

Lindtneria thujatsugina sp. nov.
(Stephanosporales, Stephanosporaceae)
and notes on other resupinate basidiomycetes
with ornamented basidiospores

by

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With 16 figures

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A new species, *Lindtneria thujatsugina*, is described. The unique morphology of the basidiospore in the Stephanosporaceae is further clarified through bright field and scanning electron microscopy. *Lindtneria trachyspora* is lectotypified and the taxonomic positions of *Serpula rugospora*, *Lindtneria pellicularis* and *Poria baboquivariensis* are re-evaluated. *Lindtneria rugospora* is proposed as a new combination,

Lindtneria Pilát was proposed (Pilát 1938) to encompass *Poria trachyspora* Bourd. et Galz. in the Phylacteriaceae (= Thelephoraceae s. str.). Recently, Oberwinkler and Horak (1979) proposed the new family Stephanosporaceae for the aphylloroid *Lindtneria* and gastroid *Stephanospora* Pat., making particular reference to *L. trachyspora* and *Stephanospora caroticolor* (Berk. et Br.) Pat. Oberwinkler and Horak's (1979) conclusion concerning the relatedness of these two species was based, for the most part, on the practically indistinguishable and unique nature of the basidiospores. The basidiospore character that is fundamental to their (Oberwinkler and Horak 1979) thesis is the corona situated around the plage and associated with the hilar region.

Hansen (1960) was apparently the first to observe a collar or "corona" associated with the apiculum [= hilar appendix; Pegler and Young 1971 (hilar appendage; Hawksworth et al. 1983)] and provided substantive data on the ontogeny of the basidiospore of *L. trachyspora*.

My purposes here are (1) to lectotypify *Lindtneria trachyspora*, (2) to describe a new species of *Lindtneria*, paying particular attention to the plage region of the basidiospore and also the proximal submedial circumferential skirt, (3) to review some taxa that may constitute additional *Lindtneria* species — e.g., *Serpula rugospora* W.B. Cooke (Cooke 1957) and *Poria baboquivariensis* Gilbn. in Gilbn., Burds., et Canf. (Gilbertson et al. 1976), and (4) to re-examine and assess the nature of the hilar region of those species currently assigned to *Lindtneria* — e.g., *Lindtneria pellicu-*

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laris Jülich (Jülich 1978), *L. pterospora* Reid (Reid 1975), *L. leucobryophila* (P. Henn.) Jülich (Jülich 1977), and *L. flava* Parm. (Parmasto 1968).

Data on microscopic characteristics were obtained from small portions of basidiocarps squash-mounted in 5% KOH (w/v) and stained with 1% Phloxine-B (w/v), Melzer's reagent (Melzer 1924), or lactophenol cotton blue. Photomicrographs were prepared with the aid of a Leitz Ortholux microscope and Orthomat camera. Specimens examined by scanning electron microscopy (SEM) were rehydrated in 10% KOH for 5 minutes, dehydrated sequentially in 25, 50, 75, and 95% ethyl alcohol for 5 minutes at each concentration, and 100% ethyl alcohol for two changes at 5 minutes each, subjected to critical point drying, and gold coated. Micrographs were taken with a Cambridge Mark IIa scanning electron microscope. Terminology describing basidiospore morphology follows that of Pegler and Young (1971). Capital letters used to designate herbaria are those of Holmgren et al. (1981).

Lectotypification of *Poria trachyspora*

Bourdot and Galzin (1914, 1927), characteristically, did not cite a particular specimen when they described *Sistotrema sulphureum* 'ut "2°" without explicit rank' *retigera* Bourd. et Galz. (1914) or *Poria trachyspora* Bourd. et Galz. (1927). They eventually chose the latter binomial to represent their fungus at the specific level. Five specimens from the Bourdot Herbarium at PC were available for examination.

They are:

1. "*Sistotrema sulphureum* var. *retigera* B.G.; état jeune.... *Poria trachyspora* (Rev. VII 1916); l'Aveyron, Vabres; sur *Thymus*, debris, humus; legit Galzin, No. 7083, 9 X 1910 (Bourdot No. 7501)."
2. "*Sistotrema sulphureum* var. *retigera* B.G.; état jeune.... *Poria trachyspora* (H.B. rev. VII 1916); l'Aveyron, Millau; sur humus, pierres, sous de *Thymus*: legit Galzin, no. 7504, XII 1910 (Bourdot No. 7642)."
3. "*Poria trachyspora*: l'Aveyron; sur humus, pierres; legit Galzin, No. 14347, 20 XI 1913 (Bourdot No. 12372)."
4. "*Sistotrema sulphureum* var. *retigerum*: l'Aveyron; sur debris; legit Galzin, No. 16660, XI 1914."
5. "*Sistotrema retigerum*: l'Aveyron, St. Rome-De-Cernon; sur pierre, thym, debris; legit Galzin, No. 25893, IX 1920 (Bourdot No. 30775)."

All five collections represent the same species and all are potential lectotypes. Although the individual collections are small and fragmentary, most macro- and microscopic characters are demonstrable with the exception of the poroid nature of the hymenophore. On the basis of the information published by Bourdot and Galzin (1914, 1927) regarding locality, substrate, date of collection and macro- and microscopic characteristics, Bourdot No. 7501 (Galzin No. 7083) is selected as lectotype.

The five specimens sent from PC have also been compared to the collection (PR 490967, coll. V. Lindtner, Flora Macedonica) cited by Pilát when he proposed the

new genus *Lindtneria* Pilát (1938) to encompass *Poria trachyspora* [or *L. trachyspora* (Bourd. et Galz.) Pilát]. The Lindtner collection represents the concept of *Poria trachyspora* as embodied in the lectotype specimen designated here.

Based on studies of the above specimens, a somewhat revised description of *Lindtneria trachyspora* is provided. Also, descriptions are given for *L. rugospora* and *L. thujatsugina*.

Descriptions of Species

Lindtneria trachyspora (Bourd. et Galz.) Pilát, Stud. Bot. Chech. 1: 72 1938

Figs. 1-5

≡ *Sistotrema sulphureum* 'ut "2°" without explicit rank' *retigera* Bourd. et Galz., Bull. Soc. Mycol. France 30: 274. 1914.

≡ *poria trachyspora* Bourd. et Galz., Hym. de France, p. 659. 1927 (1928).

≡ *Trechispora trachyspora* (Bourd. et Galz.) Bond. et Sing., Ann. Mycol. 39: 48. 1941.

Lectotype — France, l'Aveyron, Vabres; sur *Thymus*, debris, humus; legit Galzin, No. 7083, 9 X 1910 (Bourdot No. 7501) (PC).

Basidiocarps annual, effused, separable, fragile and crumbly, 2-3 cm across; hymenial surface composed of irregularly shaped shallow pores 1 mm deep and 1-1.5 mm across; hymenial surface forming a distinct separable pellicular layer, pale yellow to cream colored in immature areas, becoming yellowish orange to purplish ochraceous or dull clay brown when more mature; subiculum very thin, at first pale cream but eventually concolorous with the hymenial surface; margin arachnoid to farinaceous, pale cream, narrow; cordons evident at 10×

Hyphal system monomitic. Subicular hyphae 2.5-4.5(-6) μm diam., with some swollen unbranched hyphae up to 8 μm diam., usually constricted at septa, with large clamp connections infrequent, branching at right angles from roughly spherical to subspherical swellings 7-11 μm across (with up to as many as seven individual hyphae arising from such swellings); with hyphae next to the substratum pale brown, sparsely encrusted with a granular substance and noticeably thick-walled; cordons up to 25 μm diam., pale tan, branched, individual hyphae 2-4 μm diam., septate, large clamp connections infrequent and then ampullate at the septum, hyphae sometimes swollen to 10 μm , frequently with encrusting material on hyphal walls; tramal hyphae 2-3.5 μm diam., hyaline, thin-walled, septate with clamp connections infrequent, frequently and intricately branched; basidia 30-40(-50) \times 9-13 μm , 4(-5) sterigmate, with a median constriction, noticeably pluriguttulate, septate at the base, clamp connections not observed; basidiospores (7.5-)8.5-9.5(-10) \times (6.5-)7-8 μm excluding ornamentation, broadly ellipsoid to subglobose, aculei 1.5-2 μm long and frequently coalescing and forming continuous and irregular ridges, with the plage area encircled by a corona of which the hilar appendix is an integral part, cyanophilous but staining inconsistent and occurring in the spore wall and associated ornamentation, in unstained material clay-colored to very pale tan, frequently in aggregates of two or three spores; cystidia or cystidioles not seen.

For illustrations see Hansen (1960) and Eriksson and Ryvarden (1976).

Lindtneria thujatsugina M. Larsen, sp. nov.

Figs 6-13

Basidiocarp poro, ochraceo-incarnato vel salmaneo, byssoideo vel arachnoideo; hyphis septatis, fibulatis vel afibulatis; basidiis $40-50 \times 10-12(-14) \mu\text{m}$, constrictis mediis, guttulatis; basidiosporis globosis, aculeatis $6-7.5 \mu\text{m}$ diam. (aculeatis exclusis), collo circumnexo apiculum, pallidobrunneis.

Holotypus — U.S.A., Idaho, Priest River Experimental Forest, ad humo consociata *Thuja plicata* Donn. ex D. Don et *Tsuga heterophylla* (Raf.) Sarg., legit M.J. Larsen, 23 VII 1981, FP* 134615 (CFMR et isotypus in ARIZ.).

Basidiocarp annual, effused, growth indeterminate, separable, arachnoid by byssoid, 1-3 mm thick; hymenial surface with irregularly shaped pores up to 1.5 mm across, ochraceous orange, not pelliculose; margin arachnoid, concolorous with to paler than the hymenial surface; cordons evident at $10 \times$.

Hyphal system monomitic. Subicular hyphae $(2.5-)3-4.5 \mu\text{m}$ diam., hyaline to very pale tan, frequently branched at right angles at hyphal swellings that are $7-9 \mu\text{m}$ across, septate, with clamp connections at some septa, with hyphal apices often encapsulated in a substance that stains readily in phloxine and also is cyanophilous; cordons up to $20 \mu\text{m}$ diam., with a core hyphae up to $10 \mu\text{m}$ diam. and constricted to $6 \mu\text{m}$ at septa, other hyphae associated with core hypha $2.5-3.5 \mu\text{m}$ diam., septate, clamp connections absent; tramal hyphae $2.5-3.5 \mu\text{m}$ diam., frequently and intricately branched, hyaline; basidia $40-50 \times 10-12(-14) \mu\text{m}$ diam., broadly clavate and with a median constriction when mature, when immature globose to subglobose, noticeably multi-guttulate, with clamp connections usually present at basal septa, 4-sterigmate; basidiospores $6-7.5 \mu\text{m}$ diam. (excluding aculei, the maximum length of which are $2.5 \mu\text{m}$), globose, pale yellowish brown to tan, aculeate, with a proximal submedial skirt that encircles the spore, with the plage area encircled by a collar or corona of which the hilar appendix is an integral part, the extreme outer parts of the wall often cyanophilous; immature basidiospores frequently embedded in a cyanophilous matrix (which also stains readily in phloxine), often in aggregates of two to three spores; cystidia or cystidioles variable in length to $50 \mu\text{m}$, $3-5 \mu\text{m}$ diam., apices encapsulated in a cyanophilous matrix (which also stains readily in phloxine), with one or two septa along their length, clamp connections absent.

Holotype — U.S.A., Idaho, Priest River Experimental Forest (U.S.D.A. Forest Service), Benton Creek, growing in and on duff around a brown-rotted conifer stump under live standing *Thuja plicata* Donn. ex D. Don and *Tsuga heterophylla* (Raf.) Sarg.

Lindtneria rugospora (W.B. Cooke) M. Larsen, comb. nov.

Figs. 14-15

= *Serpula rugospora* W.B. Cooke, Mycologia 49: 214. 1957.

Holotype — U.S.A., Kentucky, Crittendon, on woody substrate, coll. C.G. Lloyd, VIII 1920 (Lloyd Herb. cat. no. 5804 in BPI).

Basidiocarp annual, effused in small patches, with shallow pores delimited by irregularly arranged folds and ridges, plicate, soft, fragile, and easily separable; hy-

*Designation for CFMR herbarium specimens and cultures.

menial surface pelliculose, pale cream with the apices of ridges and folds slightly orange; subiculum white; cordons visible at 10×.

Hyphal system monomitic. Subicular hyphae 3-4.5 μm diam., hyaline, clamp connections present, frequently branching at right angles, often swollen to 8 μm ; cordons up to 20 μm diam., with core hyphae often swollen to 8 μm diam.; basidia 28-35 \times 9-11 μm , with a median constriction, noticeably pluriguttulate, 4-sterigmate, clamp connections at the base; basidiospores 5.5-6(-6.5) \times 4-4.5(-5) μm , (excluding ornamentation, which may be up to 0.5 μm long), pale tan to clay brown, globose to subglobose to broadly ellipsoid, aculeolate or with confluent ridges and reticulatae, hilar appendix associated with a barely distinguishable corona, with spore walls cyanophilous wholly, in part, or not at all (staining appears to be associated with a substance on the outer surface of the wall); cystidia or cystidioles not seen.

Notes on Other *Lindtneria* Species

Poria baboquivariensis Gilbn. in Gilbn., Burds., et Canf., Mycotaxon 3: 538. 1976.

Holotype — USA, Arizona, Pima County, Papago Indian Reservation, on velvet mesquite (*Prosopis juliflora* (Sw.) DC.), R.L. Gilbertson No. 10503, 30 XI 1971 (CFMR).

Poria baboquivariensis is a typical member of *Lindtneria* in terms of hyphal structure and basidial morphology. It is closely related to *L. rugospora*. However, the spores of the latter tend to be more ellipsoid, while those of *P. baboquivariensis* are more subglobose. Basidiospore size is approximately the same. Gilbertson and Ryvarden (1985) have recently placed this species in *Lindtneria*.

Lindtneria flava Parm., Akad. Nauk Est. SSR. Izv. Biol. 17: 408. 1969.

Holotype — R.P.S.S., Bielorusia, Brest region, on *Alnus* Sp., E. Parmasto, 26 VIII 1966 (TAA 19 187).

The type of *L. flava* has not been available for examination. However, Parmasto's (1969) description leaves little doubt as to the generic affinity of his species. The broadly ellipsoid to frequently subcitriform, basidiospores (6-9 \times 5-6 μm) with aculei up to 1.5 μm long suggests a close relationship to *L. rugospora*. The structure of the plage area and hilar appendix cannot be determined from Parmasto's published data.

Lindtneria leucobryophila (P. Henn.) Jülich, Persoonia 9: 418. 1977.

= *Thelephora leucobryophila* P. Henn., Verh. Bot. Ver. Prov. Brandenb. 39: 96. 1898.

Isolectotype — Germany, Berlin Botanical Gardens, on organic material, P. Hennings No. 4709, VI 1897 (PC).

The characters of this species that deviate from others in the genus are the corticioid

fruiting bodies and broadly fusiform-ellipsoid basidiospores. However, the cruciate-branching of hyphae and associated hyphal swellings, the nature of the plage area and hilar appendix of basidiospores (very similar to *L. rugospora*), large pluriguttulate basidia, and cyanophilic reaction of spores and basidia indicate *Lindtneria* as the most appropriate genus at present. This species is the only member of *Lindtneria* with a corticioid hymenophore.

Lindtneria pellicularis Jülich, Persoonia 9: 463. 1978.

Holotype — Australia, Victoria, Mt. Bride, on *Eucalyptus* sp., R.A. Maas Geesteranus No. 1551, 3 XI 1977 (L).

Lindtneria pellicularis does not appear to be related generically to other members of the genus, especially *L. trachyspora*. *Lindtneria pellicularis* does not possess hyphal branching characteristic of *Lindtneria*. Hyphal swellings and corona associated with the hilar appendix of basidiospores are also absent. Its position is nearer the corticioid genus *Tomentellopsis* Hjört.

Lindtneria pterospora Reid, Kew Bull. 30: 597. 1975

Figs. 16-19

Holotype — Ghana, mile 9 on Cape Coast to Jukwa Road, on fallen twig beneath *Elaeis guineensis* on wet sandy soil bordering a marsh, coll. A.C. Rose 18 V 1973 (K).

Lindtneria pterospora is an additional species whose basidiospores are characterized, in part, by the presence of a circumferential skirt and plage area encircled by a corona of which the hilar appendix is an integral part. It is decidedly similar to *L. thujatsugina*, but the basidiospores of the former are larger [7.5-8.5(-9) μ m] and yellowish buff basidiocarps are pelliculose and fragile, and fragment easily. Reid's (1975) interpretation of basidiospore morphology was correct when he stated "in most spores at least one [crest-MJL].....traverse[s] the visible hemisphere." However, he made no mention of the nature of the apiculum and associated corona.

Discussion

From the present study, it is apparent that the nature of the hilar region is fundamental to the concept of *Lindtneria*. The collar or "corona" (Hansen 1960, referring to *L. trachyspora*) is of structural significance and intimately associated with the hilar appendix. In her illustrations of basidiospores, Hansen (1960) depicts only one spore in which the hilar appendix is an integral part of the corona. Similarly, Oberwinkler and Horak (1979, figs. 2a, b, and d) have accurately detailed, through scanning electron microscopy, the nature of the plage area and the relationship between the corona and hilar appendix of the *Lindtneria* spore. However, their hand illustrations suggest that they have some doubts about the structural continuity between the corona and the hilar appendix, because some of their spore illustrations

show no continuity. Their (Oberwinkler and Horak 1979) proposal of the family Stephanosporaceae for two genera (*Lindtneria* and *Stephanospora*) is questionable for there are notable differences. The *Lindtneria* spore is born asymmetrically and that of *Stephanospora* symmetrically. In addition, the fusion of the hilar appendix with the hilar corona in *Lindtneria* versus the lack of fusion in *Stephanospora* is noteworthy.

Within the genus, as presently conceived, two subgeneric groupings may be recognized. The first is exemplified by *L. thujatsugina* and *L. pterospora*, and the second by *L. trachyspora*, *L. rugospora*, *L. baboquivariensis* and *L. leucobryophila*. *Lindtneriaflava* would probably belong to the latter group. The primary distinction between the two groups is the presence, in the *L. trachyspora* group, of the circumferential skirt around the basidiospore, well developed aculei, and a well developed corona that is fused with the hilar appendix. The remaining species lack this peculiar morphology.

Key to Species of *Lindtneria*

1. Basidiocarps corticioid. *L. leucobryophila*
1. Basidiocarps poroid. 2
 2. Basidiospores with an encircling submedial proximal skirt. 3
 2. Basidiospores not as above. 4
3. Basidiospores 6-7.5 μm diam.; basidiocarp ochraceous orange, not pelliculose. *L. Thujatsugina*
3. Basidiospores 7.5-8.5(-9) μm diam.; basidiocarp yellowish buff, pelliculose and readily fragmenting. *L. pterospora*
 4. Spore body ellipsoid to subcitriform; 6-9 \times 5-6 μm *L. flava*
 4. Spore body broadly ellipsoid to subglobose. 5
5. Spores (7.5-)8.5-9.5(-10) \times (6.5-)7-8 μm *L. trachyspora*
5. Spores 5-6.5 \times 4-5 μm
 6. Spores 5-6 \times 4-5 μm , mostly subglobose; on mesquite in Arizona. *L. baboquivariensis*
 6. Spores 5.5(-6.5) \times 4-4.5(-5) μm , mostly ellipsoid; on hardwood in Kentucky. *L. rugospora*

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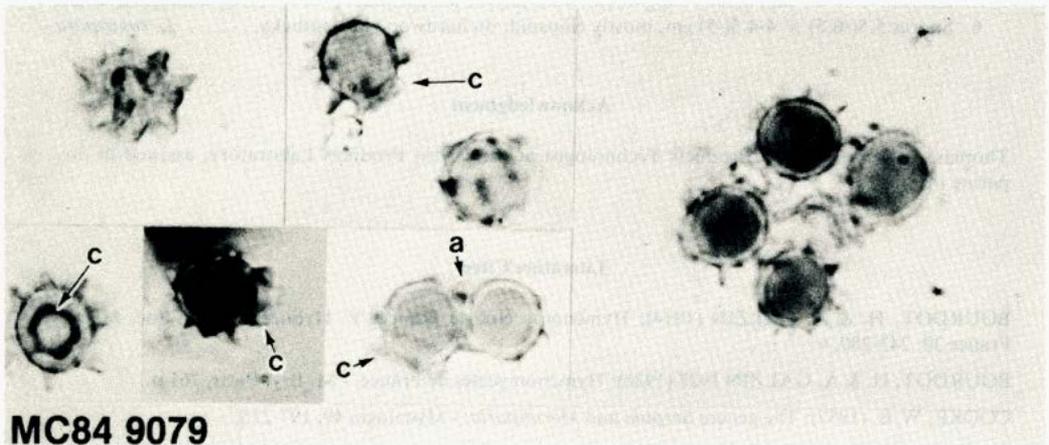
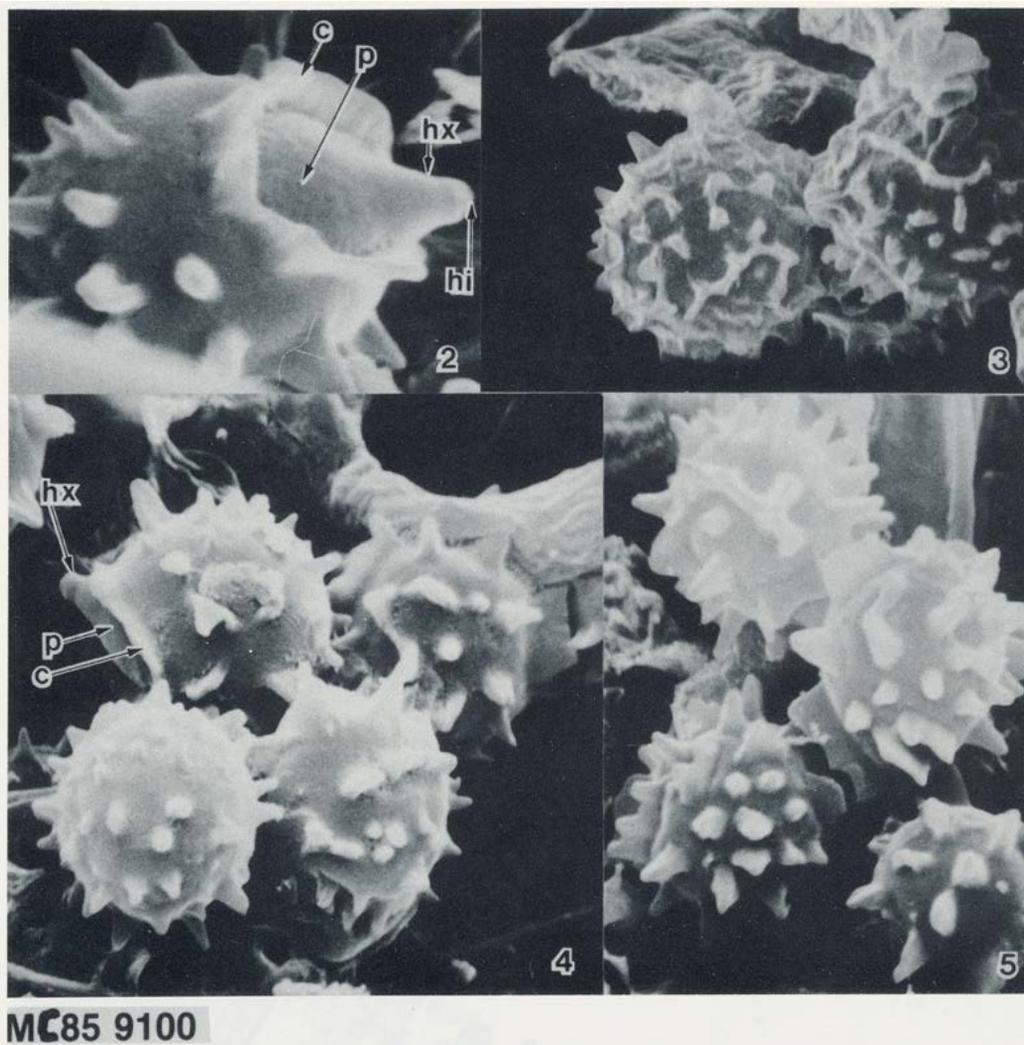
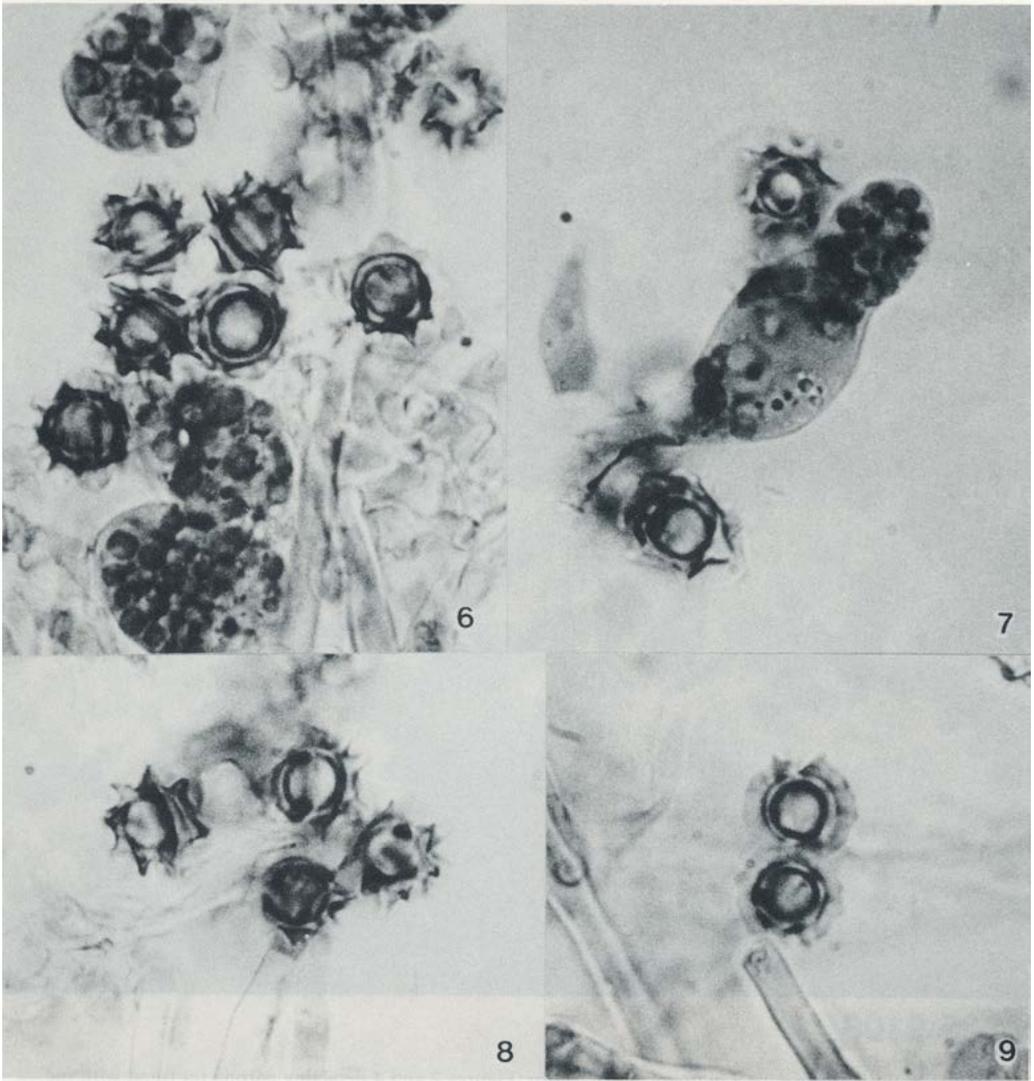


Fig. 1: Basidiospores of *Lindtmeria trachyspora* with marked variability in ornamentation, a two-spored aggregate (a), and corona (c). (From lectotype; brightfield; scale 3 mm = 2 μ m). (MC 84 9079).

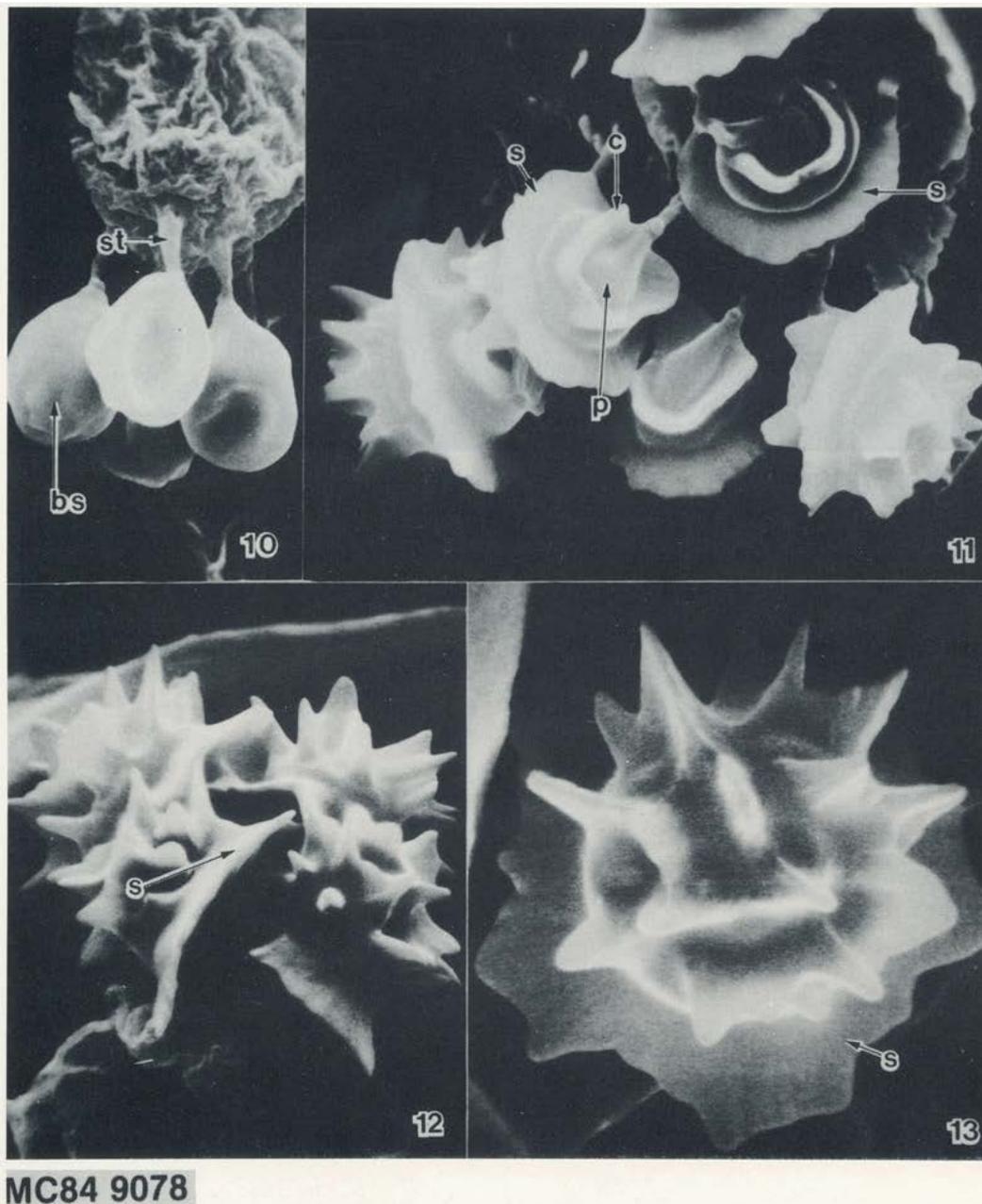


Figs. 2-5: Basidiospores of *Lindneria trachyspora*. Figures 2 and 4 depicting corona (c) fused with the hilar appendix (hx), hilum (hi), and plage (p) (SEM, $\times 10,000$ and 5000 , respectively). Figures 3 and 5 depicting variability in spore ornamentation (SEM, $\times 5000$). (From lectotype). (MC 85 9100).

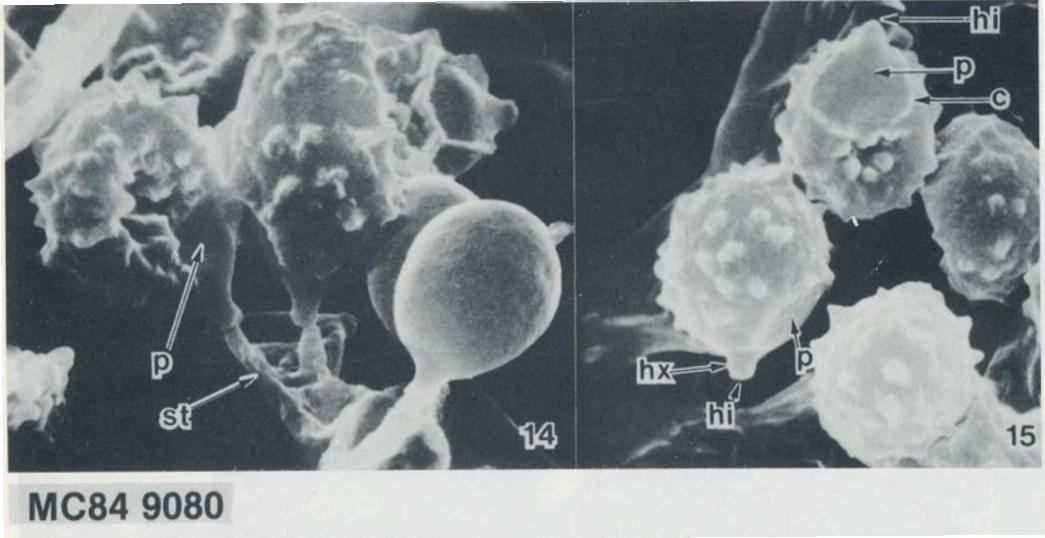


MC84 9081

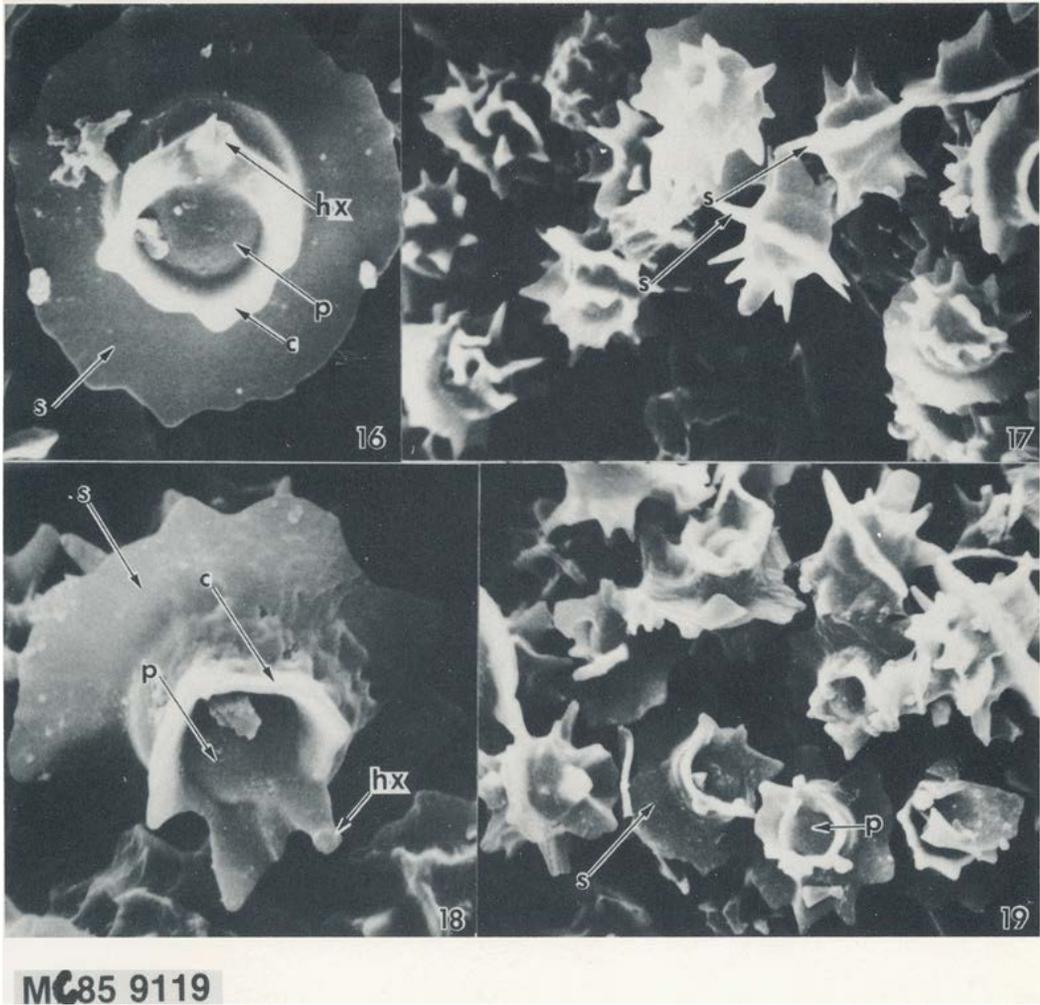
Figs. 6-9: *Lindineria thujatsugina*. Figs. 6, 8-9: Basidiospores with circumferential skirt and corona with Fig. 9 indicating that the skirt is formed early in the ontogeny of spore ornamentation (lack of noticeable aculei). Fig. 7: Elongating immature pluriguttulate basidium with median constriction. (From holotype; brightfield; scale 3 mm = 2 μ m). (MC 84 9081).



Figs. 10-13: *Lindtmeria thujatsugina*. Fig. 10: Immature basidiospores (bs) attached to sterigmata (st) (SEM, $\times 4600$). Fig. 11: Mature basidiospores showing characteristic circumferential skirt (s), corona (c), plage (p), and attachment to sterigmata (st) (SEM, $\times 4600$). Fig. 12: Basidiospore tetrad showing tilted orientation away from the central axis of the basidium (SEM, $\times 4600$). Fig. 13: Distal view of a single basidiospore depicting circumferential skirt and aculei (SEM, $\times 9000$). (From holotype). (MC 84 9078).



Figs. 14-15: Basidiospores of *Lindtneria rugospora* depicting plage (p), corona (c), attachment of hilum (hi) to sterigmata (st), and hilar appendix (hx). (From holotype; SEM, $\times 5000$).



Figs. 16-19: Basidiospores of *Lindtneria pterospora*. Figs. 16, 18: Depicting circumferential skirt(s), corona (c) fused with the hilar appendix (hx), and plage (p) (SEM, $\times 5000$). Figs. 17, 19: At lower magnification, further illustrating the nature of the circumferential skirt and plage area (SEM, $\times 2000$). (MC 859119).