *Dermatiscum fallax*, habit. F. Brusse 1102, holotype. Scale in mm.

Thallus as in *Dermatiscum thunbergii* (Ach.)Nyl., but upper cortex thinner and lacking rhizocarpic acid.

Thallus saxicolous, grey, peltate, to 3 cm diam., 400 - 800 µm thick. *Upper cortex* 10 - 15 µm thick, anticlinal prosoplectenchyma. *Algal layer* 25 - 80 µm thick. Algae *Trebouxia*, 6 - 16 µm diam. *Medulla* white, 280 - 650 µm

thick. *Lower cortex* 30 - 80 µm, anticlinal prosoplectenchyma with conglutinate hyphae, hyaline but dark brown below. *Epinecral zone* irregular, dark brown.
Apothecia lecanorine, to 1 mm diam., immersed at first then sessile, convex, sooty coloured. *Thecium* pale straw coloured or hyaline, 120 - 200 µm thick. *Exciple* reduced or absent (as in *Dermatiscum thunbergii*). *Hypothecium* pale straw or hyaline, 70 - 120 µm thick, I+ pale blue, paraplectenchymatous, cells 4 - 7 µm diam. *Hymenium* pale straw to hyaline, 50 - 80 µm high, I+ blue. *Epihymenium* brownish, not changing in potassium hydroxide, becoming pinkish in nitric acid. *Paraphyses* capitate, simple, septate, *c.* 1.5 µm thick, apices 3 - 5 µm thick, 0 - 1 septate, with brown gelatinous caps. *Gel* I+ blue. *Asci* clavate, 8 - spored, tholi I+ blue, as in *Physcia*. *Ascospores* brown, uniseptate, ellipsoid, torus and even walls as in *Dimelaena*, 8.5 - 13 x 5.5 - 7.5 µm. *Pycnidia* globose, hyaline, immersed, 100 - 120 x 70 - 100 µm. *Pycnidiospores* hyaline, straight rods, 5 - 8 x 0.8 µm. *Chemistry:* squamatic acid and an unidentified terpene present.

Dermatiscum fallax is closely related to the strikingly yellow-coloured *Dermatiscum thunbergii*, but differs in the thinner upper cortex which also lacks the yellow pigment rhizocarpic acid of that species; the upper cortex of *D. fallax* is 10 - 15 µm thick, whereas that of the latter species is 30 - 40 µm thick. The two species are otherwise very similar and must be closely related. The relationships of the genus *Dermatiscum* to other members of the Physciaceae are discussed by Hafellner, Mayrhofer & Poelt (1979). However, the family is heterogeneous as discussed by them, including as it does genera with various ascus types.

The medullary chemistry of the two species show different trends as well. All (8) the samples of *D. thunbergii* that I have examined (South Africa only), contain gyrophoric acid. *D. fallax* may also contain gyrophoric acid, but it often contains thamnolic acid as well. Squamatic acid is also known (type). Harper & Letcher (1966) found squamatic acid in *D. thunbergii* from Zimbabwe, and it seems certain that these are only chemical strains, which cannot be correlated to any morphological trend.

An interesting ecological separation of chemical strains of this species was observed at Tradouw Pass near Barrydale, where many thalli (small at this locality) were collected from two different aspects of a large Table Mountain sandstone outcrop. The thalli from the steeper north face all contained gyrophoric acid only, whereas all the thalli from the gentler south face contained both gyrophoric and thamnolic acids, the latter easily visualized by its K+ rich yellow reaction. However thalli containing gyrophoric acid only,have been collected on south faces at other localities.

This second species of *Dermatiscum* from southern Africa, occurs only in the Cape floral area, where it is common.

SPECIMENS EXAMINED: SOUTH AFRICA, Cape Province - 3218 (Clanwilliam): Pakhuis Pass near Clanwilliam (-BB), *F. Brusse 1102*, 8.ii.1977, 610 - 670 m (type; squamatic acid; BM, PRE). 3320 (Montagu): 4 km SW of Montagu, Kogmans Kloof near the old British fort of 1899, on top of an E - W ridge, on S sides of TMS outcrops (-CC), *F. Brusse 3741*, 12.v.1981, 200 - 250 m (gyrophoric acid only; PRE); 7 km S of winery at Barrydale, Tradouw Pass, Langeberg, on TMS on S slope (-DC), *F. Brusse 3673*, 11.v.1981, 300 - 350 m (gyrophoric and thamnolic acids; BM, PRE); 7 km S of winery at Barrydale, Tradouw Pass, Langeberg, on N side of TMS outcrop, on a general SW slope (-DC), *F. Brusse 3674*, 11.v.1981, 300 - 350 m (gyrophoric acid only; BM, PRE). 3321 (Ladismith): Seven Weeks Poort, about 16½ km from the main Calitzdorp - Ladismith road, on large TMS boulder in the cove of a high water trickle (waterfall), (-AD), *F. Brusse 3552*, 9.v.1981, 850 - 950 m (gyrophoric and thamnolic acids; PRE).

ACKNOWLEDGEMENTS

The author would like to thank the South African Department of Agriculture and Water Supply for financial support of this study. Thanks are also due to Mrs A. J. Romanowski for the photography and to Mrs S.M. Thiart for the typing. The author is grateful to Mr. P. W. James for reviewing the manuscript.

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MYCOTAXON

Vol. XXV, No. 1, pp. 165-174 January-March 1986

ON THE ANAMORPH OF PHILLIPSIA CRISPATA

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SUMMARY

The genus Molliardiomyces is emended to include species with both sympodial and percurrent proliferation of conidiogenous cells. The new species M. crispatus, the anamorph of Phillipsia crispata is described. In M. crispatus, proliferation of conidiogenous cells is usually percurrent, sometimes sympodial. In all other known species of Molliardiomyces proliferation is sympodial. This is the first reported instance of percurrent proliferation in an anamorph of a species of the Pezizales.

Phillipsia crispata (Berk. & Curt. in Berk.) Le Gal is a species of the Sarcoscyphaceae (Pezizales, Sarcoscyphineae) that is widely distributed in the neotropics (Denison, 1969). Cultures obtained from a strain of P. crispata collected in Costa Rica have produced an anamorph in which proliferation of conidiogenous cells is most commonly percurrent (annellidic), but is sometimes sympodial. The conidia are produced holoblastically and accumulate in small, mucoid masses. Were it not for the percurrent mode of proliferation, the P. crispata anamorph could readily be accomodated in Molliardiomyces Paden, a genus recently described for the anamorphs of species of several genera of the Sarcoscyphaceae, including Phillipsia spp. (Paden, 1984). Proliferation in Molliardiomyces, as presently circumscribed, is sympodial. If the *P. crispata* anamorph is to be treated as a species of *Molliardiomyces*, then that genus should be amended to include percurrent proliferation of conidiogenous cells. This problem has been discussed in *Sporidesmiella* Kirk by Zhang et al (1983). In *S. hyalosperma* (Corda) Kirk var. *hyalosperma* proliferation is percurrent; in var. *novaezelandiae* Hughes proliferation is sympodial. In *S. brachysporioides* Zhang & Kendrick proliferation is sympodial; however broken-off conidiophores will occasionally resume vegetative growth by percurrent proliferation. In the Diatrypaceae Glawe (1983a, b; 1984), and Glawe and Rogers (1982a, b) have shown both sympodial and percurrent proliferation in *Cryptosphaeria pullmanensis*, *Eutypella parasitica*, and species of *Diatrype*, *Diatrypella*, *Eutypa*, and *Eutypella*.

Because of the close similarity of the *P. crispata* anamorph to species already described in *Molliardiomyces*, and taking into account the reports of Zhang et al., Glawe, and Glawe and Rogers previously cited, *Molliardiomyces* is emended to include species showing both sympodial and percurrent proliferation.

MATERIALS AND METHODS

Cultures were obtained from germinated ascospores from apothecia collected at the Centro Agronomico Tropical de Investigación y Enseñanza (C.A.T.I.E.), Turrialba, Costa Rica. Pieces of apothecia were suspended over plates of 2% Difco agar containing aureomycin + streptomycin (2.5/250 ppm). Germinated ascospores were cut out after 24 hr and transferred to potato-carrot agar (PCA) plates (Dade, 1960). Cultures have been maintained on PCA. For observation of cultural characters and the anamorph, cultures were incubated at 23-24 C in 9 cm plastic Petri dishes exposed to diurnal illumination from a cool-white fluorescent tube.

Molliardiomyces Paden, Can. J. Bot. 62: 211. 1984, emend.

Ad instar generis, sed conidiophoris sympodice et percurrenter proliferantibus.

Phillipsia crispata (Berk. & Curt. in Berk.) Le Gal, Discom. de Madagascar 262. 1953.

Stat. anam. Molliardiomyces crispatus Paden, sp. nov.

Conidiophora repentia, ramosa vel simplicia, hyalina, laevia, typice curvata, percurrenter vel sympodice proliferantia, 8-45 X 1.6-5.6 μm; conidis holoblasticis, inseptatis, hyalinis, laevibus, ovatis, obovatis, ellipsoideis vel oblongatis-ellipsoideis, frequenter inaequilateris, 9.6-19.3 X 5.8-8.8 μm, ad basim truncatis vel cum appendice, singulatim vel brevibus catenis productis, in mucilaginosis massulis accumulantibus.

Cultura exsiccata in agaro JWP 1103, Holotypus.

Colonies on PCA up to 70 mm in diam in 14 da at 23-24 C, colorless and mostly submerged except for some white, floccose aerial mycelium in the central part of the colony; margin irregular; reverse colorless. Conidiophores and conidia produced after about 1 month. Conidiophores 8-45 X 1.6-5.6 μm, smooth, colorless, usually curved, unbranched or branched, usually but not always tapered toward the apex, proliferation of conidiogenous cells usually percurrent, sometimes sympodial, producing conidia holoblastically. Conidia smooth, hyaline, 1-celled, broadly ovate, obovate, ellipsoid, or oblong-ellipsoid, frequently unequal-sided or with the base eccentrically positioned, 9.6-19.3 x 5.8-8.8 μm, with a distinctly truncate base and often a basal frill or appendage, borne singly or in short chains of 2 or 3, accumulating in small mucilaginous masses. Germination has not been observed.

Colonies on Czapek's agar (Raper and Thom, 1949) restricted, 32-37 mm in diam in 30 da at 23-24 C, colorless, appressed, sterile; margin irregular; reverse colorless.

Description based on a culture from JWP 1103, Centro Agronomico Tropical de Investigación y Enseñanza (C.A.T.I.E.), Turrialba, Costa Rica, Nov. 5, 1975 (UVIC).

Type: a dried culture deposited at UVIC.

DISCUSSION

In the P. crispata anamorph described herein, proliferation of conidiogenous cells is usually percurrent (annellidic), but is sometimes sympodial. This is the first report of percurrent proliferation in an anamorph of a species of the Pezizales. It is described as a species of Molliardiomyces, as emended. This concept of Molliardiomyces is in accord with the inclusion in Sporidesmiella of species with both sympodial and percurrent proliferation by Zhang, et al (1983), and the reports of Glawe (1983a, b; 1984), and Glawe and Rogers (1982a, b) of both types of proliferation in species of the Diatrypaceae. Glawe and Rogers (1982b) have noted that the finding of both types of proliferation in several species of the Diatrypaceae indicates that they are not very distinct or invariable in those fungi. For additional discussion see Zhang, et al (1983). With the exception of the percurrent proliferation of most conidiogenous cells, the P. crispata anamorph closely resembles species of Molliardiomyces previously described (Paden, 1984).

Considerable variation was noted with regard to the presence or absence of an appendage on the conidia. Some conidia simply had truncate bases. In other cases the end of a conidiophore became slightly enlarged and adhered to the conidium as an appendage (Figs. 9, 14), or remained attached to the conidiophore (Fig. 8). Conidia were sometimes borne in short chains (Figs. 3, 5, 12). It is possible that the appendages represent aborted or partially developed conidia. The conidia are multinucleate (Fig. 13), as are conidia of other Phillipsia spp. (Paden, unpublished).

Paden (1975) described ascospore germination and the formation of arthroconidial (thallic) anamorphs in Cookeina sulcipes (Berk.) O. Kuntze and P. crispata. This report now appears to be in error, at least with regard to the P. crispata anamorph, and probably also for C. sulcipes. The culture on which the present study is based (JWP 1103) is different from that of the 1975 report (JWP 1104). The latter is most likely a contaminant. The ascospore germination data (Paden, 1975) are still valid. Hopefully, new cultures of C. sulcipes can be obtained in the future.

ACKNOWLEDGEMENTS

This research was supported by grants from the Natural Sciences and Engineering Research Council of Canada (grant No. A-4437) and the University of Victoria. I thank Dr. Peter L. Smith for correcting the Latin diagnoses and Dr. Jack D. Rogers for reviewing the manscript.

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PLATES

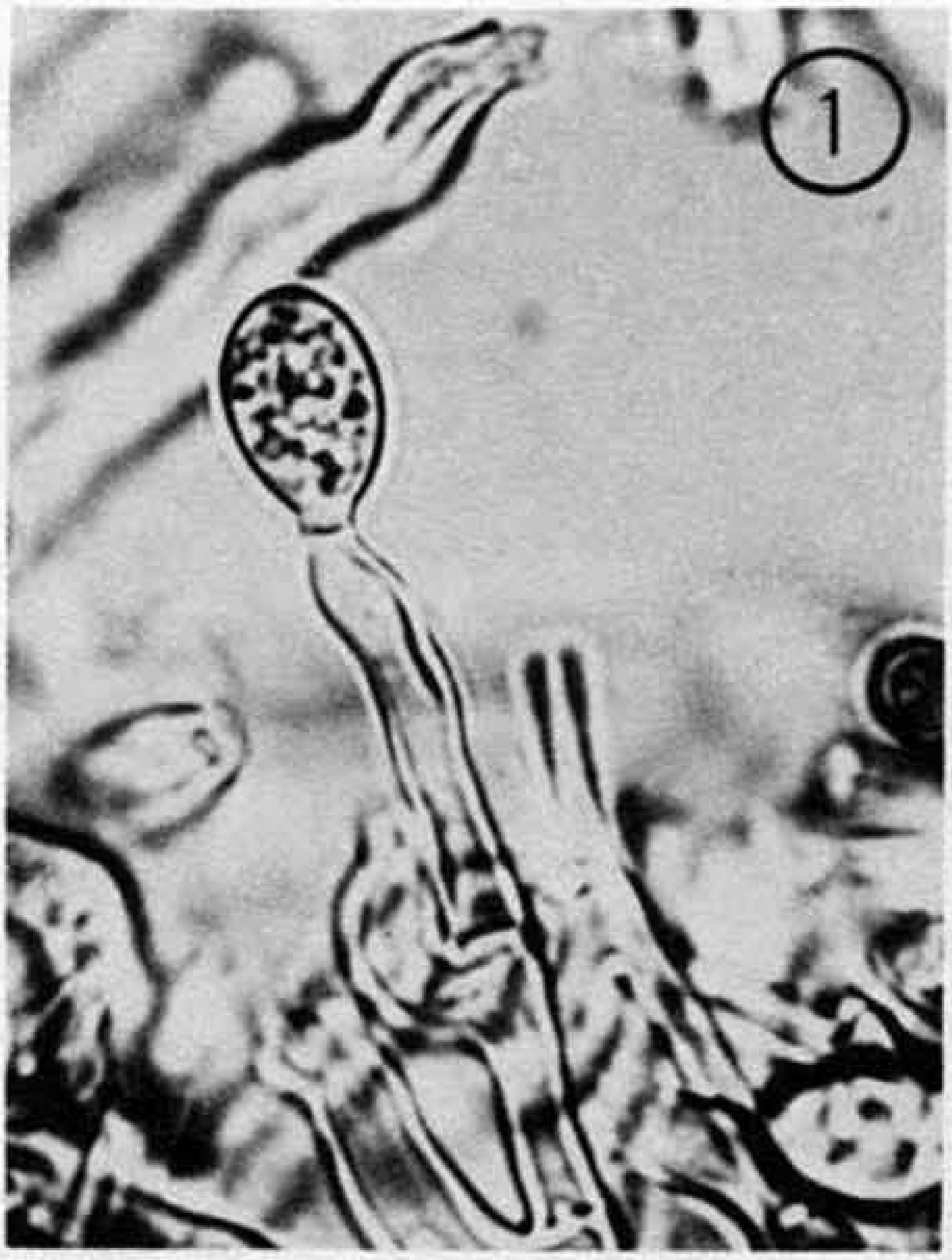
(on pages that follow)

FIGS. 1-3: Phillipsia crispata. 1. Conidiophore producing first conidium. No annellation evident. X 1230. 2. Conidiophore producing second conidium. One annellation evident (arrow). The conidium on the left appears to have been produced sympodially. The large cell below the center conidium may be developing into a second conidium in a short chain. X. 1530.

FIGS. 4-7: Phillipsia crispata. 4. Two conidia appearing to be produced sympodially. X 1270. 5. Two conidia borne in a short chain. No annellations evident. X 1550. 6. Conidia borne in short chains with annellations evident (arrows). X 1550. 7. Conidium produced percurrently with the upper part of the conidiophore somewhat swollen, but not deliminated by a septum. X 1430.

FIGS. 8-10: Phillipsia crispata. 8. Conidia produced percurrently. The slightly swollen upper portion of the conidiophore on the left has not become attached to the conidium. X 1300. 9. Conidium produced percurrently. The upper part of the conidiophore is attached to the conidium as an appendage. X 1430. 10. Conidia produced sympodially, except at the lower left where an annellation is evident (arrow). X 1730.

FIGS. 11-14: Phillipsia crispata. 11. Conidia produced percurrently. Two annellations are evident on the lower conidiophore (arrows). X 1430. 12. Conidia in a short chain, produced percurrently. Annellation at arrow. X 1470. 13. Multinucleate conidia, Giemsa-stained. X 1400. 14. Conidium with basal appendage (arrow). X 1370.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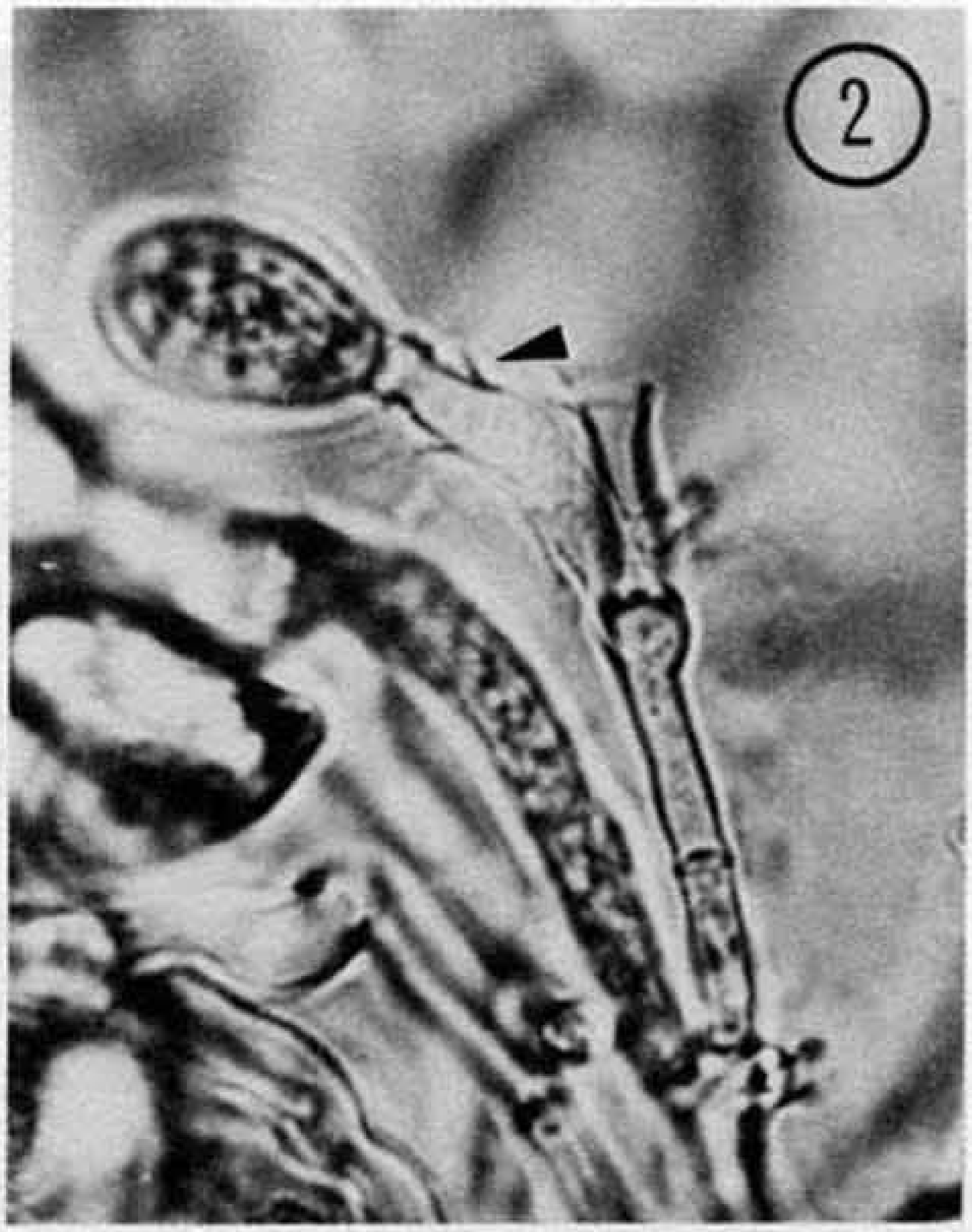
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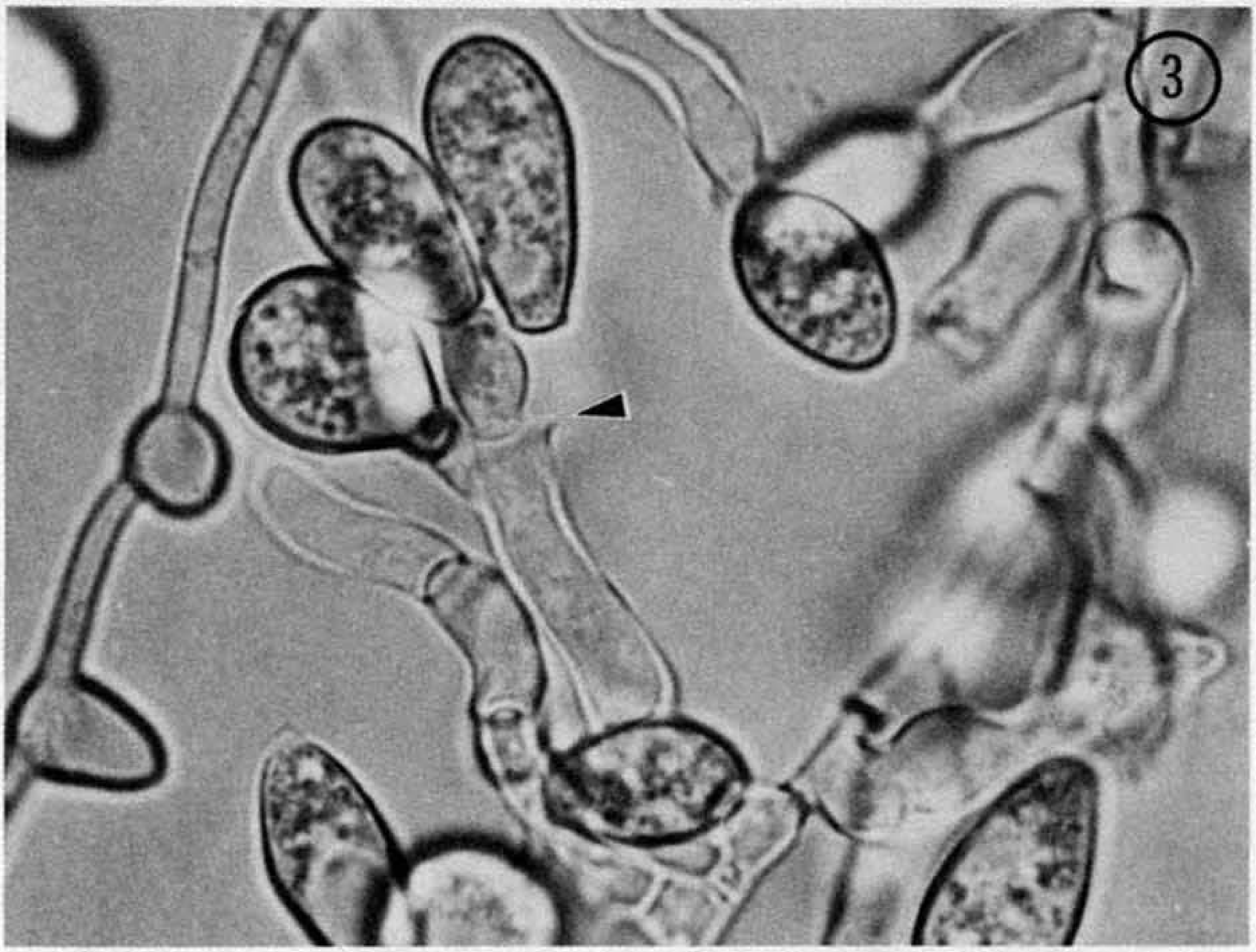
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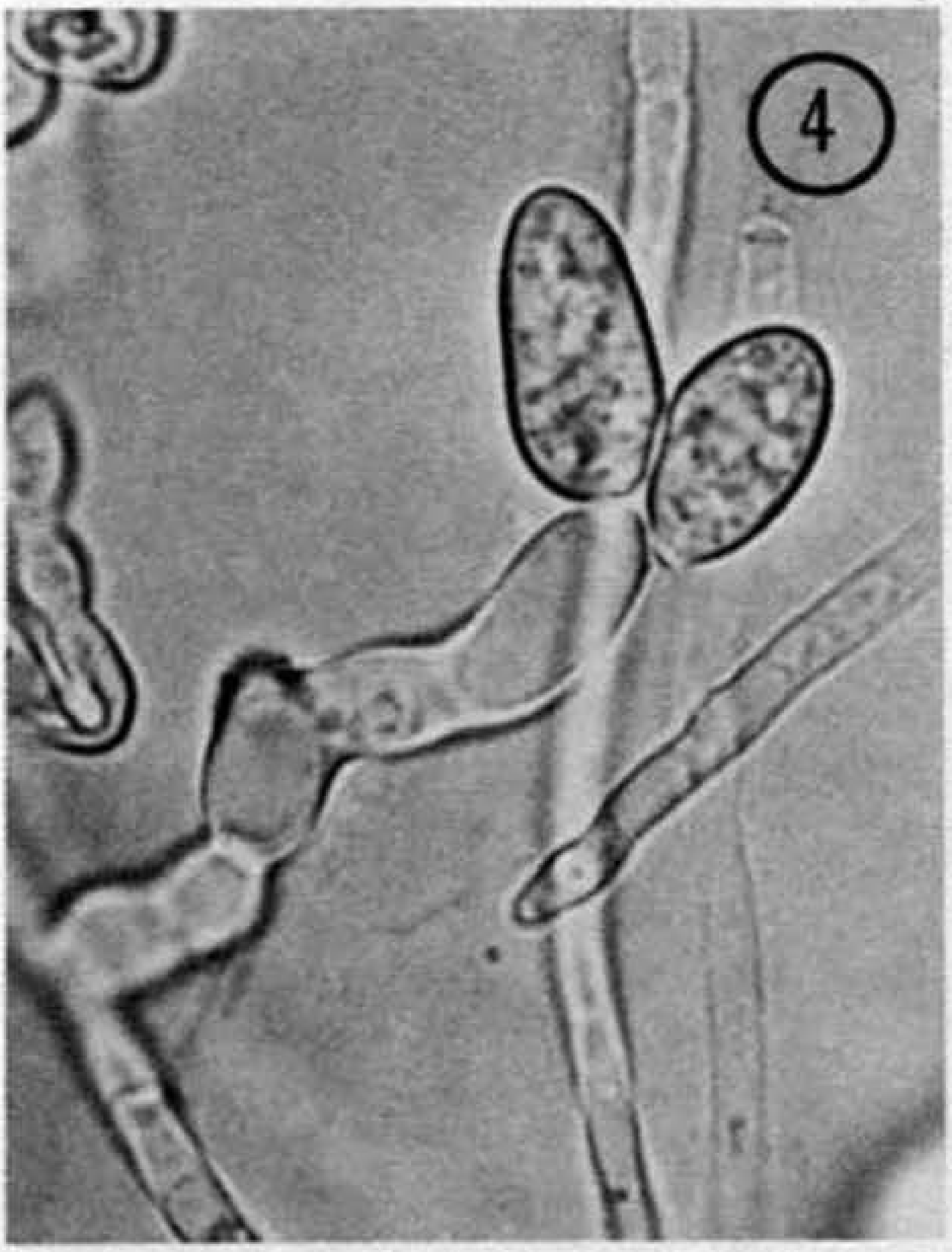
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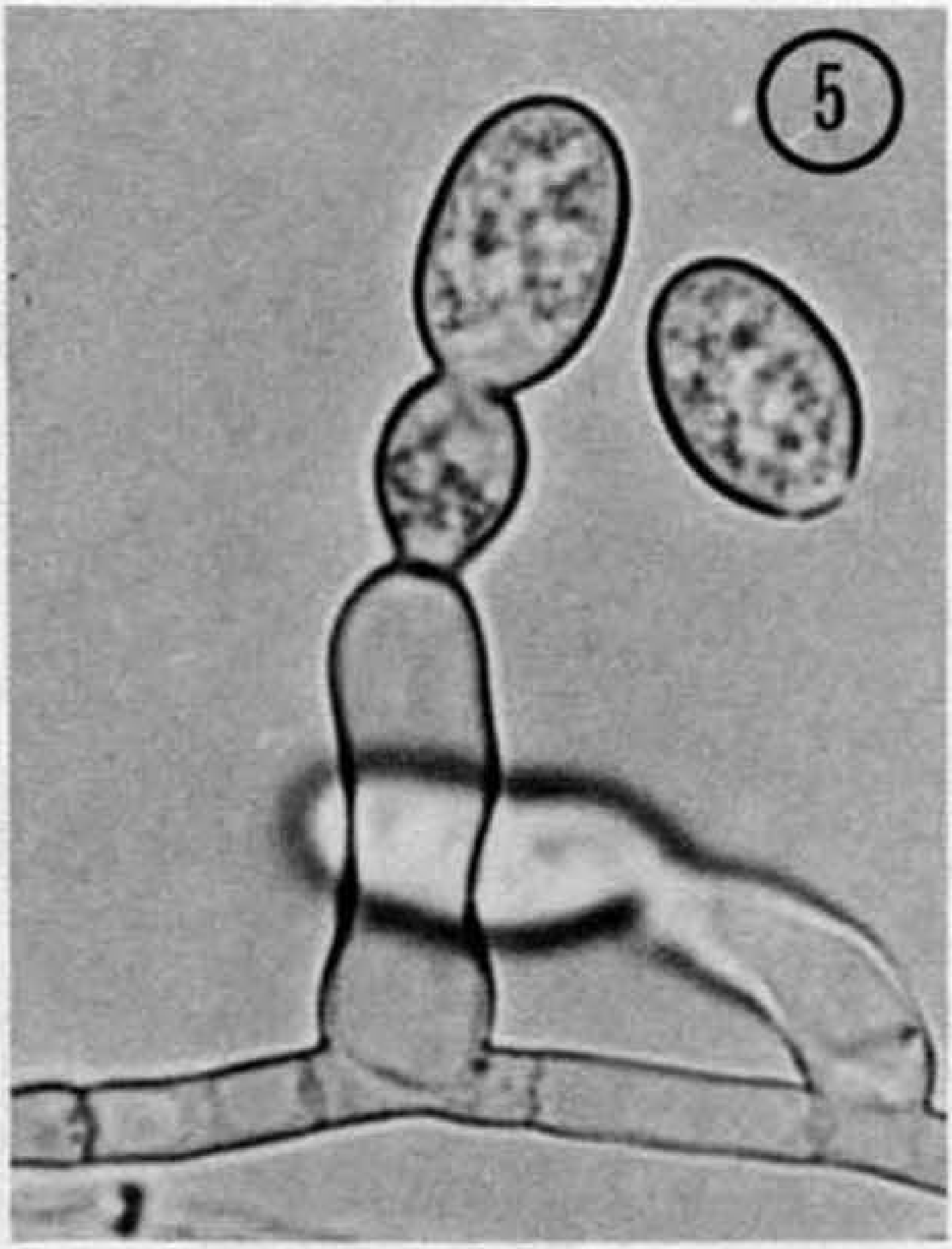
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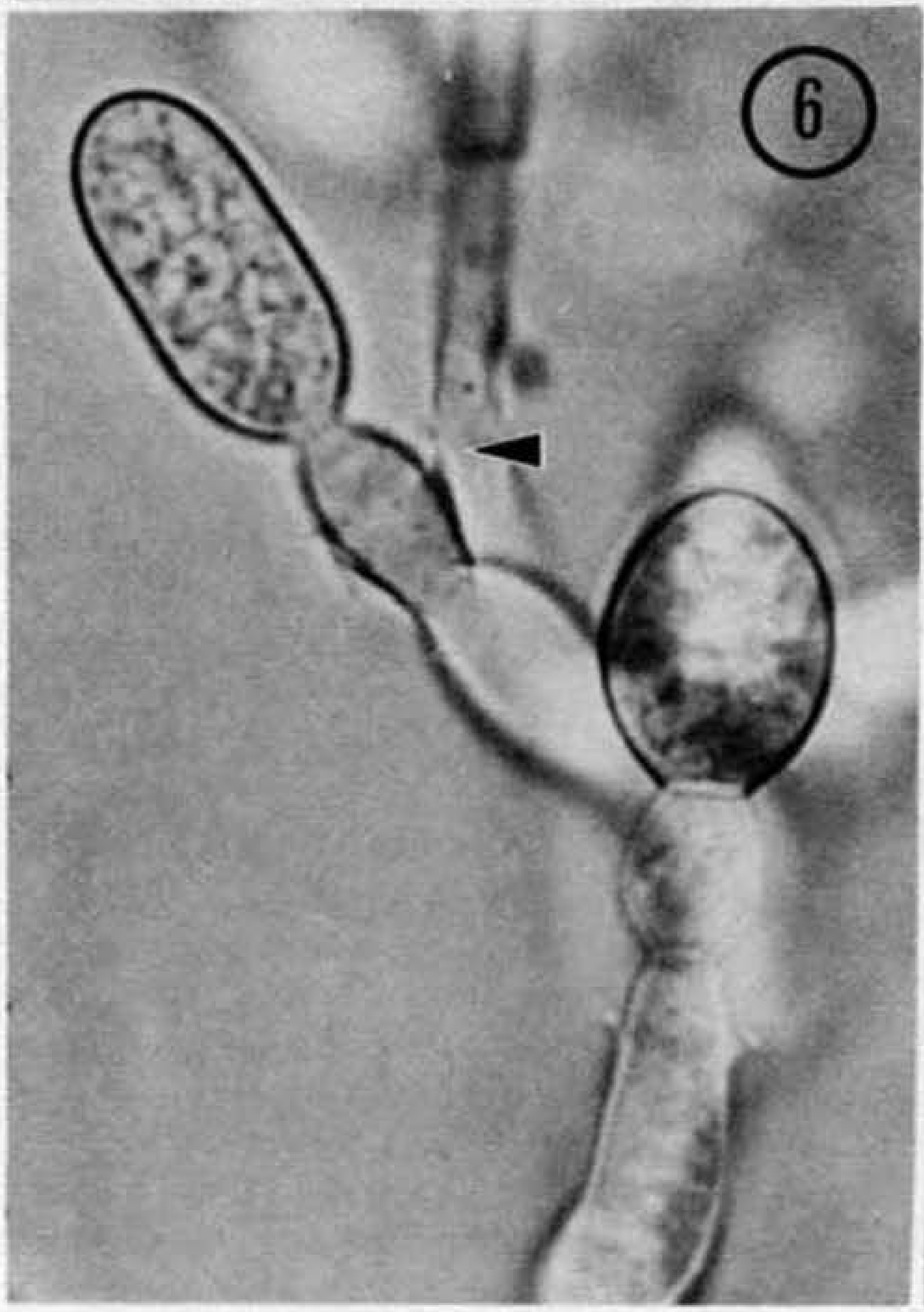
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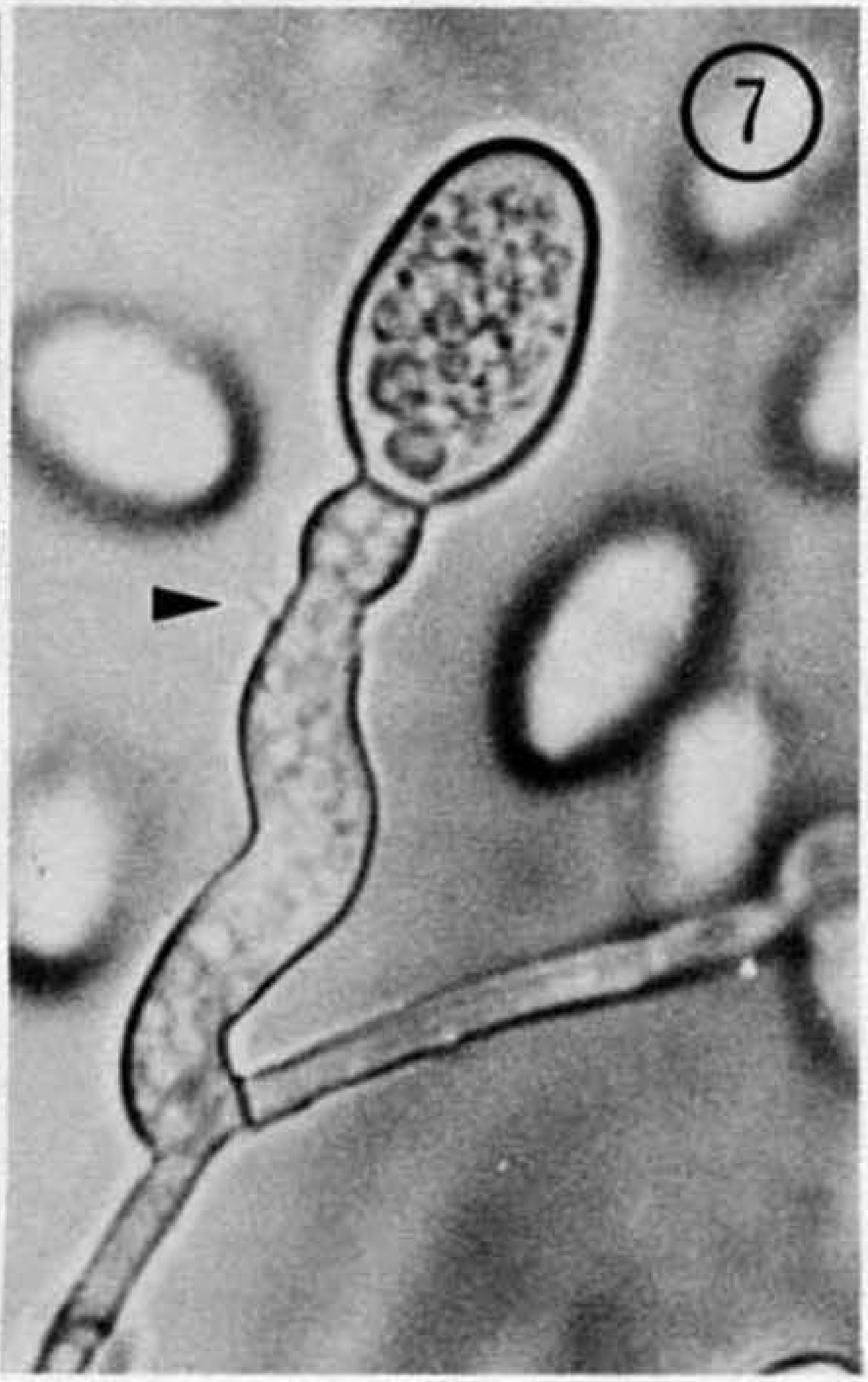
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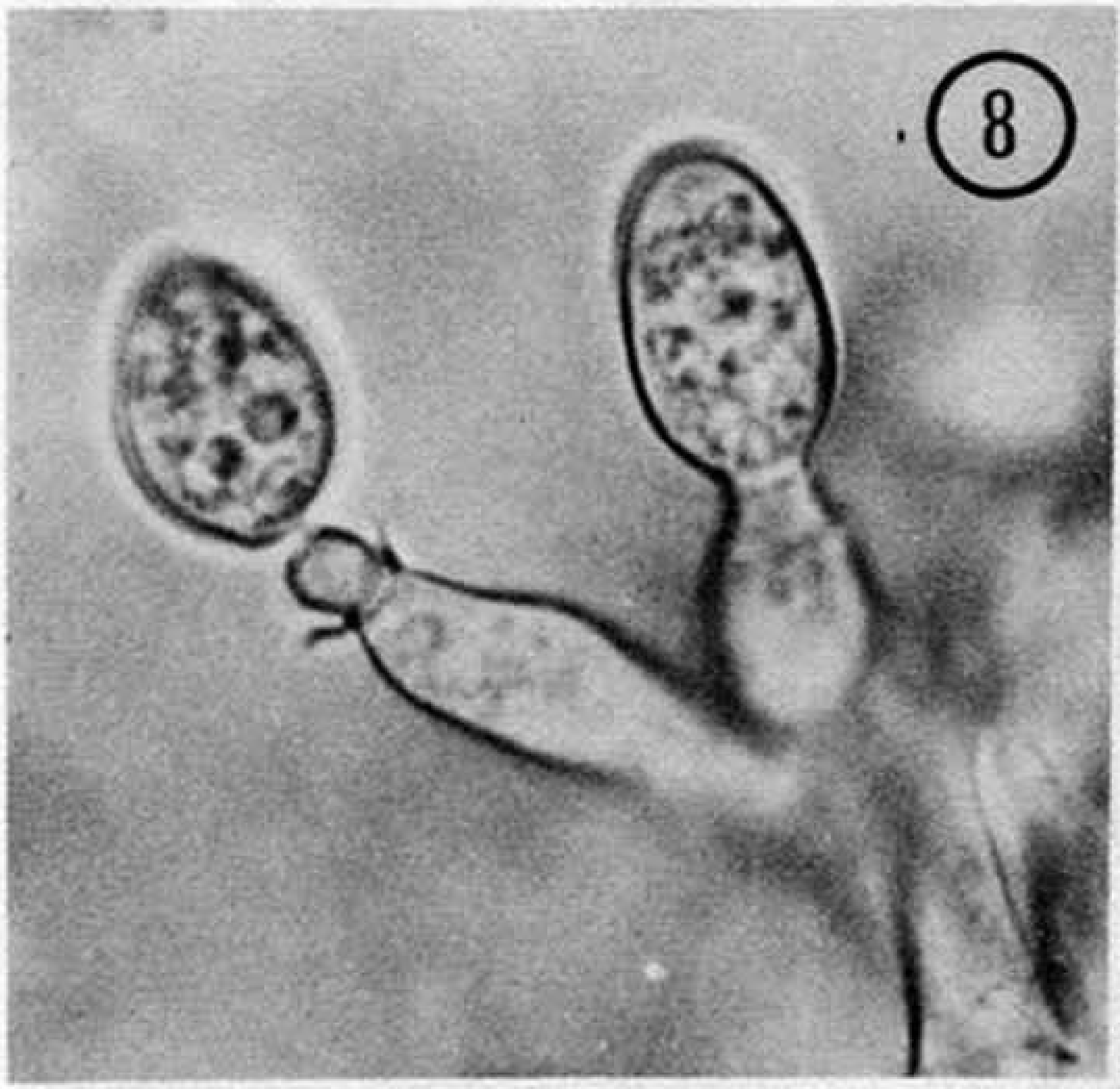
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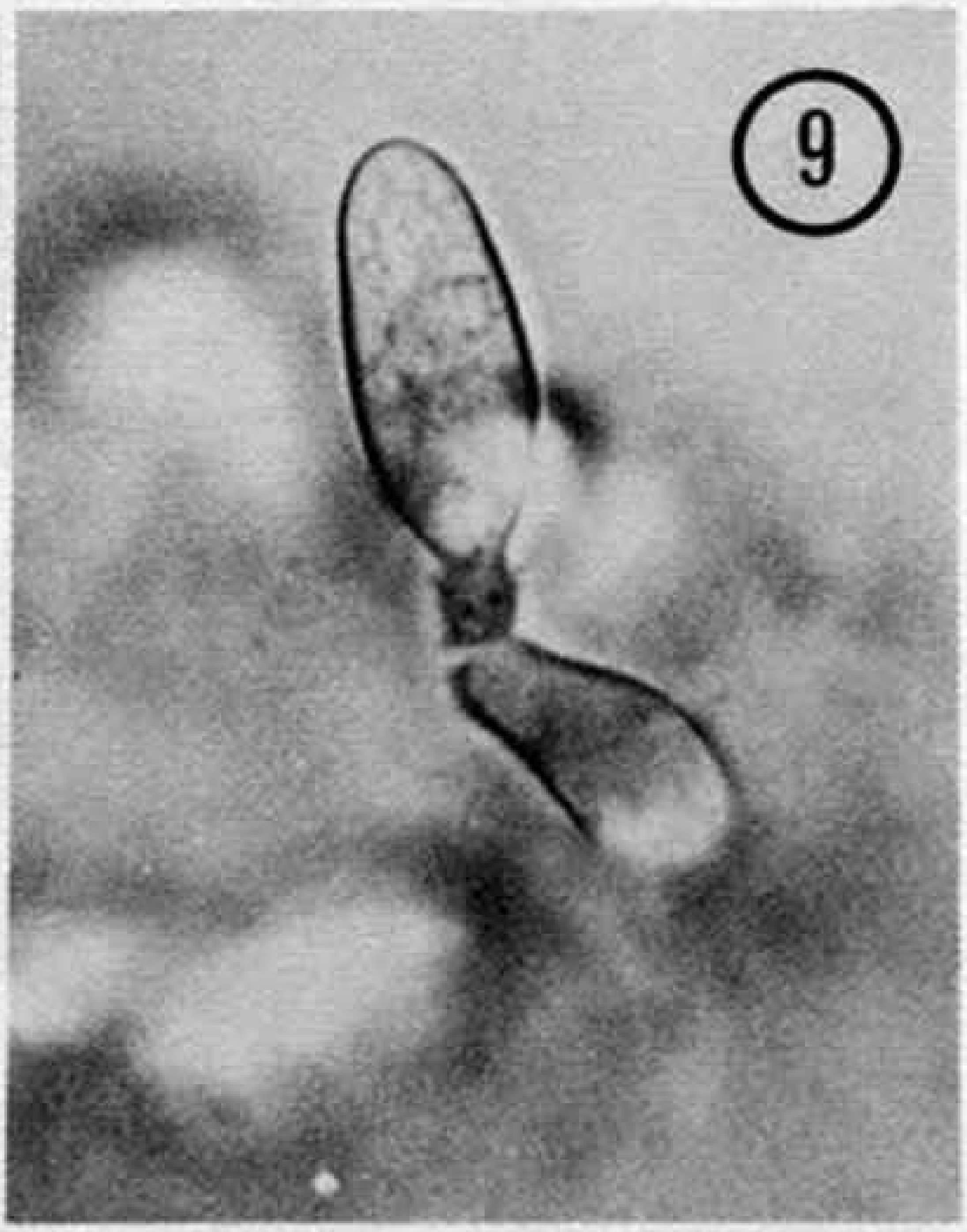
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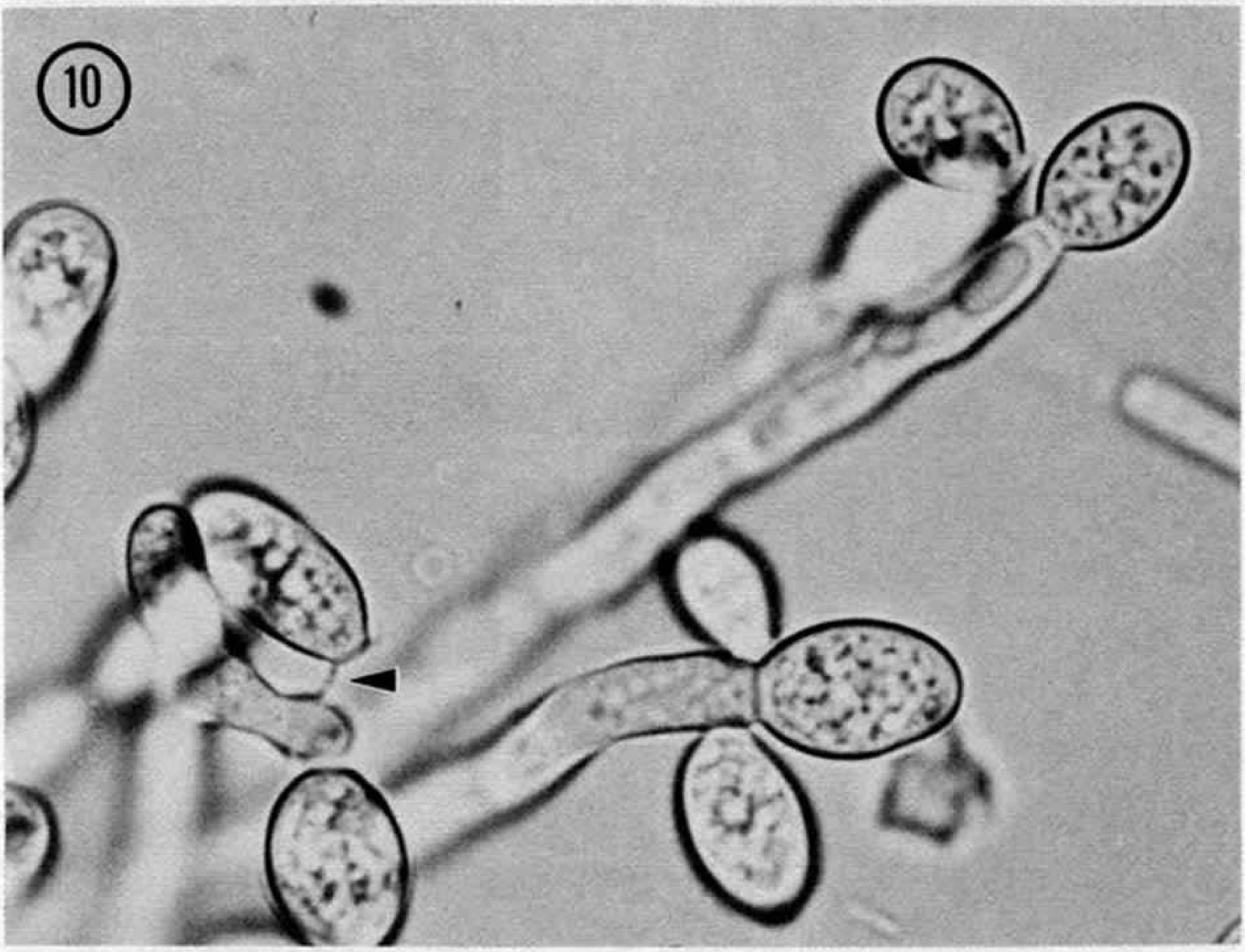
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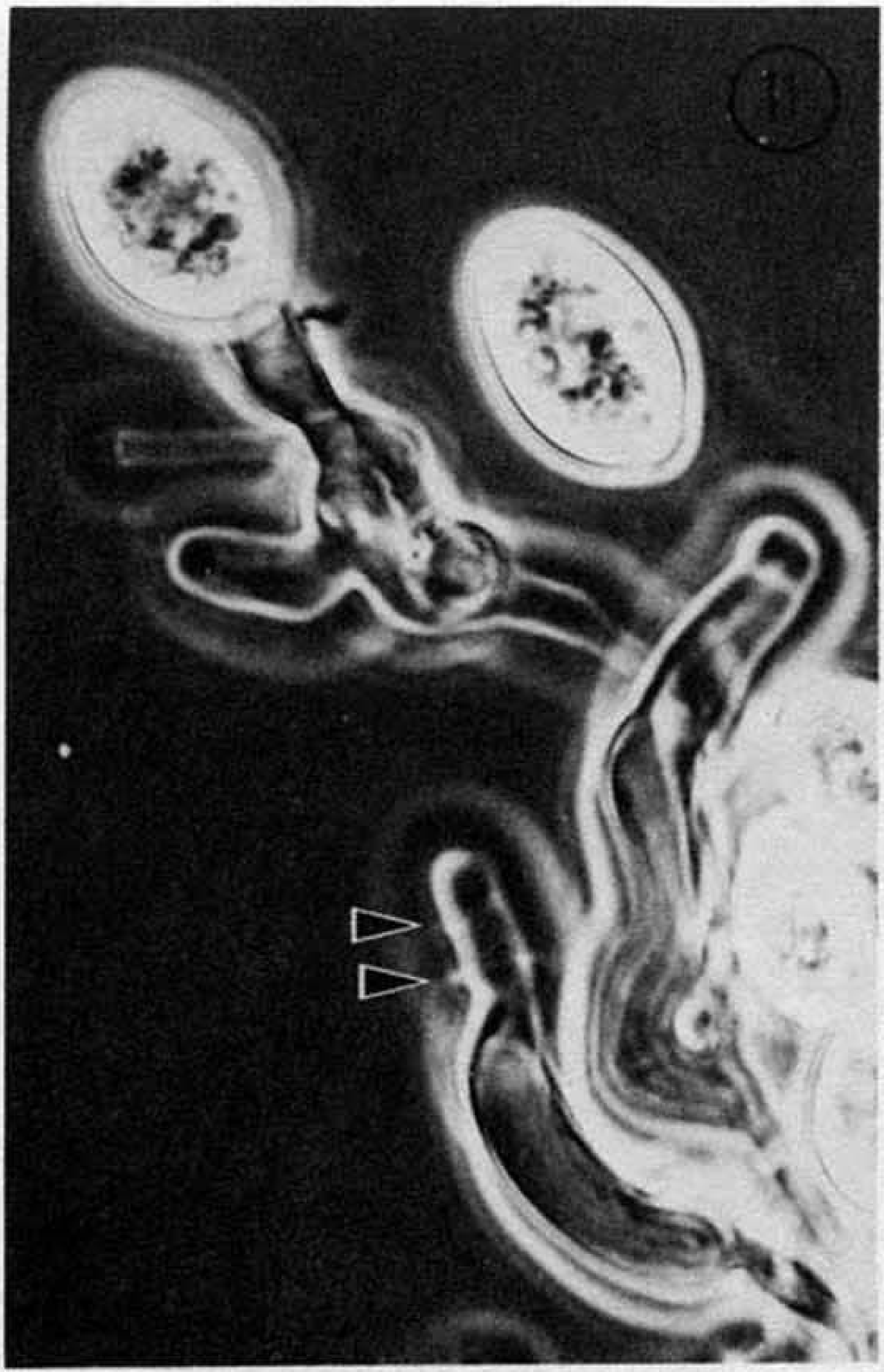
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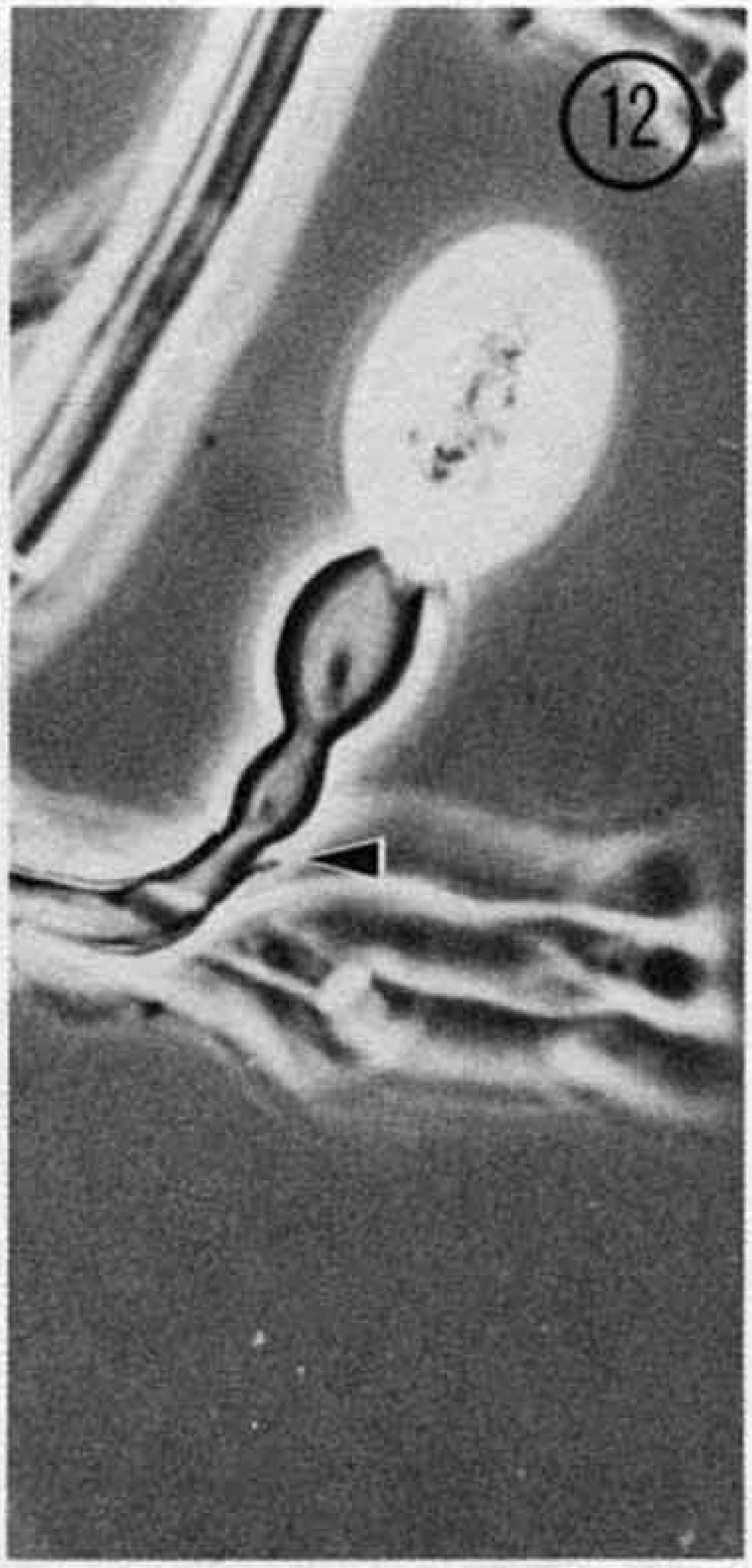
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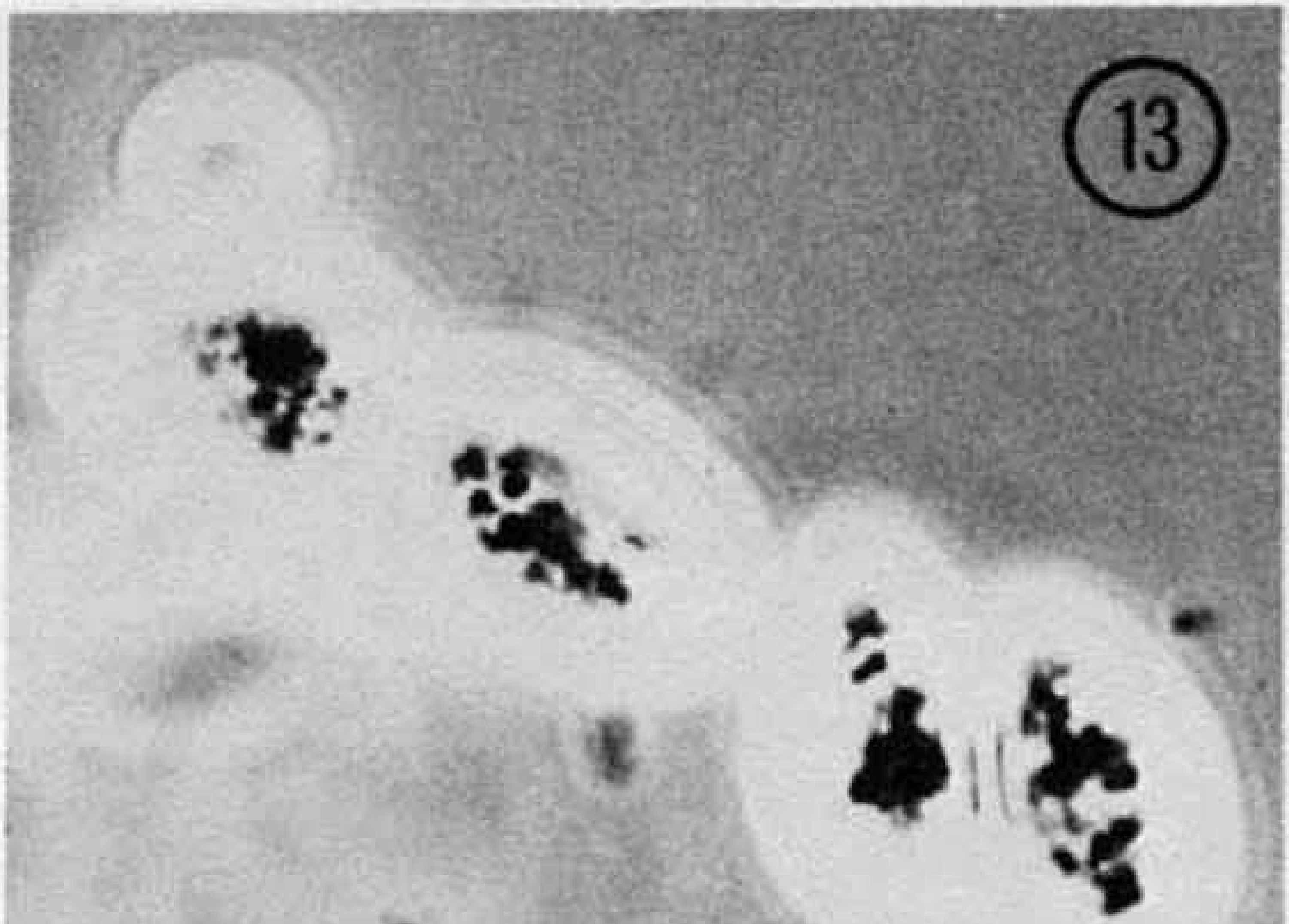
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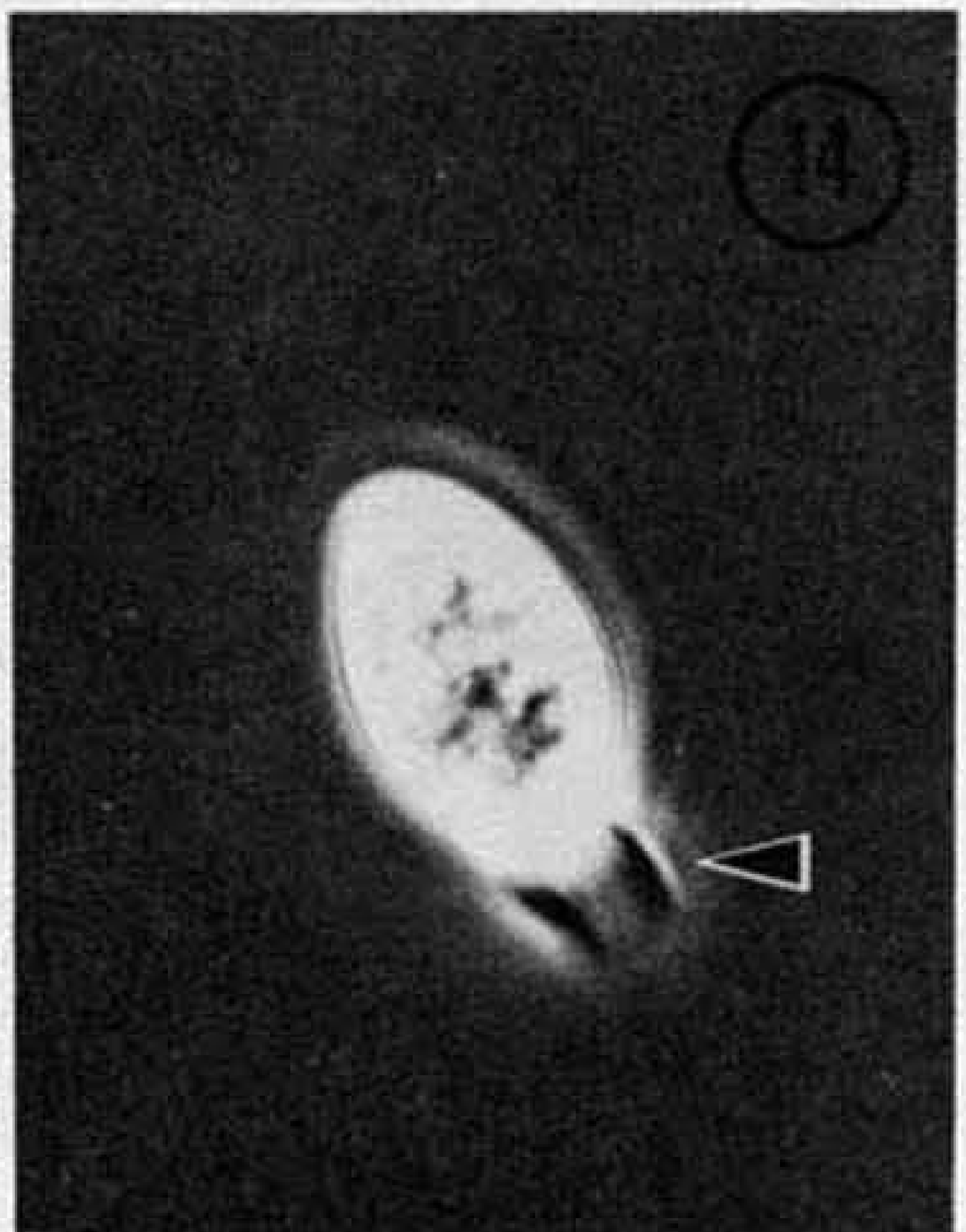
14

MYCOTAXON

Vol. XXV, No. 1, pp. 175-182 January-March 1986

EXPERIENCES IN COMPUTERIZING THE NATIONAL FUNGUS COLLECTIONS' SPECIMEN LABEL DATA

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The National Fungus Collections (NFC) is associated with the Mycology Laboratory, Agriculture Research Service, U.S. Dept. of Agriculture. The collections contain about 875,000 dried fungus specimens with about 10,000 specimens added each year. The specimens are arranged in a 'phylogenetic' sequence based on Saccardo. Additional information on the collections and their history can be found in Lentz (1968).

Space charges and personnel costs associated with the maintenance of the collections are substantial. This cost demands a fuller utilization of the herbarium resources. For example, we should be able to retrieve information about individual specimens. After all, how many institutions would support the storage of books if there was no card catalog? Computers are very useful for storage, manipulation, and retrieval of specimen data, and with decreasing prices and increasing capabilities of computers their use in managing herbarium data becomes more attractive. Recognizing that label data is the key to an herbarium's holdings, the Mycology Laboratory initiated a project in 1978 to computerize the label data associated with the herbarium specimens.

This paper presents a review of the procedures developed for the project so that future efforts by other groups can benefit from our experiences. The discussion will deal with general procedures rather than details of specific hardware or software and is intended for scientists who are considering initiating a similar project. The discussion is divided into three sections: 1. History of project 2. Current procedures 3. Additional important concepts.

HISTORY OF THE PROJECT

The project has evolved through several phases, which I have listed below. Two of them (optical character recognition and use of outside contractors) are discussed in some depth as they may be of general interest.

A. Exploratory -- involving discussions with various individuals and organizations.

B. Initial data entry -- procedures developed for data entry and for handling the specimens.

C. Optical character recognition data entry -- the data stored on magnetic tape and manipulated using a remote mainframe computer.

D. Contracted data entry -- utilizing outside contractors to enter data.

E. In-house data entry -- hiring permanent personnel for data entry.

F. Complete in-house system -- purchase of hardware and software.

In the first years of the project optical scanners were used for data entry. An optical scanner is a device that is capable of scanning a page of typewritten information and transferring that information to the computer file. The information was typed on specially formatted sheets using any typewriter that can reproduce the type style required by the optical scanner. Over half the records in the current data base were entered in this manner. The mechanical nature of the process was its major disadvantage. Accurate data input from a scanner requires that the text begin at a precise location on each page, that the paper is aligned correctly in the typewriter, and that corrections are clearly typed and properly spaced. It was frequently faster to retype a sheet than it was to make a successful correction (assuming no new errors were made). Simply inserting the paper into the typewriter is time consuming.

The advantages of using the scanner for data input were:

1) It was not necessary to purchase any special computer equipment, and 2) expertise in using a computer was not required. We were able to enter a significant number of records into the computer file and then evaluate the viability of the project without committing significant financial and personnel resources except for inputting the data. The use of an optical scanner still represents a possible approach for small data bases or feasibility studies where direct (on line) access to a computer is limited.

For two years work was contracted out to an organization located outside Washington D.C. area. Photocopies of the specimen labels were sent to the contractor and completed OCR sheets returned. This procedure was discontinued for the following reasons.

1. Inability to find a qualified contractor. Contractors were not knowledgeable in herbarium practices or mycology. Training them was complicated by the physical separation.

2. Use of copied labels by contractor. Contractors were unable to check labels that did not copy well.

3. Need to critically review contractor's product. Close scrutiny of the returned data was critical to monitoring the accuracy of the contractor's work. We had to develop personnel with the necessary skills and knowledge and thus we were paying both the contractor and in house personnel to do the same job.

4. Lack of resources, especially literature. This hampered the contractor's ability to deal with questions such as spelling of scientific names. Again we found ourselves doing work that we hoped would be done by the contractor.

CURRENT PROCEDURES

The way an institution handles a project such as this depends upon the available human, computer, and financial resources. There are some factors which have general application and merit consideration when planning such a project. These factors will be discussed in the explanation of our present procedures.

A minicomputer with 300 megabytes of disc storage is currently used for the project. The typists and the computer are located in a room adjacent to the herbarium. Three typists each working 32 hours a week enter the data. One full time employee edits foreign and illegible labels. The supervision of the data entry, editing of domestic labels and preparation of the herbarium is carried out by a fifth employee who spends about 80% of his time on these activities. Temporary help (25% of a full time position) is used to assist in the numbering and copying of labels.

Because groups of related fungi are closely located in the herbarium, we have proceeded to computerize the herbarium by major fungal groups. At this time we have completed the rusts, smuts and many of the polypores making a total of 260,000 computerized specimens. With the personnel listed above, we are proceeding at the rate of 45,000 specimens per year.

Below is a list of our current procedures followed by a detailed discussion of each activity:

1. Prepare herbarium.
2. Number specimens.
3. Copy labels.
4. Segregate labels as needed for editing.
5. Edit labels.
6. Input data.
7. Proofread output against copies.
8. Make additional corrections using specialized editing printouts.

1. Prepare herbarium.

Our first activity is to make a general inspection of the portion of the herbarium to be computerized. This includes checking that the specimens are in proper order, making new folders as needed and any other changes that might be required to improve the efficiency of the computerization. By affixing the same color of tape to both the herbarium case and the genus folders and then sequentially numbering the folders contained in each case we are able to quickly and accurately replace folders removed from the cases.

2. Number specimens.

The specimens are numbered sequentially using small stick-on labels with printed numbers. It is essential that each label have a permanent unique number. During the editing, data entry and proofreading, an easy, unambiguous means of recognizing a label is necessary. Because the label data on herbarium specimens may not be unique, it can be time consuming or impossible to recognize labels based solely on the actual label data. A unique number on each specimen obviates the problem of identifying one particular label. In addition, most computer programs will allow rapid access to one particular record using a unique data element. Because not all of our specimens have accession numbers, we number packets sequentially providing an easy means to determine if all labels have been added to the computer file. This may not seem to be an important point, but in reality we have found that labels were indeed left out of the file unless some means is available of identifying the number of records in the file.

3. Copy labels.

The copy machine we use accepts "foolscap" which is identical in size to a herbarium sheet. Making copies of labels is advantageous for the following reasons:

a. A group of specimens can be removed from the herbarium, immediately copied and returned to the herbarium lessening the possibility of misfiling specimens and reducing handling of the specimens.

b. Edited notations can be easily added prior to typing. A significant number of labels required some annotation before the data could be efficiently entered by the typists.

c. Labels can be segregated for specific editors.

d. Herbarium sheets are difficult to type from.

The diversity of labels in terms of color of paper and clarity of writing present a challenge to the copying process. Copy machines with user adjustable contrast are best suited for this type of copying. Even with a versatile copy machine, some copies have to be edited using the original label.

4. Segregate labels as needed for editing.

At this stage we segregate labels that have difficult handwriting or unclear locality information and give them to the knowledgeable individual who works full time on editing.

5. Edit labels.

The editors clarify information about localities, correct spellings and write out data that is difficult to read and add other notations necessary to assist the typists in inputting the data. To derive maximum value from the data base, consistency of data entry is important. To assure consistency in editing and entering data, a set of data entry standards has been formulated. These instructions cover in detail how the various elements of the label are to be entered. Included are items such as the type of information to be entered in each field, the format for entering the data, the punctuation to be used in separating the different data elements in each field and how to enter atypical data such as a date "during the summer of 1976." These instructions answer questions that might arise during the editing or inputting of the label data. These instructions have a "biblical" status and adherence to these instructions is mandatory. They are modified or added to only after consultation with the relevant higher authority.

Searching the data base for a particular type of data is greatly facilitated if you know exactly how the data has been entered in all cases. Another institution or individual can more easily incorporate your data into their system if it is known exactly how your data is organized. I transferred 190,000 records from our original software program to an entirely different software running on the laboratory's minicomputer. The success and efficiency of this transfer were a direct result of the consistency of the data entry.

6. Input data.

At this stage the software being used and your ability to take full advantage of its capabilities can have a significant effect on the overall efficiency of the project. A high degree of control over the data entered is possible. For example we maintain a computer list of the genera in our herbarium. When generic names are entered they are automatically checked against this list and if a corresponding name is not found on the list the typist is requested to re-enter the data. Thus consistency in the data entry is assured and the time needed for proofreading is reduced.

7. Proofread output against copies.

At the end of each day a printout of the labels typed by each typist is produced. This printout is proofread against the copies of the labels by a different typist. A supervisor then reviews all the corrected printouts and records the number of errors and number of records for each typist.

8. Editing printouts

The computer is used to generate special printouts for additional editing. For example, we make an alphabetical listing of collectors to check further for misspellings and consistency of data entry. These printouts are created as we complete each herbarium case. At this time we also check that all specimens in the case have been entered.

Progress of the project is closely monitored. We can accurately assess that the data is being correctly and consistently entered and that individuals are working at a reasonable level of efficiency by daily proofreading, by a review of the data for each herbarium case, and by a tally of the number of records typed each day. Monthly totals of records typed are noted in order to monitor the rate of progress. Without this type of continuous examination we have found it very easy to fall prey to inconsistent data entry and lowered efficiency. Equally important regular monitoring allows the early detection of problems so that they can be dealt with immediately.

ADDITIONAL CONSIDERATIONS

Our experience suggests the following guidelines:

1. Do not get bogged down with extraneous data that is not critical to meeting the goals of the project. Solving all the nomenclatural or taxonomic problems before entering the data will slow progress in computerization. Such

problems can generally be handled more efficiently after the data has been entered.

2. Establish well-defined, attainable, long-term, sort-term and intermediate goals. These goals are helpful in providing a realistic picture of the rate at which the project is progressing; daily or monthly rates don't clearly indicate the overall efficiency of the project. The impact of illness, vacation time, holidays, delays due to computer malfunction, and other miscellaneous activities can only be assessed over a period of several months. A short term goal provides an opportunity to stop and evaluate procedures. Intermediate goals provide the members of the project with an indicator of the project's progress and are positive reinforcements of their contributions toward its completion.

3. Communicate. All parties must participate in developing the procedures to be followed; whenever we failed to do so, efficiency was reduced. The success of a project of this type is dependent on the efficiency of the typists and their comments and suggestions must be carefully considered. Elaborate programming by the computer people will be of no value unless the needs of the typists are taken into consideration.

4. Develop adequate computer expertise. Every location will have a different mix of computer expertise, hardware, and software and thus it is difficult to make any broad generalizations about how best to make use of these resources. I doubt that a project of this type can be carried out without a member of the staff developing some interest in and knowledge of computers. This does not have to be prior knowledge, but can be knowledge gained during the course of the project. We started the project without any computer expertise and thus were dependent on outside help. Available options and the the opinions of others should be considered in order to determine the appropriate procedures. The use of a pilot project will help to clarify the correctness of your decisions.

5. Computerize new accessions. Even if you don't anticipate doing the backlog of herbarium specimens, I strongly urge that the accession of new specimens be automated. Specimen labels can easily be generated from computer records. Replacement of damaged labels or erroneous labels or new labels with annotations are easily produced. Adding new specimens to a computer file assures that the backlog will not increase. Many of the computer data bases such as <u>Bioabstracts</u> which make no attempt to enter the old data have become quite valuable with the passage of time.

7. Demand accuracy in accessioning specimens. During the 100-plus-year history of the National Fungus Collections, the quality of the label preparation has varied greatly. The computerization project is considerably

more difficult because of lazy, sloppy, and inaccurate preparation of original labels. We have had to devote scarce resources to correcting problems which never would have occurred in the first place if there had been adequate quality control when the labels were prepared. Even if computerization of an herbarium is not contemplated, resources should be devoted to monitoring the current label preparation. Later users of this data will greatly appreciate the effort.

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MYCOTAXON

Vol. XXV, No. 1, pp. 183-194 January-March 1986

THE ECOLOGICAL AND GEOGRAPHICAL DISTRIBUTION OF 108 SPECIES OF MACROMYCETES FROM THE SUBTROPICAL, EVERGREEN, BROAD-LEAVED FORESTS IN CHINA

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SUMMARY

From the subtropical evergreen broad-leaved forests of China, the authors collected 108 species of macromycetes. Their distribution in the whole country may be divided into eight districts. In the warm temperate broad-leaved forest, these fungi are most frequent (56% of the species recorded), and least frequent in Qing-Zang highland (8%).

In these fungi, 17 species are distributed widely in at leasts 5 districts, and 24 species have a narrow distribution in only 1 or 2 distrcts.

This article considers the influence of climatic factors on the distribution of fungi. The types of trees also influence the distribution of fungi. Among these fungi, 21 species are ectomycorrhizal, symbiotic with trees.

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* We would like express our thanks to Professor Richard P. Korf (Cornell University U.S.A.) and Professor Zang Mu (Kunming Institute of Botany, China) for their many valuble suggestions about this article.

Comparatively speaking, in China, research on vegetation has had a long history and a firm foundation, but this research was mainly on flowering plants. The macromycetes which are very important to the whole vegetation were not emphasized. In this article, from the ecological and geographical distribution of macromycetes, we analyse 108 species of fungi collected by us from subtropical evergreen broad-leaved forests. This will provide the basic data for deeper research on the Chinese vegetation, afforestation, and utilization of macromycetes.

This district (No.4 in table) is the largest vegetational district in China, accounting for 1/4 of the area in China. The northern boundary is about 34 degrees north latitude, the southern at the Tropic of Cancer, the eastern at seashore and Taiwan island, and the western limit the slope of Tibetan plateau stretching to the west boundaries of Yunnang. In District 4, the weather is of subtropical monsoons of east Asia, the accumulated temperature $\geqslant 10°C$ of the year is 4500-7500°C and the average temperature of the coldest day is 0-15°C. The non-frost season composes 250-350 days; the precipitate of a year is larger than 1000 mm, the highest up to 3000 mm, and the drying degree is smaller than 1.00.

Owing to the climatic conditions and higher plants serving as symbiotic trees, there are many species of fungi distributed in this district. The 108 species we collected belong to 22 families, comprising mostly families of the Polyporales and Agaricales, four other families of Basidiomycetes, and three families of Ascomycetes.

GEOGRAPHICAL DISTRIBUTION OF MACROMYCETES IN CHINA

These 108 species of fungi are not only distributed in this district, but most of them are distributed widely in other districts. From 'The Vegetation of China' (1980) according to flowering plant and after analysing the fungal flora of this area, eight districts may be delimited (see table; because there is no exact data for the first district, it is neglected in this table.). From the table it is clear that these fungi are also numerous in the third district, 'warm temperate broad-leaved forest' (56%). The second area is the second district, 'warm temperate coniferous and broad leaved mixed forest' and the 6th district,' temperate meadow' (34-51%), and in other districts there are lower (8-23%).

THE WIDESPREAD SPECIES

Owing to the large scope and the complex natual conditions of the fourth district, the numerous fungi which grow there are wide-spread species in China. We considered those species which grow over five districts to be the widespread species, and these fungi include 17 species. They belong to the seven families (most are Polyporaceae, Auriculariaceae, and Pleurotaceae) of the Basidiomycetes.

Their major characteristic is that the range of temperature and humidity for forming fruiting bodies is wider, so they can be distributed extensively. Most of their fruiting bodies are woody, leathery, or gelatinous, and they are not easy to rot. However, many species can be collected in different seasons.

THE NARROWLY DISTRIBUTED SPECIES

Characteristics of the weather and vegetation make some fungi to be the narrowly distributed. Their distribution is in only one or two districts in China. These fungi include 24 species. Most of them are fleshy and some are the mycorrhizal fungi symbiotic with trees. These fungi are influenced by the climatic condition and the forest. The associations of fungi with forest trees strongly affect these distributions.

DISCUSSION

All organisms exist under definite conditions, and distribution of macromycetes is related to these conditions. Here we considered chiefly the influence of climatic factors and of the symbiotic trees on the distribution of fungi.

(1) The influence of climatic factors on the distribution of fungi Wilkins (1946) considered that precipitation and temperature are the important factors for the growth and development of fungi. C. Teng (1966), by experiments, proved when the water in the substrate of fungi, e.g. Lentinus, is 180-260%, the mycelia can grow best. For the formation of fruiting bodies, the water of 260-340% is required. She divided the temperature forming fruiting bodies into three types:

1) Lower temperature: in this type, the highest temperature adopted for fruiting body formation is below 24°C. and the optimum is near 20°C.

Table I. Distribution and ecological factors of 108 species of macromycetes

Vegetational districts and ecological factors Names of macromycetes
Agaricus rubellus (Gill.) Sacc.
A. silvicola (Vitt.) Sacc.
Agrocybe praecox (Pers.) Fayod
Amanita farinosa Schw.
A. vaginata (Bull.) Vitt.
Amauroderma longipes (Lev.) Pat.
A. rugosum (Bl. et Nees) Bres.
Astraeus hygrometricus (Pers.) Morg.
Auricularia auricula (L.) Underw.
A. delicata (Fr.) P. Henn.
A. polytricha (Mont.) Sacc.
Bjerkandera adusta (Willd.) Karst.
Boletus edulis Bull.
B. speciosus Frost
Calvatia craniiformis (Schw.) Fr.
C. lilacina (Mont. et Berk.) Lloyd
Cantharellus cibarius Fr.
C. minor Peck
Clavulinopsis amoena (Zoll. et Mor.) Corner
Clitocybe inversa (Scop.) Quel.
C. laccata (Scop.) Quel.
C. maxima (Gartn. et Mey.) Quel.
Collybia albuminosa (Berk.) Petch

1. cold temp. forest	2. temp. coniferous broad-leaved mixed forest	3. warm temp. deciduous broad-leaved forest	4. subtropical evergreen broad-leaved forest	5. tropical monsoon & rain forest	6. temperate meadow	7. temperate desert	8. Qing-Zang highland	9. average daily temperature at the collecting time (°C)	10. monthly precipitation at the collecting time (mm)	11. *substrate	12. wide spreading	13. narrowly distributed	14. mycorrhizal
no exact data	+		+					28	176	1			
	+	+	+			+		21	219	1			
		+	+					15–21	63–127	1			
			+					28	265	1		+	
	+	+	+	+	+	+	+	22–28	282	1	+		+
			+					18	175	1		+	
			+	+				23–29	9–371	2			
	+	+	+					8–20	31–130	1			
	+	+	+	+	+	+	+	8–28	80–100	2	+		
			+	+				22–23	105–213	2			
	+	+	+	+	+	+	+	16–23	54–127	2	+		
	+	+	+	+	+	+		1–18	51–148	3	+		
	+		+					19	140	1			+
			+					19	140	1		+	+
	+	+	+					22–24	130–282	1			
	+	+	+		+	+		19	70	1	+		
	+	+	+		+			19–28	105–140	1			+
			+					27	130	1		+	
	+	+	+					122	282	1			
	+		+					22	282	1			
	+	+	+		+		+	20	130	1	+		
	+	+	+		+			21	173	1			
			+					18	140	4		+	

C. radicata (Relh.) Quel.
C. radicata (Relh.) Quel. var. furfuracea Peck
C. velutipes (Curt.) Quel.
Coltricia cinamomea (Jacq.) Murr.
Coprinus atramentarius (Bull.) Fr.
C. micaceus (Bull.) Fr.
Coriolus consors (Berk.) Imaz.
C. hirsutus (Wulf) Quel.
C. unicolor (Bull.) Pat.
C. versicolor (L.) Quel.
Corticium luridum Bres.
Craterellus cornucopioides (L.) Pers.
Cyathus stercoreus (Schw.) de Toni
Dictyophora indusiata (Vent.) Fischer
Exidia glandulosa (Bull.) Fr.
Ganoderma applanatum (Pers.) Pat.
G. japonicum (Fr.) Lloyd
G. lucidum (Leyss.) Karst.
Guepinia spathularia (Schw.) Fr.
Hygrophorus miniatus Fr.
Hypoxylon bovei Speg. var. microspora Mill.
Inocybe asterospora Quel.
I. radiata Peck
I. repanda (Bull.) Bres.
I. rimosa (Bull.) Quel.
Irpex cinnamomeus Fr.
I. lacteus Fr.
Lactarius deliciosus (L.) Fr.
L. fuliginosus Fr.
L. hysginus Fr.
L. piperatus (Scop.) Fr.
L. volemus Fr.
Lentinus subnudus Berk.
Lenzites betulina (L.) Fr.
Lepiota americana Peck
Linderiella columnata (Bosc) Cunn.
Lycoperdon pyriforme Schaeff.
Lysurus mokusin (L.) Fr.
Marasmius oreades (Bolt.) Fr.
Morchella esculenta (L.) Pers.
Mutinus bambusinus (Zoll.) E. Fischer

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	+		+	+	+		+	18-26	60-282	1	+		
			+					20	130	1		+	
	+	+	+					6-10	64-100	2			
		+	+					19-20	91-224	1			
	+	+	+		+			21	100	1			
	+	+	+		+			23	43-137	1			
		+	+					22	282	2			
	+	+	+	+	+	+	+	18-28	74-100	6	+		
	+	+	+		+			14-26	62-208	3			
	+	+	+	+	+	+		8-22	4-282	3	+		
			+					27	178	6		+	
			+	+				28	105	1			+
	+	+	+		+			8	89	5			
		+	+	+				25-27	105	1			
		+	+			+		14	98	6			
	+	+	+	+	+			12-25	28-282	2	+		
		+	+	+				28	105	2			
	+	+	+	+				11-28	4-127	2			
	+	+	+					22	146-175	2			
	+		+					23	133	1			
			+					23	178	3		+	
			+					21	282	1		+	+
		+	+					17	149	1			
			+					17	149	1		+	
		+	+		+			18	140	1			+
			+					20	130	3		+	
	+	+	+	+	+			25	143	2	+		
	+	+	+		+			19-20	70-148	1			+
			+					28	56	1		+	+
			+					28	176	1		+	
	+	+	+					18-28	108-140	1			+
	+		+	+	+			17	127	1			+
	+	+	+					26	45	2			
	+	+	+	+	+	+		12	28	3	+		
			+					26	184	6		+	
			+					16	127	1		+	
	+	+	+		+	+		19	148	1	+		
		+	+					24	141	1			
	+	+	+					19-27	140	1			
		+	+					16-18	74-127	1			
			+					23	208	1		+	

Naematoloma fasciculare (Huds.) Harst.
Panus rudis Fr.
Paxillus involutus (Batsch) Fr.
Peziza sepiatra Cooke
P. sylvestris (Boud.) Sacc. et Trott.
P. vesiculosa Bull.
Phallus rubicundus (Bosc.) Fr.
Phellinus pomaceus (Pers.) Quel.
Pholiota adiposa (Fr.) Quel.
Pleurotus ostreatus (Jacq.) Quel.
Podoscypha diaphana (Schw.) Ito
Psathyrella candolieana (Fr.) A. H. Smith
P. velutina (Pers.) Sing.
Pseudocoprinus crenatus (Lasch) Kuhner
Rhodophyllus sinuatus (Bull.) Pat.
Russula adusta (Pers.) Fr.
R. foetens Pers.
R. integra (L.) Fr.
R. lepida Fr.
R. nigricans (Bull.) Fr.
R. pulchella Borszcz.
R. subdepallens Peck
R. vesca Fr.
R. virescens (Schaeff.) Fr.
Schizophyllum commune Fr.
Sparassis crispa (Wulf.) Fr.
Spingipellis leoninus (Kl.) Teng
Steccherinum helvolum (Lev.) Ito
Stereum purpureum (Pers.) Fr.
S. rameale (Schw.) Burt
S. spectabile Kl.
Strobilomyces floccopus (Vahl) Karst.
Suillus flavus (With.) Sing.
S. luteus (L.) Gray
Trametes cinnabarina (Jacq.) Fr.
T. cinnabarina (Jacq.) Fr. var. sanguinea (L.) Pilat
T. corrugata (Pers.) Bres.
T. dickinsii Berk.
T. gallica Fr.
T. lactinea Berk.
Tremella fuciformis Berk.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	+	+	+	+			+	14	80	2	+		
	+	+	+	+	+			21–28	107	6	+		
		+	+		+			17	127	1			+
			+					16	127	1		+	
		+	+		+			20	130	1			
		+	+					17	127	1			
	+	+	+	+				18	61–74	1			
		+	+		+			16	127	2			
		+	+		+	+		19	175	2			
	+	+	+	+		+	+	12–14	20–150	6	+		
		+	+					22	282	1			
	+	+	+			+		12–22	6–282	1			
		+	+					17–18	63–98	1			
			+					25	455	1		+	
	+		+					21	282	1			
		+	+					28	125	1			+
	+	+	+	+				22	282	1			
	+		+		+			19	148	1			+
	+		+					28	125	1			+
	+		+		+			18	140	1			
	+		+					15–18	127–283	1			+
			+		+			21	218	1			
			+					20	130	1		+	
	+		+		+			28	125	1			+
	+		+	+	+			4–24	63–139	6			
	+		+					18	140	2			
			+	+				8	89	2			
			+					26	208	2		+	
	+	+	+		+			29	282	3			
			+		+			28	79	2			
			+					19	282	3		+	
	+		+					25–28	105–150	1			+
			+					19	148	1		+	+
		+	+					14	98	1			+
	+	+	+		+	+	+	18–19	33–34	6			
		+	+					18–19	232	2	+		
			+					23–26	30–208	2		+	
	+	+	+					25	236	2			
	+	+	+		+	+		29	53	6	+		
			+	+				12	28	6			
		+	+					25	40	2			

Tricholoma sordidum (Fr.) Quel.
Xanthochrous nilgheriensis (Mont.) Teng
Xerocomus chrysenteron (Bull.) Quel.
Total number of species of district
Percentage of total number

* substrate: 1. on ground 2. on dead wood 3. on stump 4. termitophile 5. stercoricolous 6. on stem

** All specimens are preserved in Shanghai Museum of Natural History

2) Middle temperature: the maximum, below 28°C. and the optimum 20-24°C.

3) Higher temperature: the maximum, below 30°C. and the optimum 24-30°C. For each fungal sample we checked the average daily temperature and monthly precipitation at the collecting time. From this data, it may be seen that the temperature for the fruiting body formation for most fungi is 18-28°C. the lower (below 20°C.) is 41%, the middle (20-24°C.) is 31% and the higher (over 24°C.) is 28%. The monthly precipitation is 9-283mm; the lower (below 50 mm) is 7%, the middle (50-150mm) is 70% and the higher (over 150mm) is 23%.

The range of optimum temperature and precipitation for the wide-ranging species is larger, e.g. in the case of 17 species, 9 have a wide range of optium temperature and 8 species for precipitation. The climatic conditions which narrowly distributed species demand are more severe.

From the table, we can see that the species which are distributed in the temperate coniferous and broad-leaved mixed forest are the fungi of middle temperature, or lower, rarely the higher temperature. Otherwise, the species which are distributed in the tropical rain forest are the higher temperature fungi or middle temperature fungi, rarely the lower.

(2) The influence of symbiotic trees on fungal distrbution

In these 108 species, 21 species are ectotrophic mycorrhizal fungi symbiotic with trees. Beside climatic factors, their

1	2	3	4	5	6	7	8	9	10	11	12	13	14
			+	+				20	130	1			
			+					20	91-178	2		+	
	+		+					18	140	1			+
	55	60	108	25	36	16	9				17	24	21
	51	56	100	23	34	15	8				16	22	19

distribution is related to the symbiotic trees.

From the distribution of symbiotic trees, in the subtropical, evergreen, broad-leaved forest, the conifers are mainly Pinus massoniana, P. yunnanensis, Tsuga and Abies distributed at a definite elevation. In the deciduous and evergreen, broad-leaved, mixed forest of this district, Quercus, Fagus, etc, are distributed widely. Many species are the symbiotic trees for mycorrhizal fungi and the climatic conditons are suitable, so District 4 may be the main distributional district for mycorrhizal fungi.

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MYCOTAXON

Vol. XXV, No. 1, pp. 195-202 January-March 1986

ALTERNARIA THEMES AND VARIATIONS (14-16)

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PROLOGUS

Being a continuation of a series of papers primarily on *Alternaria* (Simmons 1981, 1982), in this instance a few species known on *Euphorbia*: *A. euphorbiae* (Bartholomew) E. Simmons & S. M. Francis, comb. nov. (= *Macrosporium euphorbiae* Bartholomew, 1908), *A. euphorbiicola Simmons & Engelhard, nom. nov. (= Macrosporium euphorbiae* Reichert, 1921), and *A. angustiovoidea* Simmons, sp. nov.

VI. SOME SPECIES OF ALTERNARIA ON EUPHORBIA

Some excellent cultures of an *Alternaria* species isolated from lesions on poinsettia plants (*Euphorbia pulcherrima* Willd.) became available after the 1984-85 winter commercial growing season in Florida. The isolates represent one of at least three distinct species known to me from members of this genus. Two of these species are represented by published homonyms, which need to be sorted out to prevent confusion; I believe that a third species has not been described previously in publication. Problematic material of perhaps additional distinct species will be discussed in later papers.

14. **Alternaria euphorbiae** (Bartholomew) Simmons & S. M. Francis, comb. nov. Basionym: *Macrosporium euphorbiae* Bartholomew (1908), in E. Bartholomew, Fungi Columbiani no. 2633 [description published on exsiccata label]. Fig. 27.

Lectotype [NY]: "*On living and languishing leaves of Euphorbia marginata. Stockton, Kans., July 20, 1908. E. B.*"; (EGS 03-047). Representatives of this exsiccata number also are held by several other herbaria.

We do not know of a living isolate of this species. Conidia of this fungus frequently reach a maximum body size of 90-100 x 28µm and have an apical appendage "flexuous, curved, as long or longer than the conidia" (Bartholomew, l. c.); these long filamentous beaks become about 120 x 2µm in size and, in material observed, do not become converted terminally into chain-producing conidiophores. Bartholomew gave spore-body dimensions as 40-75 x 12-20µm, which is the size range of many conidia but which does not cover the maximum sizes observed in re-examination of the type.

Conidium-body shape is ellipsoid to ovoid, becoming 8-9 transversely septate and with 1-3 longitudinal septa in some of the broadest central transverse compartments. The beak appendage is initiated at a very early stage of conidium development; a juvenile conidium about 30µm long and with only three poorly defined septa may already have a beak cell about 20µm long. Conidium color in the type specimen is dilute tan; Bartholomew noted it as "light brown."

This fungus on *Euphorbia marginata* is not the same species that has been examined recently from *Euphorbia pulcherrima* in Florida, which is:

15. **Alternaria euphorbiicola** Simmons & Engelhard, nom.nov., a substitute for: *Macrosporium euphorbiae* Reichert (1921), Bot. Jahrb. Syst. 56: 723-724. Pl. IV, fig. 8., a later homonym of *M. euphorbiae* Bartholomew (1908); (see no. 14 above). Fig. 28.

Holotype [B]: "*auf Euph. prunifolia, Salamum prope Mansurah. 6.12.1911. S. Schweinfurth.*"; (EGS 09-103).

This fungus, originally collected in Egypt, is readily distinguishable from Bartholomew's fungus collected in the U.S.A. The type of *A. euphorbiicola* was described as having elongate, smooth, pale brown conidia 35-45 x 10-15µm plus a persistent beak 8-12µm long and with 3-6 transverse and 2-4 longitudinal septa. Re-examination of the type specimen indicates a maximum conidium size of about 50-60 x 18-20µm plus a pseudorostrum about 3-30 x 3µm; as many as 6-7 transverse septa and 1-2 longitudinal ones occur in some of the widest central cells of the conidia.

Excellent modern material of this species has originated with Arthur W. Engelhard, Gulf Coast Research and Education Center (University of Florida), Bradenton, as 1-conidium isolates from diseased poinsettia plants. Growth and sporulation of the fungus is excellent on PCA, Hay decoction, and 20% V8-juice agars, at ca. 20C, under a cool-white fluorescent light/dark cycle of 8/16 hrs.

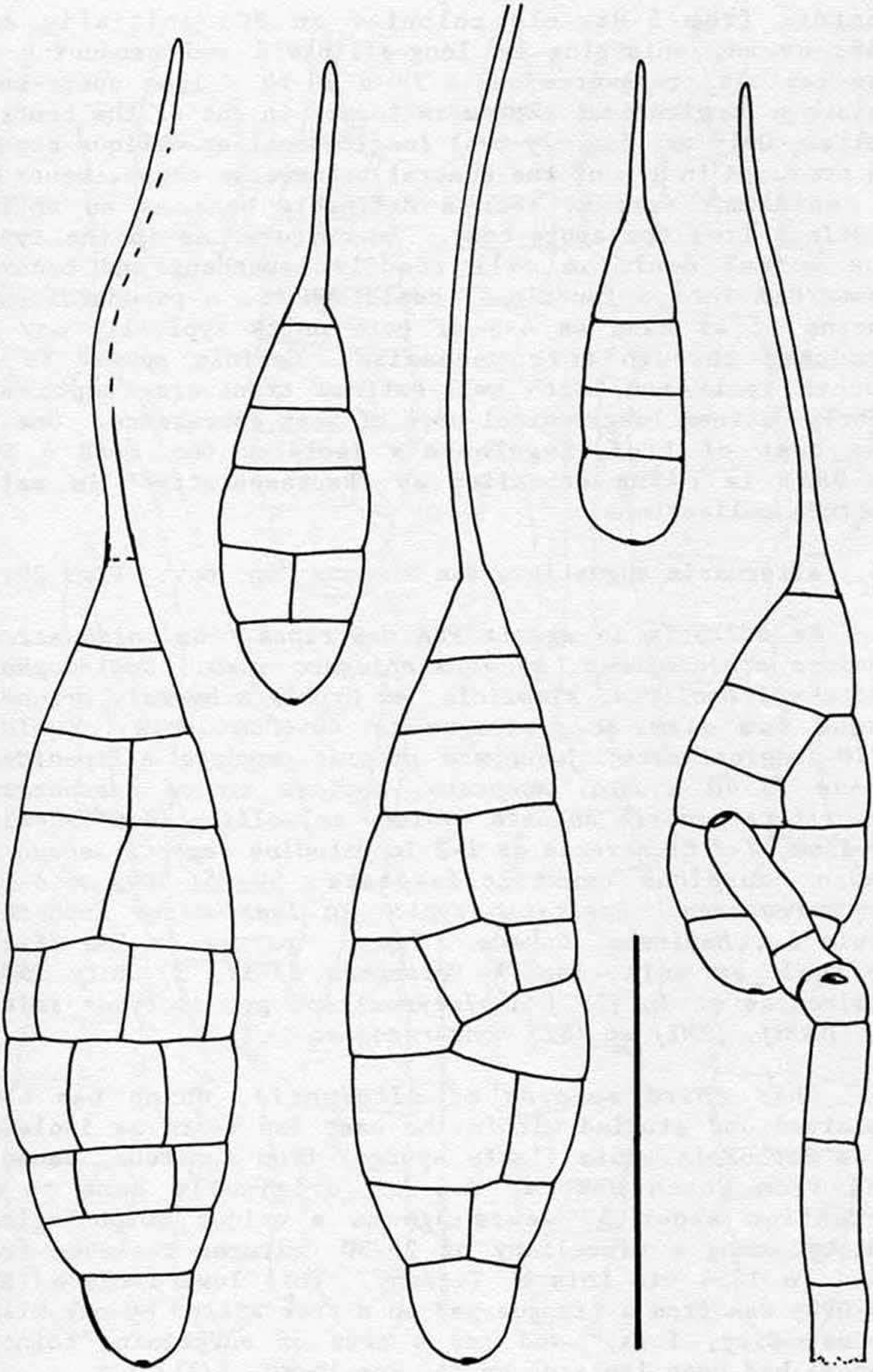

Fig. 27. Alternaria euphorbiae: conidia and conidiophore ex Type. Total length of truncated conidium is 220µm. Magn.: vertical bar = 50µm.

Conidia from 5-day-old colonies on PCA initially are long-ovoid, enlarging to long-ellipsoid and producing as many as six transverse septa in a 60-70 x 18μm spore-body before a longitudinal septum is formed in one of the central cells. Only one (rarely two) longitudinal or oblique septum is produced in 1-4 of the central transverse compartments of a conidium. Conidia lack a definable beak as an entity distinct from the spore-body. In culture, as in the type, the apical conidium cell readily lengthens and becomes converted into a functional conidiophore, a pseudorostrum; chains of as many as 4-5 or more units typically may be produced through this mechanism. Conidia appear to be smooth, pale tan, with well-defined transverse septa and poorly defined longitudinal ones of weak appearance. One of the best of Prof. Engelhard's isolates (no. 6488 = EGS 38-082) is being deposited as "Representative" in major culture collections.

16. **Alternaria angustiovoidea** Simmons, sp. nov. Fig. 29.

Ex culturis in agaris PCA descripta. Coloniae atrae, copiose conidiogenae, mycelio epiagaro raro. Conidiophora recta vel acclivia, simplicia, ex hyphis submersis oriunda, usque 4μm diam. et plerumque ca. 40-60μm longa. Conidia 8-10-longicatenata; juventute proprie anguste ellipsoidea, usque 25-40 x 8μm, aseptata, copiose minute exasperata; maturitate proprie anguste ovoidea vel ellipsoidea, 50-75 x 10-15μm, 3-8 transverse et 1-2 longitudine septata, saepe in medio conspicue constrictiseptata, 50-75(-100) x 4-5μm pseudorostrata. Habitatio typi: in laesionibus Euphorbia esula L., Manitoba, Canada. Typus: partes ex EGS 36-172 (reisol. ex cult. leg. K Mortensen 82-53, 27 July 1982) desiccatae et in [BPI] (holotypus) and pro isotypus saltem in [DAOM], [IMI] et [NY] conservandae.

This third species of Alternaria, which has been received and studied within the past few years as isolates from *Euphorbia esula* (leafy spurge) from Manitoba, Canada, and from North Dakota, U.S.A., originally came to my attention about 30 years ago as a unique morphological entity among a miscellany of 25-30 cultures received from Iowa in 1954 via Lois H. Tiffany. This Iowa isolate (EGS 04-090) was from a "fungus-pad on a tree killed by oak wilt; Forest City, Iowa," and (as a note of surprising coincidence) had been isolated by "A. Engelhard, 8/21/53."

The isolates from leafy spurge have figured in recent publications (J. M. Krupinsky and R. J. Lorenz, 1983; K. Mortensen, 1984). I have been reluctant before now to

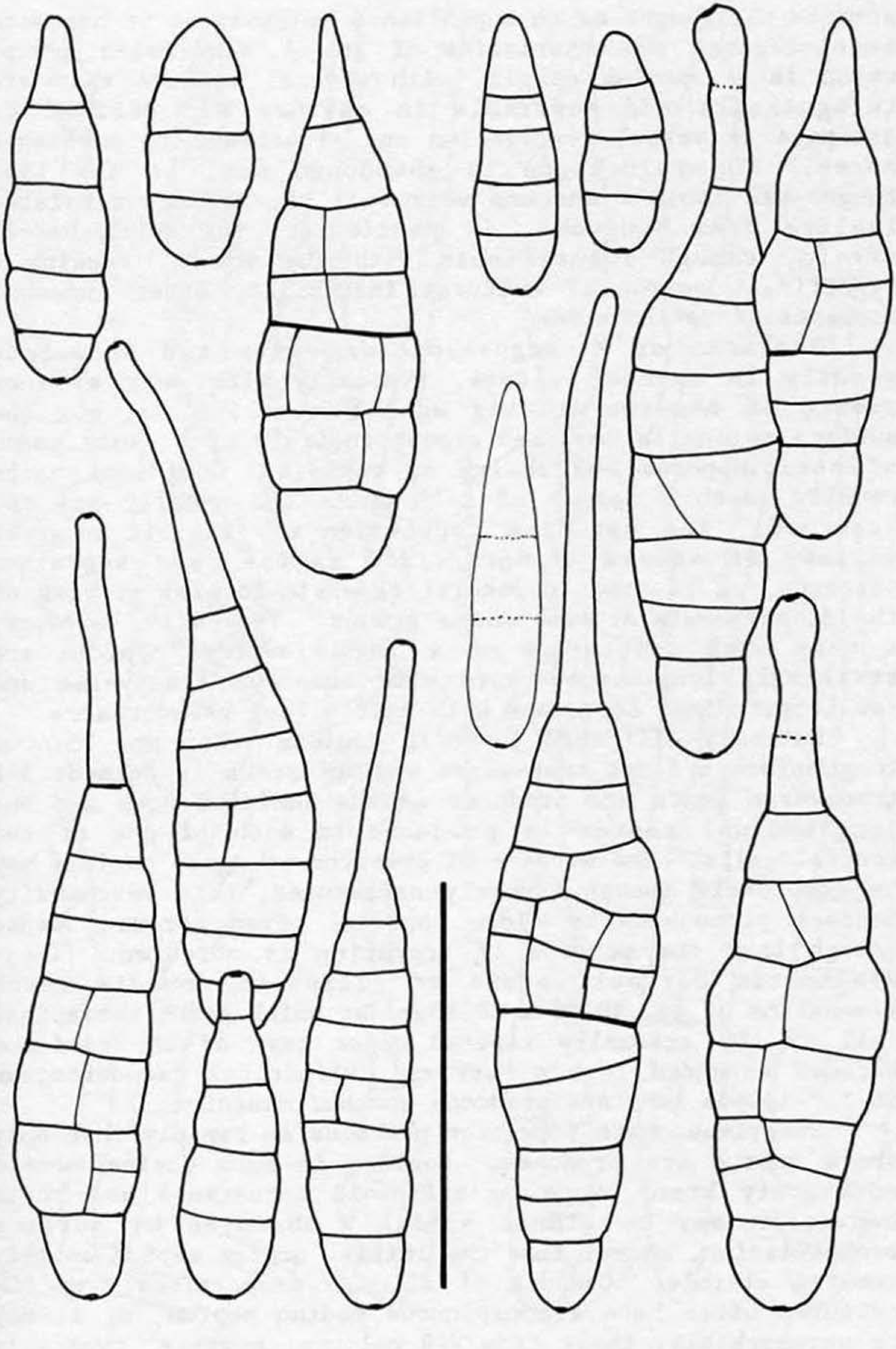

Fig. 28. Alternaria euphorbiicola: at left, conidia ex Type of Macrosporium euphorbiae Reichert; at right, conidia from representative isolate on PCA. Magn.: vertical bar = 50µm.

promote the fungus as an unpublished species, as it has some morphological characteristics of the *A. tenuissima* group, which is a species complex with several members that are recognizable and separable in culture but defiant to attempts at verbal segregation and attachment to published names. The reluctance is abandoned now, as the 1953 fungus-pad isolate matches very well the *Euphorbia*-related isolate from Manitoba, in particular; the North Dakota strain, though identifiable with the others, retains a significant degree of cultural instability after numerous attempts at re-isolation.

Isolates of *A. angustiovoidea* grow and sporulate readily in axenic culture, typically with only a minor amount of non-sporulating aerial mycelium, i. e., the surface colony is composed almost entirely of a dense stand of conidiophores and chains of conidia. Conidium chains usually reach a length of 8-10 units and usually are not branched. The conidium population may exhibit a great variety of shapes, length/width ratios, and septation patterns, as is true in general of chain-forming species of the *A. alternata-A. tenuissima* groups. Typically, however, a very high percentage of *A. angustiovoidea* conidia are strikingly long-narrow-ovoid with numerous transverse and few longitudinal septa and with fairly long pseudorostra.

Narrowly ellipsoid juvenile conidia often are 25-40µm long before a first transverse median septum is formed; 3-8 transverse septa are produced as the conidium ages and one longitudinal septum is produced in each of one or two central cells. The surface of even the youngest conidia may be completely though minutely ornamented; this verrucosity becomes pronounced on older conidia, often becoming dense enough that the pattern of septation is obscured. These diagnostic narrowly ovoid or ellipsoid conidia reach dimensions of ca. 50-75 x 10-15µm, at which point the apical cell of the gradually tapered upper part of the conidium becomes extended into a narrowly cylindrical pseudorostrum 50-75(-100)µm long and produces another conidium.

Sometimes chain formation proceeds so rapidly that only short rostra are produced. Conidia in such chains have a moderately broad ovoid to ellipsoid appearance and their septation may be almost entirely obscured by surface ornamentation, except that the initial median septum usually remains visible. Conidia of all l/w proportions from PCA cultures often have a conspicuous median septum, or it may be unremarkable; those from V-8 culture, however, typically have a strong median septum that is darker, heavier, and more constricting than any of the other septa.

Living cultures equivalent to the type (EGS 36-172) are

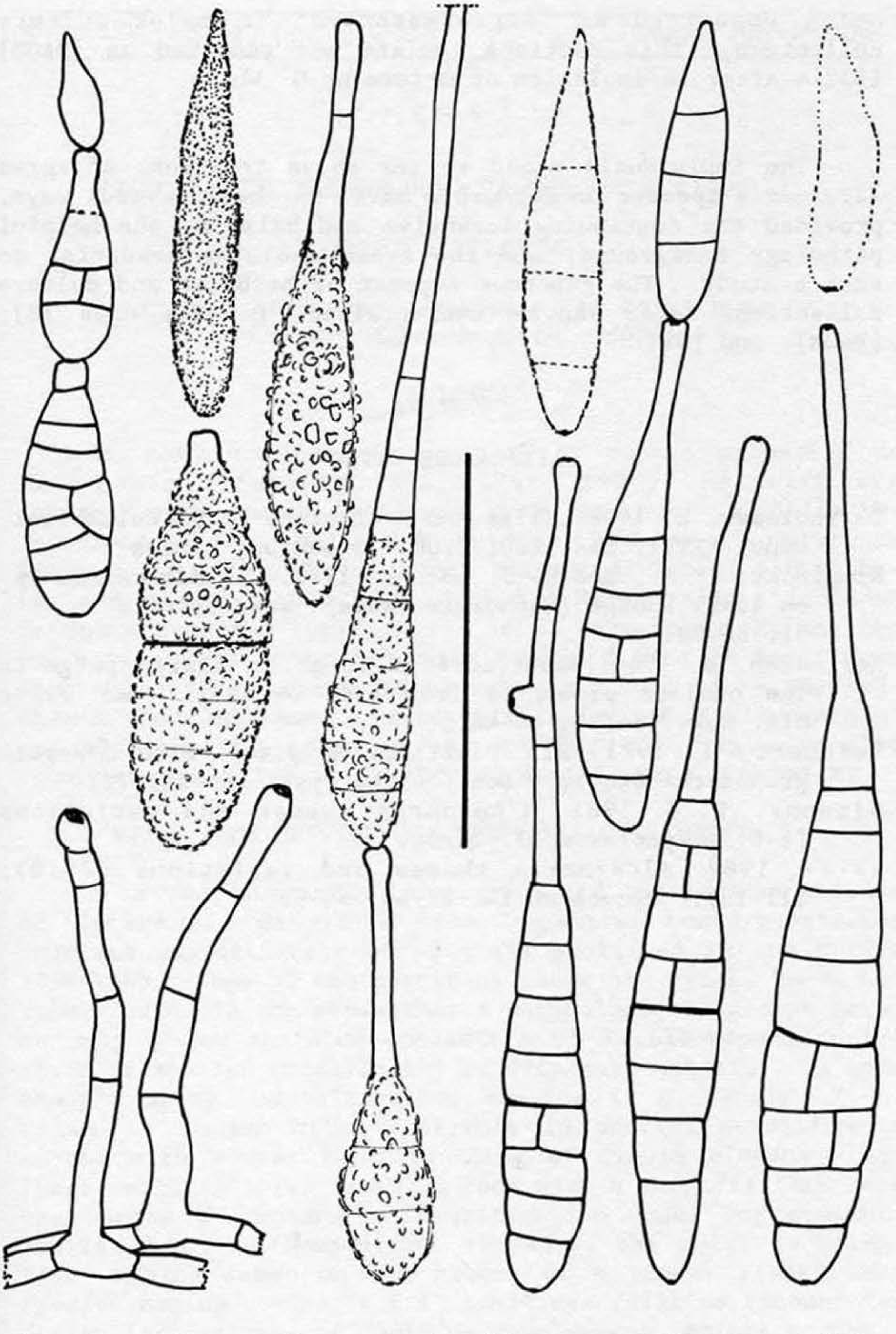

Fig. 29. Alternaria angustiovoidea: conidia and conidiophores from representative isolate on PCA. Total length of truncated conidium is 135µm. Magn.: vertical bar = 50µm.

being deposited as "Representative" in major culture collections; this Manitoba isolate was received as [DAOM] 185214 after re-isolation at Ottawa by G. White.

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The individuals named in the above treatment of three *Alternaria* species on *Euphorbia* have, in their several ways, provided the continuing incentive and balance, the helpful pathology background, and the fresh isolates essential to such a study. The generous support of herbaria and culture collections never can be over-praised, in this case [B], [DAOM], and [NY].

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MYCOTAXON

Vol. XXV, No. 1, pp. 203-216 January-March 1986

ALTERNARIA THEMES AND VARIATIONS (17-21)

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PROLOGUS

In continuation of a series of papers primarily on *Alternaria* (Simmons, 1981, 1982, 1985), herewith are comments on a few species known on *Helianthus*: *A. helianthinficiens* Simmons, Walcz & R. Roberts, sp. nov.; *A. protenta* Simmons, sp. nov.; *A. helianthi* (Hansford) Tubaki & Nishihara; and *A. helianthicola* G. N. Rao & Rajagopalan. Included is comment on the typification of *A. leucanthemi* Nelen, the validating description of which included data on fungi from both *Helianthus annuus* and *Leucanthemum vulgare (= Chrysanthemum leucanthemum)*; lectotypification of *A. leucanthemi* establishes the name as correct for the fungus usually reported since 1965 as *A. chrysanthemi* Simmons & Crosier.

VII. SOME SPECIES OF ALTERNARIA ON HELIANTHUS

A review, currently in progress, of the several species of *Alternaria* described from Compositae hosts/substrates involves approximately 60 epithets published in the period 1838-1985. Some of the pertinent names are widely known but wildly used, in the sense that a morphological concept based on only a few conidium characters of a well-known species often is applied uncritically to disparate material. A good example among compositicolous species is *A. zinniae* M. B. Ellis, a fungus often available in natural condition to anyone with access to a planting of *Zinnia elegans*. Its large, multicellular conidium body with a long filiform beak has become a convenient identification model for somewhat similar fungi on Compositae. However, the model is deceptive, having taken on the nature of a group- rather than species-naming device, for it sometimes fails to account for dissimilar patterns of conidium development, mature morphology, characters in culture, and pathology. (Cfr. Fig. 32, and Simmons, 1982: *Alt.T&V* no. 7, fig. 9-10, *A. zinniae*.)

In 1983 and 1985 several isolates and a quantity of unpublished information on an undescribed *Alternaria* species known only from *Helianthus annuus* were shared with me by Rodney Roberts (USA) and Ilona Walcz (Hungary). The fungus itself had, in fact, been known previously, as it was isolated and considered remarkable as early as 1951 by Mary E. Elliott (Canada), from whom a representative culture was received in 1956. A few other isolates, misidentified as *A. zinniae*, also have been seen.

17. **Alternaria helianthinficiens** Simmons, Walcz & Roberts,
sp. nov. Fig. 30 & 32.

Ex culturis in agaris V-8 descripta. Coloniae atrae, mycelio epiagaro inconspicuo, modice conidiogenae. Conidiophora recta vel diverse flexa, simplicia, ex hyphis submersis oriunda, usque ad 200 x 6.5µm. Conidia solitaria, raro 2-catenata; juventute proprie ellipsoidea vel ovoidea; maturitate proprie longiovoidea, apice conoidea, vulgo 68 x 18µm, 7-8 transverse et varie longitudine et oblique septata, 175-200 x 2µm filiforme rostrata. Habitatio typi in semenibus Helianthus annuus L., North Dakota, U.S.A. Typus: partes ex EGS 36-184 (ex cult. R. G. Roberts August 1983 reisol.) desiccatae et in [BPI] (holotypus) and pro isotypus saltem in [DAOM], [IMI] et [NY] conservandae.

The most stable isolates of *A. helianthinficiens* spread somewhat slowly, with only moderate amounts of submerged mycelium and very little surface mycelium (culture conditions: PCA, Hay decoction, 20% V-8 juice agars; ca. 22C.; cool-white fluorescent light/dark cycle 8/16 hrs.). Sporulation occurs on an uncrowded stand of erect, usually unbranched but sometimes geniculate conidiophores. A yellowish red pigment usually is evident under and around colonies growing on V-8 agar.

Conidiophores in colonies 10 days old are up to about 200 x 6.5µm, sturdy but somewhat sinuous, occasionally closely 1-geniculate at sites of conidium production. A single conidium is produced at each conidiophore tip; a second conidium making up a short chain sometimes is produced. Juvenile conidia are ellipsoid, quickly becoming ovoid as the conidium (especially its apical cell) increases in length and constructs its first three transverse septa; conidium dimensions at this stage are about 22 x 8µm. Conidia increase in size and septation, remaining ovoid with a conoid apical cell, and becoming about 68 x 18µm with 7-8 transverse septa and one longitudinal septum in each of 3-4 of the broadest divisions. Most conidia reach this stage of

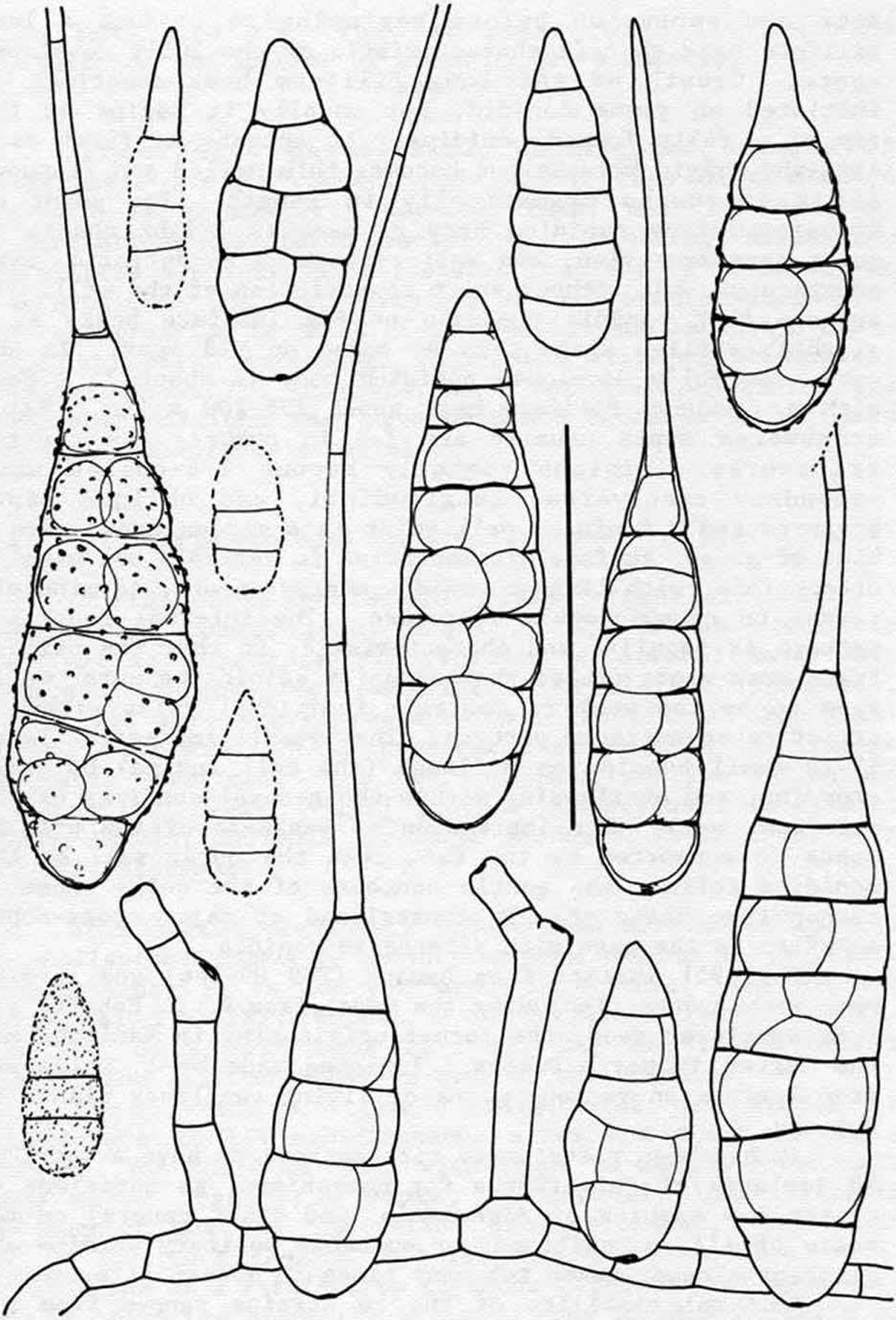

Fig. 30. Alternaria helianthinficiens: conidia and conidiophores ex Type. Total length of truncated conidium at lower left is 170µm. Magn.: vertical bar = 50µm.

size and septation before beginning to produce a long filiform beak that is characteristic of the fully developed spore. Growth of the long filiform beak sometimes is initiated on young conidia, but usually it begins at the tip of a fully formed conidium. It appears at first as a straight, rigid bristle but becomes thin-walled and flexuous as it increases dramatically in length. The point of transition from conidium body to beak (a slight change in color, ornamentation, and wall curvature) is definite, even conspicuous, but without sharp constriction of the wall. It appears that conidia produced on PCA initiate beaks at a slightly earlier stage than do those on V-8 agar. In any case, the fully developed conidium body is about 75 x 20µm with a flexuous filiform beak about 175-200 x 2µm. Major transverse septa usually are 7-8 in number; the central transverse divisions commonly become 2-6-celled when secondary transverse, longitudinal, and oblique septa are produced. Conidium wall color is a medium brown with a hint of green; surface ornamentation is variable but usually discernible, with largest conidia nearly smooth, to minutely rough, to conspicuously verrucose. The internal septation pattern is peculiar and characteristic, in that the primary transverse septa (those that actually adjoin the outer wall) seem to be too weak to restrain individual cells within a strict recto-muriform pattern. The overall impression is of 15-20 small bubbles or balloons (the cell lumina) bulging, crowding, and overlapping within the general confines of the outermost wall. The impression of weakness of the primary septa is supported by the fact that the outer wall of the conidium follows the gentle contours of the cells smoothly rather than being sharply constricted at major cross-septa as often is the case with *Alternaria* conidia.

The 1951 isolate from Canada (EGS 09-166) and several more recent ones (including the type) from R. G. Roberts are from sunflower seed, the former originating in Manitoba and the latter in North Dakota. Isolates made by I. Walcz are from lesions on various parts of living sunflower plants in Hungary.

It has been a fortunate circumstance to have a total of 10 isolates of this fungus for comparison, as decisions to typify new species of *Alternaria* (and other genera) on the basis of ill, parasitized, or unstable solitary strains are missteps already taken too many times in modern literature.

Cultural stability of the 10 strains ranged from nil (for those that became nonsporulating or failed to survive my handling routine); through unreliable (for those able to maintain growth and recognizable sporulation, however erratic, in the presence of internal hyphal parasites); to excellent (for the type, at least, with its abundant sporulation and absence of alien hyphal elements).

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(Internally parasitized, debilitated strains of *Alternaria* are so common, and ridding them of the alien element is so nearly a hopeless task, that our mycology laboratories, associated disciplines, and culture collection facilities are awash with isolates that may be "typical" or "authentic" - but that certainly are not axenic *Alternaria*. It is depressing to think of the complex and expensive host-susceptibility screening, commercial allergen production, biological control programs, and, not least, teaching and taxonomic opinions that have been and continue to be based on such duplicitous material.)

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18. **Alternaria protenta** Simmons, sp. nov. Fig. 31 & 32.

Conidiophora recta vel flexa, simplicia vel 1-5 geniculate conidiogena, usque ad 110 x 6µm. Conidia solitaria; juventute ellipsoidea, erostrata; maturitate anguste longiovoidea, basi 100-110 x 12-15µm, brunneola, levia vel raro sparsim verruculosa, 125-150 x 2.5µm filiforme rostrata, 10-13 transverse et sparsim longitudine septata. Habitatio typi in laesionibus caulium Helianthus annuus L. Typus: [IMI] 115354b (holotypus), K. Wilson, Mount Makulu, Chilanja, Northern Rhodesia, March 1963; (EGS 24-160, isotypus).

This second previously undescribed *Alternaria* species on *Helianthus annuus* is known from stem lesions in two field collections; it is not yet known in culture. The earlier material is [IMI] 68004, C. G. Hansford 1903, Kampala, Uganda, July 1936 (EGS 22-103); the later and better collection is cited above as type of the species.

Erect, medium brown conidiophores are simple or geniculate at 1-4 conidiogenous sites and about 75-110 x 5-6µm. The conidium body, with light to medium brown wall and major transverse septa, is narrowly long-ellipsoid throughout most of its period of development, matures at about 100-110 x 12-15µm in a length/width ratio of 6.0-8.3. Production of a straight to flexuous filiform beak apparently is initiated after the conidium body reaches a length of about 40-60µm; the beak becomes about 125-150 x 2.0-2.5µm at full size. Fully developed conidia have 10-13 major transverse septa and 1 paler longitudinal septum (rarely 2) in 1-7 of the transverse divisions. Most conidia appear

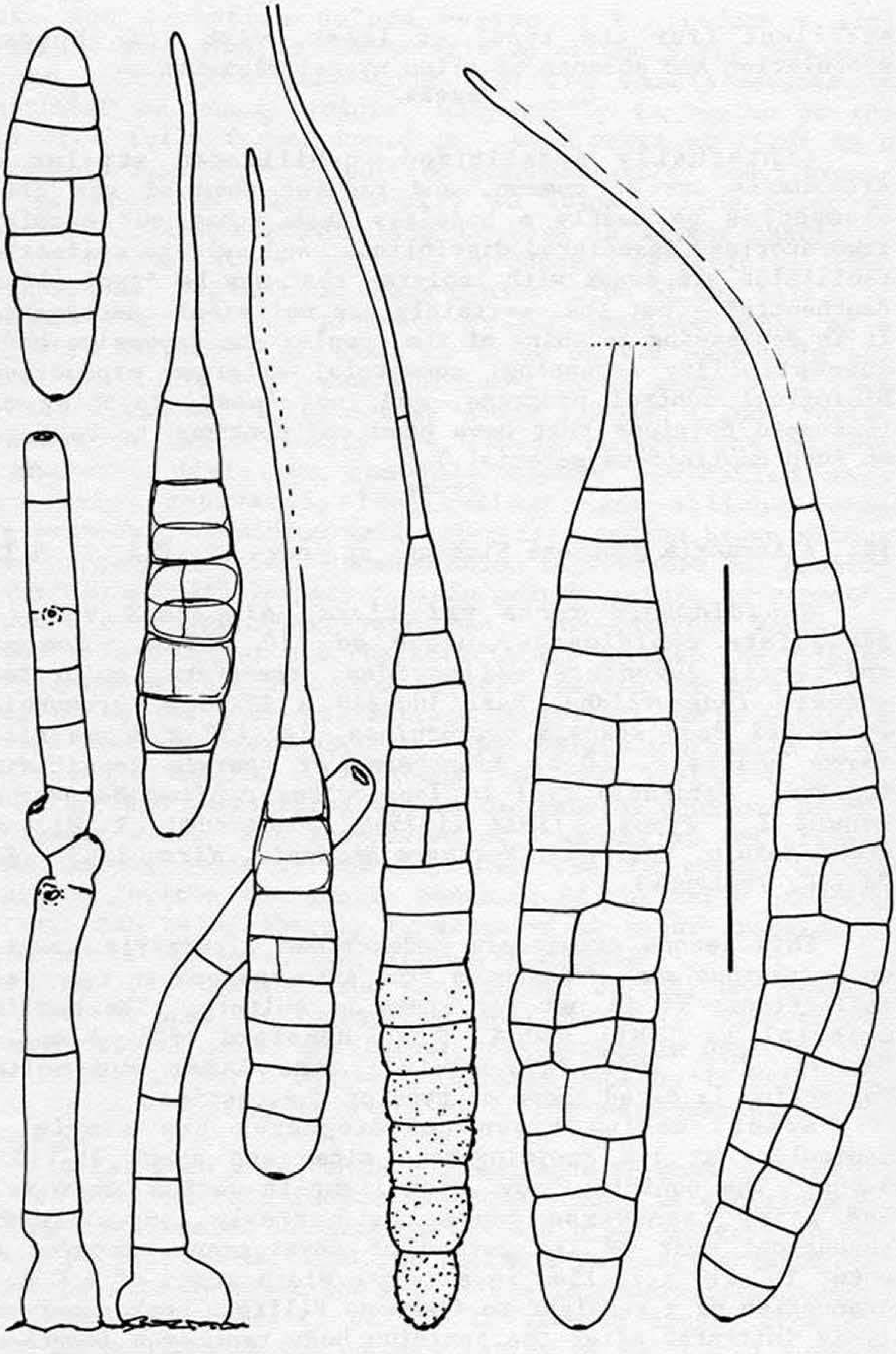

Fig. 31. Alternaria protenta: conidia and conidiophores ex Type. Total length of truncated conidium at left of center is 235μm. Magn.: vertical bar = 50μm.

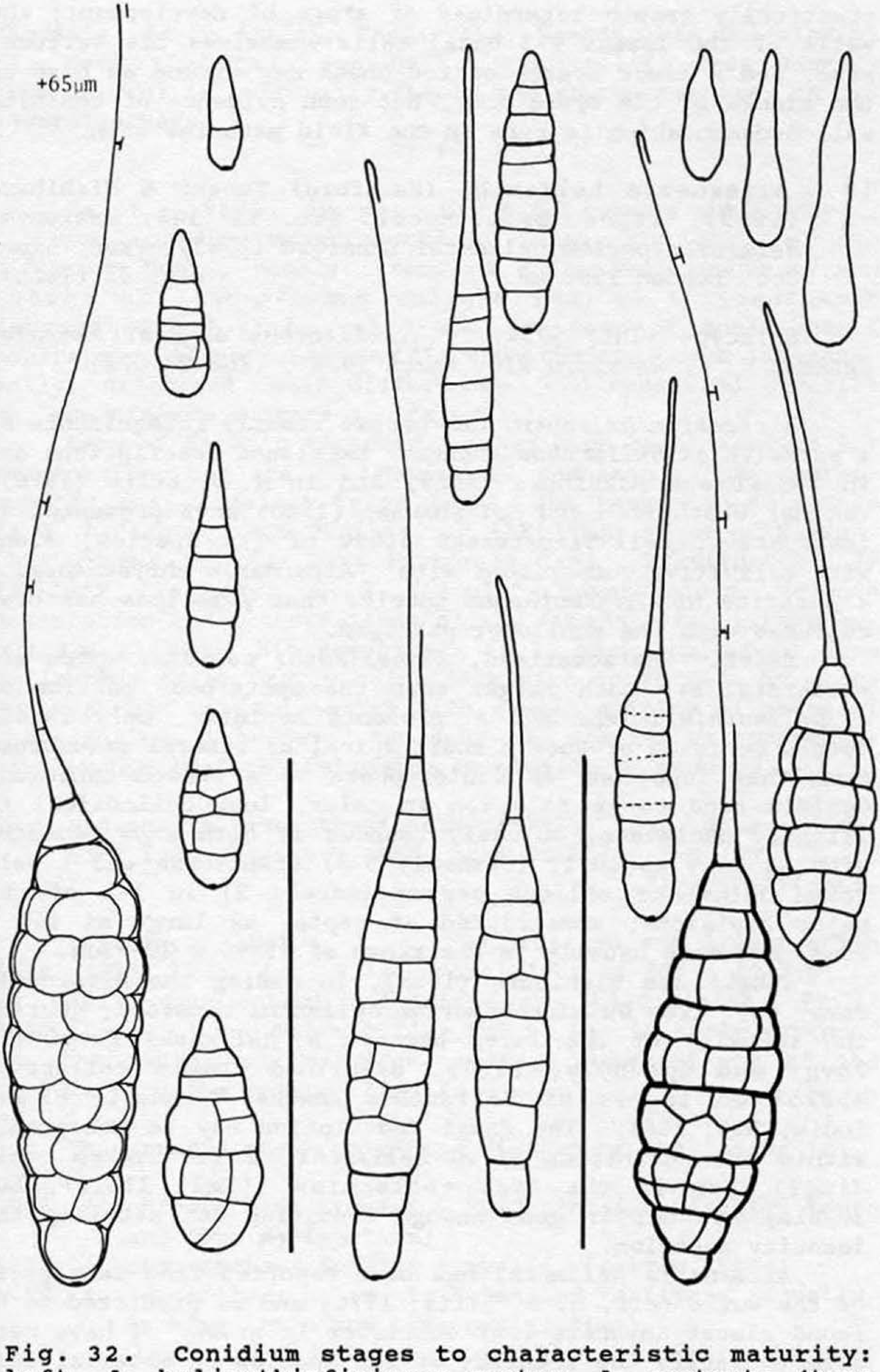

Fig. 32. Conidium stages to characteristic maturity: left, <u>A. helianthinficiens</u>; center, <u>A. protenta</u> (true juveniles not seen); right, <u>A. zinniae</u>. Magn.: vertical bars = 100µm.

practically smooth regardless of stage of development; the walls of the lowest 2-3 basal cells sometimes are verruculose, and a minor degree of roughness may extend as high as the middle of the spore body, but such evidence of conidium wall ornamentation is rare in the field material seen.

19. **Alternaria helianthi** (Hansford) Tubaki & Nishihara (1969), Trans. Brit. Mycol. Soc. 53: 148; basionym: *Helminthosporium helianthi* Hansford (1943), Proc. Linn. Soc. London 155: 49. Fig. 33 (left).

Holotype [IMI] 5754: "...*Helianthus annuus, Kampala, Uganda, C. G. Hansford 910, March 1928*"; (EGS 27-072).

Alternaria helianthi has become readily recognizable as a parasite of *Helianthus annuus*. Excellent descriptions are in Tubaki and Nishihara (1969) and in M. B. Ellis (1976). Van der Westhuizen and Holtzhausen (1980) have presented an instructive, well-illustrated study of the species, along with definitive comparisons with *"Alternaria chrysanthemi,"* a parasite of *Chrysanthemum* species that sometimes has been confused with the sunflower pathogen.

Briefly characterized, *A. helianthi* conidia, which are erostrate, are much larger than the spore-body portion of *A. helianthinficiens* and *A. protenta* conidia. Only rarely does a conidium produce a short apical or lateral pseudorostrum that functions as conidiophore to a second conidium. Conidia tend to be pale tan in color, long cylindrical to slightly obclavate, obtusely rounded at both ends, smooth, with as many as 10-12 (commonly 5-8) transverse and 1 pale longitudinal or oblique septum (rarely 2) in 1-3 of the major divisions, constricted at septa, as large as 160 x 30µm, but more usually in the range of 75-90 x 20-22µm.

Tubaki and Nishihara (1969), in making the *Alternaria* comb. nov. from *Helminthosporium helianthi* Hansford, queried the identity of the later homonym *H. helianthi* Pavgi (in Pavgi and Upadhyay, 1964), described from a collection MSP253 on leaves of *Helianthus annuus*, Varanasi, U. P., India, Nov. 1961. The Pavgi description may be acceptable within the definition of *A. helianthi*; a few broken conidia(?) seen in the type collection ([IMI] 113117, EGS 30-018) are not in good enough condition for settling the identity question.

Alternaria helianthi has been reported from many parts of the world (cfr. M. B. Ellis, 1976) and is predicted to be found almost anywhere that sunflower is grown. I have been able to verify the identity of the species on material said to originate in Hungary, India, Japan, Malawi, Northern

Rhodesia, South Africa, Tanganyika, Uganda, USA (Mississippi, North Dakota), and USSR. The isolate from Hungary (EGS 38-074) is culturally stable and representative, as are several others.

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Nelen (1962), in describing *Alternaria leucanthemi*, included conidium measurements of fungi from parts of two different hosts, namely, stems of *Helianthus annuus* L. and leaves of *Leucanthemum vulgare* Lam. (= *Chrysanthemum leucanthemum* L.); he cited the two sets of measurements separately, illustrated conidia from the two hosts independently, discussed their differences, and specified material on *Leucanthemum vulgare* as "(typus)."

Many of Nelen's *Alternaria* types have been received for examination, but the *A. leucanthemi* specimen on *Chrysanthemum* has not; I assume it is lost. The fungus on *H. annuus* is *A. helianthi* (EGS 20-164), ex [**LE**] "[*on stems of Helianthus annuus L., Far East Primorski Krai...Vladivostok...19 IX 1952, leg./det. E. S. Nelen*]." Nevertheless, Nelen's description and illustrations of the fungus from *Chrysanthemum* are so good, his comparison of it with the fungus from *Helianthus* is so nearly coincident with those made by other authors, and my familiarity with a multiplicity of material representing, I believe, the same two species is comprehensive enough that the following conclusion is reached:

20. **Alternaria leucanthemi** Nelen (1962), Bot. Mater. Gerb. Bot. Inst. Kamarova Akad. Nauk SSSR 15: 148-150.
Fig. 33 (right).

Lectotype: Nelen, l. c., description and illustration [cfr. ICBN, 1983: Art. 9.3]: "*Conidia...26-105 x 10-12µ.... In foliis Leucanthemi vulgaris Lam....Vladivostok...20 IX 1955 (typus)*," and Nelen's fig. 6 & 8; specifically excluded are the fungus on *Helianthus annuus*, descriptions of its conidia, and the related fig. 7.

The erratic name-publishing history of the fungus is:

1957 *A. chrysanthemi* Crosier & Heit (invalid, lacking Latin and type designation)
1958 *A. chrysanthemi* Schmidt (invalid, lacking Latin)
1959 *A. leucanthemi* Nelen, in Nelen and Vasilyeva (invalid, lacking Latin and type designation)
1962 *A. leucanthemi* Nelen (valid publ., now lectotypified)
1965 *A. chrysanthemi* Simmons & Crosier, in Simmons (taxonomic synonym of *A. leucanthemi* Nelen).

Briefly characterized, *A. leucanthemi* conidia are similar to those of *A. helianthi* in that they typically are large, long cylindrical to long obclavate, smooth, completely erostrate, and have numerous transverse septa. *A. leucanthemi* conidia generally reach a size range of about 75-105 x 20-30μm, with maximum lengths up to 130-160μm; form as many as 15-17 transverse and few or no longitudinal septa in field material but variable numbers of secondary transverse, oblique, and longitudinal septa in the wider transverse divisions; develop medium or darker olive-brown wall and septum color (in contrast to the paleness of *A. helianthi* conidia). Conidia produced on Hay agar tend to mature in an obclavate shape, with most of the secondary septation concentrated in the lower half of the spore; conidia produced on PCA and V-8 agars develop secondary septation in their widest transverse divisions, which occur in almost any position throughout the length of the spore. Pseudorostra and secondary conidia are extremely rare; they originate just as frequently from basal or intercalary conidium cells as they do from the apex.

Some *A. leucanthemi* isolates do not sporulate readily in culture; I probably now would spurn as unreliable the isolate QM 7227 (EGS 10-059) used in typification of *A. chrysanthemi* Simmons & Crosier. The best isolate of the species that I have handled is from a diseased leaf of Shasta daisy (*C. maximum*) received from Florida, USA, via E. K. Sobers in May 1964 (EGS 17-063 = QM 8579). It still sporulates profusely under my culture conditions and has very little tendency to produce non-sporulating aerial mycelium. Assuming similar stability elsewhere, it is a good representative and already is on deposit in major international culture collections (e. g., CBS 422.65).

Assuming correct identification of the type host *Chrysanthemum leucanthemum* (= *Leucanthemum vulgare*), the only other known host is *C. maximum* Ram. (= *L. maximum* (Ram.) DC.). A report of the species on *C. indicum* L. (V. G. Rao, 1965) describes and illustrates a fairly long-beaked *Alternaria* species quite different from *A. leucanthemi*.

Sobers (1966) made extensive attempts to induce infection of representatives of other genera of Compositae and other plant families, but was not successful.

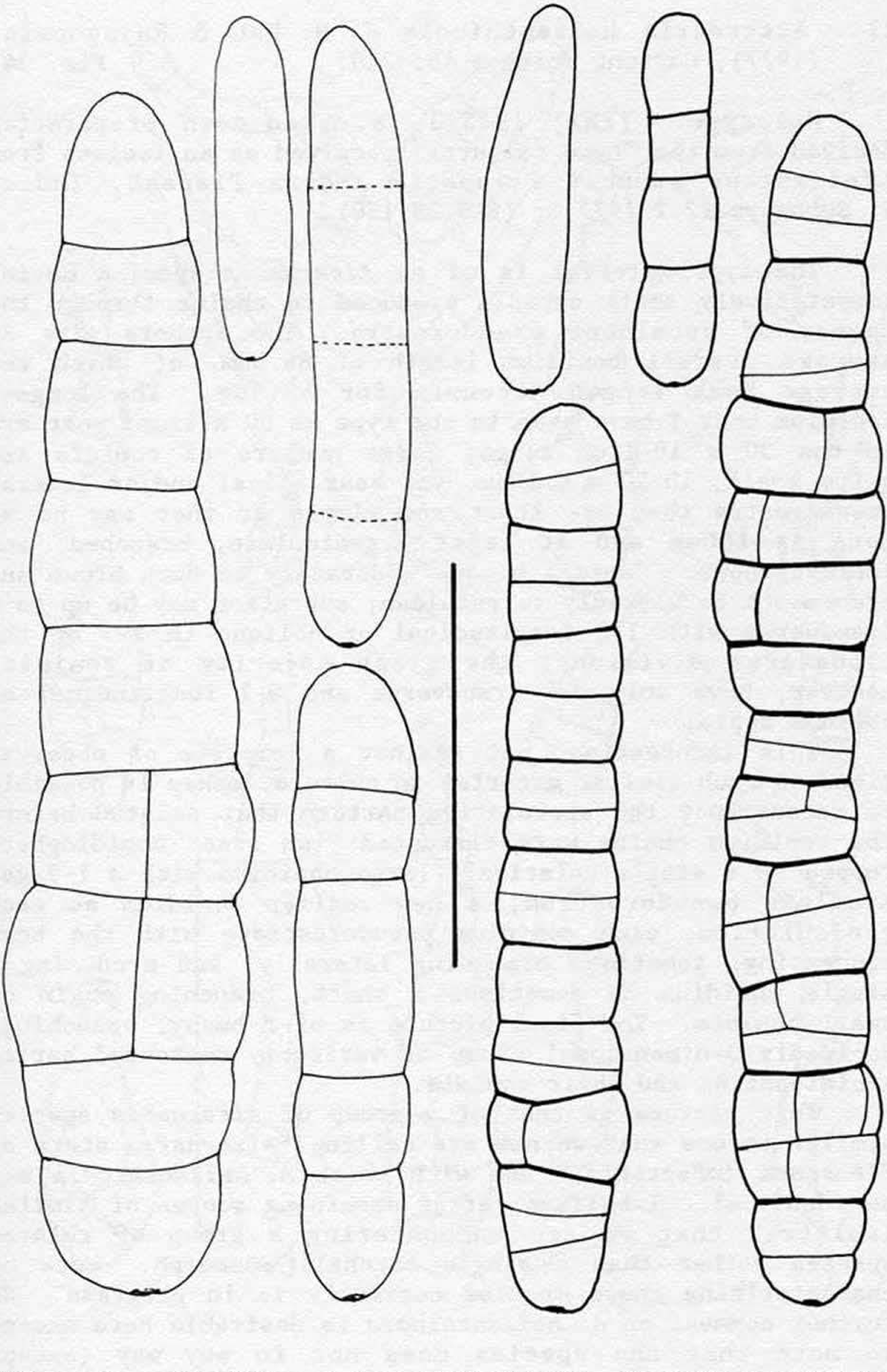

Fig. 33. Conidia and conidiophores ex representative cultures of (left) Alternaria helianthi and (right) Alternaria leucanthemi. Magn.: vertical bar = 50µm.

21. **Alternaria helianthicola** G. N. Rao & Rajagopalan (1977), Current Science 46: 750. Fig. 34.

Holotype: [IMI] 191573, a dried-down preparation derived from the "type culture," received as an isolate from "*Helianthus annuus, Tirupati, Andhra Pradesh, India, J. Subbayya 12.2.1975.*"; (EGS 38-120).

The type material is of an *Alternaria* species having comparatively small conidia produced in chains through the agency of prominent pseudorostra. The authors give an average overall conidium length of 66.5µm, of which the average beak length accounts for 45.5µm. The longest conidium body I have seen in the type is 50 x 12µm; most are in the 30 x 10-12µm range; large numbers of conidia are quite small, 10-20 x 6-10µm, yet bear apical and/or lateral pseudorostra that are short and simple or that may be as long as 100µm and at least 7-geniculate, branched, and conidiogenous. Conidia become moderately to dark brown and are smooth to markedly verruculose; septation may be up to 8 transverse with 1-2 longitudinal or oblique in 1-3 of the transverse divisions; the great majority of conidia, however, have only 0-4 transverse and 0-1 longitudinal or oblique septa.

This information, set against a template of observations on much similar material in culture, makes it possible to reconstruct the sporulation pattern that existed before the conidium chains were disrupted: an erect conidiophore topped by a single relatively large conidium with a 1-2-geniculate pseudorostrum; a new smaller conidium at each geniculation, each conidium pseudorostrate with the beak elongating, sometimes branching laterally, and producing a single conidium or sometimes a short, branching chain of small conidia. The final picture is of a bushy, branching, decidedly 3-dimensional clump of variously contorted aerial conidiophores and their conidia.

This picture is that of a group of *Alternaria* species similar to one that we now are calling "*Alternaria* state of *Pleospora infectoria*," and with which *A. helianthicola* may be identical. I believe, after examining scores of similar isolates, that we are encountering a group of related species rather than a single catchall anamorph. Work on characterizing these species currently is in progress. No further comment on *A. helianthicola* is desirable here except to note that the species does not in any way (except generically) resemble the large-spored helianthicolous species discussed in *Alt.T&V* no. 17-19 above.

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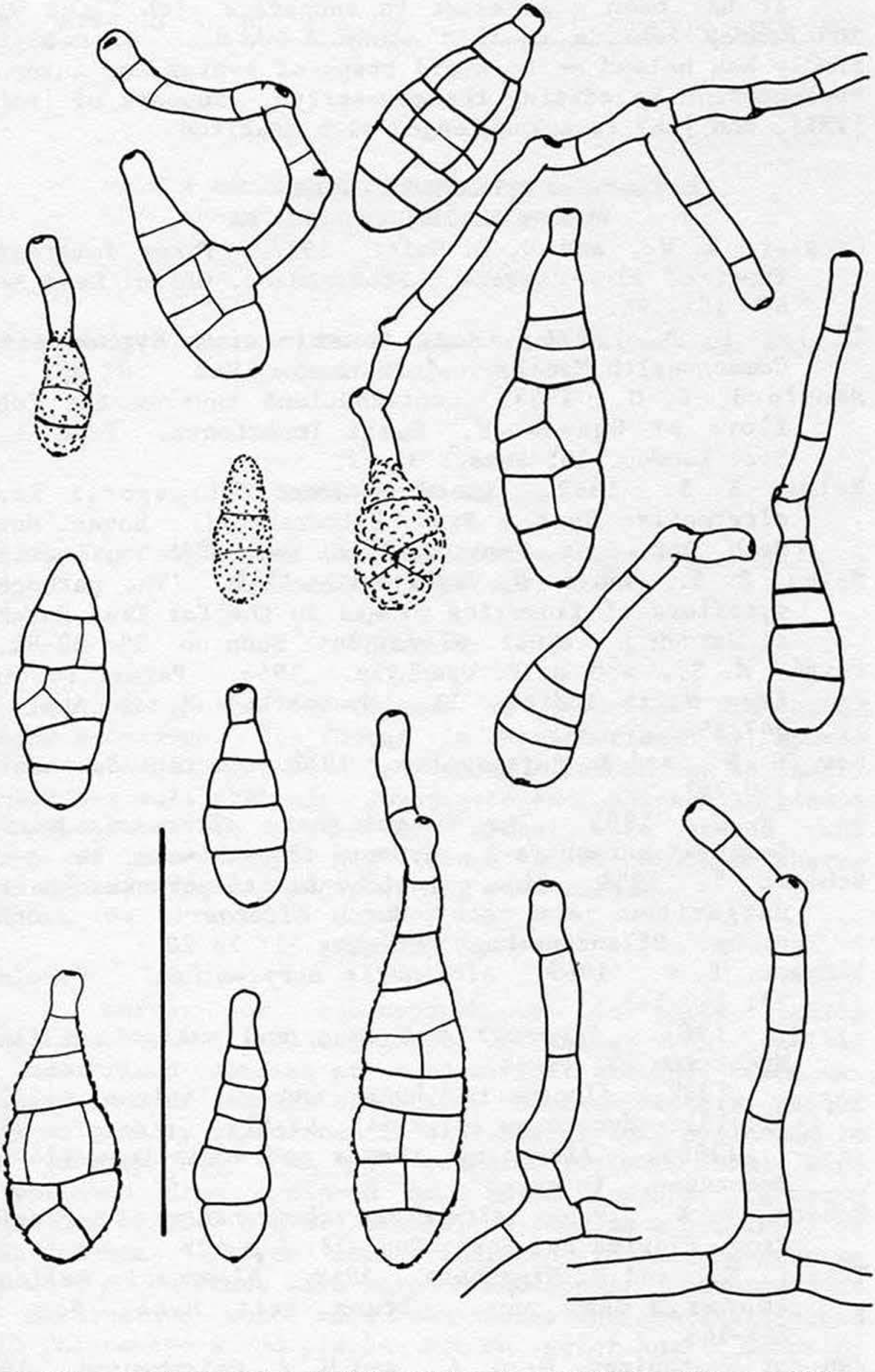

Fig. 34. Alternaria helianthicola conidia and conidiophores ex Type. Magn.: vertical bar = 50µm.

It has been a pleasure to cooperate with Ilona Walcz and Rodney Roberts in this study. Dr. M. E. Barr Bigelow kindly has helped me to avoid traps of syntax and taxonomic presentation by editing the manuscript. Support of [DAOM], [IMI], and [LE] is acknowledged with gratitude.

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MYCOTAXON

Vol. XXV, No. 1, pp. 217-227 January-March 1986

GLOMUS MACULOSUM SP. NOV. (ENDOGONACEAE): AN ENDOMYCORRHIZAL FUNGUS

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SUMMARY

A new species of *Glomus* is described and named *Glomus maculosum*. The fungus is characterised by spores which have a distinct 'endospore' formed by an inner, membranous wall that may invaginate and thicken in places to appear as if covered by 'spots' when viewed with low-power microscopy. The fungus forms endomycorrhizae with apple, sorghum, and probably with coleus.

INTRODUCTION

A survey of endomycorrhizae in apple (*Malus domestica* Borkh.) (Miller, Domoto and Walker 1985) yielded an undescribed species of *Glomus* Tul. and Tul. from an orchard in Door County, Wisconsin. Spores of this fungus were originally discovered in sievings of soil collected in the survey, and open pot cultures (Gilmore 1968) were established from unsieved soil with sorghum (*Sorghum sudanense* (Piper) Staph.) and coleus (*Coleus x hybridus*) as host plants. It was later isolated in single-species ('pure') pot culture with sorghum and apple. Observations on germination were made from spores surface-disinfested with Chloramine-T and plated out on water agar. Descriptions of walls in this paper, and the presentation of the standardized murograph (Figure 1) are those proposed by

Walker (1983). Colors used in the description correspond with those in the Flora of the British Fungi color identification chart (Anon 1969).

GLOMUS MACULOSUM Miller et Walker sp. nov. Figures 1-3.

Sporae singillatim in terra enatae, globosae vel subglobosae, (95-)135-178(-220) x (95-)130-187(-220) µm, pallide stramineae vel ochraceae maturescentes, laeves. Tunica sporae stratis tribus: exteriore 0.3-1.0 µm crasso, hyalino, adhaerenti; medio 4-13 µm crasso, pallide stramineo vel ochraceo, lamellato; interiore membranaceo, tenui, maturitate separabili, in sporis veteribus inauctos tholiformes, pectinatos ferenti. Hypha affixa strato medio tunicae sporae concolora, recta vel acute recurva, simplex, infundibuliformis vel constricta ad basim sporae, 5-13 (-25) µm longa, 5-7 µm crassa ad coniunctionem hypha parentali, hyalina, tenuitunicata. Sporae per hypham affixam germinantes.

SPOROCARPS unknown. SPORES formed singly in the soil on one to three subtending hyphae; hyaline when immature, becoming pale straw-colored to ochraceous when mature, globose to subglobose, (95-)135-178(-220) x (95-)130-187 (-220) µm.

SPORE WALL STRUCTURE of three walls (walls 1-3) in two groups (groups A and B). Wall group A of an outer, thin, hyaline, unit wall (wall 1), 0.3-1.0 µm thick, tightly adherent to wall 2, a brittle, pale straw-colored to ochraceous, laminated wall, 4-13 µm thick, with 4-16 laminae, the innermost lamina sometimes appearing to be a separate, unit wall, and often forming a septum at the spore base. Inner wall group (group B, wall 3), membranous, very thin (<0.3 µm) and tightly adherent to wall 2 in young spores, but becoming 0.5-1 µm thick and separating readily as the spore ages. Wall 3, in many older spores, bearing domed, scalloped ingrowths, 6-15 µm diameter and up to 12 µm deep, consisting of 2-8 concentric bulging discs increasing in diameter towards the inside of the spore.

SUBTENDING HYPHA concolorous with spore wall 2, straight to sharply recurved, parallel-sided, or funnel-shaped, sometimes constricted at the spore base, 5-13(-25) µm long, 5-13 µm wide proximally, and 5-7 µm wide at the point of connection to a thin-walled, hyaline parent hypha. Many spores appearing sessile due to breakage of the subtending hypha at the constriction. Walls of subtending hypha 1.5-3 µm thick proximally, tapering distally to 1 µm.

SPORE CONTENTS (Figure 2A-D) of crowded oil droplets, often appearing reticulate in optical section. On crushing, spores exude liquid with the appearance of oil, sometimes accompanied by fibrous material, especially in those spores that appear reticulate (Figure 2A).

Young (hyaline) spores are cyanaphilous in cotton blue. Older spores either are acyanaphilous or become yellowish-green in this dye due to wall 3 staining more readily than wall 2. The spores have no reaction to Melzer's reagent. The spores immediately turn sienna on immersion in 1N KOH.

The spores germinate through the subtending hypha, often by a side-branch. Septa form in the germ hyphae near the spore, but the hyphae then become increasingly sparsely septate upon rapid elongation.

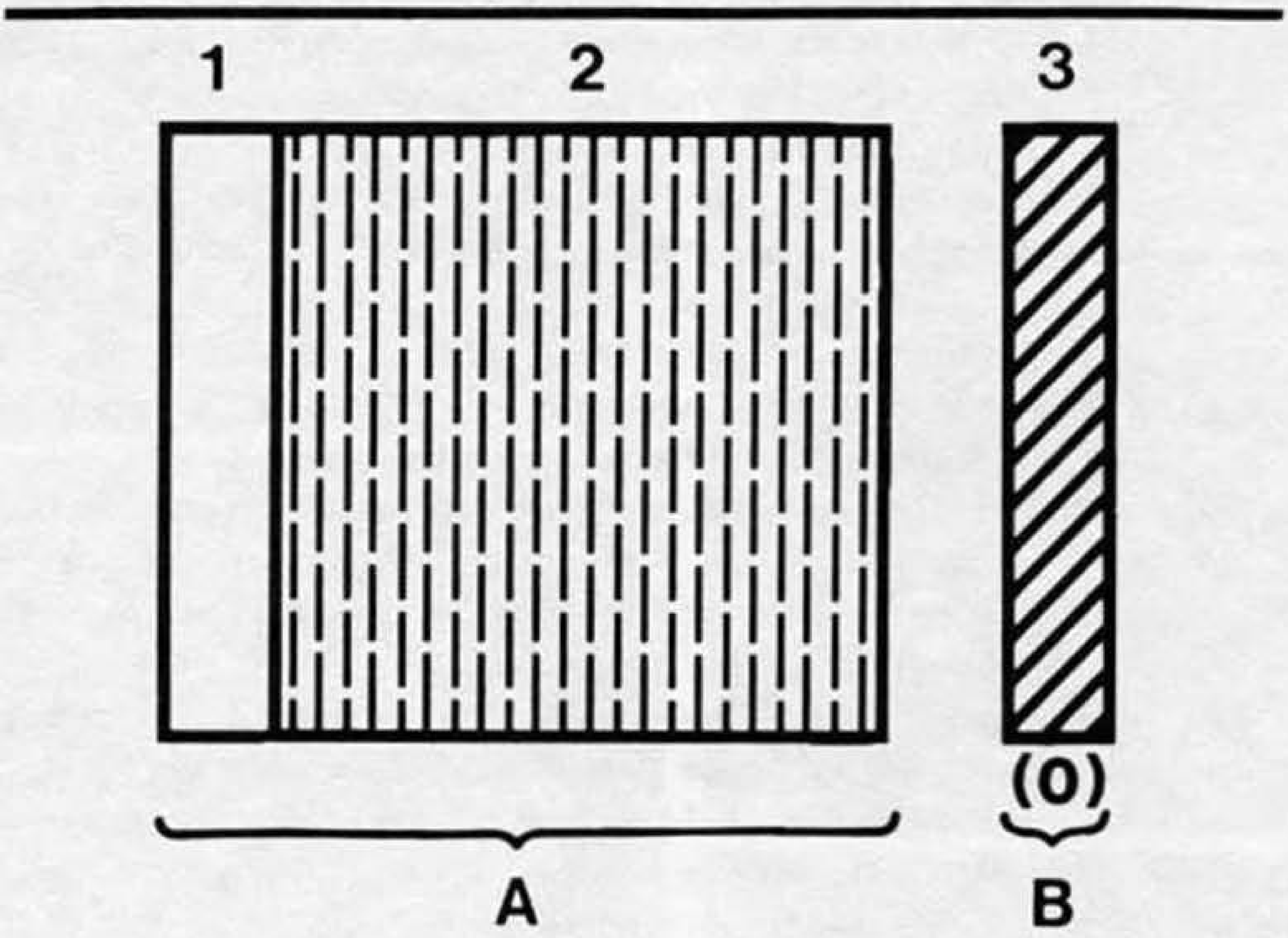


Figure 1: Murograph of *Glomus maculosum* (after Walker 1983). Spore wall structure is of three walls in two groups and consists of a unit wall (no shading) adherent to a laminated wall (dashed shading) surrounding a membranous wall (diagonal shading). Wall 3 may be ornamented.

Figure 2: Spores of *Glomus maculosum* showing spore contents and development of ornamentation of the inner wall.

A: A young spore lacking indications of scallop-shaped ingrowths. The membranous wall (wall 3) is tightly adherent to wall 2, but can be seen where the spore is broken (arrow). The fibrous nature of the spore contents can be seen (f) and an oil droplet has exuded at upper right.

B: A slightly older spore than that shown in 2A. The beginnings of ingrowth formation are evident as slight invaginations of wall 3 (arrowed). Oil droplets from the spore contents have exuded where the spore is broken.

C: At a more advanced stage of ingrowth formation, deposits of wall material are laid down on wall 3 at the points of invagination.

D: In this specimen, splits have appeared between the laminae in wall 2.

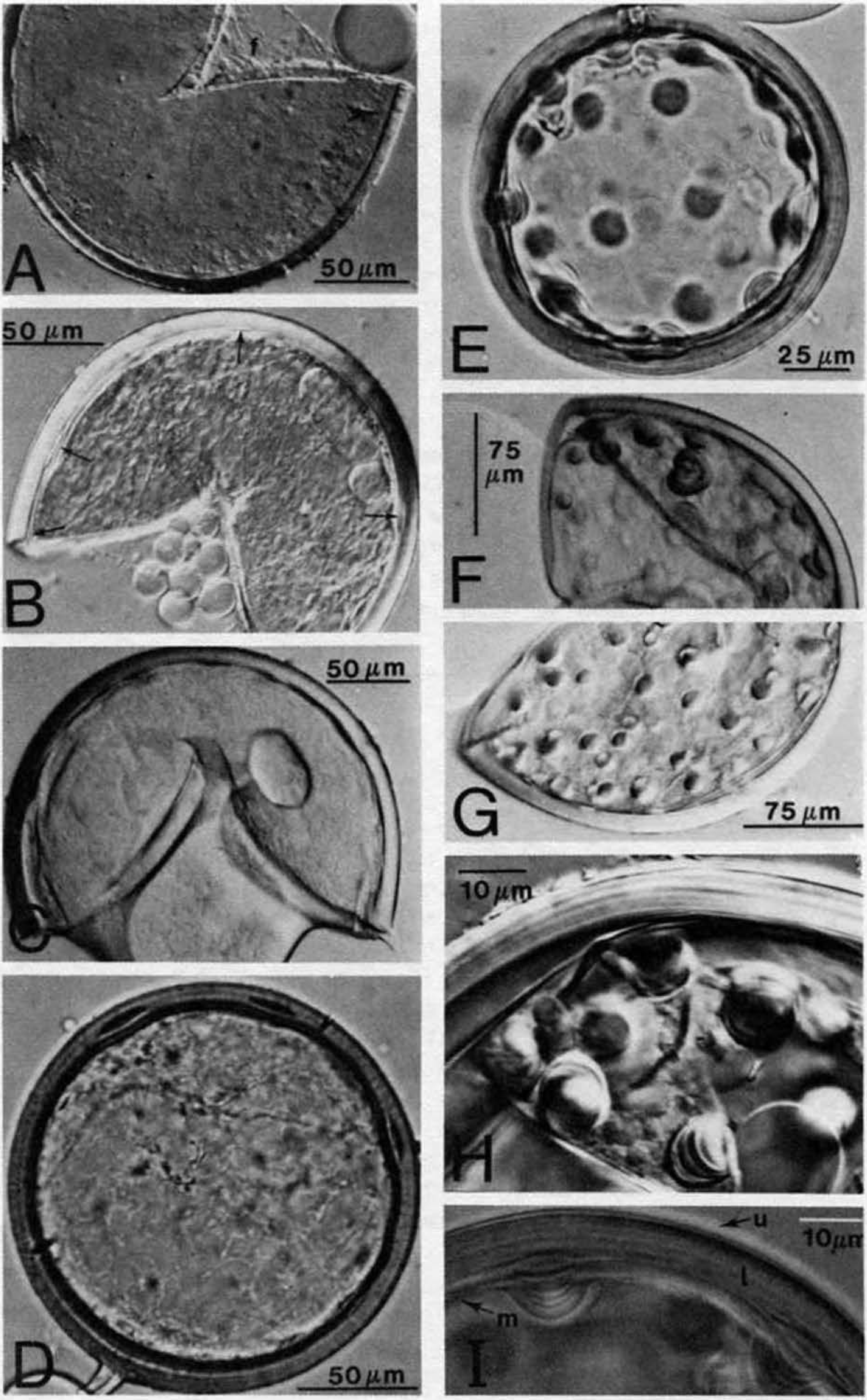
E: In this mature specimen, ingrowth formation is complete. The subtending hypha of this spore has broken off (top), rendering the specimen sessile.

F: Micrograph (brightfield microscopy) showing the 'spotted' appearance caused by the ingrowths on wall 3 in a mature spore.

G: Photomicrograph showing the appearance of the spots on the same specimen as in Figure 2F under Nomarski differential interference microscopy (DIC).

H: Details of the wall structure of a mature spore of *G. maculosum*. The laminated nature of wall 2 and the membranous nature of the ornamentation of wall 3 are evident (DIC).

I: Detail of the wall structure of a *G. maculosum* spore. The three walls, Wall 1, a unit wall (u), wall 2 a laminated wall (l) and wall 3 the inner, membranous wall (m) and its ornamentation of ingrowths can be seen in this specimen.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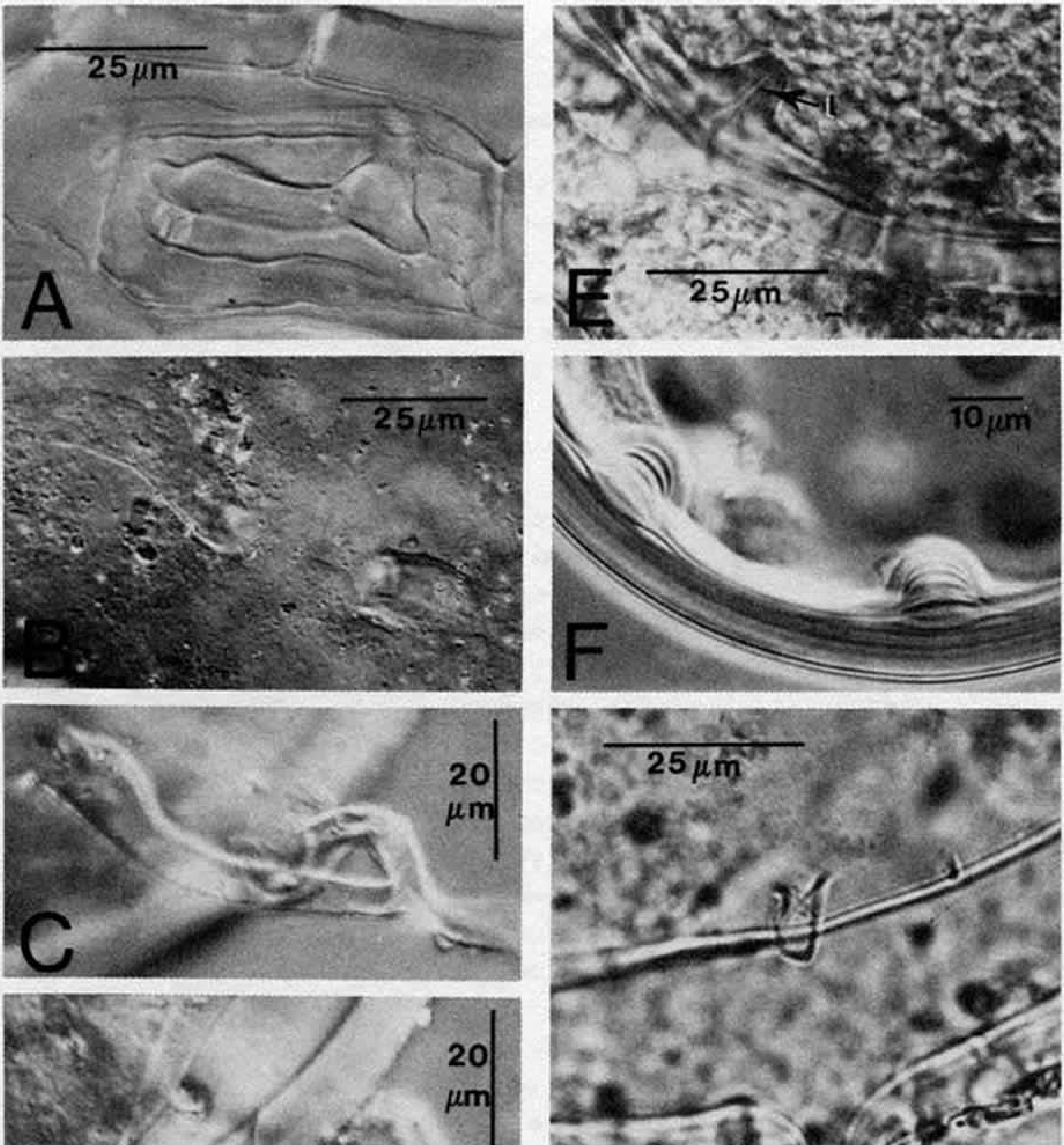
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Figure 3: *Glomus maculosum* mycorrhizal structure and details of chlamydospores.

A: Hyphal coil in root of apple seedling photographed by Nomarski differential interference microscopy (DIC).

B: Photomicrograph (DIC) showing two subtending hyphae attached to a *G. maculosum* spore.

C-D: Photomicrographs of a spore with two subtending hyphae joined to a single originating hypha. The two photographs are taken at different levels of focus in order to show both connections with the spore.

E: Tubiform ingrowths on a parasitized spore. The lumen of these ingrowths can be seen penetrating the spore wall (1).

F: Detail of the scalloped ingrowths ornamenting the inner wall of a *G. maculosum* spore. There is no evidence of invasion by parasitic organisms, and the ingrowths do not possess a lumen.

G: This photomicrograph shows the closure of the subtending hypha at the pore, and the way wall 3 forms a complete endospore.

DISTRIBUTION AND HABITAT

This species is known from one field location. It was isolated from soil samples collected on 30 July 1980 from under newly established apple trees at the Peninsular Experiment Station of the University of Wisconsin, Sturgeon Bay, Wisconsin (Miller, Domoto and Walker, 1985). The soil was Longrie silt loam (coarse-loamy, mixed, frigid Entic Haplorthods) (Anon, 1975); pH 6.6; the soil nutrient status was (mg kg^{-1}): P = 65, K = 124, Ca = 1120, Mg = 248, Mn = 13, Zn = 4.8, B = 1.6, with a cation exchange capacity of 9. Apple trees were the only cultivated crop present at the site when the original soil sample was collected. The land had lain fallow for the preceeding 2 years and although there was some weed control by mechanical cultivation, many weed species were present to provide a source of initial inoculum.

MYCORRHIZAL ASSOCIATIONS

Glomus maculosum has formed endomycorrhizae with apple and sorghum, in pure culture, and also was found with other members of the Endogonaceae in pot culture with coleus. The endomycorrhizae are not typical, neither vesicles nor arbuscules having been detected. They consist of isolated hyphal coils, filling cortical cells (Figure 3A). Numerous attempts to stain the mycorrhizas with normal methods using trypan blue, cotton (analine) blue and acid-fuchsin red, failed to reveal the fungus, and it was not until cleared roots were carefully examined with Nomarski Differential Interference Microscopy that the mycorrhizas were observed. It is possible that the extended bleaching period needed to clear the heavily-pigmented apple roots (Miller et al, 1985) rendered the hyphal structures unstainable and destroyed delicate structures such as arbuscules.

ETYMOLOGY

Latin - *maculosum,* spotted, referring to the appearance caused by the scalloped ingrowths on the membranous inner wall of older spores.

COLLECTIONS EXAMINED

Holotype: WISCONSIN, Door County, Peninsular Experiment Station, University of Wisconsin, Sturgeon Bay, among roots of apple trees. Type specimens (OSC, isotype K) from a pot culture with sorghum and coleus in the Horticulture Department Greenhouses, Iowa State University, Ames, Iowa (Walker collection number 505, 26 January 1982) made from soil collected at the type locality. In addition, specimens from pure pot cultures with apple and sorghum were examined (Walker 531, 22 April 1982; Walker 568, 15 June 1982; Walker 765, 30 January 1983).

DISCUSSION

The most distinctive feature of *Glomus maculosum* chlamydospores is the scalloped thickening of the inner membranous wall. This characteristic is not present in young spores (Figure 2A). It begins with a slight invagination of wall 3 (Figure 2B, 2C), sometimes accompanied by localised separation of the laminae in wall 2 (Figure 2D). After initiation, there seems to be a very rapid deposition of the scalloped layers to form the structures that appear as 'spots' at relatively low magnification (Figure 2F, 2G), since spores seem to be mostly either without spots, with only primordial invaginations, or with fully developed structures (Figure 2E-I) of several layers. The frequency of spores with the spots increases with age of pot culture. Those harvested for spores after 7 months contained a majority of spores with the structures, whereas if harvested in less than 4 months, they contained spores either without them, or with the primary invaginations only. In all pot cultures, some spores can be found that appear mature, but which lack spots.

Light microscopy (up to 2000X) of the spots has given no hint of parasitism as a cause. Some specimens attacked by parasites showed a normal reaction of tubiform ingrowths as reported by Mosse and Bowen (1968). The lumen of these ingrowths invariably penetrates the spore wall (Figure 3E), whereas the scalloped structures found on wall 3 of *G. maculosum* spores never shows evidence of penetration or other attack (Figure 3F). Pure pot cultures which produced spotted spores were started from spores which had been surface disinfested by immersion for 7 min in a solution of 3% Chloramine T with with 500 μg l^{-1} Streptomycin. The addition of spotted *G. maculosum* spores to pot cultures did not result in the transfer of the characteristic to other endogonaceous species.

Glomus maculosum is mainly distinguished from previously described similar *Glomus* species by the characteristics of its spore walls. In particular, no other *Glomus* is described as having an inner, membranous wall forming a complete endospore (Figure 3G), and no other species in the genus possesses the ingrowths on the inner spore wall.

Spores of *Glomus etunicatum* Becker and Gerd. are of somewhat smaller average size than those of *Glomus maculosum* (68-162 μm diameter compared with 95-220 μm) and have a different wall structure. Spores of the former have two walls; a hyaline, evanescent, outer wall up to 5 μm thick overlaying a yellow to brown laminated wall 2-8 μm thick, whereas those of the latter have three walls; a thin, hyaline, unit wall up to 1 μm thick attached to a pale, colored laminated wall, 4-13 μm thick that surrounds a membranous wall up to 1 μm in thickness. In older spores, wall 3 of *G. maculosum* is very distinctive, especially when it becomes ornamented with the characteristic scallop-shaped ingrowths. Young spores of *G. etunicatum* and *G. maculosum* are similar in color, but as the spores mature, in the former species they darken and become brown, whilst in the latter they remain rather pale, and do not become brown.

Some spores of *G. maculosum* have multiple hyphal attachments (Figure 3B-D), a characteristic feature of *Glomus multisubstensum* Mukerji et al., a species described from India. Requests for the loan of specimens of this fungus made to both the senior author and the herbarium at Delhi have been ignored, and we therefore have been unable to make direct comparisons. Nevertheless, the description of the latter indicates that these species have little else in common, size range, color, and wall structure all being different.

Spores of *Glomus geosporum* (Nicol. and Gerd.) Walker are of a similar size range to those of *G. maculosum*, but are much darker in color (light yellow-brown when young becoming dark brown at maturity). Superficially, the wall structure of these two species appears the same, but while the inner wall of the former is a colored, unit wall, not separating from the middle wall, wall 3 of the latter is hyaline, membranous, and in a separate wall group. Additionally, the subtending hypha of *G. geosporum* is persistent and extends 30-100 µm beyond the spore base, whereas that of *G. maculosum* usually extends little more than 5 µm distally and often is broken away completely.

Glomus versiforme (Karst.) Berch and Fortin is of similar spore size to *G. maculosum*, and young spores of these species may be similar in color. However, spores of the former have only two walls in a single group, whilst the latter has spores with three walls in two groups. Wall 3 of *G. maculosum* is apparent even on immature spores.

ACKNOWLEDGEMENTS

We wish to thank Dr. J. M. Trappe, USDA Forest Service, for the Latin diagnosis and for reviewing the manuscript. We also thank Annelise Green, Forestry Commission, for assistance in preparation of this publication.

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MYCOTAXON

Vol. XXV, No. 1, pp. 229-245 January-March 1986

FOUR NEW JAPANESE SPECIES OF THE CERATOSTOMATACEAE (ASCOMYCETES)

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Key Word Index ----- *Arxiomyces*; *Persiciospora*; *Sphaerodes*; *Syspastospora*; Ceratostomataceae; Melanosporaceae; soil fungi; Japan

SUMMARY

Four new species of the Ceratostomataceae, isolated from cultivated and forest soils in Japan, are described and illustrated: *Arxiomyces campanulatus*, *Persiciospora japonica*, *Sphaerodes micropertusa* and *Syspastospora boninensis*. They are compared with similar species of their respective genera.

Classification of the Ceratostomataceae Winter (syn. Melanosporaceae Bessey (Cannon & Hawksworth, 1983a)) is difficult because superficially similar ascomycetes have undoubtedly been derived from a number of unrelated sources through convergent evolution. This can be illustrated by comparing, for example, *Melanospora* Corda, *Ceratocystis* Ellis & Halsted and *Microascus* Zukal; most species in these genera having ascomata with long necks, often with terminal hairs, and evanescent asci. Each of these features is an adaptation for passive dispersal of ascospores, through water-splash or animal contact, rather than by active discharge into air currents. The three genera mentioned above have long been treated separately, and are now regarded as belonging to different orders (Hawksworth *et al.*, 1983). There are, however, a number of groups of superficially similar fungi that have recently been classified close to or within *Melanospora* (*nom. cons. prop.*; Cannon & Hawksworth, 1983b), such as *Scopinella* Lév. and *Sphaeronaemella* P. Karsten, which are now thought to be distantly related. *Melanospora* itself as currently constituted is probably monophyletic, but the relationship of this genus to similar ones, such as *Sphaerodes* Clem., *Syspastospora* P. Cannon & D. Hawksw. and *Arxiomyces* P. Cannon & D. Hawksw. is not yet clear. The relationship of the Ceratostomataceae to the Chaetomiaceae is also not properly understood, and genera such as *Canariomyces* von Arx (1983) defy appropriate placement.

Particular note must be taken of characters which are unlikely to be subject to strong selection pressures, since these are more likely to reflect the true relationships of fungi than are ecological or nutritional similarities (though these features may of course be taxonomically significant). Characters such as the number and form of germ pores, ornamentation of ascospores and structure of ascomatal walls should be emphasised in classification of the Ceratostomataceae. The most recent account of the group (Cannon & Hawksworth, 1982), which drew on a number of earlier works (e.g. Udagawa & Cain, 1969; Malloch, 1976a,b; Hawksworth & Udagawa, 1977; von Arx, 1981), used these features in the establishment or reestablishment of several genera. In treating *Microthecium* Corda as a synonym of *Melanospora*, however, previous emphasis on cleistothecium versus perithecium as a generic criterion was rejected. Once used to separate classes and orders, this feature is now considered to be of minor significance, sometimes varying within a single isolate of a species.

The current emphasis on micromorphology of ascospores in classification of the Ceratostomataceae may, in time, be supplemented by other characters (perhaps data from the analysis of secondary metabolites). The present delimitation of genera seems, however, generally satisfactory and may well reflect the true relationships of the taxa concerned.

During the past decade *Melanospora*-like ascomycetes have been isolated repeatedly from soil samples collected in several parts of Japan. Only a few species of *Melano-*

spora and allied genera have been reported previously from Japanese soil (Hawksworth & Udagawa (1977), Horie & Udagawa (1973), Udagawa (1965,1970), Udagawa & Cain (1969), Udagawa & Takada (1974)) and attempts to assign them to previously described members of the family have been largely unsuccessful. Recently, the report on re-evaluation of *Melanospora* Corda and similar Pyrenomycetes by the junior author and Hawksworth (1982) prompted the taxonomic investigation of the additional isolates from Japan. During the course of this four new species have been encountered: *Arxiomyces campanulatus*, *Persiciospora japonica*, *Sphaerodes micropertusa* and *Syspastospora boninensis*.

Arxiomyces campanulatus Horie, Udagawa & P. Cannon, sp. nov. (Figs. 1, 5)

Perithecia superficialia vel semiimmersa, dispersa vel in catervis parvis aggregata, atrobrunnea vel fere nigra per massam ascosporarum, basi globosa, 160–200 µm diam, glabra vel parum pilosa; collum dilute flavo-brunneum, cylindricum, 70–190 x 40–70 µm, ad apicem expansum, 'textura globulosa' vel 'textura angularis', ex cellulis 8–15 x 4–6 µm composito. Peridium flavo-brunneum, 12–20 µm crassum, membranaceum, bistratum; stratum exterius 'textura angularis', ex cellulis flavo-brunneis, 8–20 µm diam composito; stratum interius ex cellulis hyalinis. Asci vulgo tetraspori, late clavati vel obpyriformes, 12.5–18 x 7.5–10 µm, brevistipitati, celeriter evanescentes; paraphyses indistinctae. Ascosporae primo hyalinae et tenues, deinde modice brunneae vel valde olivaceo-brunneae, in massa fere nigrae, ovoideo-ellipsoideae, (5–)6–7 x 4–5 µm, basi truncatae, apice rotundatae, leves, cum (uno) poro germinali basali praeditae, 2–2.5 µm diam.

Holotypus ----- isolatus e solo sativi cum *Stachybotrys chartarum* (Ehrenb.) Hughes, Ohwadashinden, Yachiyo-shi, Chiba, in Japonia, 28.ix.1975, legit. Y. Horie, No. 2918. In Herbario NHL. Isotypi: IMI 281910, IFM 4612.

Etymology: Latin, *campanulatus* = campanulate, referring to the ascospore shape.

Perithecia superficial to semiimersed, scattered or aggregated in small clusters, dark brown to nearly black due to spore mass, base globose, 160–200 µm diam, glabrous or slightly hairy; neck pale yellowish brown, cylindric, 70–190 x 40–70 µm, flared at the tip, composed of slightly elongated vertically oriented *textura globulosa* to *textura angularis* with cells 8–15 x 4–6 µm in size. Ostiolar setae absent. Peridium yellowish brown, 12–20 µm thick, membranaceous, two-layered, the outer layer consisting of yellowish brown, *textura angularis* with cells measuring 8-20 µm diam, the inner layer hyaline. Asci usually 4-spored, broadly clavate or obpyriform, 12.5-18 x 7.5-10 µm, without apical structure, short-stipitate, quickly evanescent; paraphyses indistinct. Ascospores at first hyaline and thin, becoming mid-brown to dark olivaceous brown, nearly black in mass, ovoid-ellipsoidal, (5-)6-7 x 4-5 µm, base truncate with a hyaline, often collapsed appendage, apex rounded, smooth-walled, with a single large basal germ pore, 2-2.5 µm diam. Anamorph not observed.

Cultures on cornmeal agar, with *Stachybotrys chartarum* (Ehrenb.) Hughes, developing gradually, producing abundant perithecia within 28 days at 25 C.

Isolation: on *Stachybotrys chartarum* in mixed culture from cultivated soil, Ohwadashinden, Yachiyo-shi, Chiba-pref., Japan, 28.ix.1975, coll. Y. Horie, No. 2918, NHL

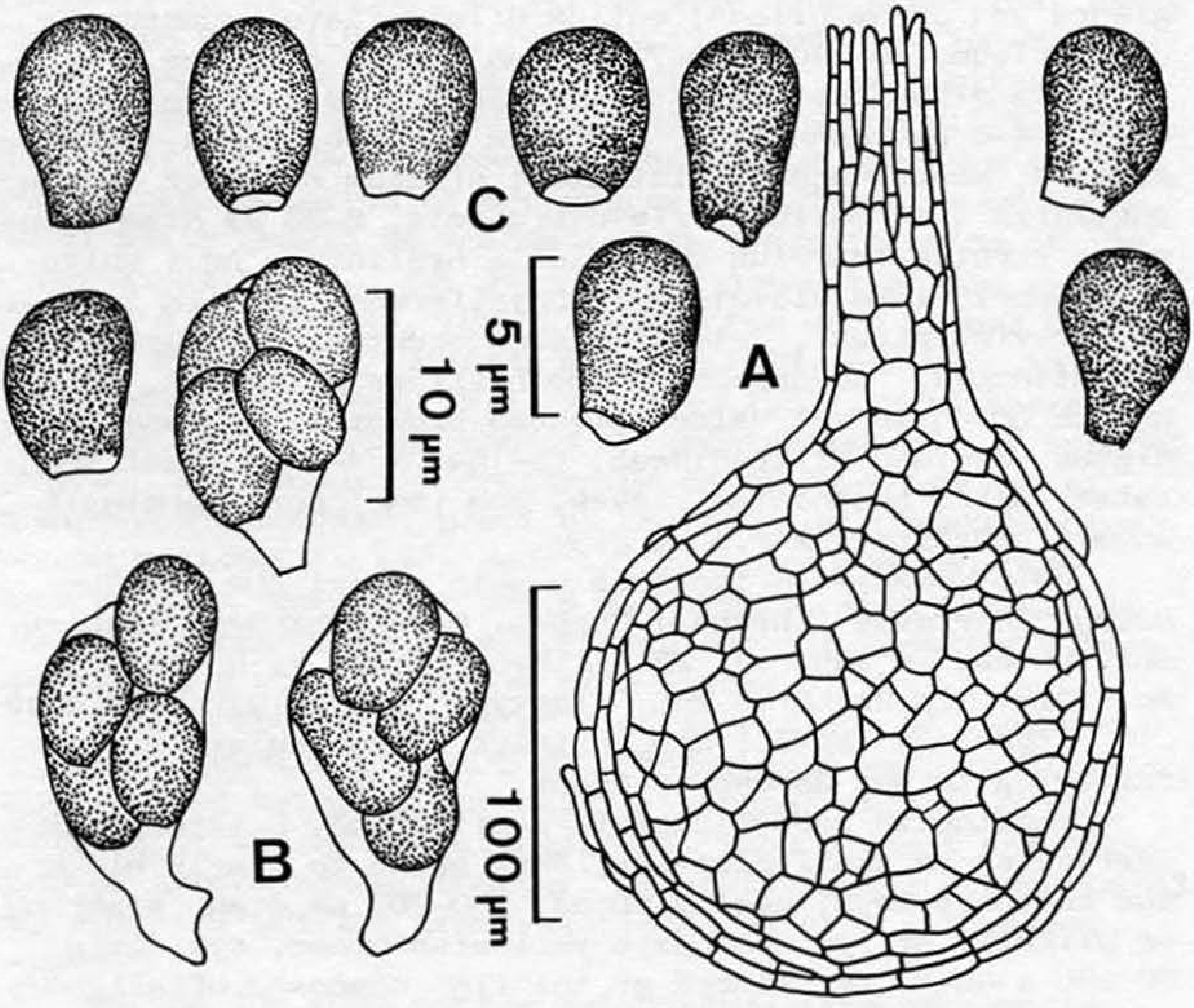


Fig. 1. *Arxiomyces campanulatus*, NHL-2918.
A. Perithecium. B. Asci. C. Ascospores.

(Holotype). Isotypes: IMI 281910, IFM 4612.

Arxiomyces was published by Cannon & Hawksworth (1983a) as a replacement name for *Phaeostoma* von Arx & E. Müller, non Spach, the conservation of the later homonym having been rejected by the Special Committee for Fungi (Hawksworth & Sherwood, 1981; Petersen, *in litt.*). The type of the genus is *A. vitis* (Fuckel) P. Cannon & D. Hawksw., and the three other species previously assigned to *Phaeostoma* have been disposed elsewhere.

Arxiomyces has ovoid ascospores each having a conspicuous truncate base (probably acting as a very large germ pore) and a hyaline gelatinous appendage (often not visible in dried material) attached to the base. *Arxiomyces* is probably not closely related to *Melanospora*, and may well belong to the Lasiosphaeriaceae rather than the Ceratostomataceae (Hawksworth, *pers. comm.*), but its affinities remain unclear.

A. campanulatus is distinguished from *A. vitis* by its shorter neck, and larger ascospores ((5–)6–7 x 4–5 µm in *A. campanulatus* but 5–6 x 3–4 µm in *A. vitis*).

Persiciospora japonica Horie, Udagawa & P. Cannon, sp. nov. (Figs. 2, 6)

Perithecia superficialia, dispersa, dilute flavo-brunnea, globosa vel subglobosa, 240–440 µm diam, glabra vel sparsim pilosa; pili hyalini, recti, graciles, non-ramosi, leves, basi 3–5.5 µm diam; collum brevissimum vel nullum, usque 20 µm longum, 65–80(–120) µm diam; setae ostiolorum rectae vel parum curvae, hyalinae vel parum flavae, leves et plus minusve incrassatae, remote septatae vel non-septatae, 70–160 µm longae, basi 3–3.5 µm diam, apice 1.5–2 µm diam et obtusae. Peridium tenue, flavum vel modice flavo-brunneum, membranaceum, semitranslucens, 'textura angularis' vel 'textura globulosa'; stratum exterius ex celluis dilute flavis, 8–24 x 7–20 µm composito; stratum inferius ex cellulis hyalinis. Asci octospori, late clavati, 52–56 x 18–20 µm, superne rotundati, sine annulo incrassati, brevistipitati, evanescentes, in fasciculo irregulari dispositi, cum cellulis hyalinis, inflatis, 12–18 µm diam intermixti, sed paraphyses indistinctae. Ascosporae irregulariter biseriatae, primo hyalinae, deinde valde olivaceo-brunneae vel atrobrunneae, in massa fere nigrae, anguste ellipsoideae vel fusiformi-ellipsoideae, (16–)18–21(–23) x (8–)9–10 µm, utrinque subapiculatae, reticulate visae sub 'LM' sed punctatae vel punctato-reticulatae sub 'SEM'; foveae numerosae, isodiametrae vel plus minusve irregulares, 0.5–0.8 µm diam; pori germinales ca. 1 µm diam in utroque apice instructo.

Mycelium ex hyphis hyalinis vel dilute flavis, ramosis, saepe anastomosantibus, septatis, levibus, incras-

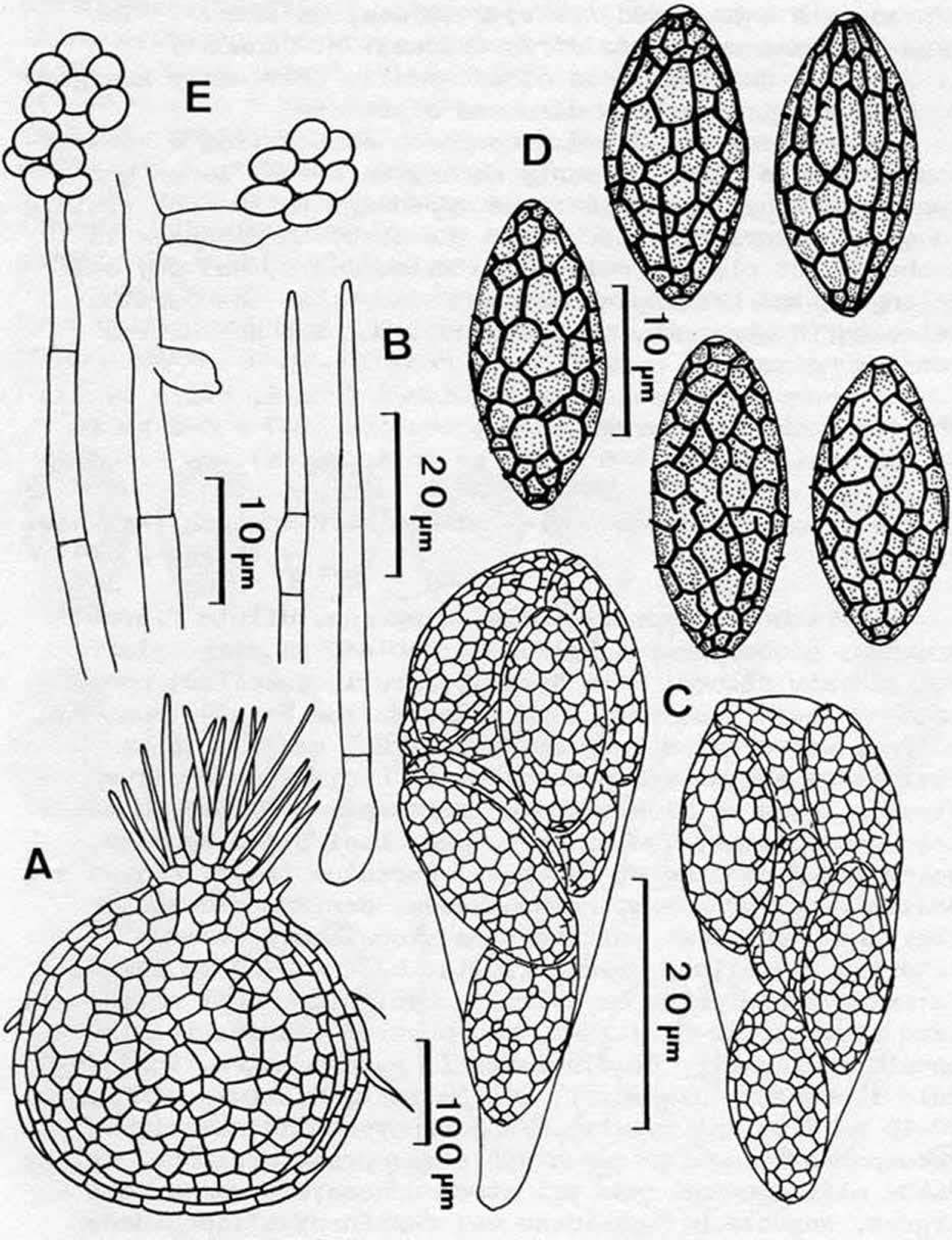


Fig. 2. *Persiciospora japonica*, NHL-2809.
A. Perithecium. B. Ostiolar setae. C. Asci.
D. Ascospores. E. Conidiogenous cells and conidia.

satis, 2-10 µm diam composito. Conidiophora plerumque nulla. Cellulae conidiogenae (monophialides) statim ex hyphis aeriis oriundis, raro in brevistipitibus, hyalinae, lageniformes, 6-10(-13) x 2.5-4 µm, cum cupula apicali. Conidia hyalina, unicellularia, obovoidea, 2.5-3.5(-4) x 2-3 µm, levia, in capitula globosa ad apices phialidum aggregatis. Chlamydosporae terminales vel intercalares, hyalinae, plus minusve globosae, 6-8 µm diam, leves et incrassatae.

Coloniae in agaro 'oatmeal' effusae, tenues, floccosae, albidae vel brunneo-aurantiacae; perithecia dispersa sed conidia limitata; reversum incoloratum vel griseo-aurantiacum.

Holotypus ----- isolatus e solo sylvatici, Ryozu-shi, Niigata, in Japonia, 20.ix.1975, legit. K. Furuya, No. 2809. In Herbario NHL. Isotypi: IMI 281909, IFM 4613.

Etymology: Latin, *japonica* = of Japan, referring to its wide distribution in this country.

Perithecia superficial, scattered, light yellowish brown, globose to subglobose, 240-440 µm diam, glabrous or sparsely clothed with hyaline, straight, slender, unbranched, smooth-walled, hyphal-like hairs measuring 3-5.5 µm wide at base; neck very short or absent, less than 20 µm in length, 65-80(-120) µm diam, terminated by straight to slightly curved ostiolar setae which are hyaline to very slightly yellow, smooth and rather thick-walled, remotely septate or aseptate, 70-160 x 3-3.5 µm at base, 1.5-2 µm at tip, apex obtuse; peridium thin, yellow to light yellowish brown, membranaceous, semitransparent, composed of *textura angularis* or *textura globulosa*; with an outer layer consisting of pale yellowish cells measuring 8-24 x 7-20 µm and an inner layer of hyaline cells. Asci 8-spored, broadly clavate, 52-56 x 18-20 µm, rounded above, without apical structure, short-stipitate, evanescent, borne in an irregular fascicle, intermixed with hyaline, swollen, 12-18 µm diam cells but with no definite paraphyses. Ascospores irregularly biseriately arranged, at first hyaline, becoming dark olivaceous brown to dark brown, nearly black in mass, narrowly ellipsoidal to fusiform-ellipsoidal, (16-) 18-21(-23) x (8-)9-10 µm, subapiculate at both ends, surface appearing reticulate in LM, the reticulum well-developed and fairly coarse, but punctate to punctate-reticulate in SEM, with many small isodiametric to somewhat irregular pits 0.5-0.8 µm diam, with terminal germ pores measuring ca. 1 µm diam.

Mycelium composed of hyaline to pale yellow, branched, often anastomosed, septate, smooth and thick-walled hyphae measuring 2-10 µm diam. Conidiophores often lacking or not distinctly differentiated from the hyphae. Conidiogenous cells monophialidic, directly scattered on the aerial hyphae as side branches or on short stalks in a few groups, hyaline, lageniform, 6-10(-13) x 2.5-4 µm, with a small collarette. Conidia hyaline, one-celled, obovoid, 2.5-3.5 (-4) x 2-3 µm, smooth-walled, becoming aggregated into small globose heads at the apices of the phialides. Chlamydospores terminal or intercalary, hyaline, more or less globose, 6-8 µm diam, smooth and thick-walled.

Colonies on oatmeal agar growing rapidly, attaining a diameter of 62-75 mm within 14 days at 25 C, thin, consisting of submerged vegetative mycelium and floccose aerial hyphae, white to brownish orange (Methuen, 5C5); perithecia scattered amongst the aerial hyphae as black patches; conidia limited in number, not influencing the colony appearance; reverse uncoloured to greyish orange (Methuen, 5B4).

Colonies on potato-carrot agar growing rather slowly, conspicuously floccose.

At 37 C, growth is nil.

Isolation: forest soil, Ryozu-shi, Sado-gun, Niigata-pref., Japan, 20.ix.1975, coll. K. Furuya, No. 2809, NHL (Holotype). Isotypes: IMI 281909, IFM 4613.

Other isolations: grassland soil, Sugadaira, Sanada-machi, Chiisagata-gun, Nagano-pref., Japan, 20.vii.1978, coll. S. Udagawa, No. 2937, NHL; forest soil, Chichijima, Ogasawara-mura, Tokyo, Japan, 9.xii.1977, coll. Y. Horie, IFM 4613, 4616.

Persiciospora P. Cannon & D. Hawksw. (1982) is distinguished from *Melanospora* Corda essentially by the structure of the ascospores, which are delicately pitted rather than smooth-walled, and have very small, inconspicuous terminal germ pores, unlike the easily visible ones in *Melanospora*. Two species were originally placed in the genus, *P. moreaui* P. Cannon & D. Hawksw. and *P. masonii* (Kirschst.) P. Cannon & D. Hawksw.

P. japonica is evidently closely related to *P. moreaui* but differs in the much shorter neck of its perithecium, and in its slightly smaller ascospores which are more delicately and regularly punctate. *P. japonica* is associated with a *Phialophora* anamorph which is not known, in the other species.

Sphaerodes micropertusa Horie, Udagawa & P. Cannon, sp. nov. (Figs. 3, 7)

Perithecia superficialia, dispersa vel in catervis parvis aggregata, flavo-brunnea, pyriformia, basi globosa, ca. 180–220 µm diam, glabra vel parum pilosa; collum brevicylindricum, plus minusve contractum, 65–100 µm longum, basi 50–70 µm latum, apice 40–50 µm latum, glabrum, ad extremum ostiolatum; setae ostioli hyalinae vel stramineae, septatae, leves, non-ramosae, usque 20–35 µm longae, basi 3–5 µm latae, apice rotundae. Peridium dilute flavo-brunneum, incrassatius, membranaceum, semitranslucens, 'textura globulosa' vel 'textura angularis', ex cellulis angularibus, 10–25 µm diam composito; collum 'textura globulosa' vel 'textura epidermoidea', ex cellulis 8–12 x 4–6 µm diam composito. Asci octospori, late clavati vel ovoidei, 44–60 x 18–25 µm, superne late rotundi, sine annulo incrassato, brevistipitati, evanescentes; paraphyses nullae. Ascosporae irregulariter biseriatae, primum hyalinae et guttulatae, deinde valde olivaceo-brunneae vel atrobrunneae, in massa fere nigrae, fusiformi-limoniformes vel fere rhombeae, plus minusve complanatae e latere visis, 18–22(–28) x 9.5–11(–13) x 8–9 µm, aliquot cristis praeditae, parte convexa foveolatae; pori germinales manifeste in utroque apice instructi, 1–1.5 µm diam.

Mycelium ex hyphis hyalinis vel stramineis, ramosis, septatis, vulgo tenuibus, 2–6 µm diam composito. Conidiophora nulla. Cellulae conidiogenae (monophialides) plerumque ex hyphis aeriis oriundis, singulares vel in catervis parvis aggregatae, cylindraceae vel lageniformes, 4–8 x 2.5–4 µm. Conidia hyalina, unicellularia, tenuia, obovoidea vel pyriformia vel ellipsoidea, 3–5 x 2–3.5 µm, levia, in capitula globosa ad apices phialidum aggregatis.

Coloniae in agaro 'potato-carrot' lente crescentes, planae, tenues, floccosae, brunneo-flavae; perithecia abunde producentia sed conidia limitata; reversum incoloratum vel flavo-brunneum.

Holotypus ——— isolatus e solo sativo, Ohwadashinden, Yachiyo-shi, Chiba, in Japonia, 28.ix.1975, legit. Y. Horie, No. 2769. In Herbario NHL. Isotypi: IMI 281908, IFM 4614.

Etymology: Latin, *micro* = small and *pertusa* = perforated, referring to the ascospore ornamentation.

Perithecia superficial, scattered or aggregated in small groups, yellowish brown, pyriform, base globose, 180–220 µm diam, glabrous or very sparsely hairy; neck short cylindric, slightly tapering, 65–100 x 50–70 µm at base, 40–50 µm at tip, glabrous, terminated by poorly developed straight ostiolar setae which are hyaline to straw-coloured, septate, smooth-walled, unbranched, up to

20–35 µm long, 3–5 µm wide at base and with a rounded tip. Perithecial peridium pale yellowish brown, rather thick, membranaceous, semitransparent, composed of *textura globulosa* to *textura angularis*, consisting of large angular cells measuring 10–25 µm diam. Neck consisting of somewhat

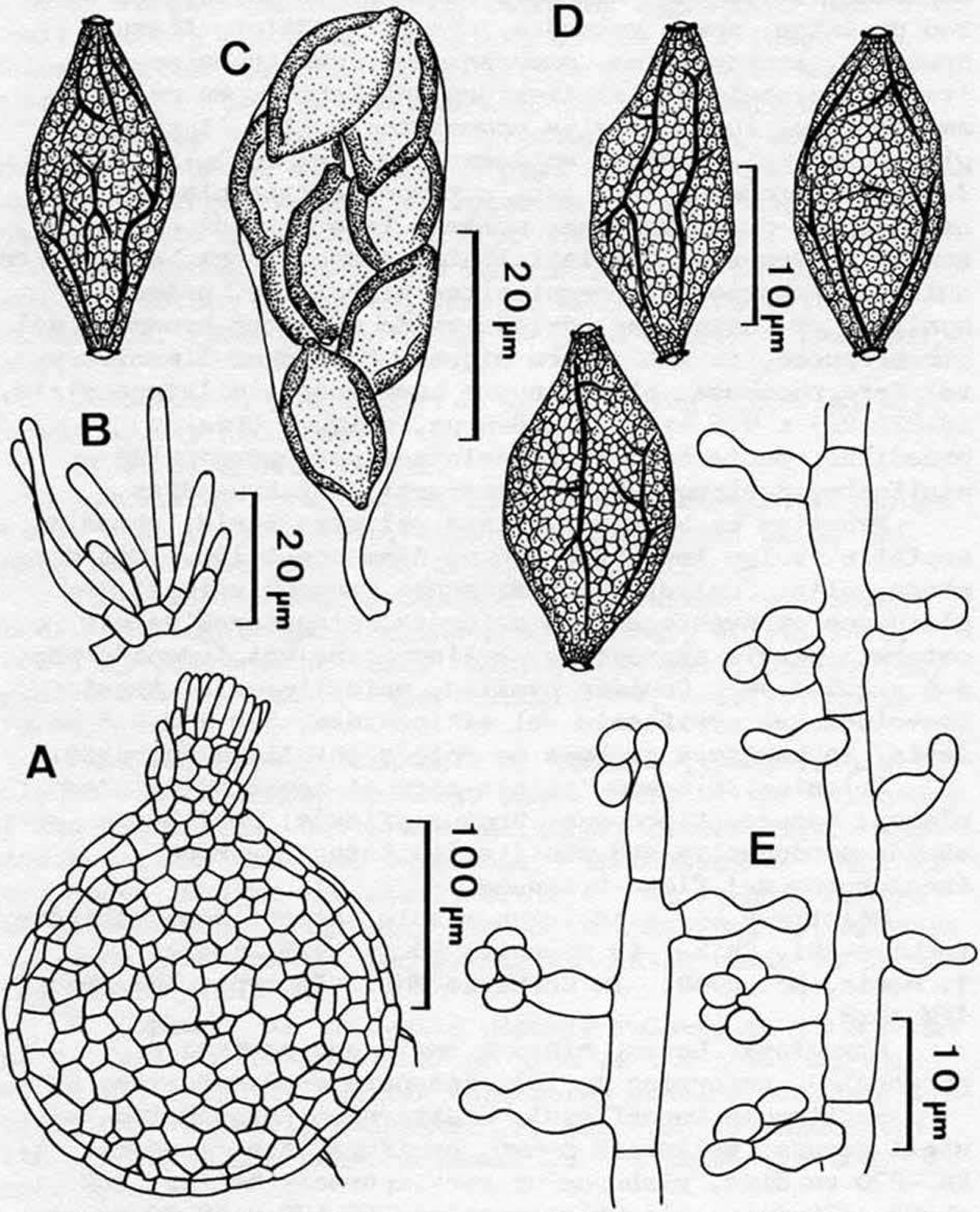


Fig. 3. *Sphaerodes micropertusa*, NHL-2769.
A. Perithecium. B. Ostiolar setae. C. Ascus.
D. Ascospores. E. Conidiogenous cells and conidia.

elongated and irregularly oriented *textura globulosa* to *textura epidermoidea* with cells 8-12 x 4-6 µm. Asci 8-spored, broadly clavate to ovoid, 44-60 x 18-25 µm, broadly rounded above, without apical structure, short-stipitate, evanescent; paraphyses lacking. Ascospores irregularly biseriately arranged, at first hyaline and guttulate, becoming dark olivaceous brown to dark brown, nearly black in mass, fusiform-limoniform to nearly rhombic in outline, slightly flattened in transverse section, 18-22(-28) x 9.5-11(-13) x 8-9 µm, ornamented with inconspicuous ridges forming a very coarse reticulum, surfaces delicately pitted, with prominent terminal, apiculate germ pores measuring 1-1.5 µm diam.

Mycelium composed of hyaline to straw-coloured, branched, septate, mostly smooth-walled, 2-6 µm diam hyphae. Conidiophores lacking. Conidiogenous cells monophialidic, usually scattered on the aerial hyphae as side branches, solitary or in small clusters, cylindric to flask-shaped, 4-8 x 2.5-4 µm. Conidia hyaline, one-celled, thin-walled, obovoid or pyriform to ellipsoidal, 3-5 x 2-3.5 µm, smooth-walled, becoming aggregated into 10-12 µm diam, globose heads at the apices of the phialides.

Colonies on potato-carrot agar growing restrictedly, attaining a diameter of 9-12 mm within 14 days at 25 C, flat, thin, consisting of submerged vegetative mycelium and white floccose aerial hyphae, brownish yellow (Methuen, 5C8), developing abundant perithecia in black patches on the agar surface; conidia limited in number, not influencing the colony appearance; reverse hyaline to yellowish brown (Methuen, 5E4). Colonies on malt agar growing rather rapidly, thin, floccose.

At 37 C, growth is nil.

Isolation: cultivated soil, Ohwadashinden, Yachiyo-shi, Chiba-pref., Japan, 28.ix.1975, coll. Y. Horie, No. 2769, NHL (Holotype). Isotypes: IMI 281908, IFM 4614.

Additional isolation: cultivated soil, Sugadaira, Sanada-machi, Chiisagata-gun, Nagano-pref., Japan, 4.x.1982, coll. Y. Horie, IFM 4614.

Sphaerodes Clem., erected in 1909 with a single species, *S. episphaeria* (Phill. & Plowr.) Clem., is also similar in appearance to *Melanospora* but differs considerably in its ascospore characters. *Sphaerodes* has very dark brown ascospores which are usually rhombic or nearly so in vertical section and often flattened in transverse section, with very coarse reticulate ornamentation. The walls of the two terminal germ pores are prominent and usually umbonate, and are themselves often reticulately ornamented.

Some smooth-spored species which apparently have the characteristic germ pores of *Sphaerodes* may also be included here.

S. micropertusa illustrates the difficulty of classifying the Ceratostomataceae relying too heavily on ascospore ornamentation, because though the spore shape and germ pores are typical of *Sphaerodes*, and it has the coarse reticulum found in that genus, it also has a secondary, very delicate reticulum which might suggest an affinity with *Persiciospora*. This second type of ornamentation is only clearly visible at magnifications of x1000 and above. The shape of the ascospores and form of the germ pores, however, make placement in *Sphaerodes* appropriate.

S. micropertusa is easily distinguished from other species of *Sphaerodes*, differing from *S. fimicola* (Hansen) P. Cannon & D. Hawksw., the only other ostiolate member of the genus, by the much longer neck of its perithecium.

Syspastospora boninensis Horie, Udagawa & P. Cannon, sp. nov. (Figs. 4, 8)

Cleistothecia superficialia vel immersa, dispersa vel in catervis parvis aggregata, nigra per massam ascosporarum, globosa vel subglobosa, 40–120 µm diam, glabra vel parum pilosa; peridium dilute flavo-brunneum, tenue, ca. 6–15 µm crassum, membranaceum, semitranslucens, 'textura intricata' vel 'textura angularis', ex cellulis hyalinis vel stramineis, tenuibus, 4–10 µm diam composito. Asci in fasciculo ad centrum dispositi, vulgo octospori, ovoidei vel late clavati, 14–22 x 10–12(–15) µm, superne late rotundi, sine annulo incrassati, brevistipitati, evanescentes; paraphyses nullae. Ascosporae irregulariter bi- vel triseriatae, unicellulares, primum hyalinae et guttulatae, deinde modice brunneae vel olivaceo-brunneae, cylindraceae vel doliiformes, 6–9 x 4–4.5 µm, leves, utrinque truncatae et labiatae; pori germinales 1.5–2 µm diam in utroque apice instructo.

Mycelium ex hyphis hyalinis vel dilute flavo-brunneis, ramosis, septatis, levibus, 2–6 µm diam composito. Chlamydosporae 6–10 µm diam, globosae vel ovoideae, hyalinae, leves, crassae, terminales vel intercalares, solitariae vel catenulatae.

Coloniae in agaro 'potato-carrot' effusae, tenues, floccosae, albidae vel pallide flavae; cleistothecia abunde producentia in areas centrales, griseo-brunnea; reversum fere incoloratum.

Holotypus ----- isolatus e solo sativi, Hahajima, Ogasawara-mura, Tokyo, in Japonia, 6.xii.1977, legit. Y. Horie, No. 2845. In Herbario NHL. Isotypi: IMI 281907, IFM 4615.

Etymology: Latin, *boninensis* = the Bonin Islands (Ogasawara), referring to the type locality.

Cleistothecia superficial or immersed in the substratum, scattered or aggregated in small groups, black due to spore mass, globose to subglobose, 40–120 µm diam, glabrous

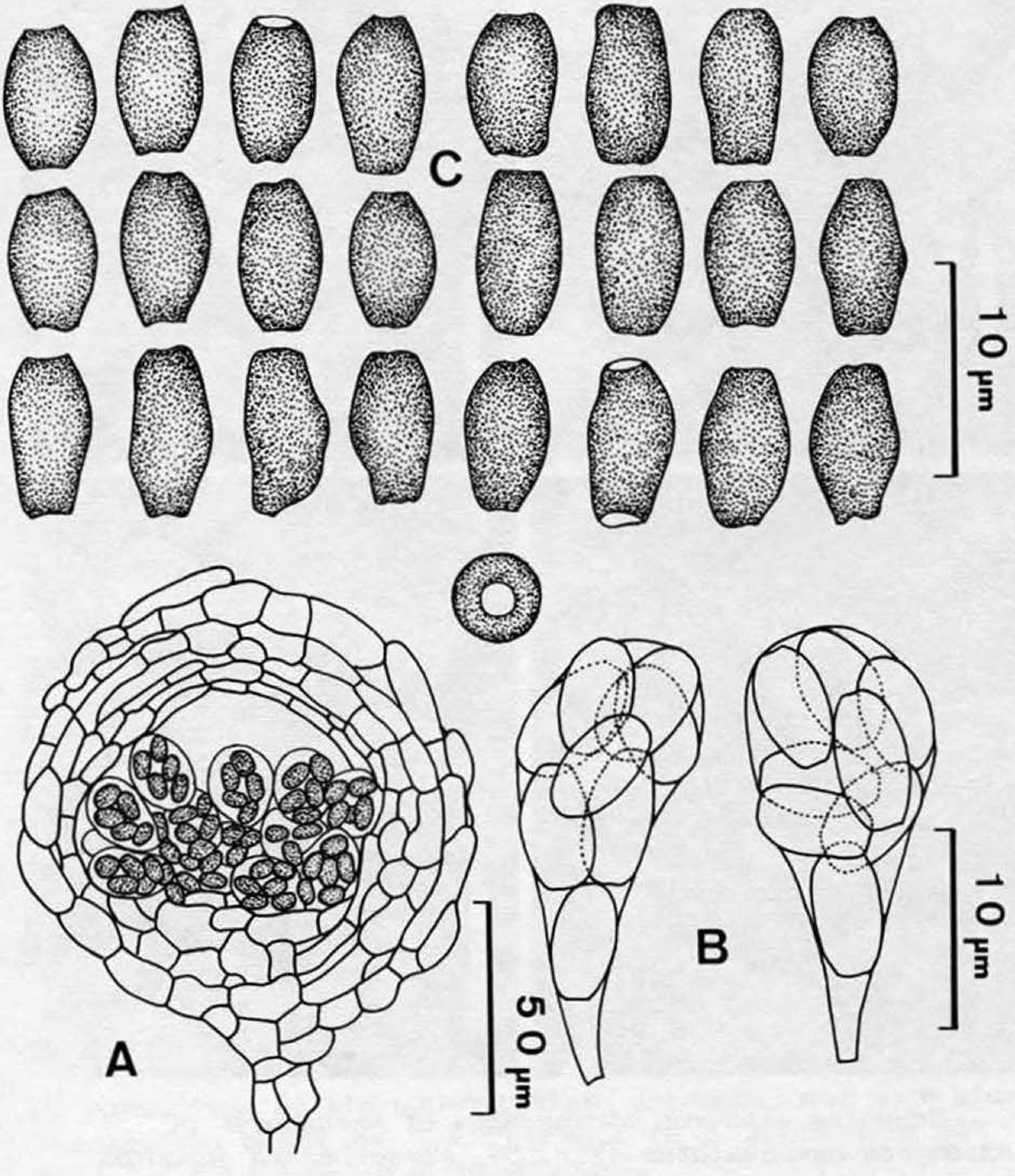
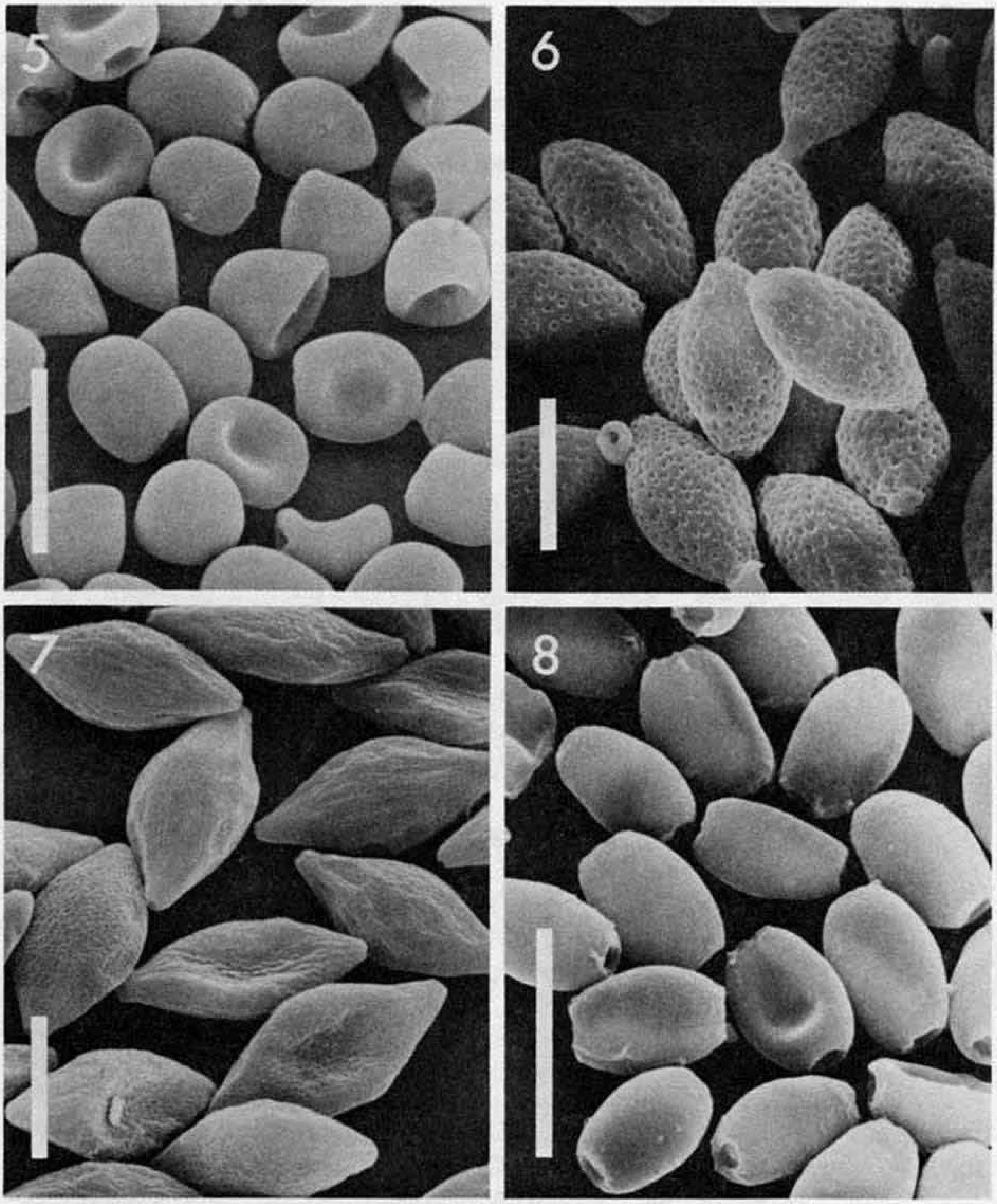


Fig. 4. *Syspastospora boninensis*, NHL-2845. A. Cleistothecium. B. Asci. C. Ascospores.

or very sparsely hairy; peridium pale yellowish brown, thin, ca. 6–15 µm thick, membranaceous, semitransparent, composed of *textura intricata* to *textura angularis*, consisting of hyaline to straw-coloured, thin-walled cells



Scanning electron micrographs of ascospores of *Arxiomyces campanulatus* (Fig. 5), *Persciospora japonica* (Fig. 6), *Sphaerodes micropertusa* (Fig. 7) and *Syspastospora boninensis* (Fig. 8). All scales = 10 µm.

measuring 4-10 µm diam. Asci arranged in a fascicle in the central part of the cleistothecium, usually 8-spored, ovoid to broadly clavate, 14-22 x 10-12(-15) µm, broadly rounded above, without apical structure, short-stipitate, evanescent; paraphyses lacking. Ascospores irregularly bi- or triseriately arranged, one-celled, at first hyaline and guttulate, becoming mid-brown to olive-brown, cylindric to doliiform, 6-9 x 4-4.5 µm, smooth-walled, ends truncate, with two large slightly sunken apical germ pores 1.5-2 µm diam, with puckered rims.

Mycelium composed of hyaline to pale yellowish brown, branched, septate, smooth-walled hyphae measuring 2-6 µm diam. Cleistothecial initials appearing as swollen knots of branches on hypha, becoming contorted and interlaced each other. Chlamydospores present, 6-10 µm diam, globose to ovoid, hyaline, thick-walled, terminal or intercalary, solitary or a few in connectives, tending to aggregate in small clusters.

Colonies on potato-carrot agar spreading broadly, attaining a diameter of 78-82 mm within 14 days at 25 C, consisting of a thin basal felt with abundant aerial growth, appearing floccose, white or light yellow (Methuen, 4A4), developing abundant cleistothecia at the central areas coloured in greyish brown (Methuen, 5F3) shades; reverse almost uncoloured.

Colonies on Weitzman and Silva-Hutner's medium (Weitzman and Silva-Hutner, 1967) spreading, floccose, with little production of cleistothecia.

At 37 C, growth-rate is similar to that at 25 C, but cleistothecia are not usually formed.

Isolation: cultivated soil after burning, Hahajima, Ogasawara-mura, Tokoyo, Japan, 6.xii.1977, collected by Y. Horie, no. 2845, NHL (Holotype). Isotypes: IMI 281907, IFM 4615.

Syspastospora, erected by Cannon & Hawksworth (1982) to accommodate *S. parasitica* (Tul.) P. Cannon & D. Hawksw., differs from *Melanospora* by its cylindrical to doliiform ascospores with very large terminal crateriform germ pores, which have slightly puckered rims. In addition, the neck of the perithecium in *Syspastospora* is made up of parallel hyphae while in *Melanospora* it is cellular in construction.

S. boninensis is immediately distinguished from *S. parasitica* by its non-ostiolate ascomata, and much wider ascospores, which are 4-4.5 µm wide in *S. boninensis* but only 2-2.5 µm wide in *S. parasitica*.

ACKNOWLEDGMENTS

The authors gratefully acknowledge Dr. Kouhei Furuya, Sankyo Co. Ltd.,for supplying the culture of *Persiciospora japonica*, and Dr. David L. Hawksworth, Director of the Commonwealth Mycological Institute, for providing useful suggestions. The authors also thank Prof. R. T. Hanlin of the University of Georgia and Prof. G. Morgan-Jones of the Auburn University for reviewing this paper.

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MYCOTAXON

Vol. XXV, No. 1, pp. 247-250 January-March 1986

NOTES ON HYPHOMYCETES. LI.
KAMESHWAROMYCES, A NEW FOLIICOLOUS, SOOTY MOLD-LIKE GENUS FROM MADHYA PRADESH, INDIA

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ABSTRACT

Kameshwaromyces globosus Kamal, Verma and Morgan-Jones, a new genus and species, which occurs superficially on the abaxial surface of leaves of *Elephantopus scaber* L., in Madhya Pradesh, India, is described and illustrated.

INTRODUCTION

During the course of a study of foliicolous, dematiaceous Hyphomycetes occurring in the Panchmari Hills of Madhya Pradesh, India, one of us (R.K.V.) has collected a fungus of unique morphology growing superficially in the manner of a sooty mold on the abaxial surface of leaves of *Elephantopus scaber*. Examination of its habit by means of the collodion technique for the study of foliicolous sooty molds (Hughes, 1976) indicates that it produces an extensive network of anastomosing, repent hyphae closely appressed to the leaf surface. Its hyphae do not penetrate the epidermis. It perhaps qualifies to be referred to as a sooty mold in the broad vernacular sense although it does not produce an intense, truly sooty appearance such as that characteristic of fungi associated with honey dew deposited by various insects. It is presumed that it obtains nutrients to sustain growth from leachates in the phylloplane.

We believe this fungus to be undescribed and to be so distinct as to warrant accommodation in a new genus.

TAXONOMIC PART

Kameshwaromyces gen. nov.

Deuteromycotina, Hyphomycetes, Dematiaceae.

Alabama Agricultural Experiment Station Journal Series No. 6-85899.

Coloniae effusae, atrae. Mycelium superficiale, ex hyphis pallide brunneis, laevibus, septatis, cylindricis, repentibus, ramosis, anastomosantibus compositum. Conidiophora micronemata. Cellulae conidiogenae monoblasticae, in hyphis vegetativis incorporatae, intercalares vel terminales, cylindricae. Conidia solitaria, sicca, ex apice lateribusque hypharum oriunda, globosa, parietibus crassis, brunnea vel atrobrunnea, muriformia, multicellularia, laevia vel aspera.

Species typica: *Kameshwaromyces globosus* Kamal, Verma and Morgan-Jones.

Colonies effuse, black. Mycelium superficial, composed of pale brown, smooth, septate, cylindrical, repent, branched, anastomosing hyphae. Conidiophores micronematous. Conidiogenous cells monoblastic, incorporated in the vegetative hyphae, intercalary or terminal, cylindrical. Conidia solitary, smooth, arising terminally and laterally on the hyphae, globose, thick-walled, brown to dark brown, muriform, multicellular, smooth or roughened.

[Etymology: the new genus is named in honor of Professor Kameshwar S. Bhargava, the teacher of one of us (Kamal), et Gr. *myces* = fungus]

Kameshwaromyces globosus sp. nov. (Figure 1).

Coloniae semper hypophyllae, late effusae, diffusae, primo cinnamomea, demum ubi densiores atrae. Mycelium superficiale, ex hyphis pallide brunneis, laevibus, septatis, cylindricis, repentibus, ramosis, anastomosantibus, 2-3µm crassis comositum. Conidiophora micronemata. Cellulae conidiogenae monoblasticae, in hyphis vegetativis incorporatae, intercalares, cylindricae. Conidia solitaria, acrogena, sicca, ex apice lateribusque hypharum oriunda, globosa, parietibus crassis, brunnea vel atrobrunnea, muriformia, multicellularia, laevia vel aspera, interdum fimbriata, 32-50µm diam.

In foliis vivis Elephantopi scaber, Panchmari Hills, Madhya Pradesh, India, August 1984, R.K. Verma, AUA, holotypus.

Colonies always hypophyllous, spreading relatively widely, diffuse but tending to be better developed in the vicinity of the main leaf veins, at frist pale cinnamon-brown in color, assuming a black appearance with the production of conidial clusters. Mycelium superficial, composed of pale brown, smooth, septate, cylindrical, repent, branched, anastomosing, 2-3µm wide hyphae. Hyphae forming a loose network or a somewhat dense subiculum in places, with short, interlocking lateral branches. Laterally produced hyphal branches frequently becoming acutely bent following contact with other hyphae and ensuing terminal growth. Conidiophores micronematous. Conidiogenous cells monoblastic, incorporated in the vegetative hyphae, terminal or, more frequently, intercalary, cylindrical. Conidia solitary, acrogenous, dry, arising terminally but mostly laterally from intercalary hyphal cells, where lateral frequently on a very short hyphal extension, globose, thick-walled, brown to dark brown, muriform, multicellular, with individual cells disctinctly angular in configuration, smooth or irregularly roughened, often with a portion of the wall of the conidiogenous cell remaining attached as a basal frill following secession, 32-50µm in diameter.

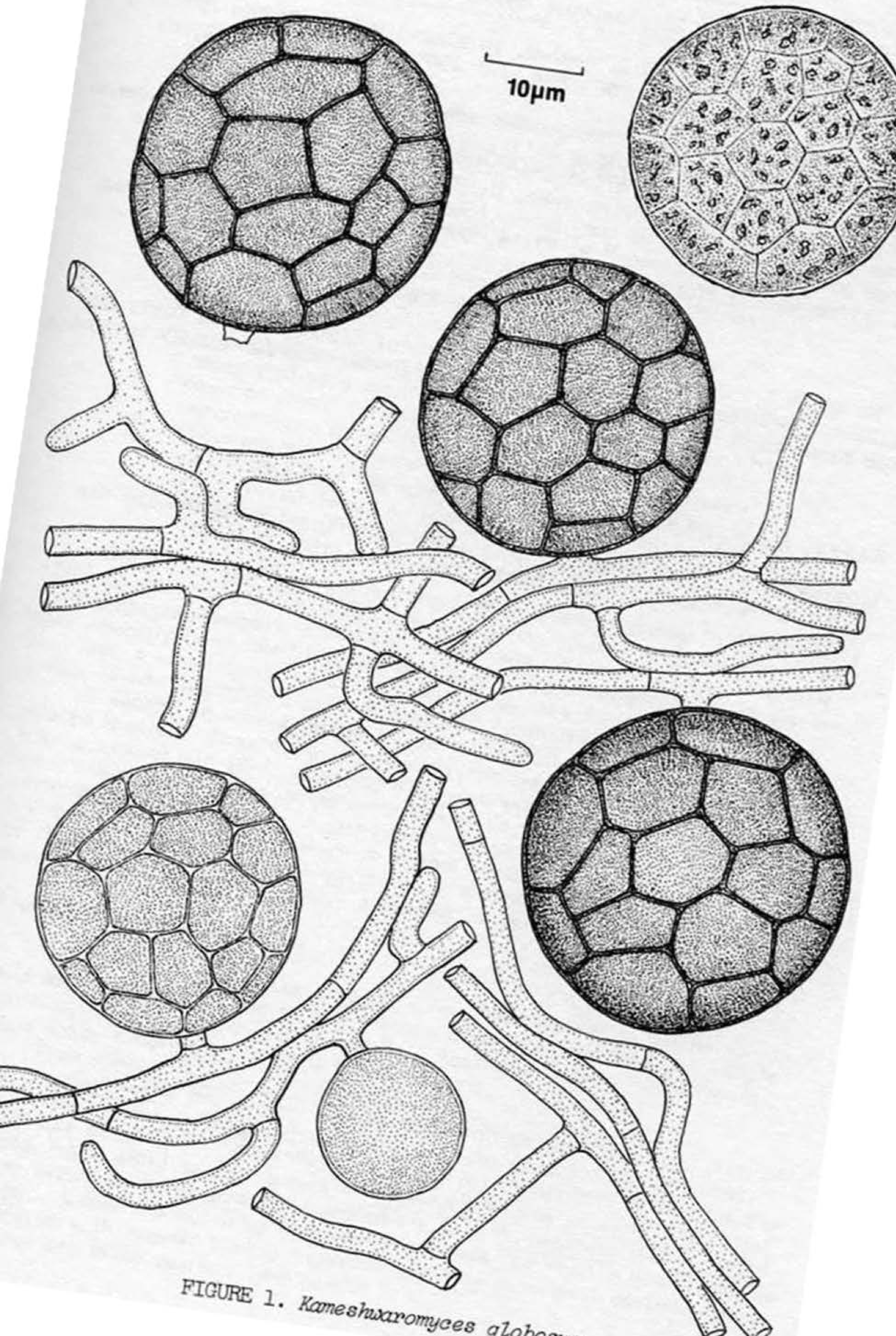

FIGURE 1. *Kameshwaromyces globosu*

On living leaves of *Elephantopus scaber* L.; India.

Collection examined: on *E. scaber*, Panchmari Hills, Madhya Pradesh, India, August 1984, R.K. Verma, AUA, IMI 290576, GPU (KRN 5), type.

When viewed under a stereoscope the conidia of *Kameshwaromyces globosus* appear as shiny, black balls. They occur predominantly in dense clusters. The conidia are chlamydosporic in character and appearance and are not true *conidia vera sensu* Vuillemin (1910). Among known dematiaceous Hyphomycetes they most closely resemble in morphology those of *Dictyopolyschema* M.B. Ellis, but that genus is very different in having well-differentiated, discrete, tretic conidiogenous cells.

ACKNOWLEDGMENT

We thank Dr. J. Leland Crane, State Natural History Survey Division, Illinois Department of Energy and Natural Resources, for kindly reviewing the manuscript.

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MYCOTAXON

Vol. XXV, No. 1, pp. 251-254 January-March 1986

ARCTOPARMELIA, A NEW GENUS IN THE PARMELIACEAE (ASCOMYCOTINA)

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Abstract.--The Xanthoparmelia centrifuga group is recognized as a distinct genus, Arctoparmelia, on the basis of lower surface characters, medullary chemistry, macromolecular iodine reactions and geography. The following new combinations are made: Arctoparmelia aleuritica (Nyl.) Hale, A. centrifuga (L.) Hale, A. incurva (Pers.) Hale, A. separata (Th. Fr.) Hale and A. subcentrifuga (Oxner) Hale.

The genus Xanthoparmelia (Vain.) Hale was established in 1974 (Hale, 1974) to accomodate the obligately saxicolous, epicorticate, usnic-acid containing species formerly classified in Parmelia. Several anomalous groups have recently been identified within the genus as I originally circumscribed it. One, a small group of umbilicate species, the Parmelia hottentotta group, is now recognized as a new genus, Xanthomaculina (Hale, 1985a).

A second anomalous group includes the well-known X. centrifuga and related species. They differ from other species in the genus in always containing alectoronic acid, in having a curious velvety, ivory-white to purplish lower surface and in geographic restriction to arctic-boreal regions. This combination of characters is sufficiently distinct to remove these species from Xanthoparmelia and place them in a new genus, Arctoparmelia. The removal of these groups leaves Xanthoparmelia as a highly homogeneous assemblage of about 210 species predominantly occurring on rocks in dry temperate regions.

Arctoparmelia Hale, gen. nov.

Thallus adnatus vel laxe adnatus, viridi-flavicans vel raro cinereo-albus, lobis sublinearibus, cortice superiori epicorticato, cortice inferiori minute papillato, rhizinis sparsis vel fere nullis. Apothecia adnata, imperforata, sporis 8:nis, simplicibus, conidiis bifusiformibus.

Type species: Lichen centrifugus L.

Arctoparmelia has several interesting morphological features. The cortex is epicorticate, although the surface is often obscured by amorphous pruina-like accretions. Externally the lower cortex appears to be dull and velvety, ivory white to pale brown in A. aleuritica and A. centrifuga, but darker brown in A. incurva and purplish black in A. separata and A. subcentrifuga. Under the scanning electron microscope the velvety nature can be correlated with regular knobby projections of the outermost cortical cells. Rhizines are often sparsely developed.

Arctoparmelia exhibits significant chemical differences from *Xanthoparmelia*. The medullary chemistry is uniform in all the species in the new genus: Alectoronic acid usually accompanied by α-collatolic acid. Except for one rare Andean species with normal *Xanthoparmelia* morphology, *X. alectoronica* Hale (Hale, 1985b), alectoronic acid does not occur in *Xanthoparmelia*. In addition, the upper cortex of *Arctoparmelia* species contains considerable amounts of atranorin, easily detected on TLC plates, and usnic acid (except for *A. aleuritica*), whereas atranorin is absent or produced only in trace amounts in *Xanthoparmelia*. A more significant chemical difference between the two genera, however, is their macromolecular chemistry. While both contain lichenin, *Arctoparmelia* species give a negative reaction with I(CH) (chloral hydrate). *Xanthoparmelia* is I(CH) positive (Imshaug, in litt.).

There are five closely related species in *Arctoparmelia*, as follows:

Arctoparmelia aleuritica (Nyl.) Hale, comb. nov.
Parmelia aleuritica Nyl., Flora 58:103. 1875.
Parmelia centrifuga var. *dealbata* Th. Fr., Lichenogr. Scand. 1:129. 1871.

This is the only species lacking usnic acid in the cortex. It is restricted to Scandinavia where it is considered as an usnic acid-free mutant of *A. centrifuga*.

Arctoparmelia centrifuga (L.) Hale, comb. nov.
Lichen centrifugus L., Sp. Pl. 1142. 1753.
Parmelia centrifuga (L.) Ach., Meth. Lich. 206. 1803.
Xanthoparmelia centrifuga (L.) Hale, Phytol. 28:486. 1974.

This is one of the most abundant, conspicuous foliose lichens on rocks in the Arctic (see Thomson (1984) for detailed distribution in North America).

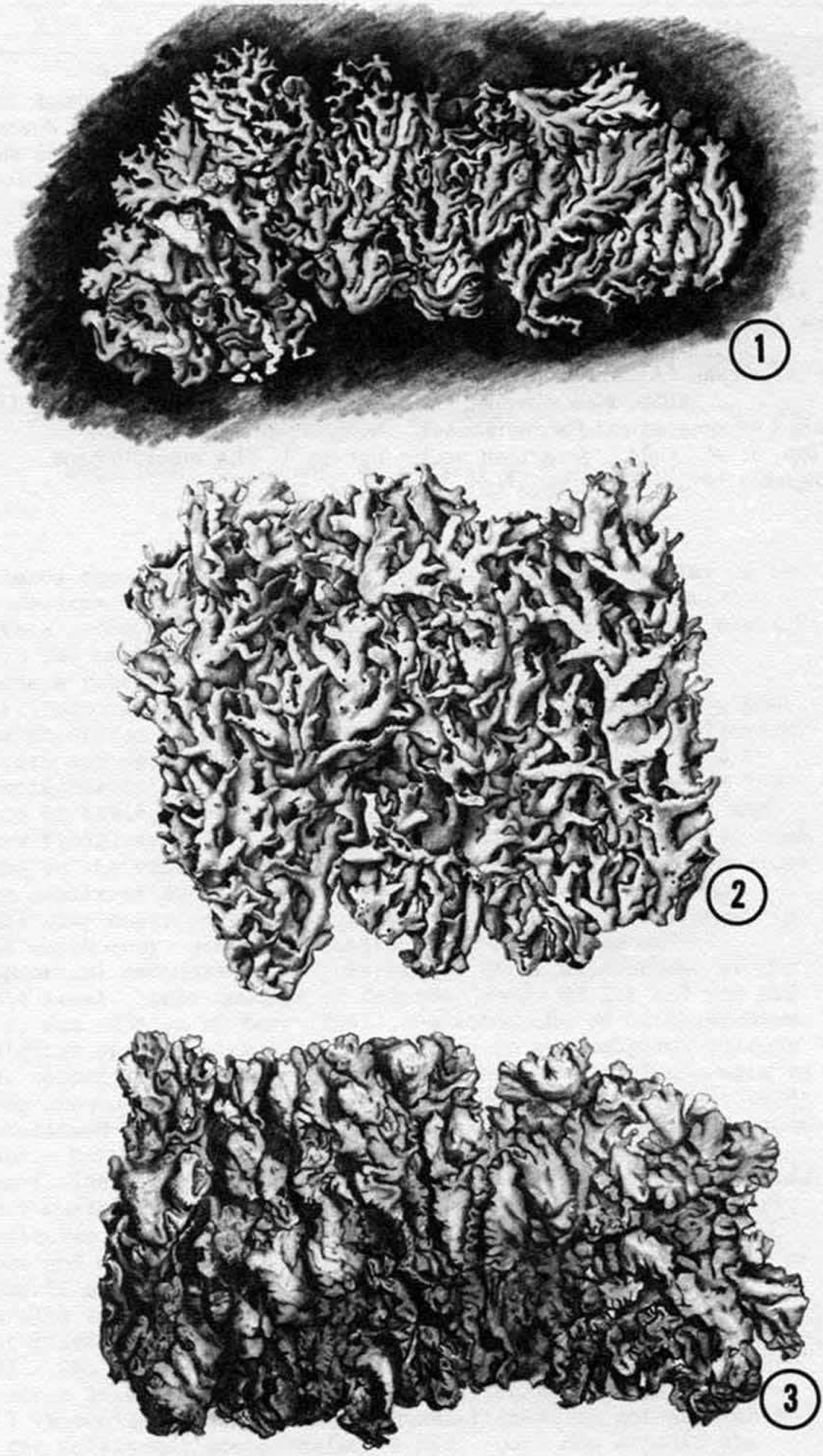
Arctoparmelia incurva (Pers.) Hale, comb. nov.
Lichen incurvus Pers., Usteri Ann. Bot. 3:24. 1794.
Lichen multifidus Dicks., Pl. Crypt. Brit. 3:16(7). 1793. Not *L. multifidus* Scop., Fl. Carniol. 2:396. 1772 (=*Collema*).
Parmelia recurva Ach., Meth. Lich. 201. 1803.
Xanthoparmelia incurva (Pers.) Hale, Phytol. 28:488. 1974.

This is the only sorediate species in the genus (Fig. 1). It is circumpolar with *A. centrifuga*.

Arctoparmelia separata (Th. Fr.) Hale, comb. nov.
Parmelia separata Th. Fr., Jour. Linn. Soc. Lond. 17:353. 1880.
Parmelia centrifuga var. *muscivaga* Nyl., Bull. Soc. Linn. Norm., ser. 4, 1:201. 1887.
Parmelia birulae Elenkin, Ann. Mycol. 4:36. 1906.
Parmelia diffugiens Zahlbr., Bot. Mag. (Tokyo) 41:348. 1927.
Parmelia muscivaga (Nyl.) Gyel., Ann. Mus. Nat. Hung. 30:23. 1935.
Parmelia birulae var. *grumosa* Llano, Jour. Wash. Acad. Sci. 41:197. 1951.
Xanthoparmelia separata (Th. Fr.) Hale, Phytol. 28:489. 1974.

The lower surface is deep purplish black and the long lobes divaricately branched (Fig. 2), characters which separate the species from *A. centrifuga*. It occurs across arctic Canada into Alaska, in Japan and in Siberia west to Novaya Zemlya. There are no records from Europe.

Arctoparmelia subcentrifuga (Oxner) Hale, comb. nov.
Parmelia subcentrifuga Oxner, Jour. Bot. Acad. Sci. RSS Ukraine 1(3-4):39. 1940.
Parmelia groenlandica Lynge in Lynge & Scholander, Skrift. Svalb. Ishav. 41: 73. 1932. Not *P. groenlandica* (Oed.) Ach., Meth. Lich. 241. 1803. (=



Figs. 1-3. Species of *Arctoparmelia*. 1: *A. incurva* (X3). 2: *A. separata* (X1.5). 3: *A. subcentrifuga* (X2). Drawings by J. Schroeder.

Nephroma).

Xanthoparmelia subcentrifuga (Oxner) Hale, Phytol. 28:489. 1974.

This rare species occurs sporadically in Greenland, Baffin Island, along the north shore of Lake Superior in Canada, the Rocky Mountains, Alaska, SW Siberia and Nepal (records in US). The blackish lower surface is similar to that of A. separata but the upper surface is strongly and coarsely rugose-pustulate (Fig. 3).

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MYCOTAXON

Vol. XXV, No. 1, pp. 255-257 January-March 1986

HORMOTHECA FOR SPECIES OF COLEROA WITH HEMISPHERICAL ASCOMATA

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Coleroa chaetomium (Kunze:Fr.) Rabenh., the type species of the genus *Coleroa* Rabenh., possesses saccate asci and greenish, 1-septate ascospores within globose, setose ascomata which develop beneath the cuticle of living leaves of *Rubus* species. *Hormotheca robertiani* (Fr.) v. Höhn. (=*Hormotheca geranii* (Wallr.) Bonorden), the type species of the genus *Hormotheca* Bon. is characterized by oblong to saccate asci, greenish to yellowish, 1-septate ascospores but is distinguished from *C. chaetomium* by its hemispherical, non setose ascomata which develop beneath the cuticle of living leaves of *Geranium robertianum* L. Müller and von Arx (1962) synonymized *Hormotheca* under the older generic name *Coleroa* in the family Venturiaceae Müller & v. Arx ex Barr because of the similarities of the asci and ascospores and the common subcuticular habit on leaves. They considered the differences in ascoma morphology, globose ascomata in *C. chaetomium* and hemispherical ascomata in *H. robertiani*, to be unimportant at the generic level. This concept of *Coleroa*, sensu Müller and von Arx (1962), was adopted by Barr (1968) who accommodated *C. chaetomium* and similar species with globose ascomata in the subgenus *Coleroa* and *H. robertiani* and other species with hemispherical ascomata in the new subgenus *Hormotheca* (Bon.) Barr. Corlett (1977a, b; 1978) also followed the taxonomic concepts of Müller & von Arx and those of Barr. Luttrell (1973) however, maintained *Hormotheca* as distinct, including this genus in the family Munkiellaceae (Theiss. & Syd.) Luttrell, characterized by the presence of hemispherical, subcuticular ascomata. He retained *Coleroa* in the Venturiaceae. Von Arx and Müller (1975) considered *Hormotheca* to be a synonym of *Coleroa* in an enlarged Venturiaceae (as Stigmateaceae Theiss.) which also included the Munkiellaceae. Barr (1979, 1982), in her recent classification of the Loculoascomycetes, agreed with Luttrell (1973). She maintained *Coleroa* in the Venturiaceae and *Hormotheca* in the closely related Munkiellaceae. O. Eriksson (1981) recognized that the family Munkiellaceae is not separable from the Polystomellaceae Theiss. & Syd. Barr now accepts the family Polystomellaceae to include genera such as *Hormotheca*.

We now believe that the differences in ascoma morphology between *Hormotheca* and *Coleroa* warrant their retention as distinct genera in the Polystomellaceae and the Venturiaceae, respectively. We would restrict the genus *Coleroa* to *C. chaetomium* and similar species with globose ascomata. The species with hemispherical ascomata previously accepted in *Coleroa* by Müller and von Arx (1962), Barr (1968) and Corlett (1977a,b; 1978) are disposed in *Hormotheca* as follows with the requisite new combinations.

Hormotheca plantaginis (Ellis) comb. nov.
BASIONYM: *Asterina plantaginis* Ellis, Bull. Torrey Bot. Club 9:74. 1882.
Asterella plantaginis (Ellis) Sacc., Syll. Fung. 9:398. 1891 (as *Asterella plantaginis* Ellis).
Mycosphaerella plantaginis (Ellis) Theiss., Ann. Mycol.10:196. 1912.
Mycosphaerella theissenii Tomilin, Nov. Sist. niz. Rast. 8:152. 1971, syn.:*Mycosphaerella plantaginis* (Ellis) Theiss., non *Mycosphaerella plantaginis* (Sollm.) Vest.
Aphysa plantaginis(Ellis) Theiss., Ann. Mycol. 15:402. 1917.
Coleroa plantaginis (Ellis) Barr, Can. J. Bot. 46:833. 1968.

Hormotheca robertiani (Fr.) v. Höhn., Hedwigia 62:44. 1921.
Dothidea robertiani Fr., Syst. Mycol. 2:564. 1823.
Stigmatea robertiani (Fr.)Fr., Summa Veget. Scand. p. 421. 1849.
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Munkiella robertiani (Fr.) v. Höhn., Ann. Mycol.16:172. 1918.
Coleroa robertiani (Fr.) Müller, in Müller & v. Arx, Beitr. Krypt. Fl. Schweiz 11(2):416. 1962.
Cryptosphaeria nitida Grev., Fl. Edin. p.363. 1824.
Sphaeria geranii Wallr., Crypt. Germ. 2:771. 1833.
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Hormotheca rubicola (Ellis & Everh.) comb. nov.
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The authors thank Dr. J.C. Krug, Department of Botany, University of Toronto and Drs. R.A. Shoemaker and G.A. Neish, Biosystematics Research Institute, for reviewing the manuscript.

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MYCOTAXON

Vol. XXV, No. 1, pp. 259-269 January-March 1986

TAXONOMIC NOTES ON SOME POWDERY MILDEWS OF VARIOUS GENERA

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The present paper contains the following descriptions and combinations: *Leveillula simonianii* U. Braun spec. nov., *Microsphaera itoana* Y. Nomura, S. Tanda & U. Braun spec. nov., *M. orixae* U. Braun & S. Tanda spec. nov., *M. paederiae* S. Tanda, Y. Nomura & U. Braun spec. nov., *M. wallrothii* U. Braun & S. Tanda spec. nov., *Sphaerotheca euphorbiae-hirtae* U. Braun & R. B. Somani spec. nov., *Uncinula matsunamiana* Y. Nomura, S. Tanda & U. Braun spec. nov., *U. viburni* Y. Nomura, S. Tanda & U. Braun spec. nov., *Oidium cinnamomi* (Yen) U. Braun stat. nov., *O. cinnamomi-japonici* U. Braun spec. nov., *O. schmiedeknechtii* U. Braun spec. nov., *O. stapeliae* (Picbauer) U. Braun stat. nov., *O. nephelii* Hadiwidjaja ex U. Braun spec. nov., *O. caesalpiniacearum* Hosagoudar & U. Braun spec. nov., *O. ipomoeae* (Yen & Wang) U. Braun stat. nov., *O. robustum* U. Braun & E. Oehrens B. spec. nov., and *O. araliacearum* U. Braun & E. Oehrens B. spec. nov.

1. *Leveillula simonianii* U. Braun spec. nov.

Syn.: *Leveillula taurica* f. *thevenotiae* Jaczewski (1927, p.406), nom. nud. *Leveillula thevenotiae* (Jacz.) Golovin (1956, p.231), not valid, basionym a nom. nud., no Latin description added.

Etym.: Dr. S. Simonian, mycologist in Armenia.

Mycelium amphigenum. Conidiis primariis ± lanceolatis, conidiis subsequentibus ± cylindraceis - ellipsoideis, ca. 35-50 x 13-19 µm. Conidia verrucosae - squamulosae. Cleistothecia sparsa vel gregaria, 150-220 µm diam., cellulae peridii irregulariter angulatae, obscurae, ca. 8-15 µm diam., appendices mycelioideae, hyalinae, tenuitunicatae, verruculosae, 4-6 (-8) µm latae, diametro cleistothecii 0.25-1 plo longiores, asci numerosae, ca. 20-25, 70-95 x 30-40 µm, ascosporae 2, 24-32 x 14.5-21 µm. Fig. 1.

Holotypus: hospes - Thevenotia scabra Boiss., Iran, Teheran, 1892, Bornmüller 4370 (FH).

The cleistothecia possess few to fairly numerous appendages in the lower half, they are aseptate or with few inconspicuous septa. This fungus differs from all species of Leveillula by the structure of the conidial surface. The conidia are very conspicuously verrucose (fig. 1). L. simonianii is known on Thevenotia scabra and persica from Iran and Turkmenia.

2. Microsphaera itoana Y. Nomura, S. Tanda & U. Braun spec. nov.

Etym.: S. Ito, Japanese mycologist.

Mycelium amphigenum. Cleistothecia sparsa, 90-115 µm diam., cellulae peridii irregulariter angulatae, ca. 9-17 x 6-14 µm, appendices 5-7, diametro cleistothecii 1-1.5 plo longiores, ca. 95-160 µm, hyalinae, non septatae, superne tenui-, inferne crassitunicatae, ad apicem dichotome ramosae (3-5 x), ramis ultimis recurvatis, asci 6-7, 50-55 x 33-40 µm, ascosporae 6, 16-18 x 6-12 µm. Fig. 2.

Holotypus: hospes - Atractylodes japonica Koidz., Japan, Mt. Mitake-san, Tokyo, Oct. 31, 1961, Y. Nomura (YNMH, herb. Nomura).

The appendages arise equatorially, they are rather stiff, the branchings are regular, somewhat loose. The asci are shortly stalked. The type host, a member of the Asteraceae, is very unusual for a species of the genus Microsphaera. Nomura & al. (1978, p.304, + Tab. 4 and fig. 3, 5-8) described and illustrated this fungus as Microsphaera spec. The new species is allied to M. clethrae, but differs by fewer appendages and larger ascocarps. The closely related M. staphyleae Sawada possesses larger ascospores.

3. Microsphaera orixae U. Braun & S. Tanda spec. nov.

Syn.: M. alni auct. p.p.

Mycelium amphigenum, saepe epiphyllum, subpersistens. Cleistothecia sparsa vel subgregaria, (60-) 75-100 (-110) µm diam., cellulae peridii irregulariter angulatae, ca. 8-25 µm diam., appendices (3-) 5-18, diametro cleistothecii 1-1.5 plo longiores, ca. 65-135 µm, 0-2 (-4) septatae, hyalinae vel ad basim brunneae, superne tenui-, inferne crassitunicatae, ad basim 6-11 µm latae, ad apicem dichotome ramosae (3-6, saepe 4-5 x), ramis ultimis recurvatis, asci 2-5, 40-65 x 30-50 µm, ascosporae 3-6, saepe 4-5, ellipsoideae - ovoideae, 14-25.5 x 8-14 µm. Fig. 3.

Holotypus: hospes - Orixa japonica Thunb., Japan, Ya-

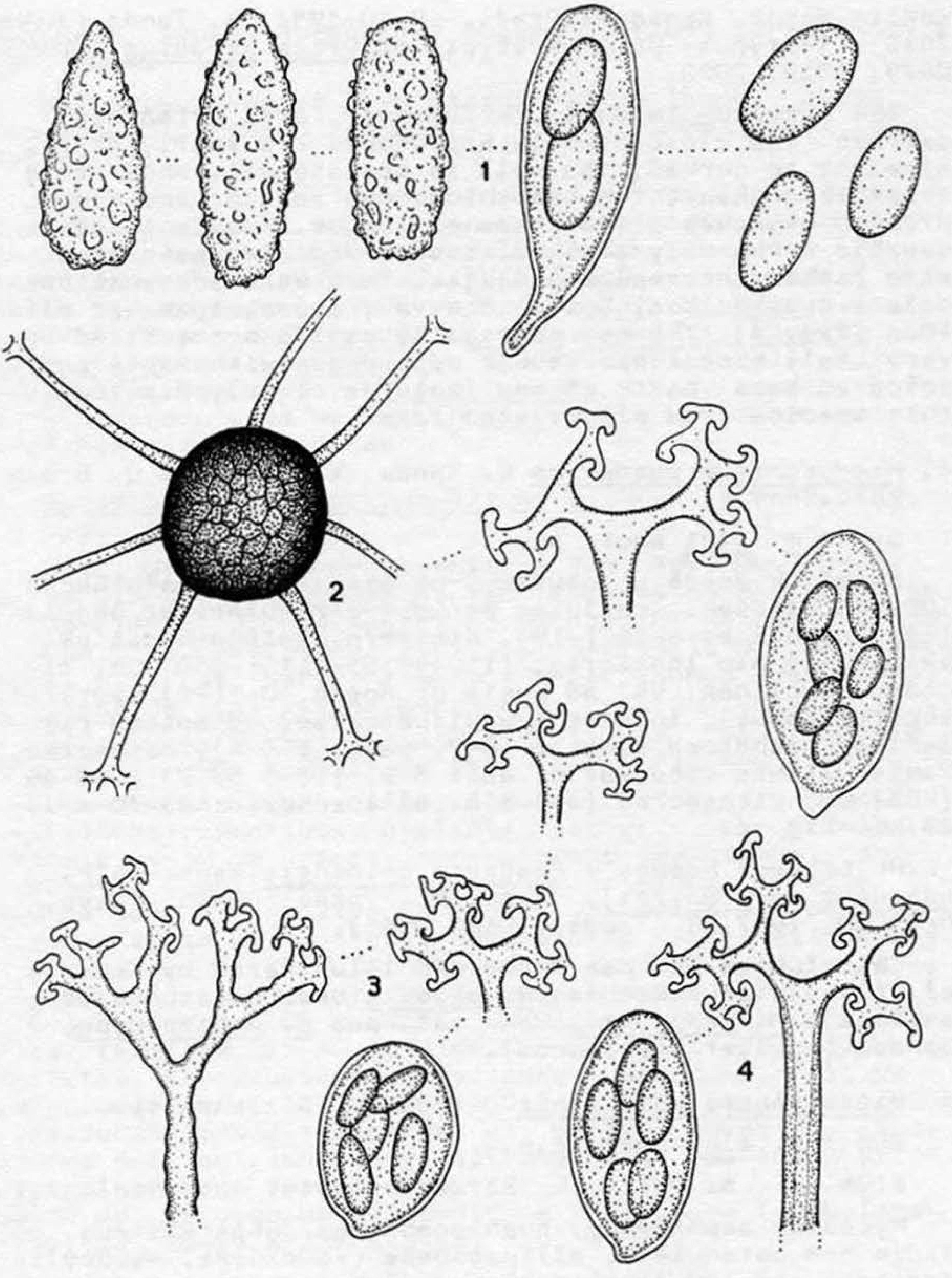

Fig. 1-4. Leveillula simonianii (1), conidia, ascus, ascospores. Microsphaera itoana (2), ascocarp, branched part of an appendage, ascus. M. orixae (3), apical parts of appendages, ascus. M. paederiae (4), ascus, apical part of an appendage. U. Braun del.

makita-machi, Kanagawa Pref., 18-10-1984, S. Tanda (TUAMH 2613). Isotypus: HAL. Paratypi: on Orixa japonica, TUAMH 0849, 1819, 2026.

The mycelium is white, effused or forms irregular patches. The cleistothecialappendages are fairly stiff, straight to curved, the wall is occasionally moderately thick throughout, the branchings are regular and close, primary branches often somewhat longer. The asci are sessile or shortly stalked. I observed some ascocarps with rather abnormal appendages. They were somewhat undulate-subnodulose, branchings very loose, somewhat diffuse (fig. 3). The new species is well characterized by very small ascocarps, robust appendages with septa and coloured basal parts. These features clearly distinguish this species from all related taxa.

4. Microsphaera paederiae S. Tanda, Y. Nomura & U. Braun spec. nov.

Syn.: M. alni auct. p.p.

Mycelium saepe epiphyllum, persistens. Cleistothecia 108-143 µm diam., cellulae peridii irregulariter angulatae, appendices 8-16 (-19), diametro cleistothecii ca. 1-1.5 (-2) plo longiores, (110-) 151-211 (-250) µm, rigidae, hyalinae, vel ad basim brunneae, 0-1(-2) septatae, superne tenui-, inferne crassitunicatae, ad apicem regulariter dichotome ramosae (4-7, saepe 5-6 x), compactae, ramis ultimis recurvatis, asci 3-9, (53-) 58-73 x 33-48 (-53) µm, ascosporae (4-) 5-6, ellipsoideae, 23-30 x 13-16 µm. Fig. 4.

Holotypus: hospes - Paederia chinensis Hance (= P. scandens var. mairei), Japan, Mt. Takamizuyama, Tokyo, Oct. 20, 1967, S. Tanda (TUAMH 0045).

This fungus was described and illustrated by Tanda & al. (1973). It resembles M. akebiae Sawada (ascocarps smaller), M. menispermi Howe s.l. and M. schizandrae Sawada (smaller ascospores).

5. Microsphaera wallrothii U. Braun & S. Tanda spec. nov.

Syn.: M. alni auct. p.p.

Etym.: F. W. Wallroth, German botanist and mycologist.

Mycelium amphigenum, evanescens vel subpersistens, conidia non catenulata, ellipsoideae (-ovoideae, -subcylindraceae), ca. 30-45 x 14-22 µm. Cleistothecia sparsa (-subgregaria), 85-125 µm diam., cellulae peridii irregulariter angulatae, ca. 8-25 µm diam., appendices 3-12, rigidae, diametro cleistothecii 0.75-1.5 plo longiores, hyalinae, 0-1 septatae, superne tenui-, inferne crassitunicatae, ad basim ca. 8-10 µm latae, ad apicem regulariter dichotome ramosae (4-6 x), compactae, ramis ultimis recurvatis, asci (3-) 4-6 (-7), (40-) 45-65 (-70) x (25-) 30-50 (-55) µm, ascosporae (3-) 5-6 (-7), ellipsoideae -

ovoideae, subcylindraceae - oblongae, (16-) 18-28 (-32) x (8-) 10-16 (-20) µm, Fig. 5.

Holotypus: hospes - Vaccinium hirtum Thunb., Japan, Tsu-shi, Mie Pref., 1-11-1977, Abiko (TUAMH 2782). Isotypus: HAL.

The mycelium is effused or forms irregular patches. The cleistothecial appendages are very rarely trichotomously branched, smooth to usually rough. The asci are sessile or shortly stalked. This fungus was recorded by Abiko and Hagiwara (1980) under M. alni. M. alni s.l. is known in Japan on Vaccinium hirtum, smallii, usunoki, and versicolor var. glabrum. The new species is related to M. akebiae Sawada and M. schizandrae Sawada (appendages more numerous), as well as M. miyabeana U. Braun (primary branches often elongated).

6. Sphaerotheca euphorbiae-hirtae U. Braun & R. B. Somani spec. nov.

Syn.: Oidium euphorbiae-hirtae Yen, Rev. Myc. 31(4), p.296 (1966). O. pedilanthi Yen, Cahiers du Pacifique 11, p.104 (1967). O. pedilanthi R. Mathur, B. Mathur & L. Bhargavan, Ind. Phytopath. 24(1), p.63 (1971). O. cyparissiae auct. p.p. (ss. Narayanaswamy & Ramakrishnan 1969, p.86). Acrosporium cyparissiae auct. p.p. (ss. Subramanian 1971, p.837). Sphaerotheca fuliginea auct. p.p. (ss. Somani & al. 1976). Sph. euphorbiae auct. p.p. (ss. Rao 1961).

Mycelio amphigeno, albo, effuso, confluenti. Hyphis sterilibus repentibus, hyalinis, septatis, tenuitunicatis, ramosis, 4-10 µm crass., appressoriis mammatibus. Conidiophoris simplicibus, ex hyphis sterilibus oriundis, 50-250 µm longis, cellulis ad basim cylindraceis, rectis, 35-90 x 10-14 µm. Conidiis catenulatis (3-8), ellipsoideis - ovoideis, vel doliiformibus, (20-) 25-38 (-40) x (12-) 13-21 (-23) µm. Cleistothecia sparsa vel subgregaria, (70-) 75-100 (-110) µm diam., cellulae peridii irregulariter formatae, 15-40 µm diam., appendices mycelioideae, septatae, tenuitunicatae, hyalinae - brunneae, 4-11 µm latae, diametro cleistothecii 0.5-2.5 plo longiores, asci (immaturae) crassitunicatae, ca. 60-85 x 50-65 µm, ascosporae 6-8, subglobosae (-ellipsoideae), ca. 15-22 x 13-20 µm, vel asci (maturae) tenuitunicatae, ca. 70-130 x 65-80 µm, ascosporae ellipsoideae - ovoideae (-subglobosae), ca. 20-28 x 17-22.5 µm. Fig. 6.

Holotypus: hospes - Euphorbia hirta L., India, Akola, Nov. 1984, Somani (HAL).

This fungus, distributed in Asia on Euphorbia hirta and Pedilanthus tithymaloides, differs from all allied taxa by the features of the asci. The immature asci (content filled with oil drops) are thick-walled, the spores are small and mostly subglobose. The mature asci are characteristically elongated, ellipsoid - ovoid, very thin-walled. They rapidly swell in water and may reach a size larger than the cleistothecial diameter. The mature ascospores are also large. The conidial state as well as the ascocarps on *Pedilanthus* agree with *Sph. euphorbiae-hirtae* entirely. I investigated two Indian samples on *Pedilanthus* with cleistothecia (IMI 209585, 254720).

7. *Uncinula matsunamiana* Y. Nomura, S. Tanda & U. Braun spec. nov.

Etym.: Y. Matsunami, Japanese mycologist and phytopathologist.

Mycelium amphigenum. Cleistothecia sparsa, 106-147 µm diam., cellulae peridii irregulariter angulatae, ca. 17-21 µm diam., appendices 11-16, diametro cleistothecii ca. 1-1.5 plo longiores, 146-243 µm, 1 septatae, hyalinae, tenuitunicatae, ad basim ± crassitunicatae, ca. 6-7 µm latae, ad apicem incrassatae et circinatae, asci 10-13, 59-70 x 36-40 µm, ascosporae 6 (-7), ellipsoideae - ovoideae, 19-25 x 11-16 µm. Fig. 7.

Holotypus: hospes - *Rhus sylvestris* Sieb. & Zucc., Japan, Hatunoso, Tokyo, Oct. 30, 1961, Y. Nomura (YNMH, herb. Nomura).

This fungus was described and depicted by Nomura & al. (1978, p.302, + Tab. 3, fig. 2). The new species differs from *U. verniciferae*, a common powdery mildew on numerous species of *Rhus*, by the features of the appendages. They are regular, not geniculate, the wall is thin or only slightly thicker near the base, and the width is increasing upwards. *U. matsunamiana* is related to *U. kusanoi*, but differs by very numerous, fairly large asci.

8. *Uncinula viburni* Y. Nomura, S. Tanda & U. Braun spec. nov.

Mycelium amphigenum. Cleistothecia sparsa, 75-120 µm diam., cellulae peridii irregulariter angulatae, ca. 10-23 x 6-13 µm, appendices 13-30, diametro cleistothecii ca. 1-1.5 plo longiores, 80-180 µm, ca. 5-7 µm latae, ad basim, ad apicem incrassatae, hyalinae, non septatae, superne tenui-, inferne crassitunicatae, ad apicem uncinatae - circinatae, asci 4-6, 45-57 x 38-40 µm, ascosporae 3-5, ellipsoideae - ovoideae, 20-25 x 10-14 µm. Fig. 8.

Holotypus: hospes - *Viburnum dilatatum* Thunb., Japan, Sagamiko lake side, Kanagawa Pref., Nov. 2, 1975, Y. Nomura (YNMH, herb. Nomura). Paratypus: hospes - *Viburnum erosum* Thunb., Japan, Kinomiya, Shizuoka Pref., Nov. 30, 1975, Y. Nomura (YNMH, herb. Nomura).

The scattered ascocarps are generally mixed with fruit bodies of *Microsphaera sparsa* Howe. The equatorial appendages are straight or curved, seldom flexuous, increasing from base to top, especially the apical part is conspicuously enlarged (ca 20-25 µm diam). The circinate part of the closely allied *U. kusanoi* is narrower (ca 17-20 µm

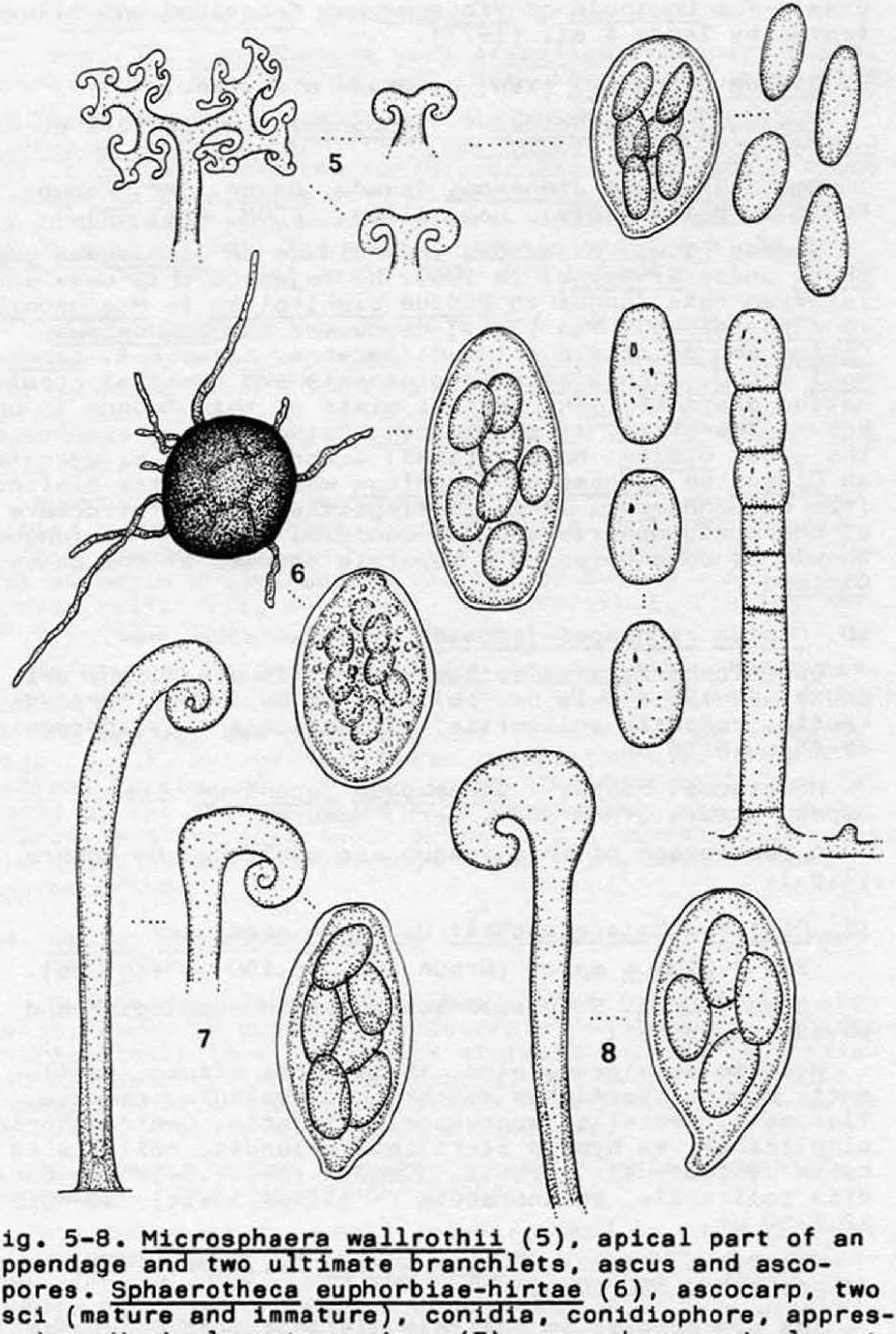

Fig. 5-8. *Microsphaera wallrothii* (5), apical part of an appendage and two ultimate branchlets, ascus and ascospores. *Sphaerotheca euphorbiae-hirtae* (6), ascocarp, two asci (mature and immature), conidia, conidiophore, appressorium. *Uncinula matsunamiana* (7), appendage, apical part of an appendage, ascus. *U. viburni* (8), appendage, ascus. U. Braun del.

diam). The *Uncinula* on *Viburnum* was described and illustrated by Tanda & al. (1977).

9. *Oidium cinnamomi* (Yen) U. Braun stat. nov.

Bas.: *O. erysiphoides* f. *cinnamomi* Yen, Cahiers du Pacifique 11, p.96 (1967).

Syn.: *Erysiphe cinnamomi* Sawada, Descr. Cat. Formos. Fungi I, p.144 (1919), nom. illeg. (ICBN, Art. 59).

Sawada (l.c.) described this Oidium on *Cinnamomum camphora* under *Erysiphe*. In 1959, he rejected this name and referred this fungus to *Oidium alphitoides* (= *Microsphaera alphitoides*). Yen (l.c.) discussed the *Cinnamomum Oidium* and pointed out the differences between f. *cinnamomi* and *O. alphitoides* (appressoria and conidial germination distinct). The perfect state of this fungus is unknown. Therefore, it should be considered as a species of the genus *Oidium*. Nomura (1981) described and illustrated an *Oidium* on *Cinnamomum japonicum* which is quite distinct from *O. cinnamomi*. It is distinguished by the structure of the conidiophores and the conidial shape. This fungus should be considered as a separate species of the genus *Oidium*.

10. *Oidium cinnamomi-japonici* U. Braun spec. nov.

Conidiophoris simplicibus, ex hyphis sterilibus oriundis, 90-150 x 8-12 µm, cellulis ad basim cylindraceis, rectis, conidiis solitariis, ellipsoideis - cylindraceis, 42-55 x 18-26 µm.

Holotypus: hospes - *Cinnamomum japonicum* Sieb., Japan, Nomura (YNMH 4894, herb. Nomura).

A photograph of this fungus was published by Nomura (l.c.).

11. *Oidium schmiedeknechtii* U. Braun spec. nov.

Syn.: *Oidium* spec. (Braun 1982, p.150, + fig. 26).

Etym.: Dr.M. Schmiedeknecht, German mycologist and phytopathologist.

Mycelio amphigeno, albo, indistincte effuso, confluenti. Hyphis sterilibus repentibus, hyalinis, ramosis, flexuosis, septatis, appressoriis lobatis. Conidiophoris simplicibus, ex hyphis sterilibus oriundis, cellulis ad basim cylindraceis, rectis, 30-40 x (5-) 7.5-10 µm. Conidiis solitariis, cylindraceis (- ellipsoideis), 35-46.5 x 12.5-20 µm.

Holotypus: hospes - *Urena lobata* L., Cuba, 1967, Schmiedeknecht No. 530 (JE).

The new species is entirely distinct from *O. urenae* Yen. The two *Oidium* species on *Urena* are not closely related.

12. *Oidium stapeliae* (Picbauer) U. Braun stat. nov.

Bas.: *O. erysiphoides* var. *stapeliae* Picbauer, Sborn. vysok. škol. zem. v Brne, ČSR, Fac. Lesn., D*18*, p.26 (1931)

There are two distinct conidial states on *Stapelia*. *Oidium acrocladum* Ferr. (= *Ovulariopsis acroclada* (Ferr.) Cif. & Corte) forms the conidia singly. This fungus maybe belongs to Leveillula (cf. Blumer 1967). Var. *stapeliae* is an Euoidium (conidia in chains, cylindric-doliform, 23-28 x 11-13 µm). The name *O. erysiphoides* must be rejected (nom. dub. et ambig., cf. Braun 1982 b).

13. *Oidium nephelii* Hadiwidjaja ex U. Braun spec. nov.

Syn.: *O. nephelii* Hadiwidjaja, Landbouw (Landbouwkundig Maandblad voor Indonesie) *22*, p.253 (1950), without Latin description. *O. erysiphoides* f. *nephelii* (Hadiw.) Yen, Rev. Myc. *31*(4), p.286 (1966), not valid, based on a nom. nud.

Hyphis sterilibus repentibus, hyalinis, ramosis, septatis, 4.8-8.4 µm crass., appressoriis lobatis. Conidiophoris simplicibus, ex hyphis sterilibus oriundis, cellulis ad basim cylindraceis, rectis, 27.6-50.4 x 6 µm. Conidiis solitariis, ovoideis - doliiformibus, (19.5-) 24-39.5 (-49) x (10-) 14-19 (-26) µm.

Holotypus: hospes - *Nephelium lappaceum* L., Indonesia, Bogor, Oct. 1949, Hadiwidjaja (Fac. of Agric. Sci., Bogor).

The species was described and illustrated by Hadiwidjaja (l.c.), but without Latin description. It infects leaves, fruits and inflorescences. The foot-cells are followed by 1-2 shorter cells, the appressoria are often paired, and the germ tubes arise from a conidial end, they are short to moderately long, terminating with a lobed appressorium.

14. *Oidium caesalpiniacearum* V. B. Hosagoudar & U. Braun spec. nov.

Hyphis sterilibus repentibus, hyalinis, ramosis, septatis, 2.5-8 µm crass., appressoriis non lobatis. Conidiophoris simplicibus, ex hyphis sterilibus oriundis, cellulis ad basim cylindraceis, rectis, ca. 30-55 x 5.5-8 µm. Conidiis solitariis, ellipsoideis - cylindraceis (- doliiformibus, - ovoideis), 24-43 x 11-20 µm.

Holotypus: hospes - *Bauhinia* spec., India, Bangalore, Karnataka, 1984, Hosagoudar (HAL).

The new species is well characterized by the appearance of the infections (hypophyllous, definite patches, infected parts of the leaves discoloured, yellow or brown patches). The appressoria are nipple-shaped or only slightly lobed. *Oidium bauhiniae* Gorter & Eicker, recently described from South Africa, is clearly distinguished by multilobed appressoria and a distinct appearance of the infections.

15. Oidium ipomoeae (Yen & Wang) U. Braun stat. nov.

Bas.: Oidium erysiphoides f. ipomoeae Yen & Wang, Rev. Myc. 37(3), p.138 "1972" (1973).

The Oidium on Ipomoea resembles the anamorph of Erysiphe convolvuli DC. The taxonomic status of the Ipomoea Oidium is, however, obscure. We do not know the perfect state. Therefore, it seems to be the best way to regard this fungus as a species of the anamorphic genus Oidium.

16. Oidium robustum U. Braun & E. Oehrens B. spec. nov.

Mycelio amphigeno, saepe epiphyllo, albo, indistincte effuso. Hyphis sterilibus repentibus, hyalinis, ramosis, septatis, 3-8 µm crass., appressoriis lobatis, conidiophoris simplicibus, ex hyphis sterilibus oriundis, cellulis ad basim cylindraceis,erectis, ca. 20-30 x 8-13 µm, conidiis solitariis, ± cylindraceis, 28-50 x 13-18 µm.

Holotypus: hospes - Maytenus boaria Mol., Argentina, Villa Tacul (near Llao-Llao/Bariloche), 19-3-1984, E. Oehrens B. (HAL).

The appressoria are mostly multilobed; the foot-cells of the conidiophores are followed by 1-2 cells, the second cell is about as long as the foot-cell or longer, seldom shorter. This Oidium differs from all known conidial states on hosts of the Celastraceae by the structure of the conidiophores and their width.

17. Oidium araliacearum U. Braun & E. Oehrens B. spec. nov.

Mycelio epiphyllo, albo. Hyphis sterilibus repentibus, hyalinis, ramosis, septatis, ca. 2-8 µm crass., appressoriis non lobatis vel leniter lobatis, conidiophoris simplicibus, ex hyphis sterilibus oriundis, rectis, cellulis ad basim cylindraceis, ca. (20-) 25-35 (-40) x 6-12 µm, conidiis solitariis, cylindraceis, 30-55 x 13-19 µm.

Holotypus: hospes - Pseudopanax valdiviensis Gay, Chile, Isla Mancera, Valdivia, 1959, E. Oehrens B. (HAL).

The mycelium forms thin patches; the foot-cells of the conidiophores are straight or somewhat flexuous, followed by (1-) 2 (-3) shorter cells. The second cell is sometimes about as long as the foot-cell or even longer. There is no allied anamorphic state on hosts of the Araliaceae.

Acknowledgements

Sincere thanks are due to Dr. V. B. Hosagoudar (Coimbatore, India), Dr. Y. Nomura (Japan), Prof. Dr. E. Oehrens B. (Argentina), Dr. R. B. Somani (Akola, India), and Dr. S. Tanda (Tokyo, Japan).

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Vol. XXV, No. 1, p. 271 January-March 1986

TYPIFICATION OF DIMEROMYCES ISOPTERUS (LABOULBENIALES)

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In the original paper describing *Dimeromyces isopterus* Kimbrough (Kimbrough *et al.*, 1972) indication of the nomenclatural type was omitted. Under Article 37.1 of the ICBN (Stafleu, 1983) this taxon is not valid. The original material consisted of fungal thalli from several colonies of *Reticulitermes flavipes* (Kollar) collected in the area of Gainesville, FL. The holotype of *Dimeromyces isopterus* (in Kimbrough, Morales, and Gouger. *Mycologia* 64: 388-389, 1972) is designated here from this material: FLAS F 54070, on *Reticulitermes flavipes* (Kollar), in decaying pine log, near Corey Village, University of Florida campus, Gainesville, Alachua Co., Florida, leg. R. J. Gouger and J. W. Kimbrough. In FLAS.

According to Article 45.1 of the ICBN (Stafleu, 1983) the date of valid publication of *D. isopterus* is the final date of fulfillment of all conditions for valid publication, that is, the date of this note.

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Vol. XXV, No. 1, pp. 273-277 January-March 1986

NOTES ON
CORTICIACEAE (BASIDIOMYCETES) XIV

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Abstract

The new genus Granulocystis with the type Phanerochaete flabelliradiata is described.

Introduction

Recently Burdsall (1985) published a monograph of the genus Phanerochaete and excluded some species which did not fit into his narrower concept of the genus. Among them was Phanerochaete flabelliradiata John Erikss.& Hjortst. which he transferred to Tubulicrinis, a well known genus with a very narrow circumscription and one of the most homogeneous taxa in Corticiaceae s.l.

The genus Tubulicrinis, as treated by Donk (1956), is easily definable by the presence of lateral (bi-rooted) cystidia with a narrow capillary lumen, most often strongly amyloid or at least greyish in Melzer. Similar cystidia occur in e.g. Litschauerella and Tubulicium, but these are thick-walled throughout and generally many-rooted. The morphology of the basidia also shows homogeneity in Tubulicrinis, although deviation in size occurs and in some species they develop into a dense cluster (e.g. borealis). Similar uniformity can be observed in the hyphal configuration. The hyphae are narrow, thin to moderately thick-walled, always with clamps, and in some exceptional cases with the differentiation of skeletal hyphae (e.g. gracillimus). Furthermore, in nearly all species of Tubulicrinis the fruitbodies consist of small, more or less aggregated tufts which give the impression of an odontioid appearance (good examples are effugiens and inornatus). Another characteristic which is often stressed is that the cystidia dissolve in 5-10 % KOH. This is true in most species but not all, and is sometimes only, or most easily, observed in fresh material. This latter phenomenon also occurs in P. flabelliradiata, although it is less pronounced and cannot be solely used to indicate affinity.

The description of a new genus to accomodate P. flabelliradiata seems justifiable since there is no appropriate place for it among genera in Corticiaceae s.l. Granulocystis is

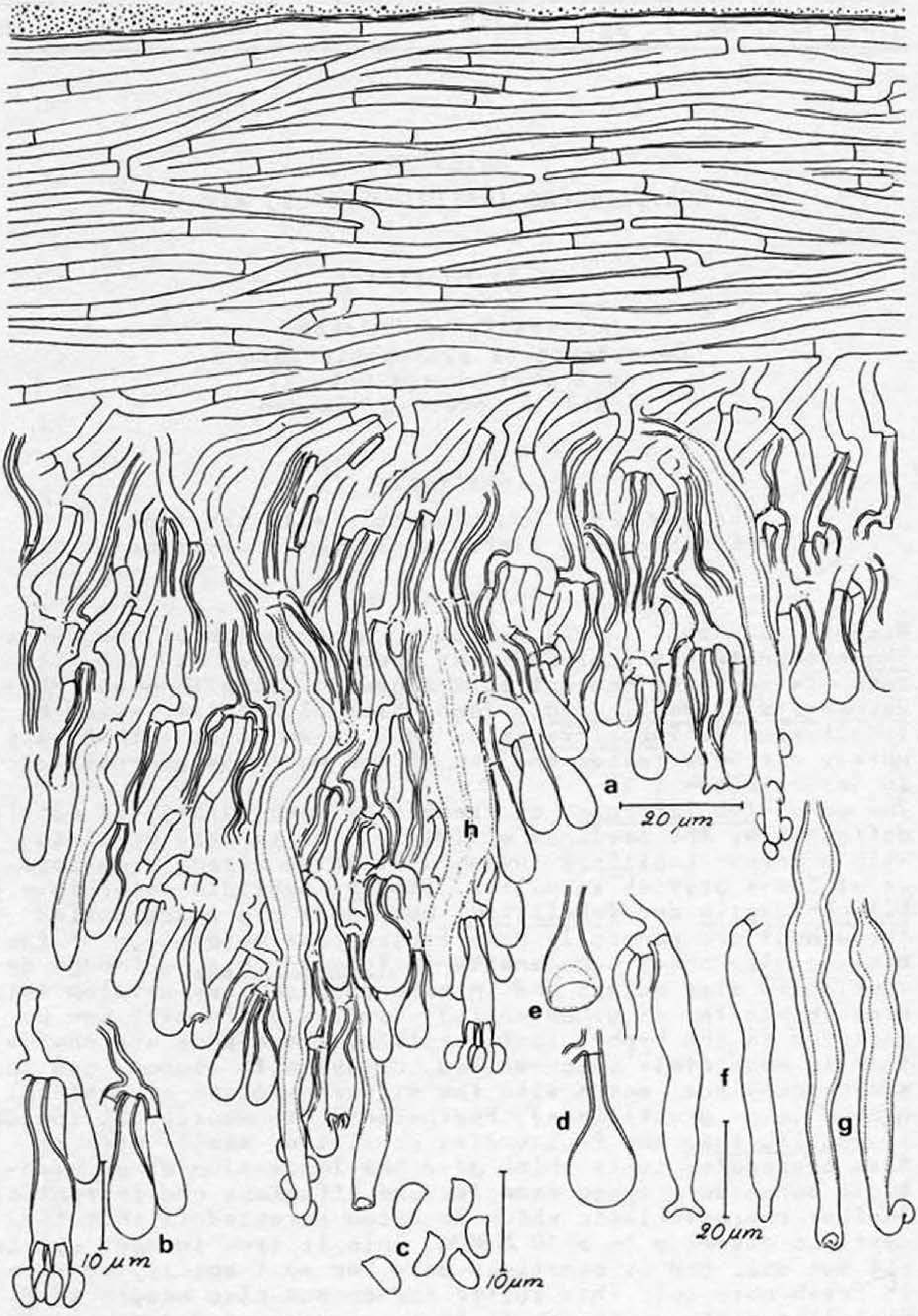

Fig.1 a) section through fruitbody b) basidia c) spores d) cystidioid basidium e) invaginated basidium f) young cystidia g) mature cystidia h) gelatinized cystidium.— Coll. Høgholen 945/77 (GB).

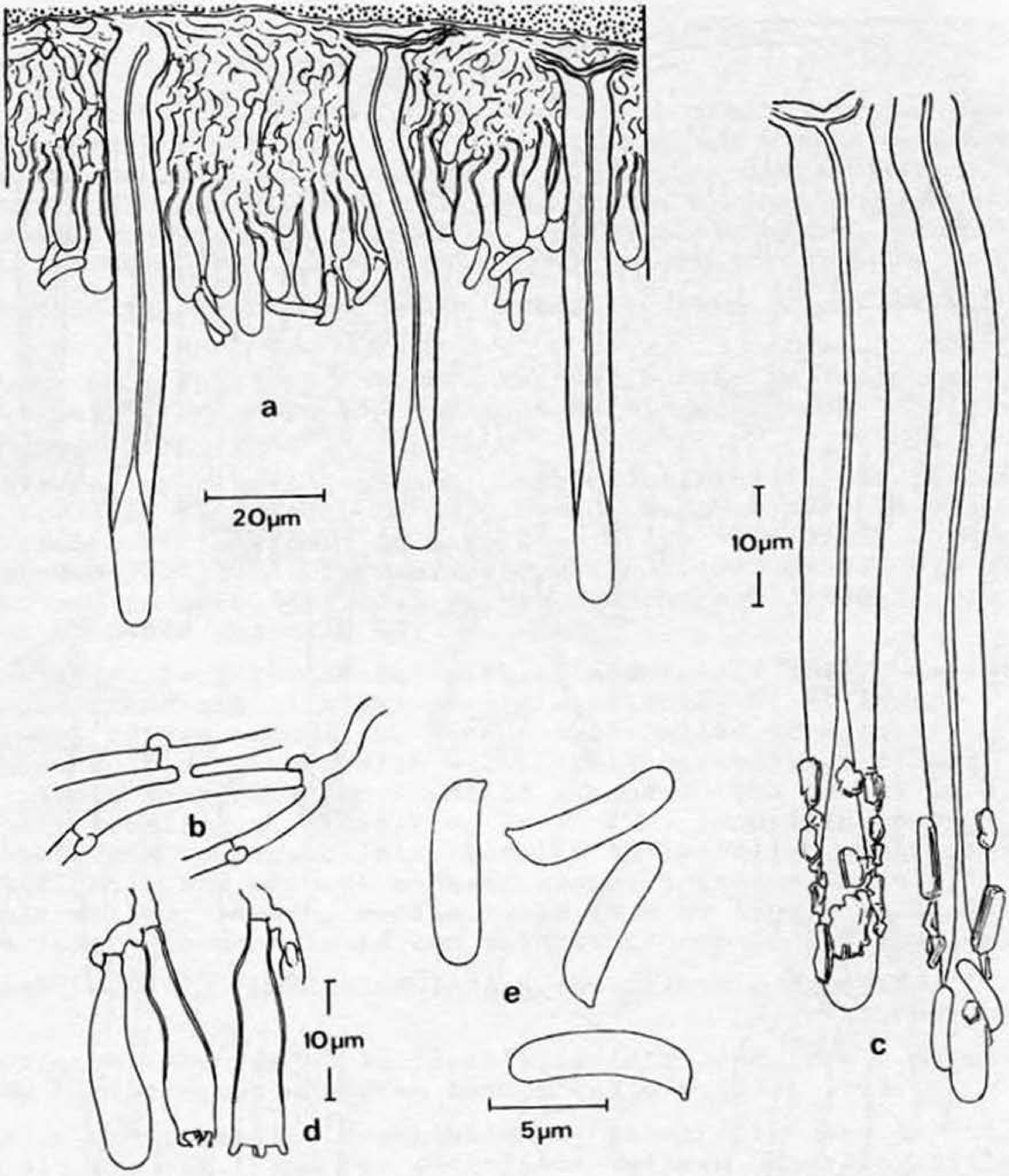

Fig.2 a) section through fruitbody b) basal hyphae c) cystidia d) basidia e) spores.— Coll. Holotype. Aug. 1885, J.B. Ellis (FH).

characterized by a combination of characters: the outward appearance of the type species is very distinctive and it is one of the very few corticiaceous fungi which is recognizable in the field thanks to the relatively large fruitbody, strongly fibrillose margin, and grandinioid appearance of the hymenium: it is monomitic with thin-walled hyphae: cystidia terminal, inamyloid, thick-walled except in the apical part: basidia more or less pedunculate: hyphae, cystidia, and basidia-walls swelling in 2% KOH.

It should be mentioned that this fungus, more than many others, is best studied from examination of fresh material. In a such material hyphae, cystidia, and basidia can be proper-

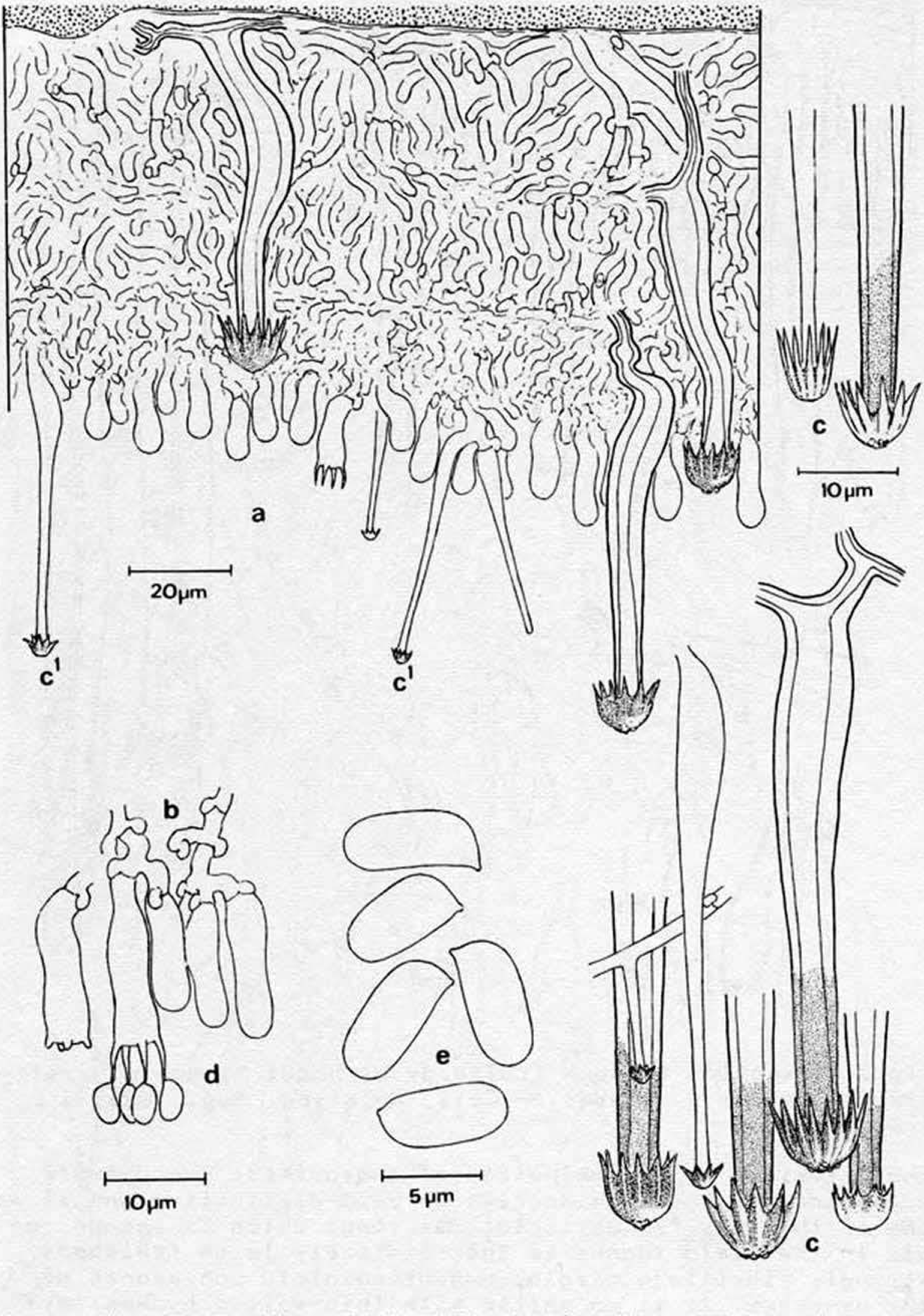

Fig.3 a) section through fruitbody b) subhymenial hyphae c) cystidia c^{1}) hymenial cystidia d) basidia e) spores. — Coll. a,b,d-e) Ryvarden 19104 (O) c) Cain 14569 (GB).

ly observed and scrutinized.

GRANULOCYSTIS Hjortst. gen. nov.

Fructificatio laxe adnata, effusa, mediocriter crassa; hymenium granulosum; margo distincte fibrillosus; systema hyphale monomiticum, omnes hyphae non-fibulatae, tenuitunicatae vel crassiusculae; cystidia terminalia, parietibus subgelatinosus, incrassatis, apicibus tenuitunicatis; basidia subclavata vel pedunculata, sine fibulis basalibus; sporae tenuitunicatae, leves, inamyloides, indextrinoides, acyanophilae.

Generic type: Phanerochaete flabelliradiata John Erikss.& Hjortst.

Generitype specimen: Norway.Akershus,Nannestad,Tømte Farm, west of Hurdal lake,250 m.a.s.l.,on Alnus incana. 1978-09-28. Leif Ryvarden 17494 (O).

Selected specimens examined: Canada.Ontario.1935-09-04.R.F. Cain. TRTC 8902 (part in GB). Norway.Hedmark.1977-09-03.E. Høgholen 491/77 (part in herb.Hjm):ditto 1978-07-19.E. Høgholen 341/78 (GB). Sweden.Västergötland.1970-09-04. Hjm 3541 (GB and in herb.Hjm). U.S.A. New Hampshire.1939-08-17.H.S. Eno.FP 84843 (part in GB).

Fruitbody loosely adnate, effuse, moderately thick; hymenium grandinioid and with the *margin* distinctly fibrillose; *hyphal system* monomitic, *hyphae* thin-walled to slightly thick-walled, in KOH with walls swelling, without clamps; *cystidia* terminal, thick-walled except in the apical part, walls swelling or dissolving in 2% KOH, inamyloid; *basidia* subclavate to pedunculate, basally thick-walled, with four sterigmata and without a basal clamp; *spores* ellipsoid, thin-walled, smooth, medium-sized (4-6 um long), walls inamyloid, non-dextrinoid and without cyanophilous reaction.

GRANULOCYSTIS FLABELLIRADIATA (John Erikss.& Hjortst.) Hjortst.comb.nov.

Basionym: Phanerochaete flabelliradiata John Erikss.&Hjortst. The Corticiaceae of North Europe Vol.6 p.1073, 1981.

For a comprehensive description of the species see Eriksson & al. loc.cit., and for comparison between *Granulocystis* and *Tubulicrinis* see fig.1 *Granulocystis flabelliradiata*, fig.2 *Tubulicrinis gracillimus*, generic type, fig.3 *Tubulicrinis hamatus*. Drawings by John Eriksson.

Acknowledgments

I am indebted to Dr. Derek Reid who has suggested improvments in the English text and to Prof. John Eriksson for preparing drawings.

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Vol. XXV, No. 1, pp. 279-286 January-March 1986

SCYTALIDIUM JAPONICUM, A NEW SPECIES, THE CAUSAL AGENT OF CATTLE BRONCHIOLITIS

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SUMMARY

Scytalidium japonicum sp. nov. isolated from Japanese cattle and causal agent of bronchiolitis is described. It is characterized by dull green to greenish gray colonies on several agar media, and by having large hyaline arthroconidia and dark-colored, catenate chlamydospores.

Scant attention has been paid in the past to *Scytalidium* infections in medical and veterinary mycology. At present three species of the genus are known from clinical specimens and have been implicated in cutaneous or subcutaneous infections. The *Scytalidium* synanamorph of *Hendersonula toruloidea* Nattrass is the commonest species associated with hyphomycoses and has been recovered frequently from infections of skin and nails in humans. Most reported cases have occurred in the United Kingdom and involve former-natives of tropical countries now residing in that country (Gentles and Evans, 1970; Campbell, 1971; Campbell et al., 1973). More recently Mariat et al. (1978) described a verrucose dermatitis of the human face accompanied by onychomycosis from Algeria. In this case, the fungus was isolated from facial lesions and affected nails. *Hendersonula toruloidea* has been described as being widely distributed in tropical areas, where it is found as a wound parasite of citrus and stone fruit trees, including walnuts (Hughes, 1952; Ellis, 1971).

The second pathogenic species of *Scytalidium* is *S. hyalinum* Campbell et Mulder (1977). The first reported occurrence to this fungus was in patients of Jamaican and West African origin having skin and nail infections. It was noted to actively invade and grow in diseased tissues. Recently, Moore et al. (1984) encountered *S. hyalinum* infecting human skin in Spain.

A case of subcutaneous phaeohyphomycosis caused by *S. lignicola* Pesante was reported by Dickinson et al. (1983) from Florida. Prior to this, Dixon et al. (1980) reported the isolation of *S. lignicola* from sawdust samples collected in Virginia. Using hamsters, they recovered the isolate from homogenized spleen tissue 6-7 weeks after inoculation. It was concluded that the persistence of the fungus in an animal for that length of time represents an indication of potential pathogenicity. Dickinson and co-workers described their isolate as having two types of conidia; some hyaline and cylindrical, others yellowish-brown, thick-walled, barrel-shaped to broadly ellipsoidal. Conidial measurements given for both types match those of the type strain of *S. lignicola* but the reported shape of the pigmented conidia is somewhat different. Sigler (personal communication) found that this isolate produces pycnidia in culture after exposure to UV light. Further confirmation of its identity is needed.

One of us has recently encountered fungal bronchiolitis in Japanese black cattle bred at Kuga-machi, Kuga-gun, Hiroshima Prefecture. As a result of histopathological diagnosis conducted at the Yamaguchi-ken Chubu Livestock Hygiene Service Center, it was determined that affected animals had difficulty breathing. Upon death, isolation of a fungus from affected lung tissue of one animal was achieved by a direct plating technique onto Sabouraud's agar medium containing 0.5% yeast extract in June 1984. The fungus was identified as belonging to the genus *Scytalidium*. Of particular interest is the fact that this is the first case of a deep form of *Scytalidium* mycosis characterized by pulmonary infection. This agent appears to perhaps have a greater capacity to adapt to a tissue environment than the related species, and has a greater potential virulence. Etiological and pathological findings in two cases of the disease have been reported in detail elsewhere (Takeya et al., 1985). The purpose of this paper is to describe cultural characteristics of the isolate and to establish a new binomial to accommodate it.

Scytalidium japonicum Udagawa, Tominaga et Hamaoka, sp.nov. (Figs. 1-4)

Coloniae in agaro decocto tuberorum post 14 dies et 23°C, 4.3-4.8 cm diam., effusae, floccosae, constantes ex mycelio coacto crassiusculo et conidio abundanti, plus minusve radiatim sulcatae, subolivaceo-griseae vel obscure virides vel viridi-griseae.

Mycelium saepe fasciculatum vel torsivum, ex hyphis hyalinis vel subbrunneis, ramosis, laevibus vel asperulatis, septatis, 1.5-6.0 μm diam. compositum. Cellulae conidiogenae a hyphis indistinctae, hyalinae vel subhyalinae, intercalares vel terminales, cylindraceae, fragmentantes et arthroconidiae formantes. Conidia duobus modis formantur: altera arthroconidia holothallica, catenata, sicca, simplicia, aseptata vel interdum uniseptata, hyalina, cylindracea, utrinque truncata, interdum clavata vel pyriformia, basi truncata et apice rotundata, raro T-formia, 9-22(-26) × 4.5-6.5 μm, interdum usque 18-35 μm longa (ubi uniseptata), tenuia et laevia, facile fragmentantia; alterae chlamydosporae pallide vel valde brunneae, catenatae, in hyphis gerentes, intercalares vel terminales, subglobosae, 7-10 μm diam., vel ovoideae vel oblongae, 5.5-18 × 4.0-6.0 μm, incrassatae et paene laeves, aegre secedentes.

Holotypus NHL 2954, isolatus e bronchiolo bove, Yamaguchi, in Japonia, in 2.vi.1984, leg. K. Tominaga. In herb. NHL.

Etymology: refers to country of origin.

Colonies on potato-dextrose agar growing rapidly, attaining a diam. of 4.3-4.8 cm within 14 days at 23°C, floccose, composed of a rather thick mycelial felt, more or less radially furrowed, Pale Olivaceous Grey (Rayner, 1970) or dull green to greenish grey (Methuen 30D3-2, Kornerup and Wanscher, 1978); conidiogenesis (both types) abundant; reverse Olivaceous Black (Rayner, 1970) or bluish grey (Methuen 24F3).

Colonies on phytone yeast extract agar (PYE) spreading broadly, attaining a diam. of 7.8 cm within 14 days at 23° C, composed of a rather tough basal felt, radially furrowed, at first white, then becoming Pale Glaucous Grey (Rayner, 1970) or greenish grey (Methuen 25B2) in age, densely woolly; conidiogenesis sparse; reverse Umber to Isabelline (Rayner, 1970) or yellowish brown to brown (Methuen 5D5-7E4).

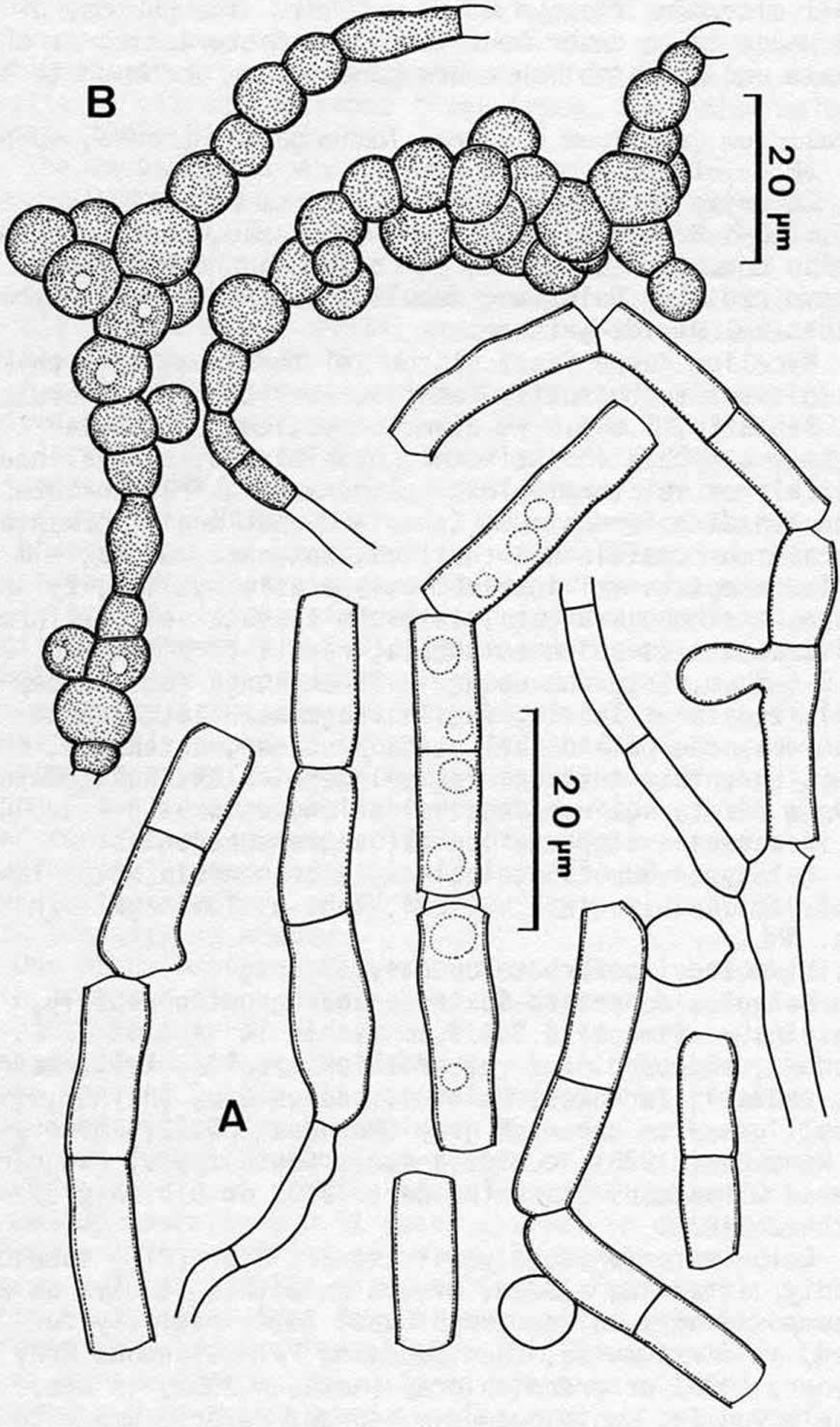


Fig. 1. *Scytalidium japonicum*.
A. Hyaline arthroconidia. B. Chlamydospores.

Colonies on malt extract agar spreading broadly, attaining a diam. of 6.8-7.0 cm within 14 days at 23°C, floccose, composed of a thin mycelial felt, at first white, then becoming Olivaceous Grey (Rayner, 1970) or dull green (Methuen 27E3); conidiogenesis abundant with hyaline arthroconidia predominant; reverse Iron Grey (Rayner, 1970) or greenish grey (Methuen 30F2).

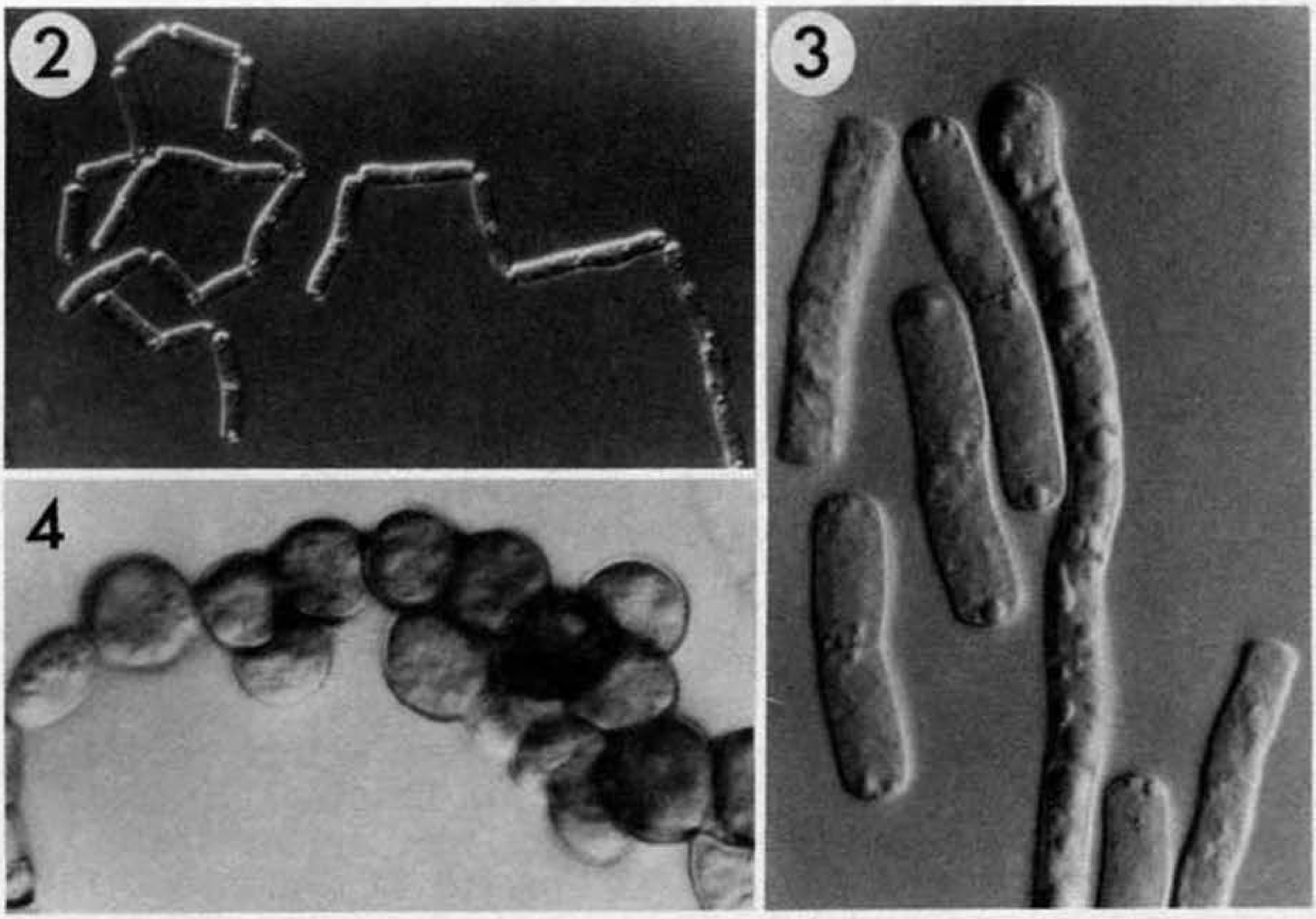
Colonies on Sabouraud's dextrose agar spreading broadly, attaining a diam. of 7.2-7.3 cm within 14 days at 23°C, thin, composed of submerged vegetative mycelium and prostrate hyphae, white to Vinaceous Buff Fawn (Rayner, 1970) or greyish orange (Methuen 6B3); conidiogenesis moderate but only hyaline arthroconidia produced; reverse Ochreus to Buff (Rayner, 1970) or greyish orange (Methuen 5B4).

Mycelium composed of hyaline to pale brown, branched, smooth to finely rough-walled, septate, 1.5-6.0 µm wide hyphae, often forming a bundle or spiral. Conidiogenous cells micronematous, hyaline to subhyaline, intercalary or terminal, cylindrical, fragmenting to form arthroconidia. Conidia of two kinds: (1) arthroconidia holothallic, catenate, dry, simple, 0(-1)-septate, hyaline, cylindrical, truncate at both ends, sometimes clavate to pyriform with a truncate base and rounded apex (when borne in terminal portion), or rarely T-shaped, 9-22(-26) × 4.5-6.5 µm or 18-35 µm long when 1-septate, thin and smooth-walled, seceding schizolytically and easily, and (2) chlamydospores, pale to dark brown, arising in chains in an intercalary or terminal position on short, lateral branches, subglobose, 7-10 µm in diam., or ovoid to oblong, 5.5-18 × 4.0-6.0 µm, thick and almost smooth-walled, not easily seceding.

Growth more rapid at 30°C than that at 23°C; at 37°C growth-rate is half to one-third that at 23°C, but sporulation occurs.

Type: NHL 2954, isolated from bronchiolus-lesion of domestic cow (*Bos taurus* var. *domesticus*, Japanese black cattle), Yamaguchi-ken Chubu Livestock Hygiene Service Center, Kagawa-ninowari, Yamaguchi City, Yamaguchi Pref., Japan, 2.vi.1984, coll. K. Tominaga. Dried cultures deposited in herb. NHL. Living cultures from the type are deposited at ATCC and UAMH.

Our isolate was compared with *Hendersonula toruloidea* (UAMH 4755), *S. hyalinum* (UAMH 4069) and *S. lignicola* (UAMH 1502-ex type strain, and FF27-Kingström), and found to clearly differ from these species. The hyaline arthroconidia of *S. lignicola* are smaller, viz. 4-11(-14) × 1.5-3.5 (-4) µm, and shape and mode of formation of the dematiaceous ones are also distinct. *Scytalidium hyalinum* is char-



Figs. 2-4. *Scytalidium japonicum*.
2, 3. Hyaline arthroconidia. 2, ×400; 3, ×1000.
4. Chlamydospores. ×1100.

acterized by the production of hyaline arthroconidia only and hence its colonies are white on agar media. The conidia of *S. hyalinum* are also smaller, viz. 5-11 × 2-3.5 µm or 4-8(-10) µm in diam. Besides the presence of a pycnidial anamorph, *H. toruloidea* is distinguished from *S. japonicum* in that its arthroconidia are smaller, hyaline or brown, and rounded.

Scytalidium was originally erected by Pesante (1957), based on *S. lignicola* found on Italian planewood. The taxonomy of this genus was considered in some details by Sigler and Carmichael (1976), who gave summarized descriptions and photographs of 6 species including the arthroconidial anamorph of *H. toruloidea* and an additional note on *S. uredinicola* Kuhlman, Carmichael et Miller (1976), a species growing in aecia of *Cronartium fusiforme*. Since then there have been a number of reports on additional species of the genus; viz. *S. terminale* Rao et de Hoog (1975), *S. thermophilum* (Cooney et Emerson) Austwick (1976), *S. hyalinum* Campbell et Mulder (1977), *S. indonesiacum* Hedger, Samson et Basuki (1982), *S. allahabadum* Narain, Srivastava et Mehrotra (1983), and *S. fulvum* Morgan-Jones et Gintis (1984). In culture, *S. thermophilum*, *S. indonesiacum* and *S. allahabadum* are peculiar by their thermophilous nature, having maximal growth at 50°C or above. *Scytalidium japonicum* can be separated from the remaining species, on the basis of its gray colony color and the large size of its hyaline arthroconidia. Although this new species well fits within the generic concept of *Scytalidium*, some questions concerning the taxonomy of this genus are still unresolved, as pointed out by Morgan-Jones et al. (1984).

ACKNOWLEDGMENTS

We wish to thank Prof. Gareth Morgan-Jones for reviewing the manuscript; and Ms Lynne Sigler for supplying the cultures of *Scytalidium lignicola* and others from the University of Alberta Mold Herbarium and Culture Collection.

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MYCOTAXON

Vol. XXV, No. 1, pp. 287-308 January-March 1986

ALTERNARIA THEMES AND VARIATIONS (22-26)

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PROLOGUS

In continuation of a series of papers primarily on *Alternaria* (Simmons 1981, 1982, and in press), five *Alternaria* anamorphs are described as new in conjunction with their teleomorphs, which are transferred into or described as new in a new genus, *Lewia* Barr & Simmons, typified by *Sphaeria scrophulariae* Desmaz. Each teleomorph-anamorph pairing is based on axenic ascospore-to-conidium cultures or, in one instance, on a conidium isolate that produces mature ascomata in culture.

VIII. PLEOSPORA /STEMPHYLIUM AND LEWIA/ALTERNARIA AS SEGREGATES FROM PLEOSPORA SENSU LATO

The name *Pleospora* Rabenhorst ex Cesati & de Notaris (1863) means different things to different mycologists. A broad concept includes characters of medium-sized ascostromata, bitunicate asci produced among pseudoparaphyses, and pigmented muriform ascospores -- a circumscription sufficiently loose as to include a multitude of heterogeneous and biologically unrelated fungi. To me the genus *Pleospora* comprises strictly those species that have hyphomycetous anamorphs of the genus *Stemphylium* Wallroth (1833) or that at least are teleomorphically very similar to the ascoma-ascus-ascospore developmental patterns found in the *P. herbarum* complex of species.

Maintaining other distinctive phaeodictyosporic generic groups, such as *Clathrospora* Rabenhorst (1857), *Leptosphaerulina* MacAlpine (1907), *Paraphaeosphaeria* Eriksson (1967), and *Pyrenophora* Fries (1849), inter alia, reduces somewhat the complexity and numerical bulk of *Pleospora Auct.* but leaves an increasingly dense, taxonomically intractable core of species.

Numerous taxa of this *Pleospora*-residuum are known to have anamorphic states, and many of these are Hyphomycetes. Some of my own observations, beginning about 1965 and based on axenic cultures, have helped to establish recognition of the relationship between species of *Stemphylium* and members of the *P. herbarum* complex of teleomorphs -- five species originally (Simmons 1969), two additional (Simmons, in press), and several more under active consideration.

P. G. Crivelli, in his published doctorate dissertation (1983), came close to attacking another portion of the common anamorph-aversion syndrome by illustrating conidia of several distinct *Alternaria* states produced in cultures derived from isolated ascospores. He noted major stable differences among the anamorphs, then made an observation of unusual pertinence to teleomorph-anamorph studies, namely, that variation in morphology of the teleomorph source materials was insignificant. In his view, in other words, the conidial states were distinctive and separable but the teleomorphs were not. The structure of Crivelli's thesis program did not permit extended attention to the differences among his *Alternaria* strains. He used the name *Pleospora scrophulariae* (Desm.) Höhnel (syn. *P. infectoria* Fuckel) for all of the numerous specimen sources of his *Alternaria* isolates. (It may be noted, in passing, that Crivelli kindly refrained from commenting directly on the *Alternaria* portion of my own doctorate dissertation (Simmons 1952), produced when I knew considerably less about *Alternaria* and isolation safeguards than I do now, which contained teleomorph-anamorph conclusions that I have doubted and disowned for the past many years.)

The purpose of the following presentation is to add to the list of generic segregates from *Pleospora sensu lato*, using whatever teleomorphic distinctions are available and emphasizing the diversity of the anamorphs.

PLEOSPORA Rabenhorst ex Cesati & de Notaris (1863), Comment. Soc. Crittog. Ital. 1: 217. [nom. cons.]

Type: *P. herbarum* (Pers.: Fries) Rabenh., l.c.
- *Sphaeria herbarum* Persoon (1801), Syn. meth. fung., p. 78.
- *Sphaeria herbarum* Pers.: Fries (1823), Syst. mycol. II(2): 511. Sanctioned name; lectotype in [E]: E. Fries, Scleromyceti Sueciae no. 38 (EGS 34-082).

Anamorphosis: *Stemphylium* sp. [described and named as novel in Sydowia vol. 38, in press; not *S. botryosum* Wallroth].

Pleospora species of the *P. herbarum* group have dark-walled unilocular ascomata generally in the size range of 0.5-1.0mm diam.; always densely pseudoparenchymatous when young, they become ascogenous rapidly (a few weeks) or slowly (several months) and mature either relatively thin-walled, somewhat collapsing (e. g., *P. herbarum*), or thick-walled, firm (e. g., *Pleospora* state of *S. botryosum*).

Asci, few or abundant per ascoma, develop from the ascoma base upward into a centrum of pseudoparaphyses; they become long clavate, ellipsoid, or subcylindrical and are conspicuously bitunicate; for the most part they are 8-spored, although 6-, 4-, 2-, or even 1-spored asci occur both in nature and in culture (with ascospore dimensions insignificantly to dramatically greater than are those of the usual 8-spored asci, a fact to be kept in mind when noting extraordinary spore sizes).

Ascospores have sturdy walls and septa, are practically equilateral, fundamentally 3-transverse-septate (4-segments; cfr. Wehmeyer 1961, p. 8-9, and Eriksson 1967, p. 342), muriform through the insertion of secondary transverse and longitudinal or oblique septa in all of the four initial segments. (All known species of *Pleospora* with *Stemphylium* anamorphs have the 3 primary entire septa and at least 4 additional transverse or (in end segments) Y-form series of septa; the largest ascospores now known for this group, those of *P. gigaspora* Karsten, have 9-12 such transverse septa.) Ascospores are essentially ellipsoid with ends more or less rounded, terete in transverse section, usually slightly swollen in the subapical segment, usually visibly constricted at least at major septa, smooth, and have walls pigmented in moderate shades of clear brown; the smallest ascospores known at present mature at about 30 x 13µm (*Pleospora* state of *S. majusculum* Simmons), the largest near 60 x 27µm (*P. gigaspora*).

The characters above define typical *Pleospora*. It is likely that there are species of the genus that will not yield an anamorph when brought into culture; but I predict that when any fungus fitting this *P. herbarum* group picture produces a conidial state, it will be a *Stemphylium*.

LEWIA Barr & Simmons, gen. nov. Pleosporaceae

Ascostromata globosa vel sphaeroidea, atra, glabra vel undulate setosa, parietibus tenuibus, apice rostellata. Asci subcylindrici vel subellipsoidei, recti vel curvati, bitunicati, (4-)8-spori. Ascosporae juventute subellipsoideae, inaequilaterae; maturitate subfusoideae, subclavatae, vel ellipsoideae, ad septa parum constrictae, 5(-6-7) septis transversis, 1-2 septis longitudinalibus in segmentis *transversalibus, et cellulis terminalibus septatis aut eseptatis. Anamorphoses species Alternaria Nees : Fries.*

Typus: L. scrophulariae (Desm.) Barr & Simmons, comb. nov.; basionym: Sphaeria scrophulariae Desmazières (1834), Plantes crypt. Nord de la France, ed. 1, fasc. 15, no. 718 [printed exsiccata label with name and description].

Ascostromata are globose or sphaeroid, dark, thin-walled, apically papillate, smooth or (in culture) conspicuously setose.

Asci, few to many per ascoma, develop from the ascoma base upward into a centrum of pseudoparaphyses; they become subcylindric to subellipsoid, straight or somewhat curved (depending on proximity to ascoma wall), thin-walled, bitunicate, (4-)8-spored.

Juvenile ascospores are narrow-clavate or ellipsoid, usually inequilateral, becoming subfusoid, somewhat clavate, or ellipsoid, somewhat constricted at septa (median septum often comparatively weak and pale, with ascospore sometimes separating in halves at this site), maturing with 5(-6-7) transverse septa and 1-2 series of longitudinal septa through the 2 major central spore segments, end cells without septa, or with 1 longitudinal or oblique septum, or with a Y-form pair of septa.

Anamorphoses, when known, are species of *Alternaria* Nees: Fries.

The genus name *Lewia* is based on the monogram of Lewis E. Wehmeyer, mentor to both authors in their mycological salad days.

Derivation of *Alternaria* anamorphs from isolated, viable ascospores of "*Pleospora*" is well-substantiated. *Pleospora infectoria* sometimes is cited, Whitehead and Dickson (1952) used the name *Pyrenophora alternarina* for their source material, and recently Crivelli (1983) cited a dozen or more *Alternaria*-genic specimens as *Pleospora scrophulariae*.

Historically, an early publication of Gibelli and Griffini (1874), using the name *Pleospora alternariae*, has influenced opinion on the subject for over a century. Their study basically was intended to determine if L. R. and C. Tulasne (1863) were correct in assigning several different anamorphs to "*Pleospora herbarum*." (The Tulasnes had listed 13 names under "*Fungus conidiophorus*" and 2 under "*fungi pycnidium*.") Gibelli and Griffini studied growths from isolated ascospores in hanging-drop cultures and decided that there are two kinds of "*Pleospora herbarum*":

Pleospora sarcinula Gib. & Griff with a sarcinula [*Stemphylium*] and a pycnidial state, and *Pleospora alternariae* Gib. & Griff. with "*Conidia exacte Alternariam tenuem Neesii referunt.*" Ascospores of their *P. alternariae*, as illustrated by them, have the same narrow-ellipsoid, basically 5-transeptate appearance as do those seen in *Lewia*, and the illustrated anamorph is of a "clumped branching chain" sort discussed below for at least one of the *Lewia-Alternaria* connections.

It has become apparent to me, through examination of many hundreds of isolates of chain-forming *Alternaria* species with relatively small to moderate-sized conidia, that there is a group of species with distinctive characters matching those of a few dozen isolates known to me from "*Pleospora*" ascospores.

Until now I have been reluctant to address this group from a taxonomic viewpoint, and for several reasons:

Firstly, the morphological variation of *Alternaria* conidia, even in a single chain (and much more so in the population of a colony several days old), almost defies descriptive communication; the problem is being approached with some hope of success by emphasizing the appearance of juvenile conidia, their patterns of development to maturity, and, when characteristic, the patterns of sporulation from single conidiophores (solitary, simple chains, weakly branching chains, complexly branching chains).

Secondly, isolates of many species of *Alternaria* tend to deteriorate in active culture, becoming non-sporulating, sectoring, or grossly mycelial -- conditions that can make critical comparison difficult or impossible. (Loss of sporulation in weak isolates may be retarded by using only low-sugar media such as a weak potato-carrot agar, hay decoction agar, or V-8 juice agar.)

Thirdly, I have found no convincing evidence that anyone has succeeded in obtaining an *Alternaria*-related teleomorph in axenic culture. (R. S. Bilgrami (1974) reported isolations from diseased tissue of *Marsilea quadrifolia* L. that yielded conidia of *Alternaria tenuis* Nees, and that produced ascomata of *Pleospora infectoria* Fuckel in the same culture tubes after about a month. I have been unable to establish contact with the author of the report or with an institution that might have a voucher of the material.)

I personally have not seen the slightest evidence of ascoma initiation in any of the isolates of "*Pyrenophora alternarina*" shared with me many years ago by M. D. Whitehead, in my own numerous isolates from collections of "*Pleospora infectoria*" sent to me by J. Webster, or in any of the Crivelli isolates of "*Pleospora scrophulariae*," all of which are pertinent to this discussion. However, numerous 1-ascus and 1-ascospore isolates from ascomata (on *Digitalis*, UK) of a species similar to those just listed invariably have yielded a distinctive *Alternaria* species and well-formed protoascomata(?), which, however, have not produced asci; the species is discussed below as *Lewia photistica* ("enlightening"). And finally, an isolate of an *Alternaria* (from *Medicago*, Australia) has produced fully mature ascomata; this species is discussed below as *Lewia eureka* (an epithet perhaps linguistically suspect, but expressing the relief felt after many years of frustration).

All of the species of *Lewia* discussed here have small ascomata and ascospores, as compared with those of *Pleospora*. Ascospores of all of them are 5-6(-7) transversely septate; they would fit in the Wehmeyer (1961) scheme as components of *Pleospora* subsect. *Vulgaris* (end cells not septate beyond the 5-transverse stage) or subsection *Pleospora* (end cells variously septate beyond the 5-transverse stage). No attempt is made here to accommodate *Lewia* species in the Wehmeyer classification system, as his subsection criteria prove untenable on examination of the type specimens of two crucial species, namely, *P. scrophulariae* (subsect. *Pleospora* of Wehmeyer) and *P. infectoria* (subsect. *Vulgaris* of Wehmeyer); ascospores of both are found to have end-cell septa. Similarly, it is necessary to question Wehmeyer's suggested relationship that would derive typical *Pleospora* (e. g., *P. herbarum* and its distinctive *Stemphylium* anamorph) from species typical of *Lewia* (e. g., *L. scrophulariae* and its distinctive *Alternaria* anamorph). The specific as well as the overall differences are too great -- and certainly more fundamental than simply increase in size and septation of ascospores.

E. Müller (1951) and his student P. Crivelli (1983) have considered *P. scrophulariae* and *P. infectoria* to be synonymous; Wehmeyer (1961) and some others have treated them as distinct taxa. The interpretation of these two commonly-used names is basic to establishing *Lewia* and to discussing related anamorphs. We have examined type material of both; we conclude that two distinguishable species are involved. In addition, the *Alternaria* anamorph of each is distinguishable. Both species are present among the numerous "*P. scrophulariae*" specimens and derivative isolates that Prof. Müller and Dr. Crivelli have generously allowed us to handle. A third species among the Crivelli material, similarly labeled, also is separable, as is its *Alternaria* anamorph. It is emphasized that the voucher specimens from colleagues in Zürich, and parallel cultures from them, are of exceptional importance in interpreting some of the teleomorph-anamorph pairs. They are discussed and cited below, along with other unique material.

An attempt to equate the novel teleomorphs with published names and type slides in the Wehmeyer files (at DAOM) and with my own records (EGS) has proved unsuccessful. All of them, therefore, are described as new species. (I have no illusions about the likelihood that one or more of these may have an earlier published name; but there are limits to good intentions where the morass of *Pleospora* nomenclature is involved. I will applaud any replacement by earlier names that can be attached unequivocally to species with *Alternaria* anamorphs.)

The *Alternaria* states of *Lewia* species have conidia that are totally beakless. Each conidium has some degree of apical taper associated with its elliptical, oval, or conical shape, but the distal cell of the fully-formed conidium is obtuse and certainly without a definable true beak. Secondary sporulation occurs to a limited extent (short, branching chains of half-a-dozen conidia per primary conidiophore) or it may be prolific (long, complexly branching chains of dozens of conidia per primary conidiophore). The connective between any two conidia always is a secondary conidiophore (pseudorostrum), which may be robust and long (as much as 2-5+ times as long as the conidium that produced it), or so short that it exists only as a conidiogenous area in a conidium tip, and thus is revealed simply as a pore in the otherwise scarcely differentiated conidium apex when the chain is broken.

Relatively long, geniculate, sometimes branching pseudorostra are a striking, often dominant feature of *L. scrophulariae* and *L. infectoria* anamorph sporulation in culture. Pseudorostra (and concomitant secondary sporulation) are produced less exuberantly in other species treated here, but they still are the invariable and characteristic conidium outgrowths from which secondary spores arise.

As is the case with types of *Lewia* spp. nov., I have reviewed scores of older type specimens in search of ones that might serve as types of the *Alternaria* anamorphs described herein. The sort of anamorphs characteristic of *L. scrophulariae* and *L. infectoria* turn up frequently among miscellaneous isolates from sources worldwide; I had expected to find several 19th Century names and types usable for these anamorphs, but have failed. The chances are good that these anamorphs have a distinctly different appearance in field material than they do in axenic culture. Until this question is resolved, there is no good reason for selecting an old name just because it is old or just "might" prove suitable. I will delight in synonymizing my own new names in this group if further work justifies such action.

22. **Lewia scrophulariae** (Desm.) Barr & Simmons, comb. nov. Fig. 35.

= *Sphaeria scrophulariae* Desmazières (l. c.); lectotype in [FH]: exsicc. cit., 718, "*...Au printemps, sur les capsules dessèchées de la Scrophulaire aquatique.*" (EGS 38-123).

= *Pleospora scrophulariae* (Desm.) Höhnel (1917), Sitzungsber. K. Akad. Wiss. (Wien), Math.-Natur., Abt. 1, 126:374.

Ascomata of the type are erumpent, becoming almost superficial on the host; scattered, subglobose to sphaeroid with a short, blunt, papillate beak; about 150-200μm diam., dark, smooth, thin-walled at maturity. Asci subcylindrical, straight or somewhat musiform, 120-140 x 13-18μm, usually 8-spored (sometimes 4-6), about 40 per ascostroma. Juvenile ascospores fusoid, obovoid, subellipsoid, inequilateral (almost flat on one side), early 3-transeptate (4-segmented), at which time initial longisepta are formed, then basically 5- and at maturity 5-6-7-transeptate; forming a single longitudinal septum completely through each of the 2 original central segments, then an oblique one in the apical (rarely basal) segment, a secondary oblique (yielding a Y-formation), and quite frequently a second series of longitudinal septa through the subapical spore segment and, fairly often, in both of the central quarter segments; yellow-brown becoming gold-brown, with slightly darker walls and septa (except for the initial median septum, which often appears fragile and almost hyaline); at full development, 23-25(-30) x 8-9μm, definitely constricted at median septum and slightly so at two other early transepta, ellipsoid in face view, inequilateral with a tapered basal quarter in side view. (See discussion in section 23. below for comparison with very similar *L. infectoria*.)

Anamorphosis: **Alternaria conjuncta** Simmons, sp. nov.
(Etym.: L., connected [with a teleomorph])

Ex culturis in agaro PCA descripta. Coloniae mycelio epiagaro lanoso, sparsim vel copiose conidiogenae. Conidiophora elongata, 5-6 geniculata, c. 150 x 4μm. Conidia ellipsoidea vel longiovoidea, erostrata, c. 30-45 x 10-12μm, aspera, aureobrunnea, 7 transverse et 1(-2) longitudine septata. Sporulatio in catenis simplicibus conidiorum 4-5

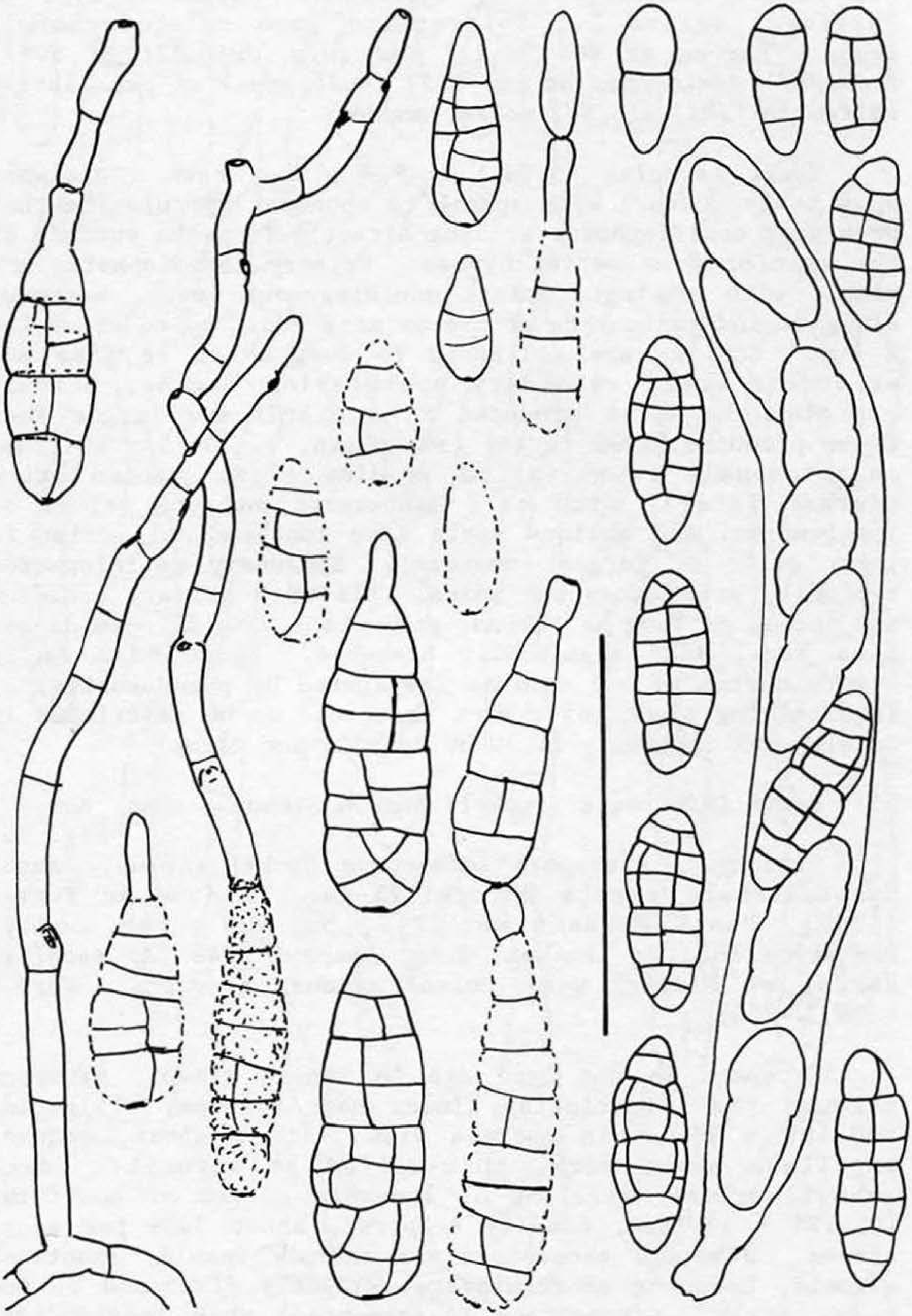

Fig. 35. Right, Lewia scrophulariae; left, Alternaria conjuncta; ex Types. Magn.: vertical bar = 50μm.

vel ramosis conidiis c. 30 aggregata. Habitatio typi in Pastinaca sativa L., Switzerland (pro teleomorphose). Typus: partes ex EGS 37-139 (ex cult. Crivelli ZT 9067, 2.6.1982) desiccatae et in [BPI] (holotypus) et pro isotypo saltem in [IMI] et [NY] conservandae.

Young colonies (5-7d.) in PCA plates have a somewhat open wooly texture with sparse to abundant sporulation that occurs on conidiophores arising directly from the surface of the agar or from aerial hyphae. Primary conidiophores are simple with a single apical conidiogenous locus, becoming elongate and geniculate at 5-6 or more loci, up to about 150 x 4µm. Conidia are ellipsoid to long ovoid in form and erostrate until secondary sporulation begins; primary conidia (the first produced in a chain) are larger than those produced later in the same chain, c. 30-45 x 10-12µm, conspicuously rough-walled, medium clear golden brown (darker later), with c. 7 transverse and one series of longitudinal and oblique septa (two longitudinal series in lower cells of largest conidia). Secondary conidiophores typically arise from the apical cell of a primary conidium and become as long as 100+µm, geniculate with 5-7 conidiogenous loci, and occasionally branched. Sporulation is in simple chains of 4-5 conidia (separated by pseudorostra) or in branching clumps of chains that tend to be restricted in development (commonly c. 20-30 conidia per clump).

23. **Lewia infectoria** (Fuckel) Barr & Simmons, comb. nov.
Fig. 36.

Basionym: *Pleospora infectoria* Fuckel (1870), Jahrb. Nassauischen Vereins Naturk. 23-24: 132. [and in Fuckel (1869), Fungi Rhenani no. 2246, but as a nom. nud.]. Lectotype in [K]: Fuckel, Fungi Rhenani 2246 "*Ad secalis, Hordei et Tritici vulg. culmos aridos, frequens. Vere.*" (EGS 37-160).

Ascomata in the type are in linear groups, erumpent through the constricting linear host tissues; ellipsoid, 400-500 x 150µm in surface view, with a short, obtuse, papillate beak, dark, thin-walled at maturity. Asci subcylindrical, straight or somewhat curved or musiform, 105-125 x 13-16µm, usually 8-spored, about 300+ per ascostroma. Juvenile ascospores are sharply fusoid, sometimes sigmoid, becoming short-clavate, slightly flattened on one side, early 3-transeptate (4-segmented) when longitudinal septa are formed, then 5-transeptate and remaining so for practically all spores seen; forming a single longitudinal septum through each of the 2 original central segments and

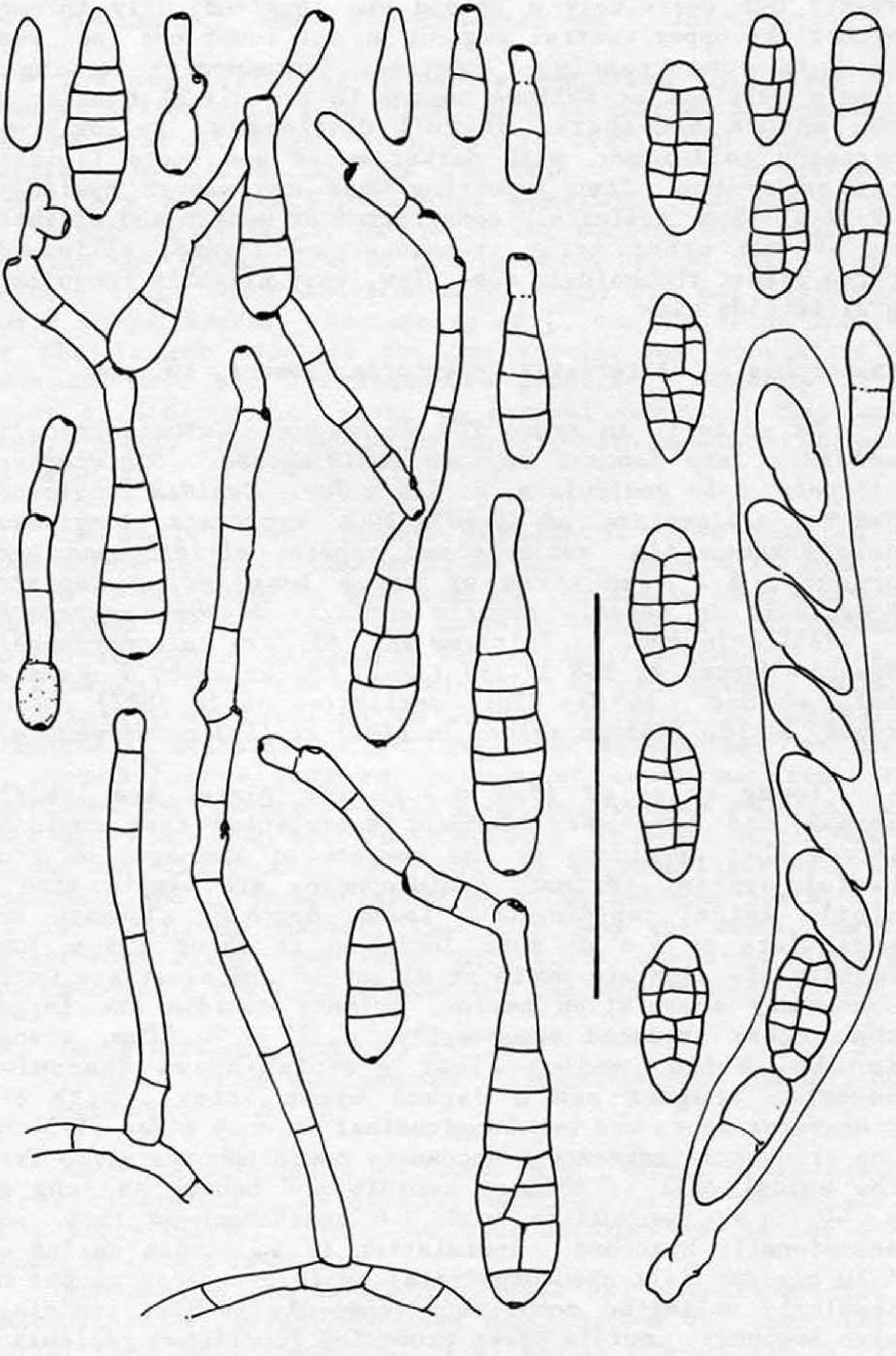

Fig. 36. Right, <u>Lewia infectoria</u>; left, <u>Alternaria infectoria</u>; ex Types. Magn.: vertical bar = 50µm.

rarely but definitely a second one longitudinally through either the upper central segment or the lower one (not seen in both concurrently); sometimes (uncommonly) forming a single vertical or oblique septum in the distal quarter of the mature ascospore; at full development, yellow-brown becoming gold-brown, with darker walls and septa (initial median septum often appearing weak and almost hyaline), 19-22 x 7-8µm, definitely constricted at median and slightly so at two other early transepta, subclavate, ellipsoid, often almost rhomboid in face view, very slightly inequilateral in side view.

Anamorphosis: **Alternaria infectoria** Simmons, sp. nov.

Ex culturis in agaro PCA descripta. Coloniae mycelio epiagaro laxe lanoso, copiose conidiogenae. Conidiophora elongata, 5-6+ geniculata, c. 125 x 3µm. Conidia longiovoidea vel ellipsoidea, ad 35-40 x 10µm, erostrata, longipseudorostratescentia, sublevia vel aspera, viridibrunnea vel brunnea, 6-7 transverse et parce longitudine septata. Sporulatio in catenis ramosis conidiis 40-50++ aggregata.

Habitatio typi in Triticum sp., UK (pro teleomorphose). Typus: partes ex EGS 27-193 (isol. EGS ex spec. J. Webster coll. et det., 16 May 1969) desiccatae et in [BPI] (holotypus) et pro isotypo saltem in [IMI] et [NY] conservandae.

Young colonies (5-7 d.) in PCA plates are loosely lanose and have very abundant sporulation from conidiophores that originate at the surface of the agar or from aerial hyphae. Primary conidiophores are simple with a single apical conidiogenous locus, becoming elongate and geniculate at 5-6 or more loci, up to about 125 x 3µm. Conidia are elongate ovoid or ellipsoid and erostrate until secondary sporulation begins; primary conidia are larger than those produced secondarily, c. 35-40 x 10µm, almost smooth-walled, medium clear greenish-brown (becoming somewhat rougher and a darker brown later), with 6-7 transverse septa and one longitudinal in only a few (1-3) of the transverse segments. Secondary conidiophores arise from the apical cell of primary conidia and become as long as c. 40-60µm, geniculate with 3-4 conidiogenous loci, and occasionally branched. Sporulation is in simple chains of 5-10 conidia (all pseudorostrate) or in branching clumps of seemingly unlimited complexity (commonly 40-50++ conidia), with secondary conidia often producing functional geniculate conidiophores from apical, lateral, or basal cells, often so rapidly that even 1- and 2-celled conidia become conidiophorogenous.

Discussion: *Lewia scrophulariae* and *L. infectoria*:

The complexity of ascospore septation progresses so gradually from that of *L. infectoria* to that of *L. scrophulariae* that it might seem almost trivial to insist on separate identities for the two taxa. Still, we believe that they are distinguishable species. Ascospores of *L. infectoria* typically mature at the smaller size observed for the two species and do not progress beyond the 5-transeptate stage (plus longitudinals); they are not conspicuously inequilateral. Ascospores of *L. scrophulariae* mature at the larger size of the two species and consistently advance into a 6-7-transeptate condition, commonly with pairs of longitudinal septa in central segments; they are conspicuously flattened/inequilateral, both as juveniles and at maturity.

It is not our present purpose to draw floristic conclusions about *L. scrophulariae* and *L. infectoria*; and it always is hazardous to make adamant statements when comparing unique field-collections as types. However, the ascoma source of typical *Alternaria infectoria* (*Triticum* sp., leg. J. Webster) fits the type distinction made above, as do P. Crivelli collections on *Elymus*, *Festuca*, *Lolium* (all Gramineae); Crivelli collections whose teleomorphs fit the *L. scrophulariae* pattern include at least material on *Pastinaca* and *Plantago*. Until considerably more material of this group has been studied in culture, it would be inappropriate to hold that *L. infectoria* is an inhabitant only of Gramineae and *L. scrophulariae* of dicotyledonous hosts. It is our opinion, however, that the type specimens, other collections cited, and their derivative anamorphs support the concept of two very similar but distinguishable species.

24. **Lewia ethzedia** Simmons, sp. nov. Fig. 37.
(Etym.: from acronym of "Eidgenössische Technische Hochschule, Zürich)

Ascomata subglobosa c. 150μm diam., atra, prope basin parce tomentosa, parietibus tenuibus, apice rostellata. Asci subcylindrici, recti vel submusiformes, 8-(rarius 6-) spori, 95-100 x 13-14.5μm.

Ascosporae juventute fusoideae vel subellipsoideae, inaequilaterae; maturitate late ellipsoideae vel inaequilateriellipsoideae, spadiceae, 5(-6) septis transversis, 1(-2) septis longitudinalibus in segmentis mediis transversalibus, interdum 1 septo longitudinali in 1-2 cellulorum termina-

lium, 19-21 x 8-9.5µm.

Holotypus in [ZT]: P. Crivelli no. 88.1.a "auf Brassica sp., Müllheim, ktTG, d.2.4.1981/[Kultur]ZT 9071." (EGS 37-178).

Ascomata of the type are erumpent, becoming almost superficial on the host, scattered, subglobose with a very small, blunt, perforate beak; about 150µm diam., dark, thin-walled, with a sparse basal tomentum of thick-walled brown hyphae. Asci are subcylindrical, straight to submusiform, 95-100 x 13-14.5µm, usually 8-spored (infrequently 6), 60+ per ascostroma. Juvenile ascospores fusoid to clavate or subellipsoid, inequilateral, early 3-transeptate (4-segmented), at which stage an initial longiseptum is laid down in each of the 2 central segments; 1 transeptum is added in each central segment, yielding a basically 5-transeptate spore with 1 series of longisepta in central segments. A high percentage of spores remain with this septation, but others add a single longitudinal or oblique septum in 1 or both of the end segments, rarely a 6th transeptum in the bottom segment of the spore, and sometimes a second longitudinal series in the widest central segment(s); at full development they are 19-21 x 8-9.5µm, constricted at 3 major septa, broadly ellipsoid to almost rectangular in face view, inequilateral-ellipsoid in side view, medium clear brown in color.

Anamorphosis: **Alternaria ethzedia** Simmons, sp. nov.

Ex culturis in agaro PCA descripta. Coloniae mycelio epiagaro arachnoideo vel laxe lanoso, sparsim vel moderate conidiogenae. Conidiophora elongata, 0-1-geniculata, c. 60-90 x 3-4µm. Conidia ovoidea vel subellipsoidea, erostrata, 35-45 x 10-14µm, pseudorostratescentia, subtiliter verruculosa, fulva, 7 transverse et 1(-2) longitudine septata. Sporulatio in catenis simplicibus conidiorum 2-6 vel parce ramosis conidiis c. 10-20 aggregata.

Habitatio typi in Brassica sp., Switzerland (pro teleomorphose). Typus: partes ex EGS 37-143 (ex cult. Crivelli ZT 9071) desiccatae et in [BPI] (holotypus) et pro isotypo saltem in [IMI] et [NY] conservandae.

Young colonies (5-7 d.) in PCA plates are arachnoid to loosely lanose with sparse to moderate sporulation on aerial hyphae. Primary conidiophores are simple, becoming 1-geniculate with 2 conidiogenous loci, up to about 60-90 x 3-4µm.

Conidia are ovoid to subellipsoid and erostrate until secondary sporulation begins; primary conidia (first-formed)

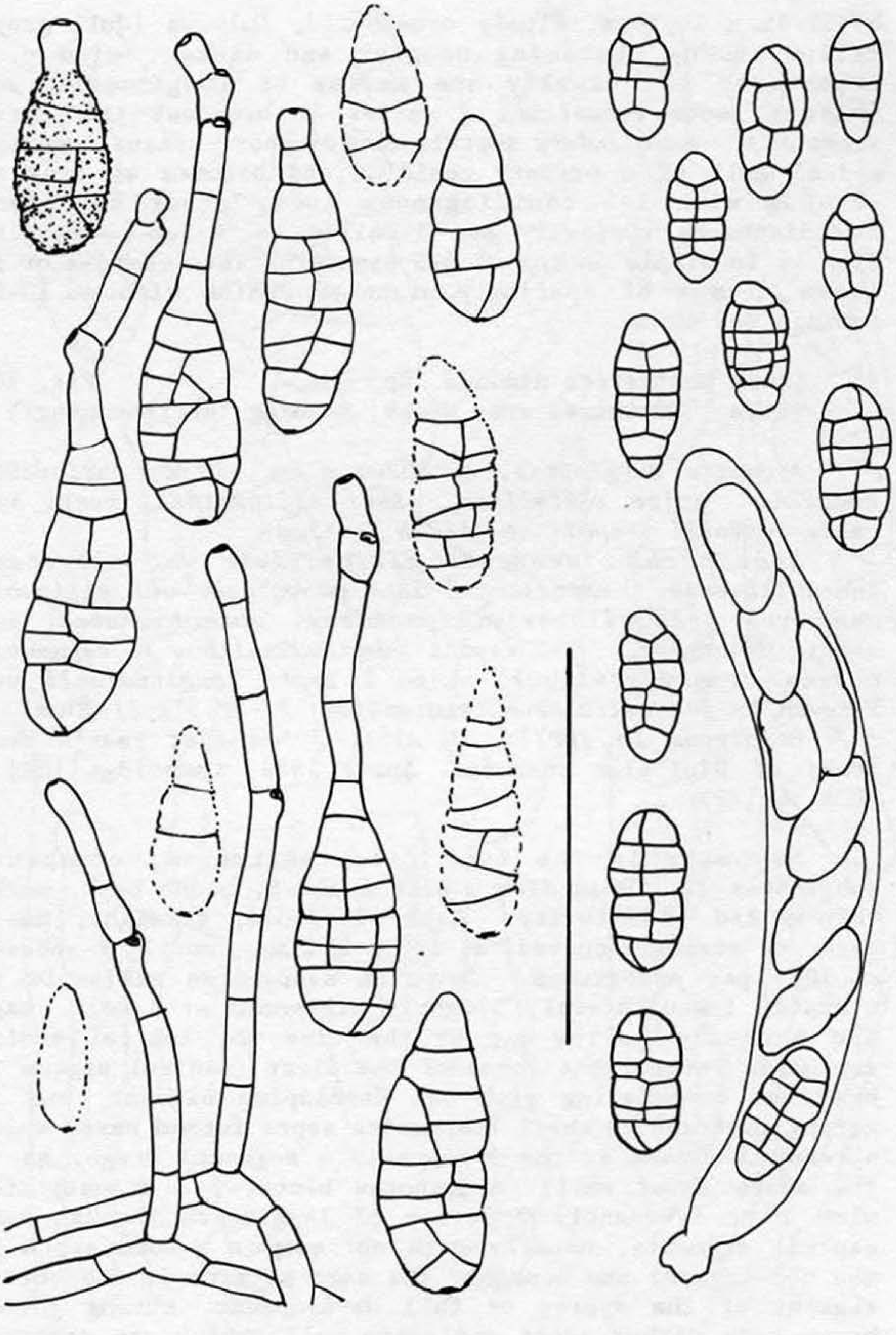

Fig. 37. Right, Lewia ethzedia; left, Alternaria ethzedia; ex Types. Magn.: vertical bar = 50µm.

c. 35-45 x 10-14µm, finely ornamented, fulvous (dull grey-yellow-brown), becoming rougher and darker, with c. 7 transverse and usually one series of longitudinal and oblique septa (sometimes 2 series in broadest transverse segments). A secondary septate conidiophore arises from the apical cell of a primary conidium and becomes as long as 30-40µm with 1-3 conidiogenous loci; other secondary conidiophores typically are 1-celled, c. 4-3µm. Sporulation is in simple chains of 2-6 pseudorostrate conidia or in loose clumps of sparingly branched chains with c. 10-20 conidia per clump.

25. **Lewia photistica** Simmons, sp. nov. Fig. 38.
(Etym.: latinized from Greek, meaning "enlightening")

Ascomata subglobosa, c. 300µm diam., atra, parietibus tenuibus, apice rostellata. Asci ellipsoidei, recti vel valde curvati, 8-spori, c. 130 x 21-23µm.

Ascosporae juventute ellipsoideae vel clavatae, inaequilaterae; maturitatae late obovoideae vel ellipsoideae vel inaequilateriellipsoideae, aureobrunneae, 6-7 septis transversis, 1-2 septis longitudinalibus in segmentis mediis transversalibus, vulgo 1 septo longitudinali vel Y-formi in 1-2 cellulorum terminalium, 21-22.5 x 11-13µm.

Holotypus in [BPI]: U. Allitt, "on last year's dead stems of Digitalis purpurea, April 1982, Cambridge [UK]." (EGS 35-172).

Ascomata in the type rare, scattered, erumpent, subglobose, c. 300µm diam., with a short, blunt beak, dark, thin-walled at maturity. Asci ellipsoid, straight, musiform, or strongly curved, c. 130 x 21-23µm, mostly 8-spored, c. 100+ per ascostroma. Juvenile ascospores ellipsoid to clavate, inequilateral, slightly pigmented at 1-cell stage and markedly yellow-tan by the time the initial median septum is formed; the locus of the first (median) septum is hyaline, contrasting with the developing pigment, and in strong contrast to the 2 transverse septa formed next, which already are dark at the 3-septate (4 segment) stage, as is the spore outer wall. Ascospores become 6-7 transeptate, with 1 or frequently 2 series of longisepta through both central segments, usually with oblique or Y-form septa in the top segment and commonly the same pattern in the bottom segment of the spore; at full development, strong golden brown with darker septa and spore wall (which are comparatively thick), 21-22.5 x 11-13µm, smoothly to sharply constricted at 3 major septa, broadly obovoid or ellipsoid in face view, inequilateral-subellipsoid in side view.

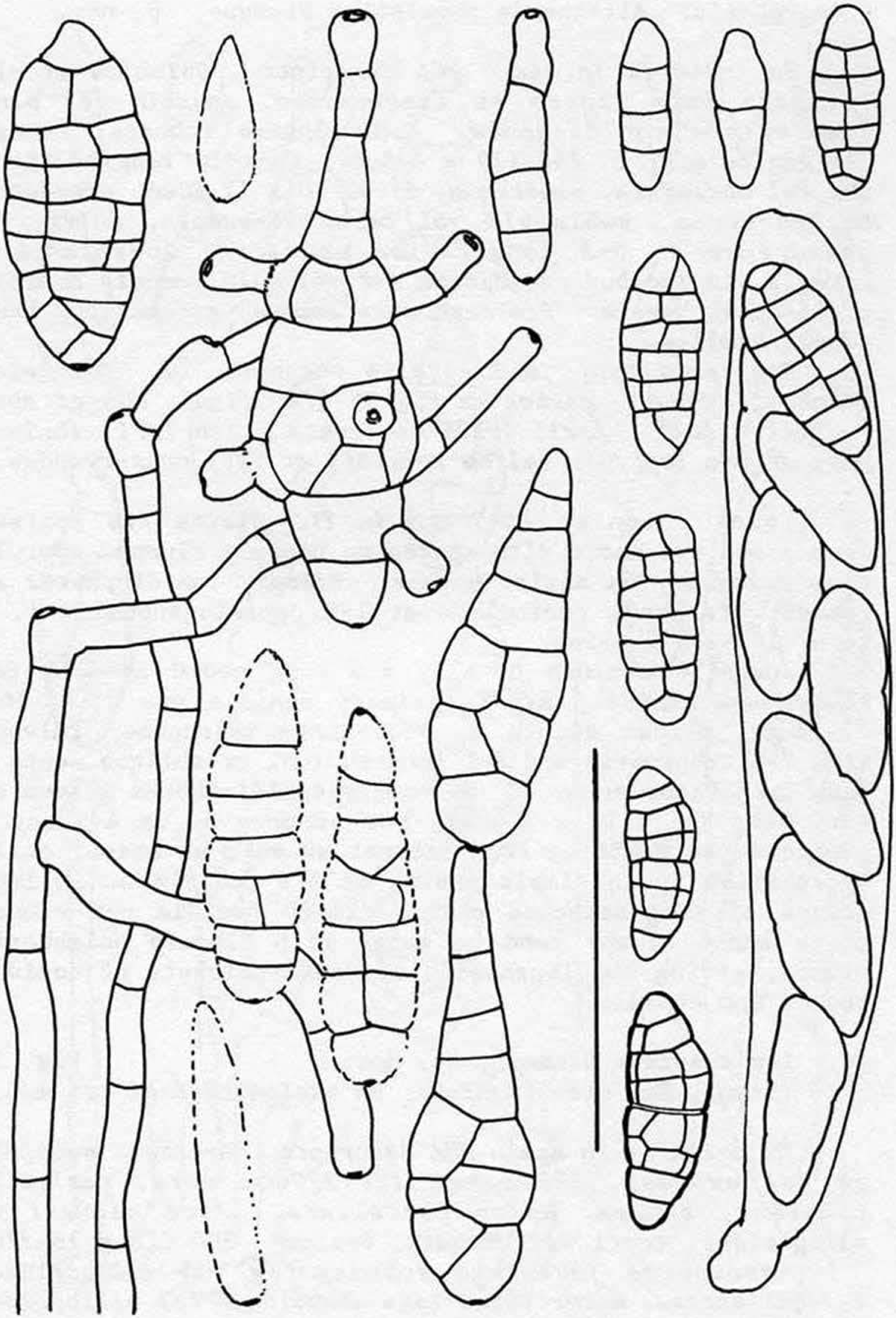

Fig. 38. Right, Lewia photistica; left, Alternaria photistica; ex Types. Magn.: vertical bar = 50μm.

Anamorphosis: **Alternaria photistica** Simmons, sp. nov.

Ex culturis in agaro PCA descripta. Coloniae mycelio epiagaro laxe lanoso et arachnoideo, sparsim vel dense fasciculate conidiogenae. Conidiophora robusta, ramosa, 1-5-geniculata, c. 150-170 x 4-5µm. Conidia longiellipsoidea vel obclavata, erostrata, c. 45-50 x 17-20µm, pseudorostratescentia, sublaevia vel parce verrucosa, fulva, 7-8 transverse et 0-2 longitudine septata. Sporulatio in catenis simplicibus conidiorum 3-6 vel multiramosis conidiis c. 16-20 aggregata. Protoascomata setosa, ascomatibus Lewia eureka similis.

Habitatio typi in Digitalis purpurea, UK (pro teleomorphe). Typus: partes ex EGS 35-172 (isol. EGS ex spec. U. Allitt coll., April 1982) desiccata et in [BPI] (holotypus) et pro isotypis saltem in [IMI] et [NY] conservandae.

Young colonies (5-7 d.) in PCA plates are sparsely lanose and arachnoid with sparse to densely clumped sporulation primarily on aerial hyphae. Primary conidiophores are robust, branched, geniculate at 1-5 conidiogenous loci, up to c. 150-170 x 4-5µm.

Juvenile conidia usually are long ovoid or sometimes almost cylindrical; mature primary conidia are c. 45-50 x 17-20µm, almost smooth to moderately verrucose, fulvous, with 7-8 transverse and 0-2 longitudinal or oblique septa in each transverse segment. Secondary conidiophores seldom are very long (c. 2-10 x 2-4µm), but as many as as 4-5 may be produced per conidium from lateral as well as apical cells. Sporulation is in simple chains of 3-6 conidia or in loose clumps of much-branched chains (16-20 conidia per clump); these loose clumps tend to merge with closely neighboring clumps, giving the impression of dense thickets of conidiophores and conidia.

26. **Lewia eureka** Simmons, sp. nov. Fig. 39.
(Etym.: fr. Greek *heureka*; an exclamation of triumph.

Ex culturis in agaro PCA descripta. Ascomata subglobosa vel ovoidea, 190-325 x 128-290µm, atra, parietibus tenuibus, setosa, apice rostellata. Asci clavati vel ellipsoidei, recti vel curvati, 8-spori, 104-112 x 16-21µm.

Ascosporae juventute subclavatae vel ellipsoideae, inaequilaterae; maturitatae late obovoideae vel ellipsoideae vel inaequilateraliellipsoideae, aureobruneolae, 5 septis transversis, 1 (raro 2) septis longitudinalibus in segmentis mediis transversalibus, et in segmentis terminalibus nullis, 26-27 x 10.5-11µm.

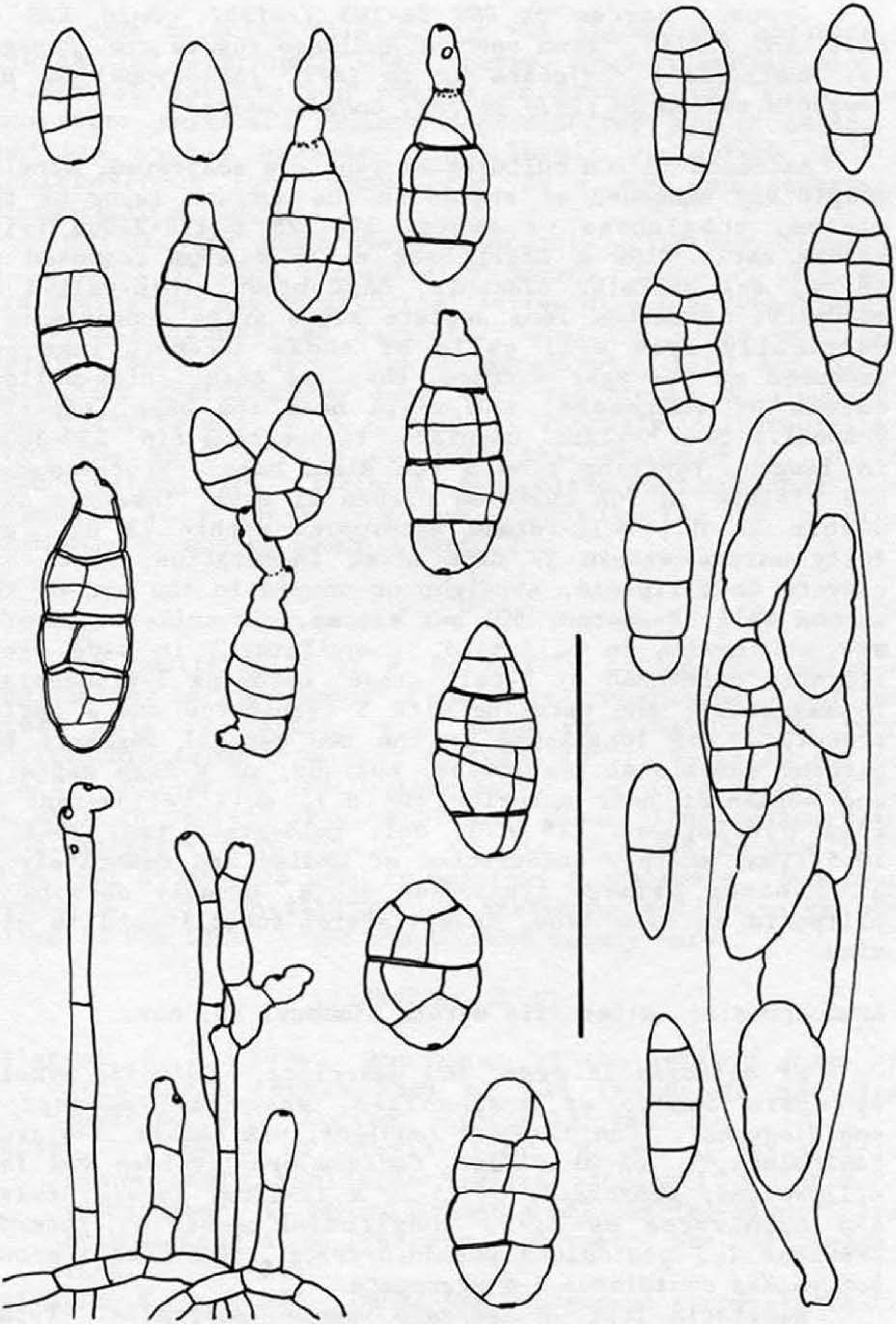

Fig. 39. Right, *Lewia eureka*; left, *Alternaria eureka*; ex Types. Magn.: vertical bar = 50µm.

Typus: partes ex EGS 36-103 (reisol. conid. EGS ex cult. IMI 273162, "from seed of Medicago rugosa c.v. Paragosa, Australia") desiccata et in [BPI] (holotypus) et pro isotypis saltem in [IMI] et [NY] conservandae.

Ascomata in PCA cultures ex Type are scattered, single, completely embedded or seated in the surface layer of the medium, subglobose or ovoid, 190-325 x 128-290μm (with mature asci) plus a small beak c. 25 x 25μm composed of short, fat cellular elements, dark brown, thin-walled at maturity. Numerous long septate setae arise approximately vertically from wall cells of those ascomata that are produced on the agar surface; they are dark, thick-walled, smooth or verrucose, and rigid near the base, tapering gradually to a hyaline, undulate, filamentous tip, 250-300μm in length, tapering from a 6μm diam. base. Protoascomata are visible in PCA cultures within 11 days, immature asci within 14 d., well-formed ascospores within 23 da., and fully mature within 29 days after inoculation. Asci are clavate to ellipsoid, straight or curved in the arc of the ascoma wall, 8-spored, 50+ per ascoma. Juvenile ascospores are subclavate to ellipsoid, inequilateral in side view, slightly pigmented at 2-cell stage, becoming 3-transeptate (4 segments), and maturing with 5 transverse and 1 series (rarely 2) of longisepta in the two central segments but without additional transverse, oblique, or Y-form septa in end segments; near maturity (23 d.), dull yellow-tan; at full development (29 d.), dull gold-green tan, 26-27 x 10.5-11μm, sharply constricted at median and moderately so at 2 other primary transverse septa, broadly obovoid or ellipsoid in face view, inequilateral-subellipsoid in side view.

Anamorphosis: **Alternaria eureka** Simmons, sp. nov.

Ex culturis in agaro PCA descripta. Coloniae mycelio epiagaro lanoso et arachnoideo, sparsim, inconspicue conidiogenae. Conidiophora tenuibus, vix ramosa, 1-4 arcte geniculata, c. 20-40 x 3μm. Conidia breviovoidea vel late ellipsoidea, erostrata, c. 15-30 x 12-13μm, laevia, fulva, 4-6 transverse et 1(-2) longitudine septata, interdum breviter 1-3 geniculate pseudorostrata. Sporulatio minute botryoidea conidiorum 5-6 aggregata.

Habitatio typi in Medicago rugosa, Australia. Typus: partes ex EGS 36-103 (reisol. conid. EGS ex cult. IMI 273162) desiccata et in [BPI] (holotypus) et pro isotypis saltem in [IMI] et [NY] conservandae.

Young colonies (5-7 d.) in PCA plates are moderately lanose and arachnoid with sparse, inconspicuous, minute clumps of sporulation mostly on hyphae just above the substrate surface. Primary conidiophores appear delicate and are poorly branched and closely geniculate at 1-4 conidiogenous loci; commonly c. 20 x 3μm, but sometimes elongate to c. 40μm.

Conidia are short ovoid or broadly ellipsoid, becoming c. 15-30 x 12-13μm, essentially smooth, fulvous, with 4-6 transverse and one longitudinal series of septa (sometimes 2 in widest transverse segments); conidium outer wall and major transverse septa are comparatively thick and dark. Secondary conidiophores have very restricted development; the first-formed (c. 3 x 3μm) is scarcely differentiated from the apex of the conidium that produced it, and a pseudorostrum with 1-3 closely geniculate conidiogenous loci measures only about 7 x 3μm. Sporulation is in tiny branching clumps of about 5 conidia.

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The availability of P. Crivelli's *Alternaria* isolates and the voucher specimens of their teleomorphs has been of great help in getting some ideas of long-standing into publishable form; I am most grateful to Dr. Crivelli and to Prof. E. Müller for their generosity. It is a pleasure to be able to publish results of many discussions shared with Prof. Margaret Barr Bigelow, who is included in the "we" when that pronoun is used in opinions given above. Numerous herbaria and contributors of specimens and cultures are cited in the text -- and are thanked warmly here.

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MYCOTAXON

Vol. XXV, No. 1, p. 309 January-March 1986

NOTICE

DEADLINE FOR PROPOSALS TO AMEND THE CODE OF BOTANICAL NOMENCLATURE AT THE XIV INTERNATIONAL BOTANICAL CONGRESS

The Nomenclature Section of the 14th International Botanical Congress will convene in Berlin, Germany, 20-24 July 1987, and will act on proposals to revise the Code (79 have already been published in *Taxon*). Further proposals may still be submitted and should follow the advice "Concerning Amendment Proposals" (Taxon 32: 660. 1983). Proposals should be sent to the editor of *Taxon* (Prof. F. A. Stafleu, Tweede Transitorium, Uithof, Utrecht, The Netherlands) as soon as possible and no later than 1 May 1986. This early deadline is required to ensure publication by November 1986, allow time for publication of the Synopsis of Proposals by February 1987, and permit completion of a Preliminary Mail Vote prior to the July 1987 meetings. Proposals received after 1 May 1986 will have to be deferred to a later Congress.

W. Greuter, Rapporteur-General
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MYCOTAXON

Vol. XXV, No. 1, pp. 311-320 January-March 1986

REVUE DES LIVRES

par

G.L. HENNEBERT

Book Review Editor, Croix du Sud 3, B-1348 Louvain-la-Neuve
Belgique.

Mrs. Helena CRAMER informed us of the death of Mr. Jörg Cramer (01.12.1931 - 04.06.1985) in Braunschweig, Germany.

The editors of MYCOTAXON express to her, on behalf of MYCOTAXON readers, their sympathy and their gratitude for the important publishing services that J. Cramer provided to mycology.

We are pleased, once more, to review here another set of 12 books recently published by J. Cramer.

LES RUSSULES D'EUROPE ET D'AFRIQUE DU NORD, by Henri ROMAGNESI, 2nd edition with supplement, 1034 p., 1139 fig., 1 col. pl., 10 x 24 cm, cloth hardcover, 1985. Publ. J. Cramer, A.R. Gantner Verlag, FL-9490 Vaduz, Lichtenstein. Price : DM 250.-

The well-known monograph by Romagnesi is reprinted here exactly as it was edited by Bordas in Paris in 1967. But the reprint is supplemented by 32 pages of descriptions or redescriptions of 14 additional species, some of them new. The genus *Russula*, as presented by the author, is divided into 9 sections and 35 subsections and includes 203 species. The philosophy of Romagnesi's classification is fully detailed in the first two chapters (110 p.). After revision of the classification of Mulzer and Zvara, Schaeffer and Blum, Romagnesi agrees with the classification of *Russula* by Singer. We note the accuracy and completeness of the descriptions and the quality of the illustrations. The key to sections, subsections and species, 60 pages long, is in French and is also translated into English by R.W.G. Dennis. That will surely help in the use of the book by many more mycologists. The edition is of excellent quality. It is fortunate for mycologists that this monograph has been reprinted and revised.

UNTERSUCHUNGEN ZUR PRODUKTION UND REINIGUNG EINES GELBEN FARBSTOFFES DES BASIDIOMYCETEN PLEUROTUS OSTREATUS (JACQ. EX FR.) KUMMER, by Wolfgang MARGRAF, Bibliotheca Mycologica Band 93, 95 p., 33 fig., 14 x 23 cm, paperback, 1984. Publ. J. Cramer, A.R. Gantner Verlag, FL-9490 Vaduz, Lichtenstein. Price : DM 32.- (subscr.), 40.-

During investigations on *Pleurotus ostreatus*, in Prof. Eger-Hummel's Laboratory, an uncommon yellow orange pigment has appeared in mycelium when fruiting was inhibited. The author has selected strains producing such a pigment under appropriate conditions. Glutamine, amongst amino acids, as nitrogen precursor, was shown most effective. The pigment was isolated, purified and proved to be a new kind of pigment, unstable in heat or oxygen, photosensitive, with a maximum absorption at 475 nm and a global formula $C_{35} H_{65} N_2 O_{32}$. The author suggests, as a conclusion of his interesting work, that the pigment might play a role as a photoreceptor in the photomorphogenesis of the sporocarps.

ARTABGRENZUNG DURCH DNA-ANALYSE BEI EINIGEN VERTRETERN DER STROPHARIACEAE (BASIDIOMYCETES), by Klaus-Dieter JAHNKE, Bibliotheca Mycologica Band 96, 186 p., 25 fig., 14 x 23 cm, cloth hardcover, 1984. Publ. J. Cramer, A.R. Gantner Verlag, FL-9490 Vaduz, Lichtenstein. Price : DM 48.- (subscr.), 60.-

For the first time that, besides the determination of the guanidine-cytosine contents of the genome, DNA-DNA hybridization is applied in the Basidiomycetes in order to evaluate relationships at the species level. The author's aim is to test 23 species in *Stropharia* (11), *Psilocybe* (8), *Pholiota* (1), *Kuehneromyces* (1) and *Hypholoma* (2) represented by 38 strains, some from DSM Culture Collection. GC contents of these range from 42.2 to 45.9% while 4 species of *Polyporus* tested in comparison yield between 50.4 and 54.1%. The percentage DNA-DNA homology demonstrates, according to the author, the conspecificity of *Stropharia albocyanea* and *S. ochrocyanea* and of *Psilocybe squamosa* var. *squamosa* and *P. squamosa* var. *thrausta* (under the name *Stropharia thrausta*), as well as a close relationship between *Stropharia aeruginosa* and *S. caerulaea* (if the strains are properly identified). The morphological studies also presented are based on carpophores but are not related to all the strains tested, nor even concern species under biochemical investigation. Also half of the biochemically investigated species are not described morphologically from their original material. This study, however, is of interest as an application and a comparison of several new methods in biochemistry of fungi. Eventually, such studies contribute to fungal taxonomy, if the biochemist can be certain of the exact taxonomic position of material studied and assure its deposit in both an accessible herbarium and a culture collection.

ZUR ÖKOLOGIE DER MYKORRHIZAPILZE, by R. AGERER, Bibliotheca Mycologica Band 97, 160 p., 31 fig., 14 x 23 cm, paperback, 1985. Publ. J. Cramer, A.R. Gantner Verlag, FL-9490 Vaduz, Lichtenstein. Price : DM : 48.- (subscr.), 60.-

This study is based on a 4-year survey of fruitbody production by 152 species of mycorrhizal fungi in two forest plots, 1200 m^2 by size, in a *Picea abies* forest on sandy and clay soil, and a similar plot on sandy soil under mixed *Fagus sylvatica* and *Quercus robur*, in south-west Germany. Every two weeks, the relative producivity of each species was recorded, in addition to the mean temperature and total precipitation. A correlation is demonstrated between spring temperatures and relative producivity later in the year, as well as to the amount of mycorrhizae in the soil during the spring. That correlation is striking in dry season and is slightly modified depending on precipitation. These correlations may also differ according to the genus or species. Such careful studies advance our understanding of mycorrhizal development in forests.

LES PHYSALACRIACEAE DU GLOBE, by Jacques BERTHIER, Bibliotheca Mycologica Band 98, 128 p., 24 pl., 14 x 23 cm, paperback, 1984. Publ. J. Cramer, A.R. Gantner Verlag, FL-9490 Vaduz, Lichtenstein. Price : DM 40.- (subscr.), 50.-

The author reports his observations on 110 herbarium specimens assigned to the *Physalacriaceae*. In *Physalacria* he redescribes 25 known species, adds 3 species, 2 of which are new, and excludes 3 species. In *Hormomitaria* he redescribes 2 of the 3 species, transfering the third to *Mucorella*. He finally reduces *Pseudotyphula* to its type species. In this revision, Corner's delimitation of the family is maintained, but the presence of apically cyanophilous cystidia is emphazised. These cystidia may be found in hymenium or in sterile parts of the stem. They are thin or thick-walled and variously capitate or not. Other characters of the family are also listed. The author suggests that his observations should receive confirmation from studies of the same taxa in culture.

INDEX AGARICALIUM CHILENSIUM, by Norberto GARRIDO, Bibliotheca Mycologica Band 99, 340 p., 10 maps, 1 colour frontispice, 14 x 23 cm, cloth hardcover, 1985. Publ. J. Cramer, A.R. Gantner Verlag, FL-9490 Vaduz, Lichtenstein. Price : DM 96.- (subscr.), 120.-

This book is a compilation, based on about 250 bibliographical references, of the 764 Chilean Agaricales reported up to now. A taxonomic part presents taxa in alphabetical order. Synonymy, habitat, locality, observations, exsiccati and references are given for each species or infraspecific taxon. 686 species are accepted including 9 new combinations in *Astrosporina, Bolbitius, Entoloma, Favolaschia, Hypholoma* and *Leptoglossum* ; 78 species are listed as questionable. In a second part are indexes to all species and genera, to edible and poisonous species, to host names and synonyms, to ecological associations of the fungi and their hosts as mycorrhizal, parasitic or saprophytic, to Chilean type material of Agaricales, to European and North American species in Chile, to collectors' names and their exsiccati, in connection with a series of 10 maps and the coordinates of the collection sites. The book is completed by a list of about 250 references. This book will be useful in appreciating the contributions by Singer, Horak, Spegazzini, Epinosa, Lazo, Campo and others to Chilean mycology.

MYCOLOGISTS AND OTHER TAXA, by Martha SINGER, 120 p., 16 fig., 14 x 23 cm, paperback, 1984. Publ. J. Cramer, Braunschweig, Germany. Price : DM 20.-

Martha Singer, Dr. Rolf Singer's wife, recounts in detail her memories of her husband's travels and encounters with mycologists and "other taxa" of scientists through Vienna, Barcelona, Paris, Leningrad, Cambridge in USA, Florida, Tucuman in Argentina and Chicago. The text is an apparently unedited and disorganized scrapbook of reminiscences, often told with humor, occasionally with thinly veiled rancor. Only Cramer would have accepted to publish a book of so little intrinsic merit.

LABOULBENIALES (FUNGI, ASCOMYCETES), by Isabelle I. TAVARES, Mycologia Memoir n°9, 628 p., 22 fig., 56 phot. pl., 14 x 23 cm, cloth hardcover, 1985. The New York Botanical Garden and the Mycological Society of America. Publ. J. Cramer, Springaeckern 2, 3300 Braunschweig, Germany. Price : DM 150.-

The Laboulbeniales, parasites on arthropods, are not always considered in mycological classes and many mycologists are not really acquainted with them, even if they know the famous study of them by Thaxter. In this ninth M.S.A. Memoir, Isabelle Tavares offers to us a well-done monograph of the Laboulbeniales. After an introduction and a history of knowledge on the field, the author describes the ontogeny of the thallus from the ascospore to the formation, fertilization and maturation of the new perithecium. Cell development is followed step by step, supported by a set of fine line drawings grouped at the end of the book. She also proposes her classification of the order, refering to Thaxter's old classification, and provides a key to 131 genera. She then revises every generic name, providing for each of them synonyms, sources of illustration, etymology, diagnostic characters, indication of the type, number of species, hosts and host species, and copious taxonomic comments, all supported by almost 300 bibliographic references. Many genera are illustrated by numerous black and white photographs. A phylogeny of the families is proposed. Geographic distribution is considered in relation to the parasitized hosts. The printing and binding by J. Cramer are of very high quality.

A CONTRIBUTION TO THE TAXONOMY OF THE GENUS PHANEROCHAETE (CORTICIACEAE, APHYLLOPHORALES), by Harold H. BURDSALL, Jr., Mycologia Memoir n° 10, 166 p., 46 fig., 14 x 23 cm, cloth hardcover, 1985. The New York Botanical Garden and the Mycological Society of America. Publ. J. Cramer, Springaeckern 2, 3300 Braunschweig, Germany. Price : DM 60.-

During the last few decades, many mycologists have devoted their efforts to the taxonomy of the old but difficult family *Corticiaceae*. Burdsall, one of them, had already regrouped more than ten, white rot producing, lignicolous, membraneous to crustaceous members of the family, with intricate textured subiculum in the genus *Grandiniella* Karst. *Phanerochaete* Karst. was later shown to be the correct name for the genus. The author therefore revised all available collections, to delimit 46 species within the genus, 16 of which are new combinations, and 2 are new species. He recognizes three subgenera, *Phanerochaete, Phanericium,* and *Scopuloides*, and presents dichototomic and synoptic keys to their species. These are treated in alphabetical order, with synonymy, description, illustration of microscopic features, list of specimens and comments. 14 excluded species are given with their correct names, synonyms and comments. Similar good contributions are awaited for many other genera of the *Corticiaceae* as revised by Eriksson et al.

AD POLYPORACEAS II & III, by E.J.H. CORNER, Beihefte zur Nova Hedwigia Heft 78, 222 p., 23 + 25 fig., 5 col. pl., 17 x 24 cm, cloth hardcover, 1984. Publ. J. Cramer, A.R. Gantner Verlag, FL-9490 Vaduz, Lichtenstein. Price : DM 96.- (subscr.), 120.-

In the first part, *Ad Polyporaceas II*, the author redefines *Polyporus* Fr. *sensu stricto* as having dimitic hyphae with skeleto-binding cells with terminals and lateral processes in the fruitbodies. The genus, retypified by *P. squamosus* instead of *P. tuberaster*, includes therefore *Favolus* and *Pseudofavolus* and shows relationship to *Lentinus, Echinochaete* differs particularly by spinose, brown cystidia. *Mycobonia*, with a smooth hymenium, can possibly be considered as an aporous *Polyporus*. Five new species, 3 varieties and 4 combinations are proposed in *Polyporus*, 7 new varieties in *Echinochaete*. Most taxa are tropical and described from living specimens. In the second part, *Ad Polyporaceas III*, the author precisely defines the hyphal system of the related genera *Piptoporus, Laetiporus* and *Buglossoporus*. The first is monomitic at first, then dimitic with generative hyphae bearing unbranched binding processes (*P. portentosus* and *P. cretaceus* excepted). *Laetiporus* has skeletal cells with many branched binding processes and *Buglossoporus* has skeletal cells or not, with a few sparingly branched or flabelliform, binding processes. Eight species, 3 varieties and one new combination in *Laetiporus* are proposed as new taxa. The affinity of *Bondarzewia* with previously mentioned genera is also discussed. Three new species are added in *Meripilus* and three new species in *Bondarzewia*. Most of the taxa described are from South-east Asia.

MITOCHONDRIALE MOSAIKGENE, Strukturaufklärung eines mobilen Introns aus dem Ascomyceten Podospora anserina, by Heinz D. OSIEWACZ, Bibliotheca Mycologica Band 94, 113 p., paperback, 1984. Publ. J. Cramer, A.R. Gantner Verlag, FL-9490 Vaduz, Lichtenstein. Price : DM 40.- (subscr.), 50.-

It is known that the senescence of *Podospora anserina* strains is controlled by mitochondrial DNA as well as by nuclear DNA. A plasmid like DNA isolated from mitochondria, cloned in *Escherichia coli* as vector and introduced in *P. anserina* protoplasts, caused early senility of cells. That pl DNA is characterized in the present work as an annular covalently linked DNA. At first integrated in mitochondrial DNA, it appears as a mobile intron that codifies cytochrome-oxydase I. After excision of the intron and ligation by covalence, a free plasmid is formed and can be replicated. The plasmids block the synthesis of maturase and of cytochrome-oxydase and therefore the cellular vital functions of mitochondria. The cell is then senescent. This work provides progress in fundamental comprehension of the common feature of senescence in fungi.

HOMOKARYOTISIERUNG VON BASIDIOMYCETEN, by Rainer DICKHARDT, Bibliotheca Mycologica Band 95, 136 p., 6 fig., 17 pl., 14 x 23 cm, paperback, 1985. Publ. J. Cramer, A.R. Gantner Verlag, FL-9490 Vaduz, Lichtenstein. Price : DM 40.- (subscr.), 50.-

Following the investigations by Leal-Lara (1980), the author, still under the guidance of Prof. Eger-Hummel, studied the monokaryotization effect of autoclaved glucose-glycine-containing culture media on dikaryotic strains of *Pleurotus ostreatus*. A labile compound is formed by autoclaving the medium, like a glycine-N-glucoside compound. Synthetized sodium glycinate-N-glucoside has indeed the same activity as N-acetylglucosamine, the effect of which is only partial. As the substance progressively disappears, dikaryotization is spontaneously restored in the culture. But cultures from monokaryotizised hyphal fragments yield neohaplonts. Similar results have been obtained in *Agaricus bitorquis* and *A. brunnescens*. The same compounds split dikaryons without clamps and even heterokaryons into neohaplonts similar to the homokaryotic parental types, nuclei being isolated into short or chlamydospore-like cells. Homokaryons have been obtained which fruited. Such strains might prove to be of practical interest. These interesting investigations also point to an important regulating factor in fungal morphogenesis.

TROPICAL PLANT DISEASES, par H. David THURSTON, 208 p., 59 fig., quarto broché, 1984. The American Phytopathological Society, 3340 Pilot Knob Road, St Paul, Minnesota 55121, U.S.A.

Cette publication est une intéressante approche du problème que causent les maladies des plantes aux cultures de basse altitude sous les tropiques. Ce n'est pas un traité de phytopathologie tropicale ni une revue technique des maladies, mais plutôt une évaluation de l'importance des principales maladies des plantes cultivées tropicales et des pertes qu'elles causent. De plus, ce livre veut aussi servir d'introduction à ces maladies qui ont ravagé et ravagent encore les grandes cultures tropicales,par la présentation d'une sélection de la littérature phytopathologique et d'ouvrages plus généraux sur chacune d'elles. En effet, dit l'auteur, le phytopathologue des tropiques connaît souvent plus les fléaux des cultures des régions tempérées que ceux qui l'entourent. Les principales céréales, plantes, racines et tubercules, légumineuses, bananes, plantes pour boissons (thé, café, cacao), plantes à huiles, canne à sucre, légumes ainsi que quelques plantes à usage industriel sont passées en revue et documentées de références sur leurs maladies. Treize maladies sont étudiées plus en détail. Ce livre, certainement, sensibilisera le lecteur à l'importance primordiale qu'il faut donner à la lutte contre les maladies des plantes sous les tropiques, de concert avec l'expérience des agriculteurs locaux.

COMPENDIUM ON PEANUT DISEASES, par D.M. PORTER, D.H. SMITH et R. RODRIGUEZ-KABANA, édit., The Disease Compendium Series (12ème fascicule), 73 p., 80 fig., 157 phot. couleurs, quarto, broché, 1984. The American Phytopathological Society, 3340 Pilot Knob Road, St Paul, Minnesota 55121, U.S.A. Price : US $ 14.- (members) 17.- (non members).

Ce nouveau Compendium, travail de 38 spécialistes, est, comme les précédents, une sorte de bible des maladies et dégâts de la culture envisagée, cette fois, de l'arachide. Parmi les principales maladies, 38 sont dues aux nématodes et 7 aux virus. Les désordres abiotiques comprennent les déficiences, les dégâts climatiques, les désordres génétiques et surtout les dégâts par les agents polluants et phytosanitaires. Un intéressant chapitre est consacré aux agents symbiotiques, mycorhizes et rhizobia. Suit un chapitre sur les insectes nuisibles tant aux gousses en stockage qu'aux plantes sur pied. L'illustration est, comme à l'habitude, abondante et excellente et recouvre tous les cas étudiés.

COMPENDIUM ON PEA DISEASES, par D.J. HAGEDORN, édit., The Disease Compendium Series (13ème fascicule), 58 p., 16 fig., 110 phot. couleurs, quarto, broché, 1984. The American Phytopathological Society, 3340 Pilot Knob Road, St Paul, Minnesota 55121, U.S.A. Price : US $ 14.- (APS members), 17.- (non members).

Ici encore on retrouve la même qualité dans l'information et la présentation de ce Compendium. Celui-ci traite du pois, légumineuse alimentaire aussi ancienne que l'agriculture. Vingt-neuf maladies sont décrites. Trois sont bactériennes, dix-neuf sont fongiques et attaquent principalement la partie aérienne, tels *Mycosphaerella pinodes, Ascochyta pisi* et *Phoma medicaginis* var. *pinodella*. D'autres maladies du système radiculaire sont importantes aussi, dues à *Fusarium, Aphanomyces* et *Pythium*. En plus de quelques viroses, les dégâts par nématodes et les désordres de nature abiotique sont décrits. Cependant, les insectes prédateurs ne sont pas traités. Ces Compendia de l'APS sont d'un grand intérêt pour les praticiens de toute région agricole du monde et peuvent rendre de grands services à l'enseignement.

THE DUTCH, FRENCH AND BRITISH SPECIES OF PSATHYRELLA, par E. KITS VAN WAVEREN, Persoonia Supplement n°2, 300 p., 448 fig., 17 x 24 cm, broché, 1985. Rijksherbarium, att. Miss M. van Zoelen, P.O. Box 9514, 2300 RA Leiden, Netherlands. Prix : NFl 92.50.-

Le genre *Psathyrella* (Agaricales) n'a pas été récemment revu. Cette monographie, bien que limitée à une partie de l'Europe occidentale, est bienvenue. Bien que l'auteur veuille présenter un guide pratique d'identification et éviter de s'apesantir sur des détails d'anatomie, de structure ou de colorations chimiques, ses descriptions de 123 espèces et variétés reconnues et ses clés témoignent d'une grande précision. Le genre est divisé en deux sous genres : *Psathyrella* comprenant 5 sections et 38 taxa et *Psathyra* avec 7 sections et 85 taxa. Chaque description de taxon se base sur les récoltes mentionnnées de Hollande et d'Angleterre et s'accompagne de dessins de carpophore, de spores, basides et cystides, d'une synonymie, de références aux descriptions et illustrations publiées et aux erreurs d'identification et de commentaires taxonomiques. Résultat de plus de 20 ans d'observations, de récoltes et d'analyses méthodiques de celles-ci, réalisées dans les temps libres, laissés par une activité médicale chargée, ce livre sera d'autant plus apprécié.

KÜKENS CATALOGUE-CULTURES OF MICROORGANISMS, by Enver Tali CETIN, 74 p., paperback, 1982. University of Istamboul, Istamboul Faculty of Medicine, Center for Culture Collections of Microorganisms (KÜKENS), Capa, Topkapi, Istambul, Turkey.

Created in 1979, the Center KÜKENS has as its aim to keep medically important microorganisms and to maintain genetically standard cultures of microorganisms for biotechnology in culture collections. The institute promotes research on these microorganisms, organizes training sessions and international symposia. It publishes bulletins in microbiology and in mycology and other scientific papers. In 1982 the Collections maintained 246 yeasts and molds, 930 bacteria, 7 protozoa, 16 viruses and 3 cell cultures. The acronym of the Collections is KUEN.

JCM CATALOGUE OF STRAINS, par Kazuo KOMAGATA, édit., 2ème édition, 263 p., quarto, broché, 1984. Japan Collection of Microorganisms, Institute of Physical and Chemical Research, (Riken), Wako, Saitama, 351-01, Japan.

La création, en 1974, au Riken de l'office de la promotion des Sciences de la vie eu pour résultat la création de la Japan Collection of Microorganisms et sa reconnaissance comme collection nationale. La Collection JCM n'eut pas comme seules tâches la caractérisation, la maintenance et la distribution de microorganismes, mais aussi une fonction de recherche, de développement technologique et de formation. Ce ne fut qu'après 10 ans qu'elle publia son premier catalogue, en 1983. Cette première édition fut très tôt épuisée et remplacée par cette seconde édition. 2417 souches de bactéries, actinomycètes, moisissures et levures. La majeure partie représente les deux premiers groupes. La JCM s'est en effet enrichie de l'importante collection d'actinomycètes (*Streptomyces, Streptosporangium, Streptoverticillium, Micromonospora,* etc.) de la Kaken Pharmaceutical Co. Les champignons comprennent une importante collection de souches originales d'*Aspergillus* et de levures. Les informations sur les souches comprennent l'histoire de la souche, son statut, son origine, ses propriétés, ses milieux de culture, ses correspondants en d'autres collections, des références bibliographiques. Un index numérique complète ce catalogue.

CULTURE COLLECTION OF WOOD-INHABITING FUNGI, by Jean E. CLARK and Edson C. SETLIFF, 108 p., quarto, paperback, 1985. Forintek Canada Corporation, Western Laboratory, 6620 N.W. Marine Drive, Vancouver, B.C. V6T 1X2 or 800 Montreal Road, Ottawa, Ontario K1G 3Z5, Canada.

Forintek Canada Corporation, a non-profit forest research corporation, with laboratories in Ottawa and Vancouver, has amalgamated its two Culture Collections of wood-inhabiting fungi (Vancouver) and wood-inhabiting microorganisms (Ottawa) into one Collection with the present catalogue. "Although Fungal Culture Collections are often taken for granted, they do represent an important foundation stone upon which much of our forestry oriented microbiological work is based. Even so, our understanding of the fungi of importance to the forest industry has only just started. Biotechnological developments will bring about dramatic changes in microbiology and in society. Culture Collections represent the gene pool for tomorrow's research". That, from the catalogue preface, tells enough about the importance of such a fungus culture collection as a working potential as well as a repository. This

Collection maintains 1,960 cultures, mostly of Basidiomycetes, Ascomycetes and Deuteromycetes and some Phycomycetes from forest trees, from wood, and from wood products in Canada.

PARASITISCHE PILZE AN GEFÄSSPFLANZEN IN EUROPA, by Wolfgang BRANDENBURGER, xxii + 1248 p., 403 fig. on 150 tables, 17 x 24 cm, cloth hardcover, 1985. Publ. Gustav Fischer Verlag, Wollgrasweg 49 D-7000 Stuttgart, Germany. Price : DM 320.-

That voluminous book is a sylloge of all fungi on living vascular plants, recorded in Europe. In the first part, pathogenic fungus species are listed by host plant, disposed according to Melchior's plant systematics and by plant organ. They are described with diagnoses, symptoms and synonyms and refered to their taxonomical position. Related morphs are also described. The second part of the book is devoted to diagnoses and illustrations of the recorded fungus genera, disposed in taxonomical order. References to a selection of recent taxonomical literature are provided. The book ends with a glossary, a list of authors' names, an index of host plants and of fungi and with a bibliography. That book is an important contribution to European plant pathology. After Saccardo's Sylloge and Petrak's Index of Fungi, the book is the first to cover plant pathogenic fungi of entire Europe at once. It compiles many regional listings, like those of Jørstad, Moore, Pantidou, Parmasto, Viennot-Bourgin, Goidanich, Menzinger and others, and about 3,000 papers published before 1980. The book is conceived indeed to facilitate recognition by the plant pathologist of the pathogenic fungi on a particular host plant. It will also be of interest to the taxonomist, but only to a certain extent. The taxonomist might wish having the nomenclatural reference of the accepted fungus species names, the reference to the source of the proposed diagnoses and the inclusions,in the fungus names index, of the specific epithets in each genus with paginated reference to their hosts. Furthermore the author has not the pretention, when compiling fungus species, to solve inherent taxonomical or nomenclatural problems, which is the task of the taxonomist. The text is in German and edited to be as short as possible. In fungus descriptions the current use of abbreviated words implies a minimum knowledge of the language. Surely the book must stand in every plant pathology laboratory in Europe. It should be considered as a basis.

THE BRITISH ASCOMYCOTINA, AN ANNOTATED CHECKLIST, par P.F. CANNON, D.L. HAWKSWORTH and M.A. SHERWOOD-PIKE, CMI Publication, vii+302 p., 25 x 19 cm, relié toilé, 1985. Commonwealth Agricultural Bureaux, Farnham House, Slough SL2 3BN, UK. Price : US $ 100.- (£ 55.- membres du Commonwealth).

Cette liste des noms de genres (1300) et d'espèces (7300) d'Ascomycètes observés jusqu'à ce jour sur les Iles Britanniques est une révision des listes existantes des Pyrenomycètes (Bisby & Mason 1940), des Discomycètes (Ramsbotton & Balfour-Browne 1951) et des genres lichénisés (Hawksworth & al. 1980) et en Irlande (Muskett & Malone 1983). Elle est complétée encore par les relevés non publiés d'herbiers et de collections de cultures britanniques. La liste est alphabétique. La nomenclature des noms, mise à jour, donne la date de création du nom, son classement, la synonymie principale, le substrat, l'anamorphe s'il y a lieu, et des références bibliographiques choisies. Une classification taxonomique suivant celle du Dictionary of the Fungi et un index des anamorphes sont proposés en fin d'ouvrage. Cet ouvrage s'avérera d'une grande utilité. Aussi, on devrait souhaiter le même type d'ouvrage pour les autres divisions des champignons et pour de plus grandes aires géographiques ?

WOOD PRESERVATION IN THE NETHERLANDS, by Niels BURGERS, Ron COCKCROFT and Dammes DE JONG, Swedish National Board for Technical Development Information 457, 72 p., 15 fig., 17 x 24 cm, paperback, 1985. Styrelsen för teknisk Utveckling, PO Box 43200, S-10072 Stockholm, Sweden.

This is the sixteenth booklet of a series of STU information, devoted to wood preservation through the world, and edited by Ron Cockcroft, the Secretary-General of the International Research Group on wood preservation. Wood preservation against fungi and insects is considered on technical points of view : methodology, products and legislation. Fourteen countries have contributed: Sweden, UK, Germany, Belgium, Japan, USA, Turkey, Thailand, Spain, Iran, Australia, Yugoslavia, Brazil and the Netherlands. A world list of wood preservative names has also been published.

BUTLLETI DE LA SOCIETAT CATALANA DE MICOLOGIA, n°7, 72 p., February 1983, n°8, 74 p., April 1984. 17 x 21 cm. Ed. Societat Catalana de Botanica, Facultat de Farmacia, Universitat de Barcelona, 08028 Barcelona, Spain.

FICHAS TÉCNICAS. Ia Serie, 1983 and IIa Serie, 1984. Ed. Societat Catalana de Micologia, ibidem.

These two publications relate the activities of Catalan mycologists. The Bulletin contains good papers on illustrated collecting records, keys and descriptions. Issue n°7 is devoted to the tenth anniversary of the Society. The Fichas Técnicas contain each twenty to thirthy descriptions of Basidiomycetes or Ascomycetes illustrated by line drawings of microscopic features.

AGARICA,MYKOLOGISK TIDSSKRIFT, a mycological journal published by the Mycological Society of Fredrikstad, n°10, 221 p., August 1984, n°11, 65 p., March 1985, 15x21 cm. Ed. Roy Kristiansen, P.O. Box 19, N-1652 Torp, Norway. Subsrciption NOK 25.- to 50.- depending on the number of pages. Two issues yearly.

Principally devoted to mushroom hunting datas, the journal also includes a number of good professional papers on Basidiomycetes and Ascomycetes.