

Corticoid Basidiomycetes. I. Morphology and ultrastructure

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The morphology of species of the genera *Basidioradulum* Nobles, *Hyphoderma* Wallr. em. Donk, *Hyphodontia* J. Erikss., *Hypochnicium* J. Erikss. and *Schizopora* Velen. is reinvestigated, described and illustrated. The ultrastructure of their septal pores is investigated for the first time. The generic relationships are discussed using the septal pore type as an objective characteristic. The following species are demonstrated to have dolipores with perforated parentheses: *Hyphoderma praetermissum*, *H. setigerum*, *Hypochnicium bombycinum* and *H. polonense*. Whereas the species *Basidioradulum radula*, *Hyphodontia alutaria*, *H. cineracea*, *H. floccosa*, *H. gossypina*, *H. pallidula*, *H. sambuci* and *Schizopora paradoxa* have dolipores with continuous parentheses.

Key words. *Basidioradulum*, Corticiaceae, doliporus, *Hyphoderma*, *Hyphodontia*, *Hypochnicium*, morphology, *Schizopora*, ultrastructure.

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INTRODUCTION

Families like Corticiaceae, Polyporaceae or Thelephoraceae have been based originally on macromorphological characteristics of basidiocarps. During the last decades extensive and unnatural genera like *Corticium* Pers., *Peniophora* Cooke or *Odontia* Fr. were divided and emended more and more by using differentiating characteristics of basidia, spores and cystidia (e.g. Donk 1956a, 1956b, 1957, 1964). Eriksson (1958)

erected more natural genera such as *Hyphodontia* and *Hypochnicium*, documenting the basidiocarp micromorphology by detailed illustrations. Parmasto (1968) included *Basidioradulum* Nobles, *Hyphoderma* Wallr. em. Donk, *Hyphodontia* Erikss. and *Hypochnicium* Erikss. in the subfamily Hyphodermoideae. *Fibrodontia* Parm. and *Schizopora* Velen. were assigned to the Steccherinaceae, although Parmasto (1968) admitted a close relationship to *Hyphodontia* by their hyphal construction. Recently Hjortstam (1990) pro-

posed synonymy of *Fibrodontia* with *Hyphodontia* on the basis of cultural characteristics.

Ultrastructural research on septal pores in Homobasidiomycetes has shown two types of dolipores, the parentheses being perforated or continuous (Oberwinkler 1985). All hitherto investigated species of the Hymenochaetaceae Donk with corticioid, hydroid or polyporoid basidiocarps showed dolipores with continuous parentheses (Oberwinkler, 1985; Setliff et al. 1972; Moore, 1980). Only a few other species of corticioid Homobasidiomycetes have been investigated on their dolipore parentheses: *Botryobasidium subcoronatum* (v. Höhn. & Litsch.), parentheses continuous (Oberwinkler, 1985); *Clavulicium macounii* (Burt) Erikss. & Boid. ex Parm., parentheses continuous (Oberwinkler, 1985); *Paulliticium pearsonii* (Bourd. & Galz.) Erikss., parentheses continuous (Oberwinkler, 1985); *Scytinostroma duriusculum* (Berk. & Br.) Donk, parentheses perforated (Besson & Froment, 1968); *Trichaptum bifforme* (Fr. in Kl.) Ryv., parentheses continuous (Traquair & Mc Keen, 1978).

As extensive studies on dolipore types of Homobasidiomycetes still are lacking, it was not possible to reinterpret the taxonomy of Corticiaceae concerning this characteristic.

Species of the genera *Basidioradulum*, *Hyphoderma*, *Hyphodontia* and *Schizopora* are discussed to be related taxa (Eriksson 1958, Eriksson & Ryvarden 1976). Especially the delimitation of *Hyphoderma* and *Hyphodontia* was vehemently discussed by Eriksson & Ryvarden (1976) and Jülich (1974). The detection of additional characteristics for an objective delimitation of the above introduced genera is therefore desirable.

MATERIAL AND METHODS

Specimens were examined from fresh and herbarium material with a ZEISS Standard light mi-

croscope using phase optics. For analyzing hyphal texture Phloxin b was used as stain after application of potassium hydroxide (5 %).

For transmission electron microscopy samples were prefixed in 2 % glutaraldehyde in 0,1 M sodium cacodylate buffer (pH 7,2) during several days; following six transfers in 0,1 M sodium cacodylate buffer (pH 7,2); fixation with 1% OsO₄ in 0,1 M sodium cacodylate buffer (pH 7,2) for 2 hours in the dark; six transfers in distilled water 10 min. each; staining in 1% uranyl acetate solution for 1 hour in the dark; dehydration in 10%, 25%, 50%, 75%, 85%, 95% and 3 times in 100% acetone 10 min. each. The material was flat embedded in Spurr's plastic (Spurr 1969). Series of sections (75–100 nm) were cut on a Reichert ultramicrotome using a diamond knife. The sections were mounted on Formvar coated single slot copper grids and stained with lead citrate (Reynolds, 1963). The ultrathin sections were examined with a Zeiss EM 109 electron microscope at 80 kV.

Abbreviations: FO = Herbarium F. Oberwinkler. GEL = Herbarium G. & E. Langer. G-B = Herbarium Grosse-Brauckmann.

Basidioradulum radula (Fr.) Nobles, typus generis, Mycologia 59, p. 192, 1967.

BASIONYM: *Hydnum radula* Fr., Syst. Mycol. 1, p. 422, 1821.

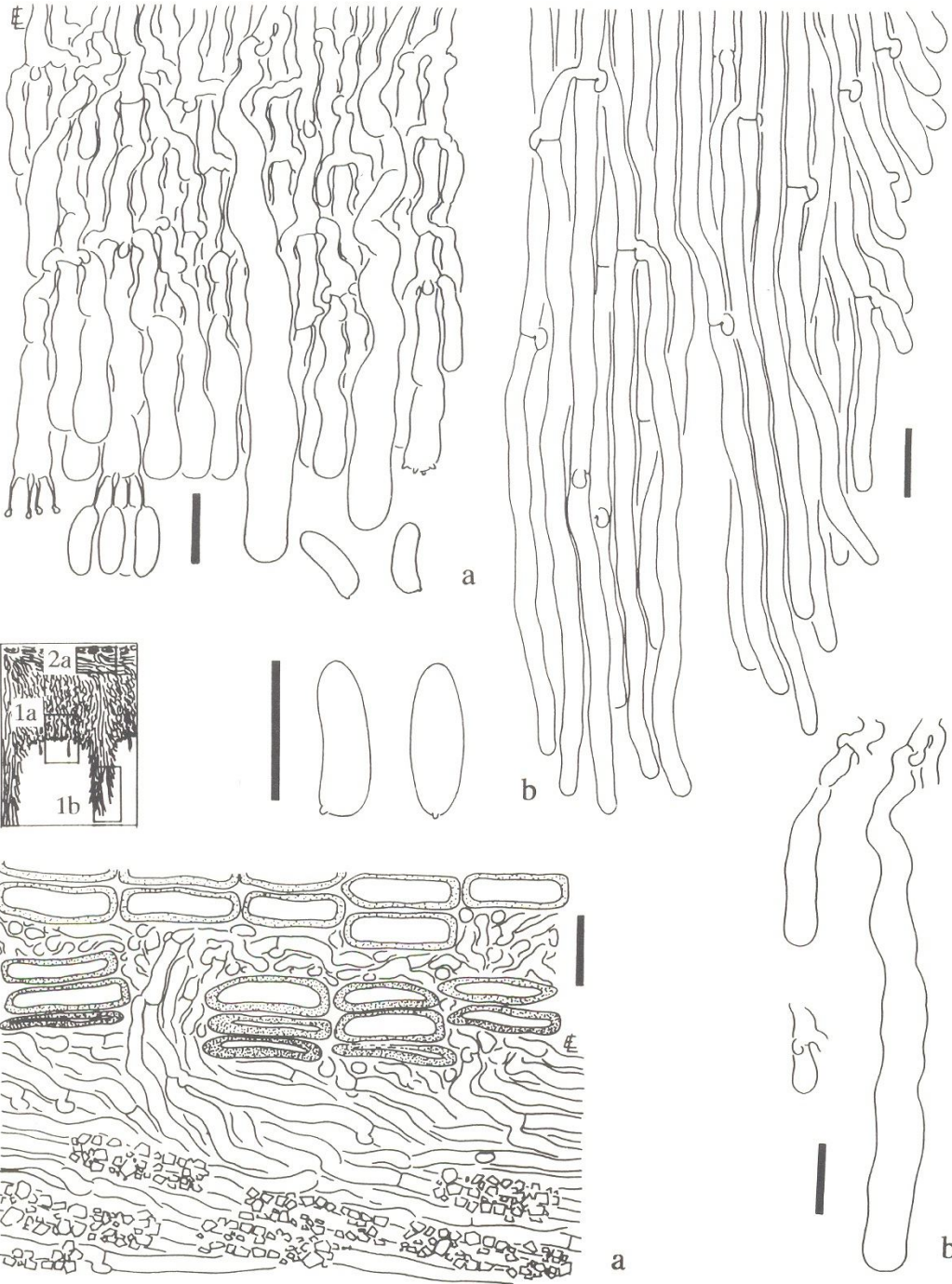
SYNONYMS: *Hyphoderma radula* (Fr.) Donk, Fungus 27, p. 15, 1957; further synonyms in Nobles (1967).

SUBSTRATE SPECTRUM: Europe: deciduous trees (Eriksson & Ryvarden 1975). Norway: *Salix* sp. (Ryvarden 1971). *Alnus* sp., *Salix* sp. (Strid 1975). Germany: *Fagus sylvatica*, *Prunus avium*, *Abies alba* (Langer). USA: *Abies balsamea*, *Betula* sp. (Nobles 1968). Japan: *Quercus* sp., angiosperm wood (Furukawa 1974).

Macromorphology: Basidiocarps resupinate, odontoid, colour distinct ochraceous to yellow, margin white. Aculei up to 0,5 cm long, with white

Fig. 1. *Basidioradulum radula*; vertical sections a) hymenium and subhymenium b) aculeal tip, bars = 10 µm.

Fig. 2. *Basidioradulum radula*; a) vertical section through substrate hyphae, b) ontogeny of a cystidium, bars = 10 µm.



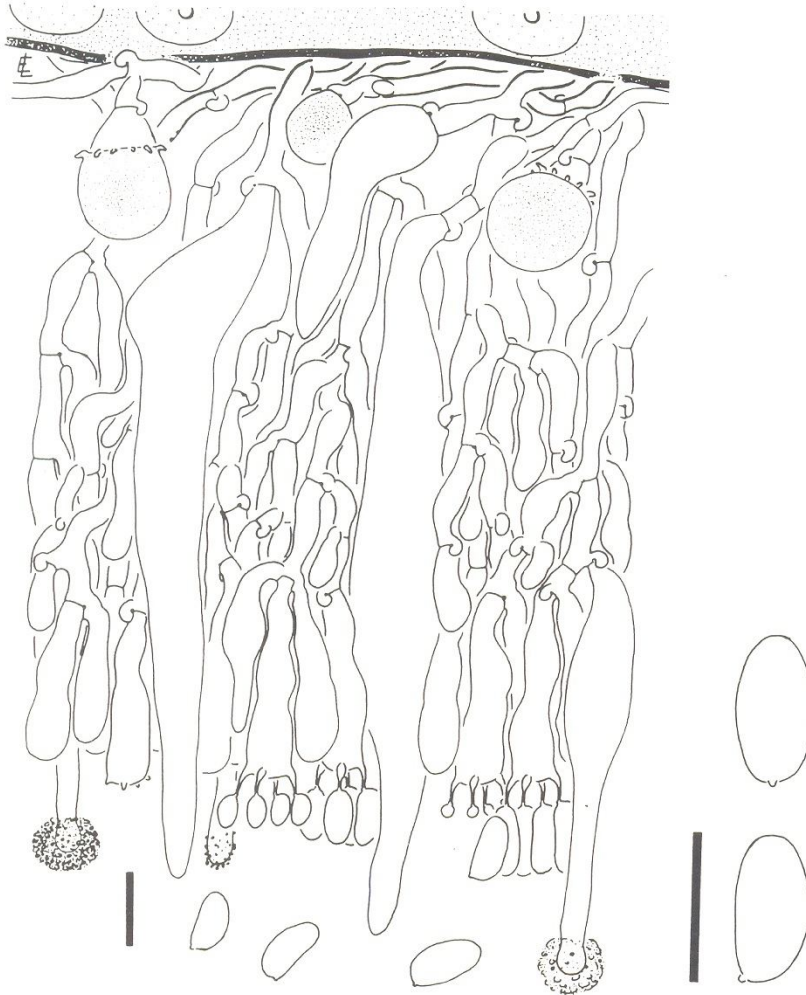


Fig. 3. *Hyphoderma praetermissum*; vertical section through whole basidiocarp, bars = 10 μm .

tip each, geotropic, concentrically arranged in young stages, confluent when older and then forming large fructifications of several square decimeter.

Micromorphology and ultrastructure (figs. 1, 2, 18a): Spores allantoid, 9–11–(12) \times 3–3,5 μm ,

thin-walled and smooth, inamyloid. Basidia sub-urniform, 25–30 \times 5–6 μm , basally 3–4 μm in diameter, with a basal clamp each, sinuous and somewhat stalked. They mature synchronously. Cystidia 50–100 \times 5–8 μm , cylindrical, thin-walled, with several constrictions each and sinuous. Hyphal system monomitic. Hyphae 3–4 μm

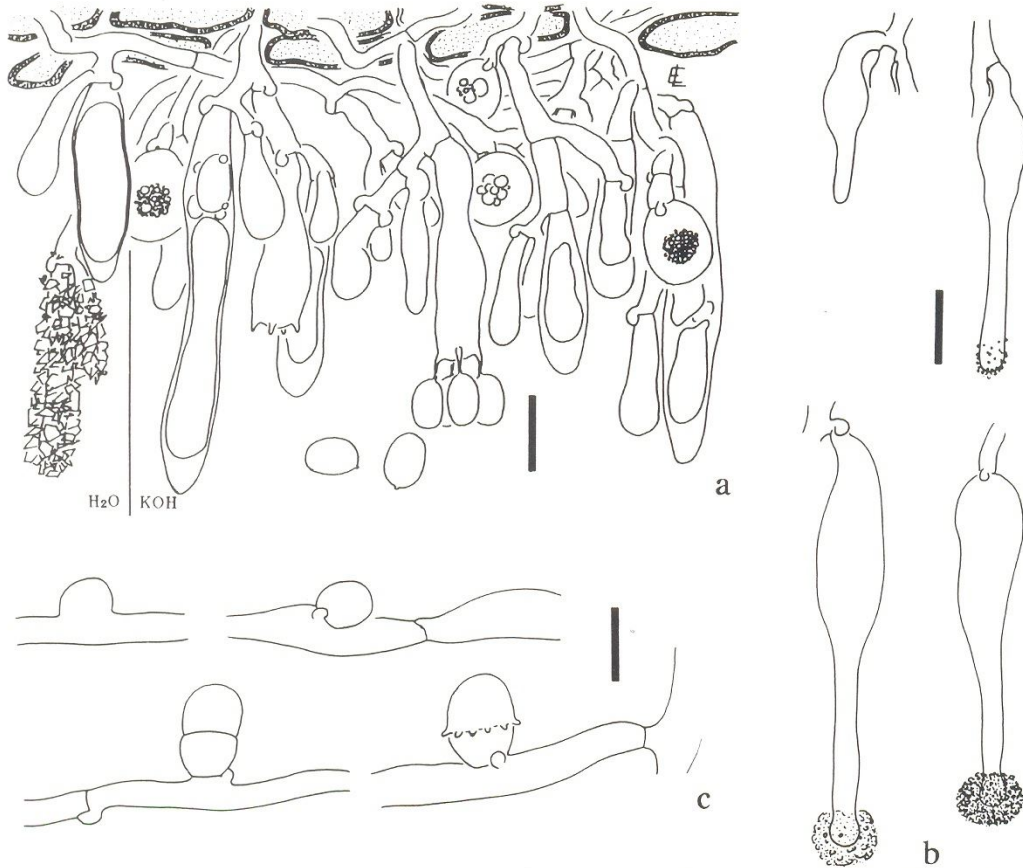


Fig. 4. *Hyphoderma praetermissum*; a) young basidiocarp, b) ontogeny of a capitate cystidium with exudate, c) ontogeny of a stephanocystidium, bars = 10 µm.

in diameter, septa with one clamp each, thin-walled, only basal hyphae slightly thick-walled. Hyphal construction dense, substrate hyphae parallel. Dolipore parentheses continuous, composed of several layers. The pore channel is often closed by electron dense areas.

Remarks: *B. radula* was separated from *Hyphoderma* by Nobles (1967). The characteristic habitus of the basidiocarp and the morphology of basidia and spores are used for delimitation. The dolipore with continuous parentheses is an additional delimiting characteristic against *Hyphoderma* (dolipores with perforated parentheses).

***Hyphoderma praetermissum* (Karst.) Erikss. & Strid, The Corticiaceae of North Europe, vol. 3, p. 505, 1975.**

BASIONYM: *Corticium praetermissum* Karst., Bidr. Känned. Finl. Nat. Folk 48, p. 423, 1889.

SYNONYMS: *Corticium tenue* Pat., Rev. mycol. 7, p. 152, 1885; *Hyphoderma tenue* (Pat.) Donk, Fungus 27, p. 15, 1957; further synonyms in Rogers & Jackson (1943).

SUBSTRATE SPECTRUM: Europe: angiosperm and coniferous wood (Eriksson & Ryvarden 1975). Norway: *Alnus sp.*, *Picea sp.* (Strid 1975). *Picea sp.*, *Pinus sp.* (Aandstad & Ryvarden 1987). Germany: *Acer pseudoplatanus*, *Aesculus hippocastanum*, *Betula pendula*, *Corylus sp.*, *Crataegus monogyna*, *Fagus sylvatica*, *Fraxinus sp.*, *Populus sp.*, *Quer-*

cus sp., *Salix sp.*, *Ulmus sp.* (Grosse-Brauckmann 1983). Spain: *Alnus glutinosa*, *Betula sp.*, *Castanea sativa*, *Corylus avellana*, *Cytisus sp.*, *Fagus sylvatica*, *Ilex aquifolium*, *Picea abies*, *Pinus radiata*, *Pinus sylvestris*, *Populus*, *Quercus ilex*, *Quercus petraea*, *Quercus pyrenaica*, *Quercus robur* (Dueñas & Tellería 1988). Morocco: *Cedrus atlantica*, *Ilex aquifolium*, *Quercus ilex* (Tellería 1984). Israel: *Pinus sp.* (Binyamini 1982). North Western Himalayas: *Cedrus deodara*, coniferous wood, angiosperm wood (Rattan 1977). USA, Gulf-Coast: *Juniperus virginiana* (Gilbertson & Blackwell 1985). USA, Colorado: *Alnus tenuifolia*, *Picea engelmannii*, *Pinus ponderosa*, *Picea pungens*, *Populus tremuloides*, *Quercus gambelii* (Lindsey 1988).

Macromorphology: Basidiocarps resupinate, hymenium smooth, margin indistinct, colour in young ontogenetic stages white, creme when old, thickness varying from ca. 50 to 200 µm. Under hand lens granulate to chalky by exudation of crystals.

Micromorphology and ultrastructure (fig. 3, 4, 18b): Spores ellipsoid, thin-walled, 7–10 × 4–5 µm, inamyloid. Basidia young clavate, suburniform when mature, 25–28 × 6–7 µm, with a basal clamp each. There are three types of cystidia: 1.) capitate, basally 7–9 µm in diameter, with apical exudation of resinous matter or crystals. 2.) spindle like cystidia, 50–100 × 7–13 µm, with a strong refracting content, no reaction with sulfovanillin. 3.) stephanocystidia, 12–14 µm in diameter, content of the end cell coarsely granuloid when young, fine granuloid when old. Their ontogeny starts with a subseptal outgrowth. Then a primary clamped septum separates a spherical cell from the mother hypha. This cell is divided by another septum without clamp. In the end a corona of small denticles is build from the terminal cell. Hyphal system monomitic. Hyphae thin-walled, basally 2,5–3 µm in diameter, subhymenial hyphae 3–4 µm in diameter, septa with one clamp each. Dolipore parentheses perforated. The pore channel is often closed by electron dense areas. The terminal cell of the stephanocystidium also shows a dolipore with perforated parentheses (Hallenberg 1990).

Remarks: *H. praetermissum* shows a striking variability in the thickness of the basidiocarp. The stephanocystidia are not found frequently in dif-

ferent specimens. *H. praetermissum* represents a species complex. This was already proved by Boidin (1950), who detected incompatible groups. Recently the ultrastructure of the stephanocystidia was investigated by Hallenberg (1990).

Hyphoderma setigerum (Fr.) Donk, typus generis, *Fungus* 27, p. 15, 1957.

BASIONYM: *Thelephora setigera* Fr., *Elench. fung.* 1, p. 208, 1828.

SYNONYMS: *Peniophora setigera* (Fr.) v. Höhn. & Litsch., *Ann. Mycol.* 4, p. 289, 1906. Further synonyms in Rogers & Jackson (1943).

SUBSTRATE SPECTRUM: Europe: angiosperm- and coniferous wood (Eriksson & Ryvarden 1975). *Quercus petraea*, *Quercus robur* (Boddy & Rayner 1981). Norway: *Alnus sp.*, *Populus sp.* (Ryvarden 1971). *Alnus sp.*, *Salix sp.* (Strid 1975). Denmark: angiosperm and coniferous wood (Christiansen 1960). Germany: *Alnus glutinosa*, *Ulmus sp.* (Grosse-Brauckmann 1982). *Betula pubescens* (Langer). Spain: *Alnus glutinosa*, *Betula sp.*, *Castanea sativa*, *Corylus avellana*, *Fagus sylvatica*, *Pinus radiata*, *Prunus sp.*, *Quercus petraea*, *Quercus robur* (Dueñas & Tellería 1988). Morocco: *Ilex aquifolium* (Tellería 1984). Israel: *Callitriche verrucosa* (Binyamini 1982. OBS! must be *Callitriche verrucosa*, a conifer species). North Western Himalayas: angiosperm wood, *Cedrus deodara* (Rattan 1977). Japan: angiosperm wood, *Quercus sp.* (Furukawa 1974). Taiwan: *Dendrocalamus giganteus*, *Pinus taiwanensis* (Langer). USA, Colorado: *Quercus gambelii* (Lindsey 1988).

Macromorphology: Basidiocarps resupinate, smooth to slightly tuberculate, white in young stages, creme to brown when old, 100 to 2000 µm thick, margin indistinct. Projecting cystidia can be seen with a hand lens.

Micromorphology and ultrastructure (fig. 5, 18c): Spores ellipsoid to suballantoid, 8–9 × 4–4,5 µm, thin-walled, inamyloid. Basidia clavate, 28–35 × 6–6,5 µm, with a basal clamp and sometimes with a slight constriction each. Mature basidia forming secondary septa at their bases. Septocystidia up to 180 µm long, 7–8 µm in diameter, thick-walled except in the apical part, heavily incrustated with crystals. Hyphal system monomitic. Hyphae 3–4 µm in diameter, basal hyphae thick-walled, subhymenial hyphae thin-walled, septa with one



Fig. 5. *Hyphoderma setigerum*; a) vertical section through hymenium and subhymenium, bars = 10 μ m.

clamp each. Dolipore parentheses perforated. The pore channel is closed by electron dense areas.

Remarks: *H. setigerum*, the generic type, was discussed to represent a species complex (Eriksson & Ryvarden 1975, Gilbertson & Blackwell 1988), although this was not proved by compatibility tests. There is a striking variability in the shape of

the septocystidia. *H. nudicephalum* Gilb. & Blackw. is a very closely related species, bearing septocystidia and aseptate cystidia.

Hyphodontia alutaria (Burt) Erikss., Symb. Bot. Ups. 16(1), p. 104, 1958.

BASIONYM: *Peniophora alutaria* Burt, Ann. Miss. Bot. Gard. 12, p. 332, 1925.

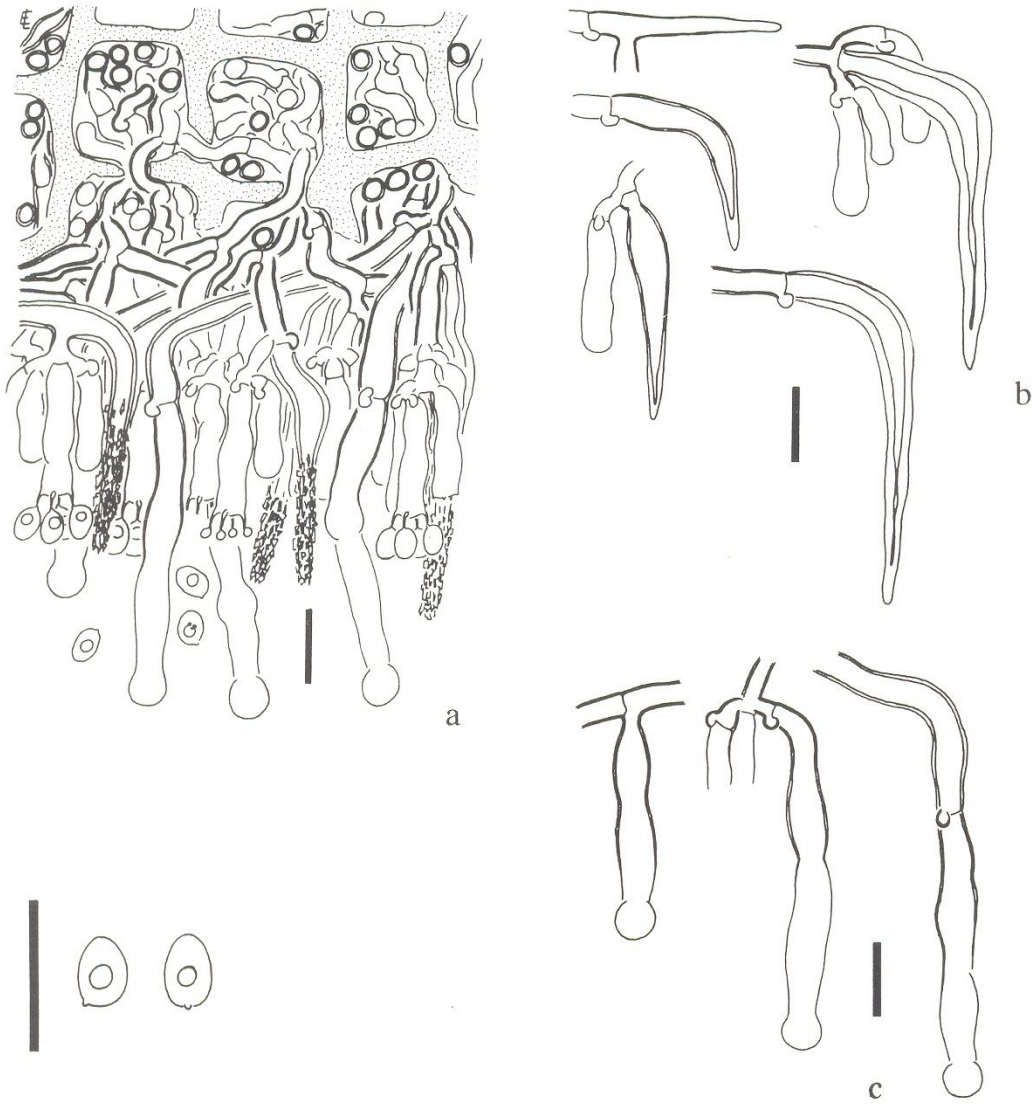


Fig. 6. *Hyphodontia alutaria*; a) vertical section through whole basidiocarp, b) ontogeny of a lagenocystidium, c) ontogeny of a capitulate cystidium, bars = 10 μm .

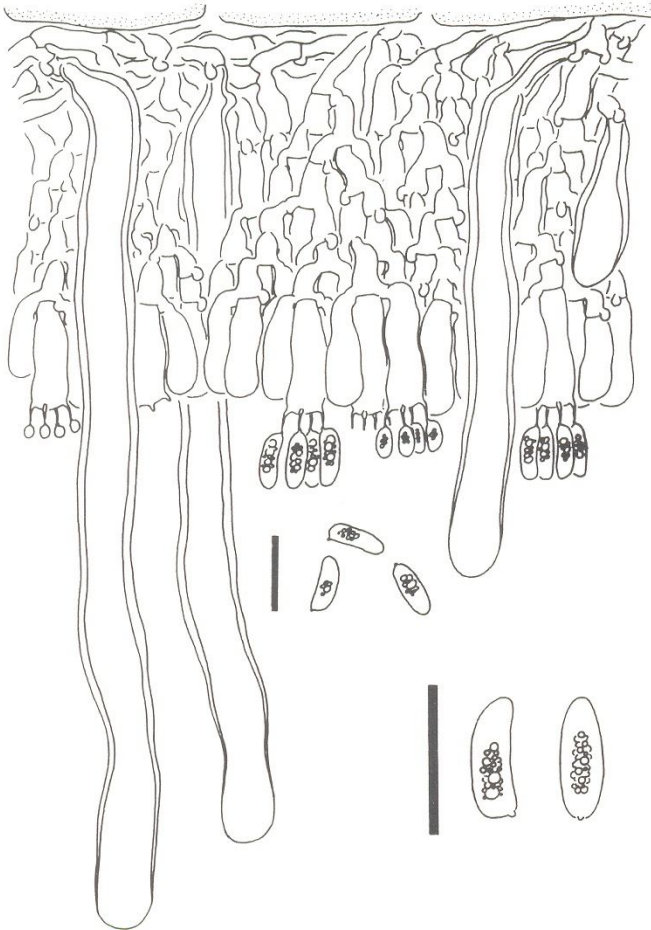


Fig. 7. *Hyphodontia cineracea*; a) vertical section through basidiocarp, bars = 10 μm .

SUBSTRATE SPECTRUM: Europe: *Juniperus sp.*, *Picea sp.*, *Pinus sp.* (Eriksson & Ryvarden 1976). *Fraxinus sp.* (Dennis 1981). Norway: *Alnus sp.* (Strid 1975). Denmark: *Picea sp.*, *Pinus sp.* (Christiansen 1960). Germany: *Picea abies*, *Pinus mugo* (Langer), *Alnus sp.*, *Picea sp.*, *Pinus sp.* (Doll 1979). Morocco: *Betula fontquerii* (Tellería 1984). North Africa: *Abies pinsapo*, *Cedrus atlantica*, *Quercus mirbeckii* (Tellería 1984, 1987). North Spain: *Fagus sylvatica*, *Pinus sylvestris*, *Quercus robur* (Dueñas & Tellería 1988). Western Himalayas: *Cedrus deodara*, coniferous wood. Japan, Hokkaido: *Picea jezoensis* (Hayashi 1974). USA, Arizona: *Pinus ponderosa* (Gilbertson & Budington 1970). USA, Colorado: *Pinus engelmannii* (Lindsey 1988).

Macromorphology: Basidiocarps resupinate, smooth, white to greyish or yellowish, not more than 100 μm thick, up to several square decimeter large. Projecting cystidia are visible with a hand lens.

Micromorphology and ultrastructure (fig. 6, 19a): Spores ellipsoid to ovoid, 4,5–5 \times 3–3,5 μm , thin-walled, smooth, inamyloid, with a single drop each. Basidia suburniform, 15–18 \times 4–5 μm , with a basal clamp each. Cystidia of two types: 1.) capitate cystidia, 5–6 μm in diameter, arising from

basal parts, sometimes with one septum each, basally thick-walled, apically thin-walled. 2.) lagenocystidia, $30\text{--}45 \times 4\text{--}5 \mu\text{m}$, apically incrustated with crystalline matter, basally thick-walled (up to $2 \mu\text{m}$). Hyphal system monomitic. Subicular hyphae thick-walled, $2\text{--}3 \mu\text{m}$ in diameter, subhymenial hyphae thin-walled, $2\text{--}3 \mu\text{m}$ in diameter, septa with one clamp each. Dolipore parentheses continuous, composed of several layers of electron dense material. The pore channel is closed by electron dense material.

Remarks: Lagenocystidia are found in four species in *Hyphodontia*: *H. alutaria*, *H. arguta*, *H. pallidula* and *H. propinqua*. The delimitation on species level is difficult because of frequency and variability of septo- and lagenocystidia. Rogers & Jackson (1943) proposed synonymy of *H. alutaria* and *H. pallidula*. Nevertheless clear delimitation was shown by Hassan & David (1983) and Hallenberg (1984) by compatibility tests.

Hyphodontia cineracea (Bourd. & Galz.) Erikss. & Hjortst., *Corticac.* North Europe 4, p. 629, 1976.

BASIONYM: *Peniophora glebulosa* Bres. *ssp. cineracea* Bourd. & Galz., *Bull. Soc. Myc. Fr.* 28, p. 387, 1912.

SUBSTRATE SPECTRUM: Europe: *Juniperus sp.*, *Picea sp.*, *Pinus sp.* (Eriksson & Ryvarden 1976). Germany: *Picea abies* (Langer).

Macromorphology: Basidiocarps resupinate, smooth, pilose from projecting cystidia, white to greyish or creamish, only up to $50 \mu\text{m}$ thick, up to several square decimeter large.

Micromorphology and ultrastructure (fig. 7, 19b): Spores allantoid, $7\text{--}8 \times 2,5\text{--}3 \mu\text{m}$, thin-walled, inamyloid. Basidia clavate, $14\text{--}17 \times 4,5\text{--}5 \mu\text{m}$, with a slight constriction and a basal clamp each. Cystidia tubular, $100\text{--}150 \times 7\text{--}9 \mu\text{m}$, thick-walled ($1,5 \mu\text{m}$) except for the apical part, arising from basal hyphae. Hyphal system monomitic. Basal hyphae thin-walled, $2\text{--}3 \mu\text{m}$ in diameter, subhymenial hyphae $2,5\text{--}3,5 \mu\text{m}$ in diameter, thin-walled and very short-celled, septa with one clamp each. Dolipore parentheses continuous, composed of several electron dense layers. The pore channel is closed by electron dense areas.

Remarks: *H. cineracea* belongs to the *H. subalutacea* group, characterized by very long, tubular and thick-walled cystidia and narrow, allantoid spores. Species delimitation is difficult, except for *H. microspora*, when using micromorphology of spores and basidia. Incompatibility was proved for *H. floccosa* and *H. subalutacea* by Faisal (1981) and Hassan & David (1983).

Hyphodontia floccosa (Bourd. & Galz.) Erikss., *Symb. bot. Ups.* 16(1), p. 104, 1958.

BASIONYM: *Odontia alutacea* (Fr.) *ssp. floccosa* Bourd. & Galz., *Hym. de France*, p. 423, 1928.



Fig. 8. *Hyphodontia floccosa*; vertical sections through apical part of aculeus, bars = $10 \mu\text{m}$.

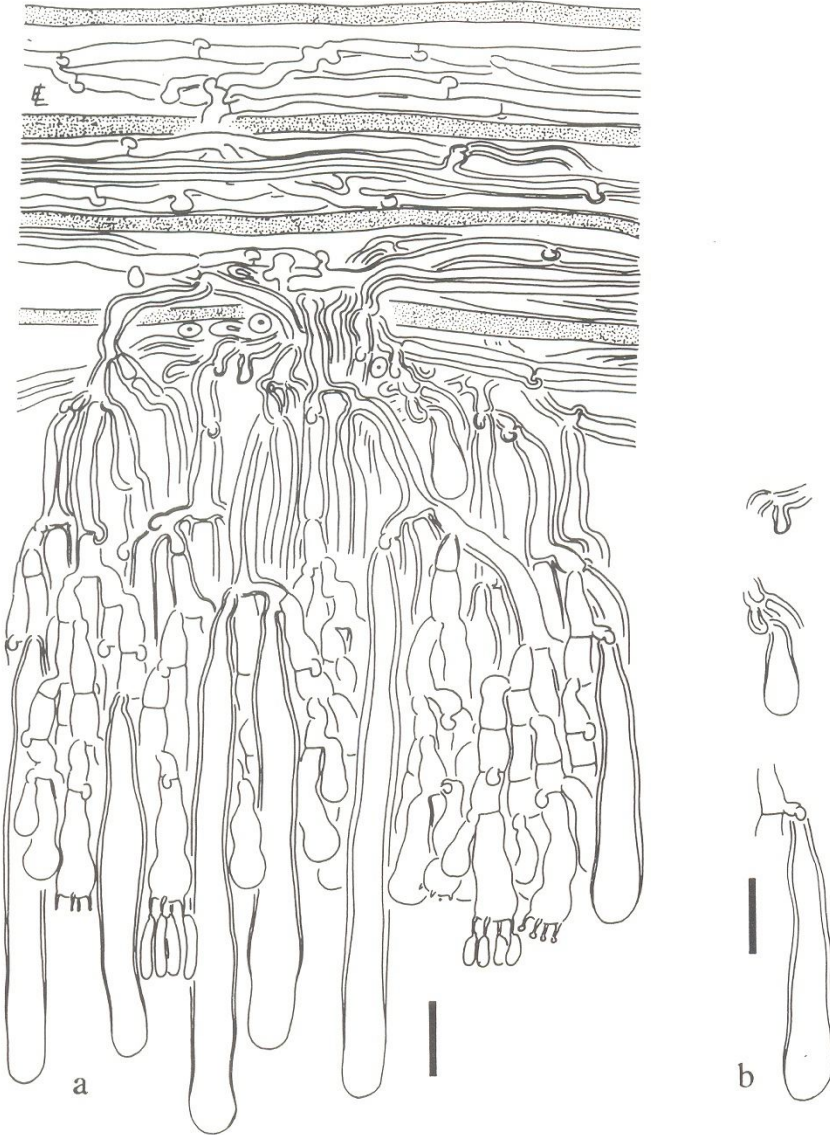


Fig. 9 *Hyphodontia floccosa*; a) vertical section through whole basidiocarp, b) ontogeny of a tubular cystidium, bars = 10 μm .

SYNONYM: *Odontia alutacea* (Fr.) ssp. *intermedia* Bourd. & Galz., Hym. de France, p. 423, 1928.

SUBSTRATE SPECTRUM: Europe: coniferous wood (Eriksson & Ryvarden 1976). Germany: *Pinus sylvestris* (Langer). North Spain: *Pinus radiata* (Dueñas & Tellería 1988). USA, Arizona: *Pinus ponderosa* (Gilbertson & Budington 1970). USA, Colorado: *Quercus gambelii* (Lindsey 1988).

Macromorphology: Basidiocarps resupinate, densely odontoid, creme to yellowish or ochraceous, up to 100 µm thick, margin distinct. Fructifications of 2 m length have been observed.

Micromorphology and ultrastructure (fig. 8, 9, 19c): Spores long allantoid, 7–9 × 1,5–2 µm, thin-walled, inamyloid. Basidia cylindrical to clavate, 15–20 × 4–6 µm, with indistinct constriction and a basal clamp each. Cystidia tubular, 50–100 × 4–6 µm, thick-walled except for the apical part, arising from the subhymenium or basal parts of the basidiocarp. There are transitions from cystidia projecting through the hymenium to hyphocystidia building up the aculei. Hyphal system monomitic. Basal hyphae thick-walled (0,5 µm), 2,5–4 µm in diameter, subhymenial hyphae thin-walled, 2–4 µm in diameter, septa with one clamp each. Dolipore parentheses continuous. The pore channel is closed by several electron dense areas.

Remarks: In contrary to other related species from the *H. subalutacea* group, *H. floccosa* is distinctly odontoid. Only a few collections on coniferous wood are known from Europe (Grosse-Brauckmann 1990, Eriksson & Ryvarden 1976, Dueñas & Tellería 1988).

Hyphodontia gossypina (Parm.) Hjortst., Mycotaxon 39, p. 416.

BASIONYM: *Fibrodontia gossypina* Parm., Conspectus system. Corticeacearum, p. 207., 1968.

SYNONYMS: *Hydnum stipatum* Fr., Syst. Myc., 1, p. 425, 1821. *Odontia stipata* (Fr.) Quélet, Fl. Myc. Fr., p. 435, 1888. Further synonyms in Furukawa (1974).

SUBSTRATE SPECTRUM: Europe: *Alnus sp.*, *Fagus sp.*, *Fraxinus sp.*, *Parrotia sp.*, *Populus sp.*, *Salix sp.*, *Ulmus sp.*, *Ulmus carpiniifolia* (Eriksson & Ryvarden 1975, Eriksson & Sundhede 1980). Germany: *Malus domestica*, *Populus sp.*,

Ulmus sp. (Grosse-Brauckmann 1982). Russia: *Fraxinus excelsior*, *Parrotia persica*, *Ulmus sp.* (Parmasto 1968).

Macromorphology: Description from herbarium material: Basidiocarps resupinate, odontoid, ochraceous, aculei dense, in groups, up to 300 µm long.

Micromorphology and ultrastructure (fig. 10, 20a): Spores ovoid, 3,5–4 × 2,5–3 µm, thin-walled, without drop (herbarium material), inamyloid. Basidia suburniform, 10–14 × 3,5–5 µm, with a basal clamp each. Cystidia none. Aculei build by thick-walled (up to 2 µm) hyphae (skeletal hyphae s. s. Parmasto 1968) with obtuse and thin-walled apices. Hyphal system dimitic (Parmasto 1968) or pseudodimitic (Eriksson & Ryvarden 1975). Basal hyphae slightly thick-walled, 2–3 µm in diameter, skeletal hyphae up to 5 µm in diameter, subhymenial hyphae thin-walled, 2–3 µm in diameter, septa with one clamp each. Dolipore parentheses continuous, composed of several electron dense layers.

Remarks: The genus *Fibrodontia* was erected by Parmasto (1968) for hyphodontioid species with skeletal hyphae imitating a dimitic hyphal system. Recently *Fibrodontia gossypina* was transferred to *Hyphodontia* by Hjortstam (1990) because of insufficient characteristics for generic delimitation.

Hyphodontia pallidula (Bres.) Erikss., typus generis, Symb. bot. Ups. 16(1), p. 104, 1958.

BASIONYM: *Gonatobotrys pallidula* Bres., Ann. Mycol. 1, p. 127, 1903.

SYNONYMS: *Gloeocystidium oleosum* v. Höhn. & Litsch., K. Akad. Wiss. Wien Math.-Nat. Kl. Sitzber. 116(1), p. 827, 1907. *Peniophora pallidula* (Bres.) Bres. apud Bourd. & Galz., Bull. Soc. Myc. Fr. 28, p. 390, 1913. Further synonyms in Rogers & Jackson (1943).

SUBSTRATE SPECTRUM: Europe: coniferous wood (Eriksson & Ryvarden 1976). Norway: *Alnus sp.*, *Picea sp.*, *Salix sp.* (Strid 1975). Denmark: *Picea sp.* (Christiansen 1960). Poland: *Betula sp.*, *Pinus sp.* (Hjortstam 1983). Germany: *Picea abies* (Grosse-Brauckmann 1982). *Alnus sp.*, *Betula sp.*, *Fagus sp.*, *Picea sp.*, *Pinus sp.* (Doll 1979). *Picea abies* (Langer). North Spain: *Pinus sylvestris* (Dueñas & Tellería 1988). Yugoslavia: *Picea sp.*, *Pinus strobus* (Tortic 1979). India: coniferous wood (Thind &

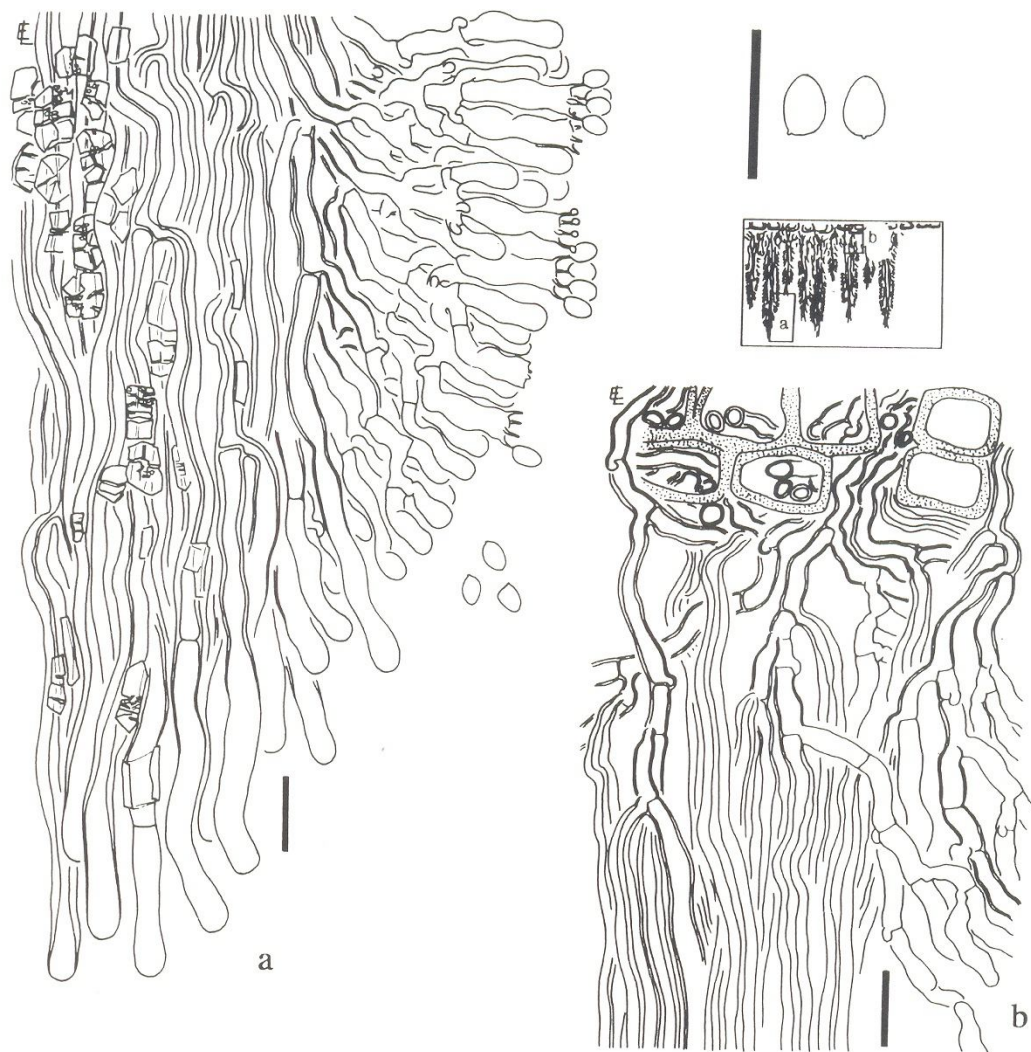


Fig. 10. *Hyphodontia gossypina*; vertical sections a) aculeal tip, b) basal hyphae under an aculeus, bars = 10 μ m.

Rattan 1976). USA, Colorado: *Picea engelmannii* (Lindsey 1988). Japan: *Pinus* sp. (Hayashi 1974).

Macromorphology: Basidiocarps resupinate, smooth to minute tuberculate, up to 250 μ m thick, margin distinct. With a hand lens pilose by projecting cystidia.

Micromorphology and ultrastructure (fig. 11, 19d): Spores ovoid, 3,5–4 \times 2,5–3 μ m, thin-walled, with a single drop each, inamyloid. Basidia suburniform, 12–15 \times 3–4 μ m, with a basal clamp each. Septocystidia, 80–300 \times 4–6 μ m, arising from the subhymenium, thick-walled, with a thin-walled clamp at each septum, apex enlarged, with resinous and refracting exudation. Rarely lagenocys-

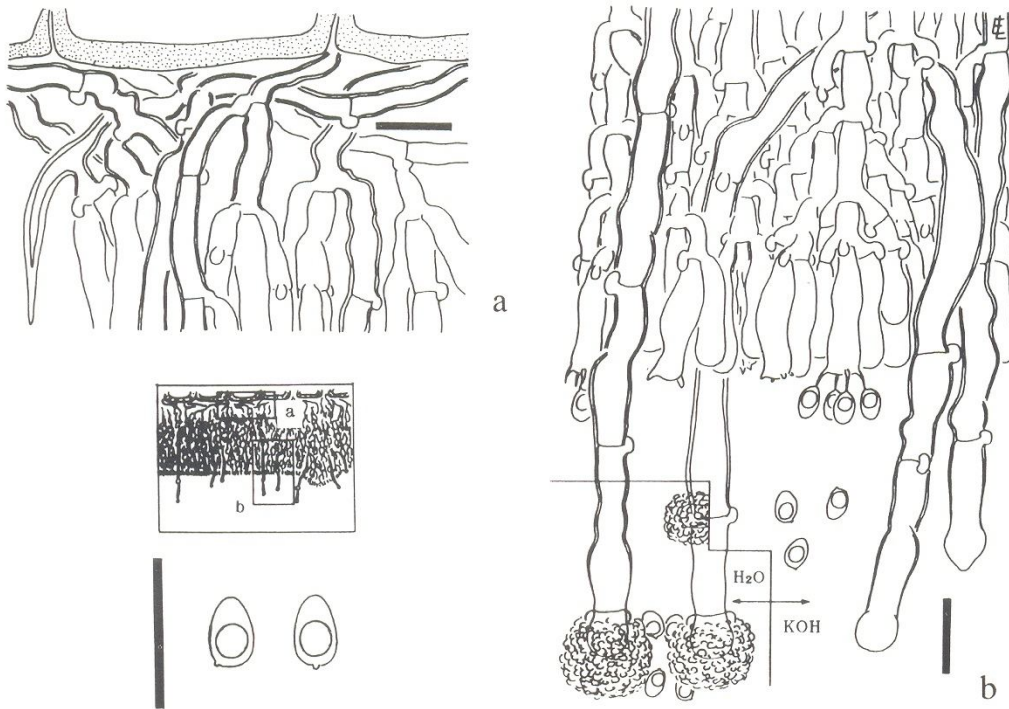


Fig. 11. *Hyphodontia pallidula*; vertical sections a) basal hyphae, b) hymenium and subhymenium, bars = 10 μ m.

tidia on basal hyphae. Hyphal system monomitic. Basal hyphae thick-walled, 2–3 μ m in diameter, subhymenial hyphae thin-walled, septa with one clamp each. Dolipore parentheses continuous, composed of several electron dense layers. Pore channel closed by electron dense areas.

Remarks. *H. pallidula* and *H. alutaria* were discussed to be synonyms by Rogers & Jackson (1943) and Jülich (1974). Nevertheless Hassan (1981), Hassan & David (1983) and Hallenberg (1988) have demonstrated incompatibility.

Hyphodontia sambuci (Pers.) Erikss., Symb. bot. Ups. 16(1), p.104, 1958.

BASIONYM: *Thelephora sambuci* Pers., Mycol. eur. I, p. 152, 1822.

SYNONYMS: *Lyomyces sambuci* (Pers.) Karst., Bidr. Känned. Finl. Nat. Folk 37, p. 153, 1882. *Peniophora thujae* Burt,

Ann. Miss. Bot. Gard. 12, p. 236, 1925. *Hyphoderma sambuci* (Pers.) Jülich, Persoonia 8, p. 80, 1974. Further synonyms in Rogers & Jackson (1943).

SUBSTRATE SPECTRUM: Europe: angiosperm wood, mainly *Sambucus nigra* (Eriksson & Ryvarden 1976). Denmark: *Sambucus nigra* (Christiansen 1960). Germany: *Sambucus sp.*, angiosperm wood (Doll 1979). *Acer pseudoplatanus*, *Aesculus hippocastanum*, *Clematis vitalba*, *Corylus sp.*, *Euonymus europaea*, *Fraxinus sp.*, *Populus sp.*, *Salix sp.*, *Sambucus nigra*, *Ulmus sp.* (Grosse-Brauckmann 1982). *Sambucus nigra*, *Sambucus racemosus* (Langer). France: *Sambucus nigra* (Lecot 1984). North Spain *Acer pseudoplatanus*, *Abnus glutinosa*, *Castanea sativa*, *Corylus avellana*, *Crataegus monogyna*, *Fraxinus excelsior*, *Pinus pinaster*, *Pinus radiata*, *Populus sp.*, *Populus alba*, *Pteridium aquilinum*, *Quercus pyrenaica*, *Quercus robur*, *Rubus sp.*, *Sambucus nigra* (Dueñas & Tellería 1988). North Africa: *Abies pinsapo*, *Ilex aquifolium* (Tellería 1984, 1987). Israel: *Pinus sp.* (Binyamini 1982). Iraq: *Phoenix dactylifera* (Rattan & Al-Dboon 1980). USA, Arizona: *Maclura pomifera* (Gilbertson & Budington 1970). *Prosopis juliflora* (Gil-

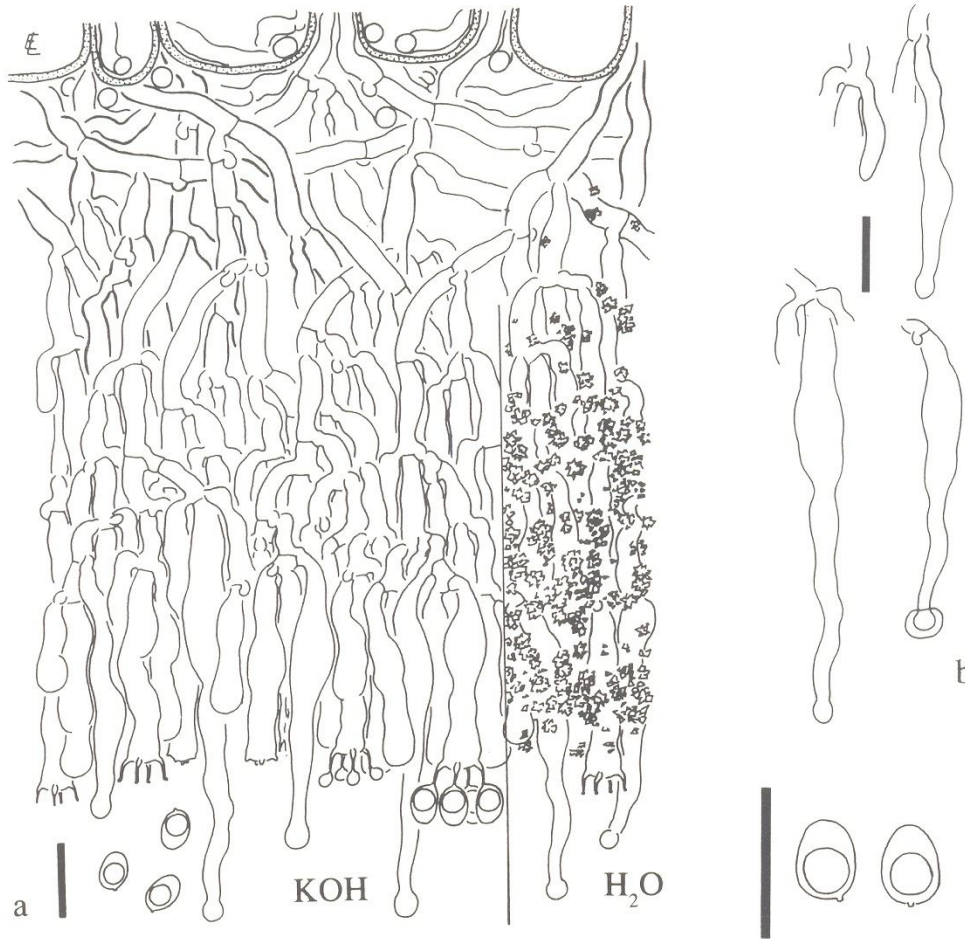


Fig. 12. *Hyphodontia sambuci*; a) vertical section through whole basidiocarp, b) ontogeny of a capitata cystidium, bars = 10 μm .

bertson et al. 1976). *Fouquieria splendens* (Nakasone & Gilbertson 1978). USA, Colorado: *Abies lasiocarpa*, *Picea pungens* (Lindsey 1988). Japan: *Chamaecyparis obtusa* (Hayashi 1974).

Macromorphology: Basidiocarps resupinate, smooth, chalky colour, yellowish when old, up to 100 μm thick, up to several square decimeter large, margin distinct.

Micromorphology and ultrastructure (fig. 12, 18d): Spores ovoid, thin-walled, 5–5,5 \times 3,5–4 μm , with a single drop each, inamyloid. Basidia suburni-

form, 23–26 \times 4–5,5 μm , with several constrictions and a basal clamp each. Cystidia capitata, ca. 60 μm \times 5–6 μm , with hyaline exudate at the apex, basally swollen. Hyphal system monomitic. Basal hyphae slightly thick-walled, 3–3,5 μm in diameter, subhymenial hyphae thin-walled, 2,5–3 μm in diameter, septa with one clamp each. Hyphae, especially during dry periods, heavily incrustated with crystals. Dolipore parenthesomes continuous, composed of several electron dense areas. The pore channel is closed by electron dense material.

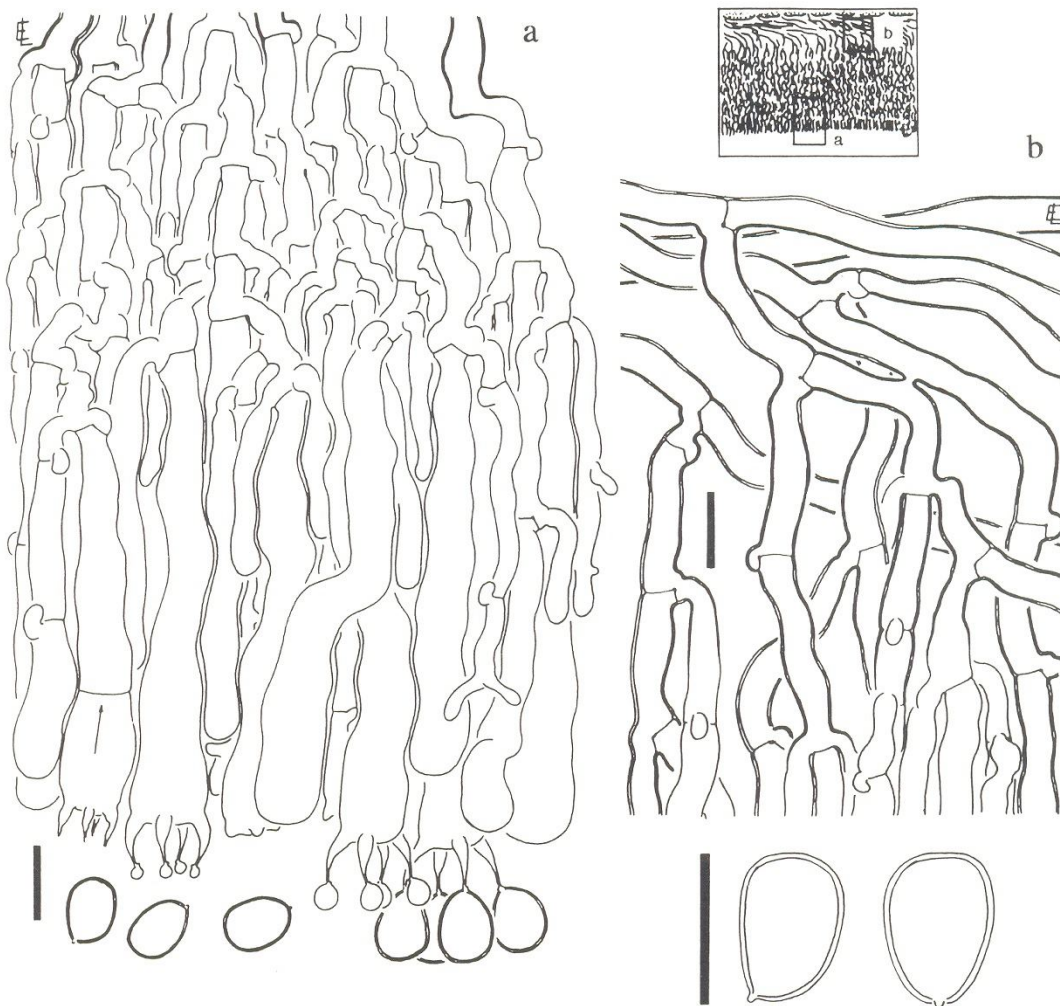


Fig. 13. *Hypochnicium bombycinum*; vertical sections a) hymenium and subhymenium, b) basal hyphae, bars = 10 μm .

Remarks. This species has been transferred to several genera during the last decades: *Grandinia*, *Hyphoderma*, *Hyphodontia*. It is also type species of the genus *Lyomyces* P. Karst. The most striking argument for the name *Hyphodontia*, leaving beside reasons of priority, is the common use of that name and the type of dolipore (parenthesomes continuous), thus proving a clear delimitation

against the genus *Hyphoderma* (parenthesomes perforated).

Hypochnicium bombycinum (Sommerf. & Fr.) Erikss., *typus generis*, *Symb. bot. Ups.* 16(1), p. 101, 1958.

BASIONYM: *Thelephora bombycina* Sommerf. ex Fr., *Elench. fung.* 1, p. 211, 1828.

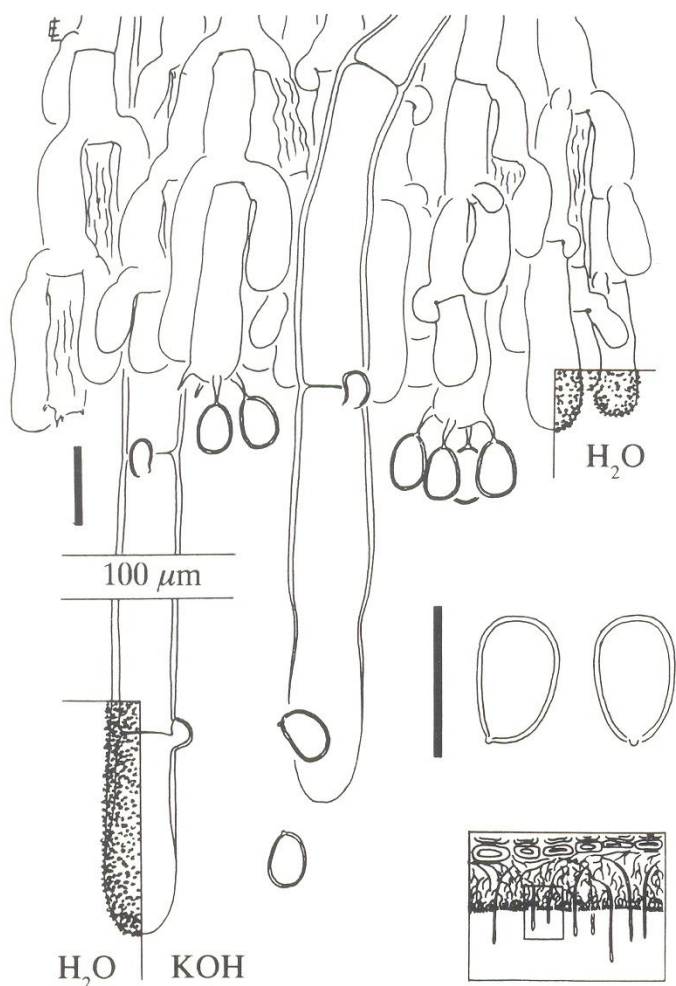


Fig. 14. *Hypochnicium polonense*, vertical section through hymenium and subhymenium, bars = 10 µm.

SYNONYMS: *Thelephora bombycina* Sommerf., Fl. lapp. suppl., p. 284, 1826. *Corticium granulatum* (Bon.) Karst., Bidr. Finl. Nat. Folk 37, p. 244, 1882. *Corticium oosporum* Karst., Hedw. 29, p. 270, 1890. *Corticium bombycinum* (Sommerf. ex Fr.) Bres., Att. Acad. Sci. Lett. Art. Agiati 3(3), p. 111, 1897.

SUBSTRATE SPECTRUM: Europe: angiosperm wood, coniferous wood (Eriksson & Ryvarden 1976). Norway: *Alnus sp.*, *Salix sp.*, *Sorbus sp.* (Ryvarden 1971). *Alnus sp.*, *Betula sp.*, *Prunus sp.*, *Salix sp.* (Strid 1975). Denmark: *Fagus sp.*, *Picea sp.*, *Populus sp.*, *Salix sp.* (Christiansen 1960). Germany: *Salix sp.* (Grosse-Brauckmann 1982). *Salix sp.* (Langer). USA, Arizona: *Prosopis juliflora* (Gilbertson et

al. 1976). USA, Colorado: *Quercus gambelii* (Lindsey 1988). USA, Gulf coast: *Juniperus virginiana* (Gilbertson & Blackwell 1985).

Macromorphology: Basidiocarps resupinate, smooth to tuberculate, ceraceous, up to 1000 µm thick, margin with single aculei.

Micromorphology and ultrastructure (fig. 13, 20b): Spores ellipsoid, smooth and thick-walled, 9–10 × 7–8 µm, distal part of the spore slightly enlarged, cyanophil, inamyloid. Basidia long clavate, 50–70 × 8–10 µm, with a basal clamp each, somewhat

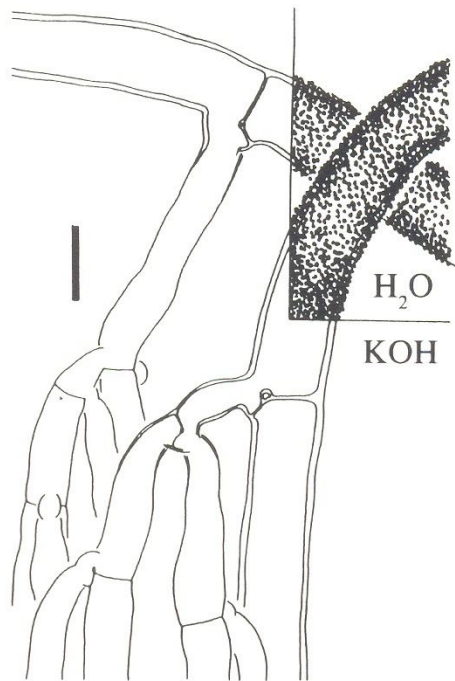


Fig. 15. *Hypochnicium polonense*, basal parts of septocystidia with arising generative hyphae, bar = 10 μ m.

sinuous. Cystidia none. Hyphal system monomitic. Hyphae 3–5 μ m in diameter, cyanophilous, hyphal construction of the subhymenium very dense, basal hyphae slightly thick-walled, 4–5 μ m in diameter, parallel arranged, cyanophilous, septa with one clamp each. Dolipore parentheses perforated. The pore channel is closed by electron dense structures.

Remarks: The genus *Hypochnicium* was erected by Eriksson (1958) for hyphodermoid species with thick-walled or thick-walled and ornamented, cyanophilous spores. This genus is accepted by Parmasto (1968) and Jülich (1974).

Hypochnicium polonense (Bres.) Strid, Wahlenbergia 1, p. 68, 1975.

BASIONYM: *Kneiffia polonense* Bres., Ann. mycol. 4, p. 102, 1903.

SYNONYMS: *Peniophora polonensis* (Bres.) v. Höhn. & Litsch., Ann. mycol. 4, p. 292, 1906. *Hyphoderma polonense* (Bres.) Donk, Fungus 27, p. 15., 1957.

SUBSTRATE SPECTRUM: Europe: *Alnus* sp., *Fagus* sp., *Fraxinus* sp., *Picea* sp., *Populus* sp., *Quercus* sp., *Salix* sp., *Ulmus* sp. (Eriksson & Ryvarden 1976). Norway: *Alnus* sp., *Fraxinus* sp., *Salix* sp. (Strid 1975). Sweden: *Corylus* sp. (Hallenberg 1983a). Denmark: *Fagus* sp., *Fraxinus* sp., *Ulmus* sp. (Christiansen 1960). Germany: *Fagus sylvatica* (Langer).

Macromorphology: Basidiocarps resupinate, smooth, pilose by projecting cystidia, yellowish, up to 200 μ m thick, margin distinct.

Micromorphology and ultrastructure (figs. 14, 15, 20c): Spores ellipsoid, thick-walled and smooth, 7.5–8 \times 4.5–5 μ m, cyanophil, inamyloid, distal part of the spore slightly enlarged. Basidia cylindrical to clavate, 25–35 \times 5–6 μ m, with a slight constriction and a basal clamp each, old basidia collapsing. Septocystidia 100–200 \times 8–15 μ m, arising from basal parts of the basidiocarp, thick-walled, with granular incrustation of crystals. Hyphal system monomitic. All hyphae are thin-walled, diameter 4–6 μ m and incrustated by granular crystals, septa with one clamp each. Dolipore parentheses perforated. The pore channel is closed by electron dense structures.

Remarks: The very big septocystidia and the hyphal construction of *H. polonense* are outstanding in the genus *Hypochnicium*. Relationships to other genera like *Botryobasidium* and *Hyphoderma* were discussed by Eriksson & Ryvarden (1976). *Candelabrochaete* Boidin (1970) shows comparable features like septocystidia, loosely constructed hyphal system and basidia with four spores.

Schizopora paradoxa (Fr.) Donk., typus generis, Persoonia 5(1), p. 104, 1967.

BASIONYM: *Hydnum paradoxum* Fr., Syst. mycol. 1, p. 424, 1821;

SYNONYMS: *Polyporus versiporus* Pers. Myc. Eur. 2, p. 105, 1825. *Polyporus laciniatus* Velen., České Houby, p. 638, 1922.

SUBSTRATE SPECTRUM: Europe: angiosperm wood (Eriksson et al. 1984). England: *Ulex* sp., *Salix* sp. (Den-

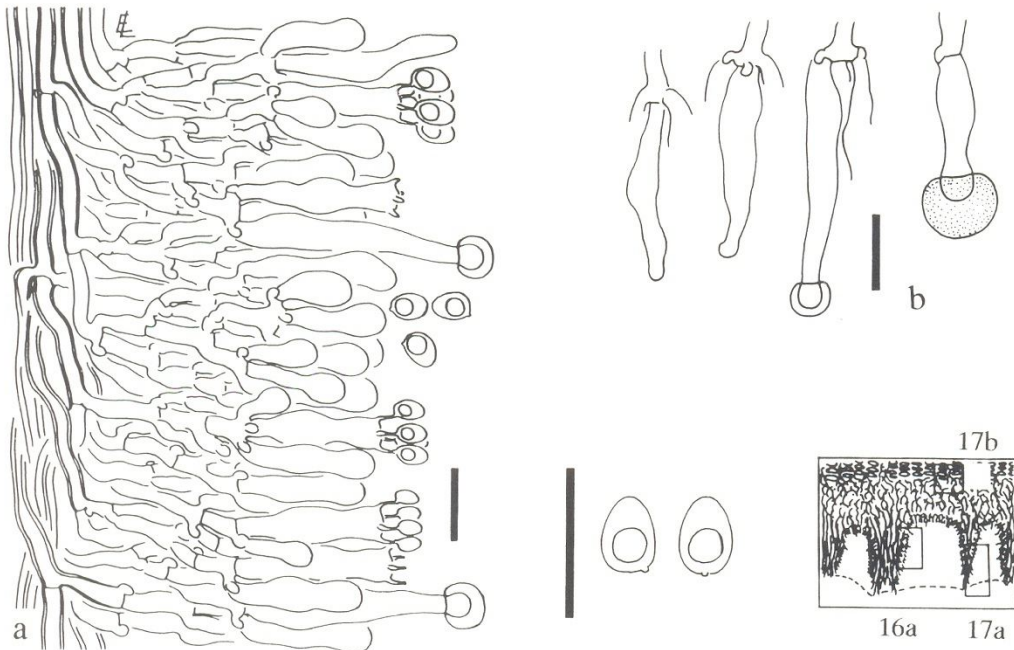


Fig. 16. *Schizopora paradoxa*; vertical sections a) lateral part of a pore wall, b) ontogeny of a halocystidium, bars = 10 µm.

nis 1981). Germany: *Alnus glutinosa*, *Carpinus betulus*, *Fagus sylvatica* (Langer). North Spain: *Acer pseudoplatanus*, *Betula* sp., *Castanea sativa*, *Chamaecyparis lawsoniana*, *Corylus avellana*, *Fagus sylvatica*, *Fraxinus excelsior*, *Ilex aquifolium*, *Pinus pinaster*, *Pinus radiata*, *Quercus ilex*, *Quercus petraea*, *Quercus pyrenaica*, *Quercus robur*, *Quercus suber* (Dueñas & Tellería 1988). Yugoslavia: *Carpinus* sp. (Jelic, Tortic 1973). North Africa: *Betula* cf. *fontquerii*, *Cedrus atlantica*, *Ilex aquifolium*, *Quercus suber* (Tellería 1984, 1987). USA, Gulf Coast: *Juniperus phoenicea*, *Juniperus virginiana* (Gilbertson & Blackwell 1985).

Macromorphology: Basidiocarps resupinate, irpicoid to poroid, margin odontoid or smooth and distinct. Pore walls geotropic, up to 0,5 cm long. Colour white, creme or yellowish when old. Large fructifications up to several meters length have been observed.

Micromorphology and ultrastructure (fig. 16, 17, 20d): Spores ovoid, $5,5-6,5 \times 3,5-4,5$ µm, thin-walled, smooth, with a single drop each. Basidia suburniform, $17-21 \times 4-5$ µm, with one to two constrictions and a basal clamp each. Cystidia

capitate, 4–6 µm in diameter, with a cap of hyalin exudate. Hyphal system pseudodimitic. Thick-walled subicular hyphae (3–4 µm in diameter) arise from thin-walled substrate hyphae (2–3 µm in diameter). Thin-walled subhymenial hyphae (2–4 µm in diameter) arise from thick-walled subicular hyphae. Septa with one clamp each. Dolipore parenthesomes continuous, composed of several electron dense layers.

Remarks: *S. paradoxa* is very frequent in deciduous forests of Europe and occurs on various substrates (Eriksson, Hjortstam & Ryvarden 1984, Grosse-Brauckmann 1990). The morphology of the hymenium surface is very variable from nearly odontoid to distinct poroid. Hallenberg (1983b) detected two incompatible groups from which he described *S. radula* as new species characterized by poroid hymenium and frequent, swollen hyphal endings in the basidiocarp. A very close related species is *Hyphodontia gossypina* with conspicuous thick-walled tramal hyphae.



Fig. 17. *Schizopora paradoxa*; a) basal hyphae, b) aculeal tip, bars = 10 μ m.

DISCUSSION

Basidia are very important in classification of Basidiomycetes (e.g. Rogers 1934; Linder 1940; Oberwinkler 1982, 1985). Looking at different basidial types in Hetero- and Homobasidiomycetes, Linder (1940) already interpreted an evolutionary tendency: genera with holobasidia (e.g. *Ceratobasidium*, *Botryobasidium*, *Sistotrema*, *Corticium*) have been developed from genera with heterobasidia (e.g. *Tremella*, *Sebacina*). On the border from Hetero- to Homobasidiomycetes Oberwinkler (1964, 1965) discussed the formation of urniform basidial types like in *Sistotrema* with a basal ventricose enlargement and median constriction. The formation of elongated basidia still having a median constriction is verified by him with the genus *Hyphoderma*.

Elongated basidia with slightly constriction occurring in the Hyphodermoideae Parm. are named "utriform" by Donk (1964), whereas the term "suburniform basidia" is used mainly by Eriksson & Ryvarden (1976) to describe basidia which are typical for the genus *Hyphodontia*.

In a review on the type species of the Hyphodermoideae, Jülich (1974) complains about the insufficient delimitation of *Hyphoderma* and *Hyphodontia* by basidial morphology. In our opinion the two genera show a clear difference in the length of their basidia. *Hyphodontia* species, like e.g. *H. pallidula*, the generic type, show in comparison to *Hyphoderma* species relatively small basidia. The basidia length of *Basidioradulum radula* (Fr.) Nobles is comparable to those of the genus *Hyphoderma*, but its basidial morphology is very different showing several constrictions and a sinuous shape. The basidial morphology of the

genus *Schizopora* is identical to that of *Hyphodontia*. Eriksson & Ryvarde (1976) and Parmasto (1968) discussed their similarity concerning the construction of subicular hyphae.

Parmasto (1968) interpreted the hyphal system of *Schizopora* to be dimitic. Analyzing the origin of the generative hyphae, this interpretation is not correct in the narrow sense of a dimitic hyphal system. Therefore Eriksson & Ryvarde (1976) called the hyphal system of *Schizopora paradoxa* subdimitic. Evolutionary tendencies from monomitic to heteromitic hyphal systems within unequivocally related genera like in the Hymenochaetaceae are discussed by Oberwinkler (1985).

The spore measurement is another micromorphological characteristic to separate *Hyphoderma* from *Hyphodontia* and *Schizopora*. In the two latter genera spores range from 3–8 µm length, whereas spores of *Hyphoderma* species are 7–17 µm long.

In contrast the genus *Hypochnicium* shows a completely different spore morphology: thick-walled or thick-walled and ornamented spores with a slightly enlarged distal part, thus clearly delimitating it from *Hyphoderma*. Nevertheless *Hypochnicium* was discussed to be related to *Hyphoderma* (Eriksson 1958, Parmasto 1968, Jülich 1974, Eriksson & Ryvarde 1976).

Cystidia occurring in the here discussed genera show various types (hypho-, lageno-, septo-, stephanocystidia, capitate cystidia). In *Hyphoderma*, *Hyphodontia* and *Schizopora* the halocystidia are mainly built from hymenial hyphae. All other cystidial types are built from subhymenial or even subicular hyphae. A transition from true cystidia standing in the hymenium to hyphocystidia (hyphal elements building up aculei) is regarded as typical for Aphyllophorales with thickening hymenium (Donk 1964). The non-uniform distribution of different cystidial types like septo- or stephanocystidia should be analyzed using phylogenetic methods.

It is the first time, that the septal pores of the here presented genera were investigated. They obviously show two different pore types:

1.) Dolipores with continuous parentheses (*Basidioradulum radula*, *Hyphodontia alutaria*, *H.*

cineracea, *H. floccosa*, *H. gossypina*, *H. pallidula*, *H. sambuci* and *Schizopora paradoxa*).

2.) Dolipores with perforated parentheses (*Hyphoderma praetermissum*, *H. setigerum*, *Hypochnicium bombycinum* and *H. polonense*).

Their substructure corresponds well with the descriptions of Moore (1978, 1980), Traquair & McKeen (1978) and Göttel (1980), showing a multilayered parentheses and electron dense structures or pore plugs.

The ultrastructure of the septal pore became important in the discussion of the taxonomy in basic fungal groups like Ustilaginales, Uredinales and auricularioid Heterobasidiomycetes (Oberwinkler 1981). The investigations on Basidiomycetes forming basidiocarps with hetero- or holobasidia have shown that only a minority of groups are characterizeable on their dolipore type like the Tremellales s.str. (Oberwinkler 1985). In the Hymenochaetaceae the dolipore type (parentheses continuous) is together with the micromorphology (setae, clampless hyphae, xanthochroic reaction of the hyphae) a good additional characteristic to accept this family as a natural taxon.

From the Homobasidiomycetes with corticioid basidiocarps only a small number of species were investigated on their dolipore type. The presence of two different parentheses types in the dolipores of *Hyphoderma/Hypochnicium* (perforated) and *Hyphodontia/Schizopora* (continuous) is a new and objective characteristic to delimitate those genera. The information on the distribution of dolipore types in Corticiaceae is too scant for far-reaching taxonomic interpretations. Therefore it would be worthwhile to widen our knowledge on the distribution of dolipore types in Homobasidiomycetes.

ACKNOWLEDGEMENTS

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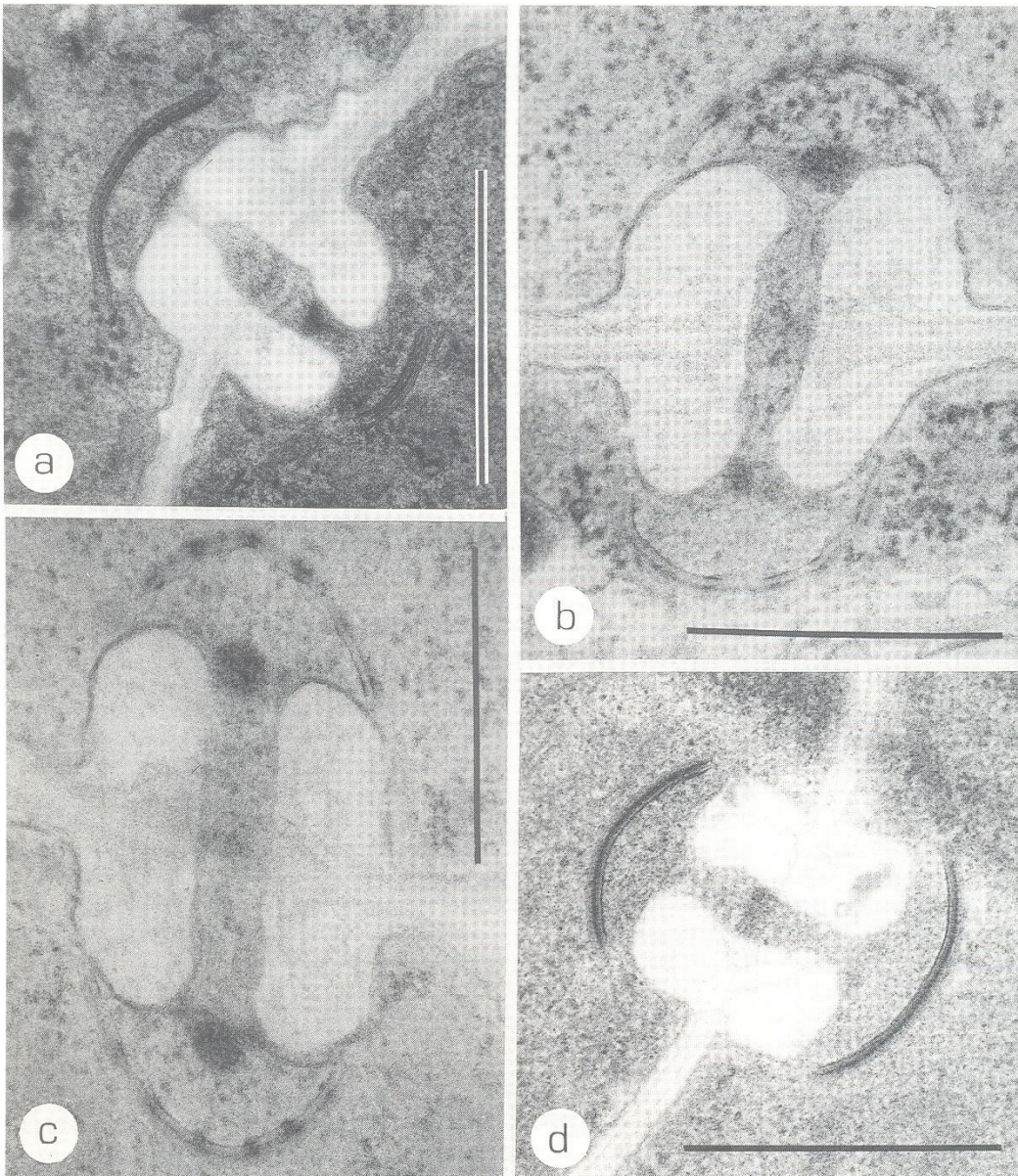


Fig. 18. Dolipores with continuous parentheses: a) *Basidioradulum radula*, d) *Hyphodontia sambuá*. Dolipores with perforated parentheses: b) *Hyphoderma praetermissum*, c) *Hyphoderma setigerum*, bars = 0,5 μm .

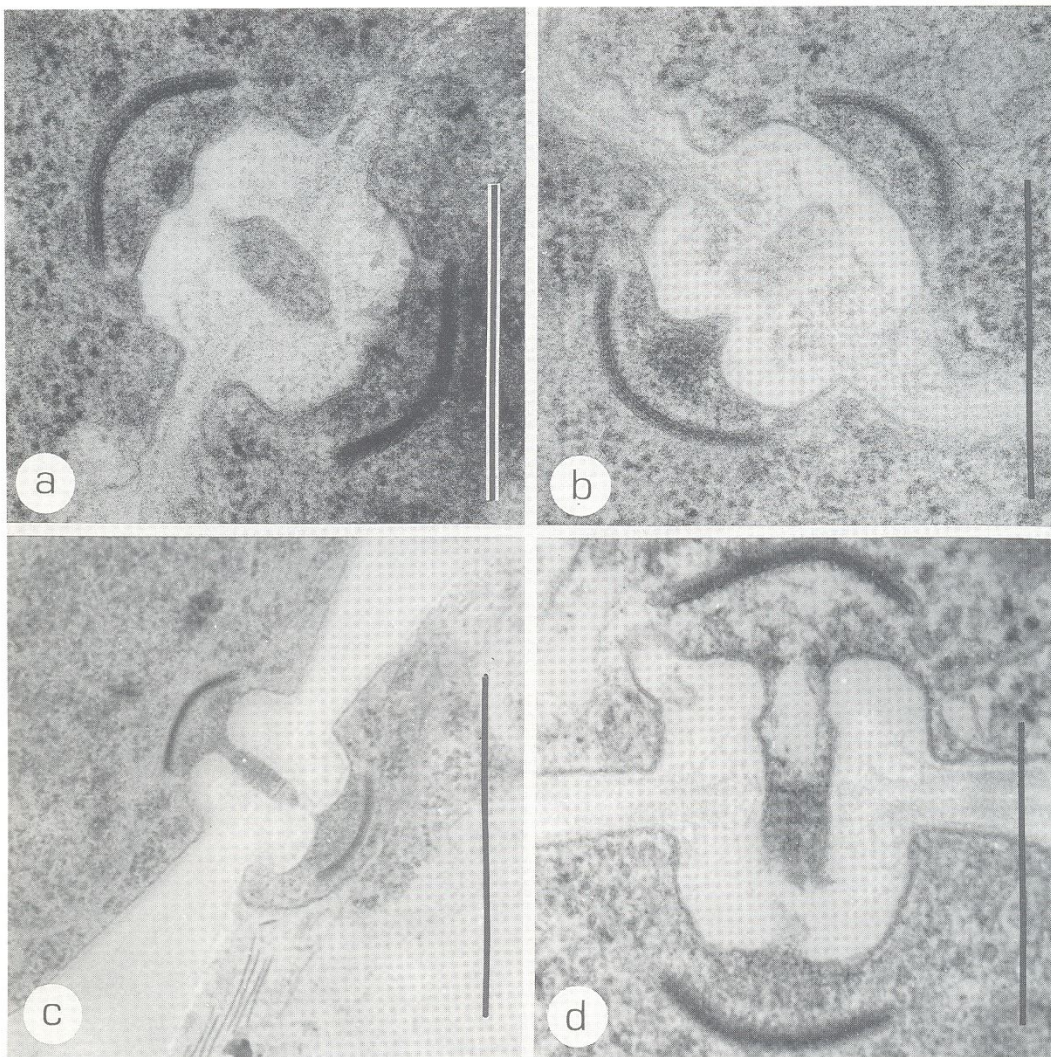


Fig. 19. Dolipores with continuous parentheses: a) *Hyphodontia alutaria*, b) *H. cineracea*, bars = 0,5 μm , c) *H. floccosa*, bar = 1 μm , d) *H. pallidula*, bar = 0,5 μm .

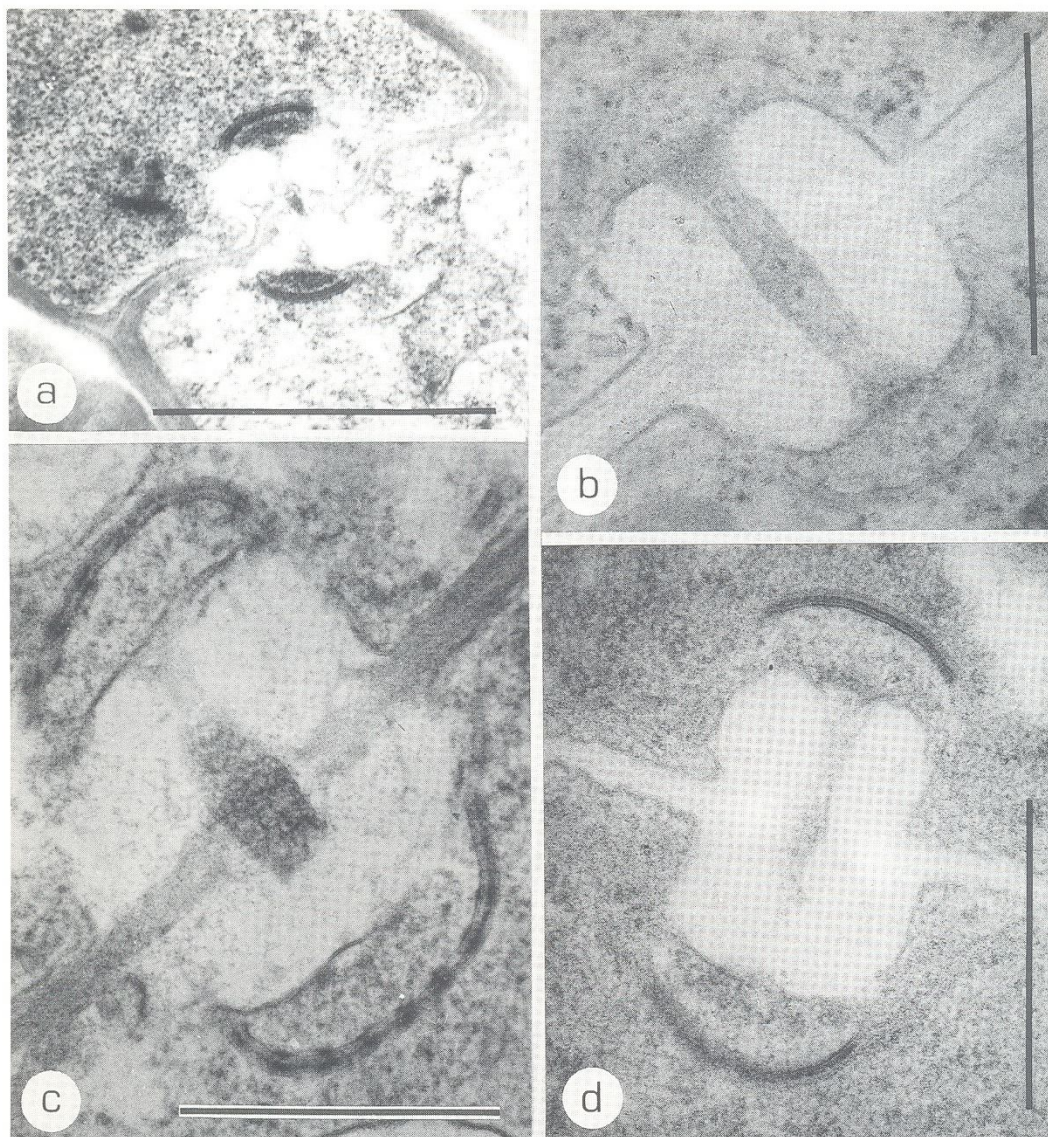


Fig. 20. Dolipores with continuous parentheses: a) *Hyphodontia gossypina*, bar = 1 μm , d) *Schizopora paradoxa*. Dolipores with perforated parentheses: b) *Hypochnicium bombycinum*, c) *H. polonense*, bars = 0,5 μm .

EXAMINED MATERIAL

Basidioradulum radula (Fr.) Nobles. GEL 667 – Germany, Bayern, Tiefenbach, Moosalpe, on wood of *Fagus sylvatica*, ca. 1000 m, 21.9.1988, leg. E. Langer. GEL 800 – Germany, Baden-Württemberg, Schwarzwald, Würzbach, Kohlhütte, Bannwald Waldmoortorfstich, on bark of *Abies alba*, ca. 680 m, 15.1.1989, leg. E. Langer. GEL 2027 – Germany, Baden-Württemberg, Tübingen-Hagelloch, Hohen Entringen, Kürnberg, on bark of *Prunus avium*, ca. 500 m, 26.6.1989, leg. E. Langer. GEL 2101 – Germany, Baden-Württemberg, Schwarzwald, Würzbach, Bannwald Waldmoortorfstich, on bark of *Alnus glutinosa*, ca. 680 m, 4.5.1990, leg. E. Langer, G. Langer, K.-H. Rexer. GEL 2107 – Germany, Baden-Württemberg, Schwarzwald, Würzbach, Bannwald Waldmoortorfstich, on bark of *Abies alba*, ca. 680 m., 15.1.1989, leg. E. Langer.

Hyphoderma praetermissum (Karst.) Erikss. & Strid. GEL364 – Germany, Baden-Württemberg, Tübingen, Roter Rain, on detritus, ca. 480 m, 20.5.1987, leg. E. Langer. GEL412 – Germany, Bayern, Pfeiffermühle near Unterjoch, coniferous forest, on decayed wood of *Picea abies*, ca. 1000 m, 7.9.1987, leg. E. Langer. GEL 2057b – Austria, Tirol, Hinterstein, Vilsalpsee, on wood of *Picea abies*, ca. 1200 m, 14.9.1989, leg. E. Langer. FO 40690 – Taiwan, Nantou county, south of Sun-Moon-Lake near Hua lien, Lien Hua Chi forest station, forest with *Dendrocalamus giganteus*, on bark of angiosperm wood, ca.700 m, 24.3.1989, leg. F. Oberwinkler, E. Langer, G. Langer.

Hyphoderma setigerum (Fr.) Donk. GEL 2049 – Austria, Tirol, Pitztal, Schön, on wood and bark of *Betula pubescens*, ca. 600 m, 13.9.1989, leg. E. Langer. GEL 2050 – Austria, Tirol, Pitztal, Schön, on bark of *Betula pubescens*, ca. 600 m, 13.9.1989, leg. E. Langer. FO 40692 – Taiwan, Nantou county, south of Sun-Moon-Lake near Hua lien, Lien Hua Chi forest station, on *Dendrocalamus giganteus*, ca.700 m, 24.3.1989, leg. F. Oberwinkler, E. Langer., G. Langer. FO 40701 – Taiwan, Nantou county, south of Sun-Moon-Lake near Hua lien, Lien Hua Chi forest station, on angiosperm wood, ca.700 m, 24.3.1989, leg. F. Oberwinkler, E. Langer., G. Langer. FO 41054 – Taiwan, Nantou county, north-east of Puli, Hui-Sun Recreation Area, forest fire area, on wood of *Pinus taiwanensis*, ca. 600–800 m, 9.4.1989, leg. F. Oberwinkler, E. Langer., G. Langer.

Hyphodontia alutaria (Burt) Erikss. GEL 780 – Germany, Hessen, Zwesten, Altenburg, on decayed bark and wood of *Picea abies*, ca. 250 m, 5.11.1988, leg. E. Langer. GEL 1578 – Costa Rica, San Jeronimo near San José, street from San Jeronimo in direction to Bajola

Hondura, ca. 1400–1500 m, 8.2.1989, leg. E. Langer, G. Langer. GEL 2043 – Germany, Bayern, Oberjoch, forest west of Berghaus Iseler, on wood and bark of *Picea abies*, ca.1300 m, 11.9.1989, leg. E. Langer. GEL 2041a – Germany, Bayern, Oberjoch, northwestern slope of Ornach, on wood of *Pinus mugo*, ca.1500 m, 12.9.1989, leg. E. Langer. GEL 2068, GEL 2071 – Austria, Tirol, Schattwald, Vils-Tal, Pfrontener Wald, Zwiersberg, on bark and wood of *Picea abies*, ca.1000 m, 15.9.1989, leg. E. Langer. GEL 2073 – Germany, Bayern, Oberjoch, forest at Kematsried Alm, on bark and wood of *Picea abies*, ca.1250 m, 16.9.1989, leg. E. Langer.

Hyphodontia cineracea (Bourd. & Galz.) Erikss. & Hjortst. GEL 2067 – Austria, Tirol, Schattwald, Vils-Tal, Pfrontener Wald, Zwiersberg, on wood of *Picea abies*, ca.1000 m, 15.9.1989, leg. E. Langer. GEL 2080 – Germany, Bayern, Oberjoch, forest at Kematsried Alm, on wood of *Picea abies*, ca.1250 m, 16.9.1989, leg. E. Langer.

Hyphodontia floccosa (Bourd. & Galz.) Erikss. GEL 366 – Germany, Baden-Württemberg, Sindelfingen, forest near the municipal hospital, on decayed wood of *Pinus sylvestris*, ca. 450 m, 28.5.1987, leg. E. Langer. GEL403 – BRD, Germany, Baden-Württemberg, Sindelfingen, forest near the municipal hospital, on decayed wood of *Pinus sylvestris*, ca. 450 m, 9.8.1987, leg. E. Langer. GEL 2029 – Germany, Baden-Württemberg, Sindelfingen, forest near the municipal hospital, on decayed wood of *Pinus sylvestris*, ca. 450 m, 2.7.1989, leg. E. Langer.

Hyphodontia gossypina (Parm.) Hjortst. G-B 1283 – Germany, Hessen, Oberrheinebene, NSG Kühkopf, Krappenschlag, on a trunk of *Populus sp.*, ca. 200 m, 2.12.1979, leg. H. Grosse-Brauckmann. G-B 1340 – Germany, Hessen, Oberrheinebene, NSG Kühkopf, Eichwald, on a twig of *Populus sp.*, ca. 200 m., 6.7.1980, leg. H. Grosse-Brauckmann. G-B 2956 – Germany, Hessen, Oberrheinebene near Kappel, on a twig of *Ulmus sp.* ca. 200 m, 27.4.1971, leg. M.A. & H. Jahn.

Hyphodontia pallidula (Bres.) Erikss. GEL 776 – Germany, Hessen, Zwesten, Altenburg, on decayed wood and bark of *Picea abies*, ca. 250 m, 30.10.1988, leg. E. Langer. GEL 781, 782 – Germany, Hessen, Zwesten, Altenburg, on decayed wood and bark of *Picea abies*, ca. 250 m, 5.11.1988, leg. E. Langer. GEL 2097 – Germany, Hessen, Zwesten, Altenburg, on decayed wood and bark of *Picea abies*, ca. 250 m, 20.11.1989, leg. E. Langer.

Hyphodontia sambuci (Pers.) Erikss. GEL607 – Germany, Baden-Württemberg, Sandhausen, Bannwald Franzosenbusch, on wood and bark of *Sambucus nigra*, ca. 200 m, 30.11.1987, leg. E. Langer. GEL609 – Germany, Baden-Württemberg, Tübingen-Hagelloch,

Gässle-säcker, on bark and wood of *Sambucus nigra*, ca. 400 m, 17.12.1987, leg. E. Langer. GEL 771 – Germany, Baden-Württemberg, Tübingen, Rosenau, on *Sambucus nigra*, ca. 450 m, 14.10.88, leg. E. Langer. GEL 2045 – Austria, Tirol, Pitztal, Schön, on wood and bark of *Sambucus racemosus*, ca. 600 m, 13.9.1989, leg. E. Langer. GEL 2091 – Germany, Baden-Württemberg, Tübingen-Bebenhausen, Schönbuch, Arenbachtal, Becklesgarten, on wood and bark of *Sambucus nigra*, ca. 380 m, 21.10.1989, leg. E. Langer.

Hypochnicium bombycinum (Sommerf. & Fr.) Erikss. GEL 790 – Germany, Baden-Württemberg, Tübingen-Hagelloch, meadows with apple trees east of Hagelloch, on wood of *Salix sp.*, ca. 450 m, 13.12.1988, leg. E. Langer. GEL 2098 – Germany, Hessen, Zwesten, bank of Schwalm, on bark of *Salix sp.*, ca. 220 m, 20.11.1989, leg. E. Langer.

Hypochnicium polonense (Bres.) Strid. GEL 492 – Germany, Bayern, Oberstdorf, Spielmannsau, on decayed wood of *Fagus sylvatica*, ca. 1000 m, 12.9.1989, leg. E. Langer.

Schizopora paradoxa (Fr.) Donk. GEL269 – Germany, Baden-Württemberg, Bebenhausen, on wood of *Quercus robur*, ca. 450 m, 16.10.1986, leg. E. Langer. GEL324 – Germany, Hessen, Zwesten, Altenburg, on bark of *Fagus sylvatica*, ca. 250 – 450 m, 1.3.1987, leg. E. Langer. GEL316, GEL318 – Germany, Baden-Württemberg, Tübingen-Hagelloch, Schönbuch, Himbachtal, on bark and wood of *Fagus sylvatica*, ca. 400 – 450 m, 12.3.1987, leg. E. Langer. GEL360 – Germany, Baden-Württemberg, Tübingen, Roter Rain, on bark of *Fraxinus excelsior*, ca. 450 m, 19.5.1987, leg. E. Langer. GEL560 – Germany, Baden-Württemberg, Tübingen, Schönbuch, Arenbachtal, Becklesgarten, on bark and wood of *Carpinus betulus*, ca. 400 m, 10.10.1987, leg. E. Langer. GEL585, GEL586, GEL587, GEL595 – Germany, Baden-Württemberg, Sandhausen, Bannwald Franzosenbusch, on bark and wood of *Carpinus betulus*, ca. 200 m, 30.11.1987, leg. E. Langer. GEL 647 – Germany, Bayern, Oberjoch, forest west of Berghaus Iseler, on bark and wood of *Fagus sylvatica*, ca. 1300 m, 20.9.1988, leg. E. Langer. GEL 745 – Germany, Bayern, Oberjoch, forest west of Berghaus Iseler, on bark of *Fagus sylvatica*, ca. 1300 m, 24.9.1988, leg. E. Langer. GEL 750 – Germany, Baden-Württemberg, Tübingen-Hagelloch, Rosenbach, on bark of *Carpinus betulus*, ca. 440 m, 1.10.1988, leg. E. Langer. GEL 2028 – Germany, Baden-Württemberg, Tübingen-Hagelloch, Bogentor, on wood and bark of *Carpinus betulus*, ca. 460 m, 26.6.1989, leg. E. Langer. GEL 2096 – Germany, Baden-Württemberg, Tübingen-Bebenhausen, Schönbuch, Goldersbachtal,

Tellerbrücke, on wood and bark of *Alnus glutinosa*, ca. 380 m, 21.10.1989, leg. E. Langer. GEL 2099 – Germany, Hessen, Camping ground near Schwalm, on wood of *Carpinus betulus*, ca. 220 m, 20.11.1989, leg. E. Langer.

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