THE THELEPHORACEAE OF INDIA—III*

The Genus Tubulicrinis and Hyphoderma in India

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This paper gives an illustrated account of seven species belonging to the genera Tubulicrinis Donk and Hyphoderma Wallr. emend. Donk, collected from the various localities in the North-Western Himalayas. Out of these, six are new records for India. The material of these collections has been deposited in the Herbarium of the Botany Department, Panjab University, Chandigarh, India, and National Fungus Collections, Beltsville, Maryland, U.S.A.

Tubulicrinis

It is a natural genus proposed by Donk (1956) and includes most of the species of Peniophora sect. Tubuliferae Bourd. and Galz. Weresub (1961) has made a detailed study of the section. The genus is recognised by its thick-walled and rooted cystidia, the wall being soluble in 10% KOH. Donk (1956) has introduced the term lyocystidia for such cystidia. The diagnosis of the genus as given by Donk (1956) follows:

"Fruit-bodies wholly resupinate, usually closely adnate, often (very) thin and pruinose to closed, often somewhat waxy patches with indeterminate margin, rarely thin cottony-membranous or starting as somewhat fleshy patches and separable in fragments, often white or whitish, the surface (under the handlens) hispid to atomate. Trama with basal layer consisting of narrow, thin-walled hyphae which usually soon become agglutinated and indistinct, pervaded by firmer and more distinct hyphae from which the cystidia arise; and a layer of ascending, collapsing, often indistinct hyphae giving rise to the hymenium; in a few species tramaal hyphae distinct, the basal ones more or less thick-walled. Cystidia (lyocystidia) arising from the

* This is a continuous series dealing with the taxonomic study of Indian Thelephoracea started by the senior author. The title "the Thelephoraceae of the Mussoorie Hills" has been replaced by "Thelephoraceae of India," since the study is being extended to the other regions in India.

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distinct basal hyphae (many with 2 more roots), often far-protruding, slender, cylindrical to slightly conical, very thick-walled (lumen capillary) but becoming more or less abruptly thin-walled towards the pointed to capitately swollen, thin-walled apex, breakable, with smooth surface, not encrusted except often at thin-walled (apical) portion with loosely attached crystals or sheathing caps, colourless; wall not stainable by eosin, often more or less amyloid, dissolving in 10% potassium hydroxide. Basidia clavate, undivided; sterigmata 2–4. Spores globular to curved-cylindric, even in outline, small to medium-sized, colourless; wall smooth, non-amyloid; not exhibiting repetition."

Epixylous, usually on very rotten wood.

Type species.—*Tubulicrinis glebulosa* (Bres.) Donk.

Distribution.—World-wide.

**Key to Species**

Sporophores 1,000 μ or more thick, cystidial base not broadened and not rooted  .. 1. *T. karstenii*

Sporophores thin (*less than 200 μ*), cystidial base broadened or rooted

   Cystidia with an attenuated and pointed apex
   Lumen capillary and not expanding at the top.  .. 2. *T. chaetophora*
   Lumen capillary and expanding into an acute conical apex  .. 3. *T. subulata*

   Cystidia cylindrical, apex obtuse, lumen capillary expanding abruptly into a cylindrical bulb  .. 4. *T. gracillima* *


Sporophores annual, resupinate, membranous, somewhat fleshy and thick, adnate, often arising as small pinhead colonies which later become widely effused often covering large areas up to 50×30 cm., up to 1–5 mm. thick in section; hymenial surface pale yellow to yellowish-brown, smooth, thicker specimens crack deeply and irregularly on drying; margin abrupt, thick, concolorous, adnate, young colonies have thick but finely fibrillose margin. Context subhyaline in section, composed of intertwined thick-walled

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* Recorded as *Peniophora gracillima* Ell. and Everh. by Rehill and Bakshi (1965) from Dehra Dun (India). This species has not been encountered during the course of the present studies.
hyphae; hyphal system monomitic, hyphae in the context are 1·5–4·5 μ wide, hyaline, branched, thick-walled, wall up to 1·2 μ thick, rarely septate, rarely clamped; subhymenial hyphae 1·5–2·5 μ wide, hyaline, thin-walled, septate, clamped, clamps common. Cystidia 100–350 × 5–8 μ, cylindrical, hyaline, with tapering base, thick-walled with capillary lumen, lumen widens towards the apex, cystidial wall soluble in 10% KOH, incrustated, incrustations in patches all along the length of the cystidia, immersed or projecting up to 35 μ out of the hymenium. Basidia up to 40 μ long and 2·5–3 μ broad, hyaline, clavate, slightly projecting out of the hymenium, 4-spored, sterigmata up to 3 μ long. Basidiospores 4·5–6 × 1·2–1·8 μ, cylindrical to narrowly ellipsoidal, hyaline, smooth, non-amyloid, aguttate or with one or two small guttules, minutely apiculate (Plate XIII, Fig. 1; Text-Fig. 1).

Substratum.—On stumps and fallen logs of conifers.


Distribution.—North America, Europe, India.

This species appears to be widely distributed in the coniferous forests of North-Western Himalayas. Collections have been made from Simla, Kulu, Dalhousie, Jammu and Kashmir Hills.

This species is easily recognised by its thick fleshy fruit bodies and long cylindrical lyocystidia with incrustations in patches.
There is some confusion regarding the exact position of this species. It was first described by Bresadola as *Stereum karstenii* [I.R. *Acad. Agiati.*

**Text-Fig. 1.** *Tubulicrinis karstenii.* A. Vertical section through sporophores, × 400, B. Basidiospores, × 1,000,
Attii, 1897, 111 (3), 108]. Later, Rogers and Jackson (1943) transferred it to Peniophora where this specific epithet was preoccupied by a Massee name. A later synonym P. crassa Burt was therefore taken and S. karstenii was listed as its synonym. Donk (1956) transferred it to Tubulicrinis where the specific epithet was not occupied and so the species got its original name. Eriksson (1958) and Weresub (1961), however, showed that this species does not have the typical cystidia of the genus Tubulicrinis and pointed out some other differences also. Eriksson provisionally kept it under Peniophora and accepted the name P. crassa for it.


Sporophores annual, resupinate, densely pruinose to pilose, separable, widely effused often following the contours of the substratum, usually thin and delicate, 45–100 μ thick in section but sometimes may be as much as 300 μ thick; hymenial surface densely pilose due to the cystidia, white to cream when fresh, becoming ochraceous on drying, smooth but thicker specimens become rough and cracked also; margin thinning out, separable and concolorous. Context indistinct; hyphae (1·5) 2–3·5 μ wide, hyaline, branched, septate, clamped, with firm walls, collapsing and often clustering around the cystidia. Cystidia 45–180 × 6–12 μ, hyaline, conical with a broad rooting base, tapering uniformly to a pointed apex, thick-walled with capillary lumen not expanded at the top, wall smooth, non-amyloid to strongly amyloid, soluble in 10% KOH. Basidia 12–20×4–5 μ, clavato-cylindrical, hyaline, 4-spored, sterigmata up to 4·5 μ long. Basidiospores 5–7 (–8)×3–3·5 μ, ellipsoid, hyaline, smooth, non-amyloid, shortly apiculate. (Plate XIII, Fig. 3; Text-Fig. 2).

Substratum.—On rotten wood of conifers.


Distribution.—North America, Europe, India.

This species is marked by its conical cystidia with a pointed apex and capillary lumen. The lumen remains uniform and does not expand at the top.


Sporophores annual, resupinate, membranous, adnate but easily separable when fresh, widely effused, up to 150 μ thick in section; hymenial surface
deep cream to pale ochre, pilose due to the projecting cystidia, even when young but becomes irregularly and areolately cracked exposing the substratum; margin indeterminate, concolorous. *Context* subhyaline in sec-

**TEXT-Fig. 2.** *Tubulicrinis chaetophora.* A. Vertical section through sporophores, × 500. B. Basidiospores, × 1,250.

tion, hyphae often collapsing and indistinct, 2–3 μ wide, hyaline, branched, septate, thin-walled, clamped. *Cystidia* 55–100 × 6·5–14 μ, conical, subhyaline, thick-walled, lumen capillary but widens towards the top forming an acute conical apex (15–20 μ long and 4·4–5 μ broad at the base), cystidia rooted, often arising from the base in young sporophores but from different parts of the context in thicker ones, immersed or projecting to 50 μ out of the hymenium, usually somewhat incrusted especially near the apex, wall amyloid and soluble in 10% KOH. *Basidia* 17–20 × 3·5–4·3 μ, clavate, hyaline, 4-spored, sterigmata up to 4 μ long. *Basidiospores* 5–7 × 1·5–2 μ, hyaline, cylindrical or narrowly ellipsoid, thin-walled, smooth, non-amyloid, minutely apiculate (Plate XIII, Fig. 2; Text-Fig. 3).

**Substratum.**—On coniferous wood.

**Collection examined.**—On a log, Bisaran, Pahelgam, J. & K., August 21, 1967, 5269.

**Distribution.**—North America, Europe, India.

This fungus can be identified by its thick-walled, broad-based, rooted cystidia with capillary lumen which widens at the top forming an acute.
conical apex, indistinct context and narrowly ellipsoid to cylindrical basidiospores.


**Hyphoderma**

As emended by Donk it is a natural and large genus with 24 new combinations proposed initially. It includes *Gloeocystidium* sect. *ceracea* Bourd. & Galz., *Peniophora* sect. *gloeocystidiales* Bourd. & Galz. and related species in other genera. It shows some resemblance with *Tylospora* Donk, *Hyphodontia* Eriksson and *Hypochnicium* Eriksson with some characters intergrading between them. Unless a detailed study of *Hyphoderma* and related genera is made it is not possible to clearly define this genus. According to Donk (1957), the average species of *Hyphoderma* may be characterised as follows:

"The hyphae in the trama! layer are mostly interwoven, distinct, thin- to firm-walled and not readily collapsing, with conspicuous clamp-connections; the spores are usually cylindrical to oblong and flattened to somewhat depressed on one side (tending to be sausage-shaped), medium-sized to rather long (on an average usually about 6–16 μ long), thin-walled, smooth, colourless and non-amyloid. Gloeocystidia or firm-walled (but not very thick-walled, heavily incrusted) cystidia which may occur both and then usually with intermediate states are present except in a few species. Fruit body strictly resupinate; hymenium rather compact, somewhat fleshy
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when fresh rather than waxy, usually smooth, or toothed or raduloid in a few species.”

Type species.—*Hyphoderma spiculosum* Wallr.
Distribution.—World-wide.

**Key to Species**

Sporophores waxy to subwaxy, gloeocystidia present  ...  1. *H. pubera*
Sporophores not waxy, gloeocystidia absent.

Cystidia subulate, thin-walled, non-septate and unincrusted ... ...  ... ... ... ... 2. *H. argillaceum*

Cystidia cylindrical, thin-walled, transversely septate, unincrusted to incrusted.

Basidiospores more than 8 μ long, sporophores usually odontoid, texture subpelliculose to membranous ... ... ... ... ... ... 3. *H. setigerum*

Basidiospores less than 8 μ long, texture floccose 4. *H. polonense*


Sporophores annual, resupinate, subwaxy to waxy, adnate, widely effused, up to 200 μ thick in section; hymenial surface white to cream, even, farinose to somewhat hairy due to the projecting cystidia; margin thinning out, adnate, white to paler concolorous. *Context* subhyaline in section, composed of a basal layer of few repent hyphae and an intermediate layer of vertically arranged hyphae, sometimes the basal layer in wanting; hyphal system monomitic, hyphae 2–5 μ wide, hyaline, branched, thin-walled, nodose-septate. *Basidia* 25–30×6–7·5 μ, hyaline, clavate, 4-spored, starig mata up to 4·5 μ long. *Gloeocystidia* scanty, 65–80×7–10 μ, hyaline, staining deeply with phloxine, cylindrical to flexuous, immersed or rarely projecting slightly, thin-walled. *Cystidia* abundant, 50–120×10–18 μ, subhyaline, conical to subfusiform, thick-walled, heavily incrusted, often arising from different parts of the context, immersed or projecting up to 60 μ out of the hymenium. *Basidiospores* 6–9×3–4·2 μ, hyaline, ellipsoid, thin-walled, smooth, non-amyloid, minutely apiculate (Plate XIII, Fig. 4; Text-Fig. 4).

*Substratum.*—On rotten wood of gymnosperms and angiosperms.

*Collections examined.*—On a stump under *Cedrus deodara* and *Quercus incana* forest, Jandri Ghats springs, Dalhousie, H.P., July 25, 1966, 5110;
on a stump of *C. deodara*, Batote, J. & K., September 25, 1966, **5208**; on a fallen log under a mixed forest, Gulmarg, J. & K., September 11, 1967, **5291**

*Text-Fig. 4. Hyphoderma pubera.* A. Vertical section through sporophores, × 500. B. Basidiospores, × 1,250.

*Distribution.*—North America, Great Britain, Europe, India, Australia.

It is easily recognised by its waxy to subwaxy nature, nodose-septate hyphae, heavily incrusted conical to subfusiform cystidia and by the presence of gloecystidia. Christiansen (1960) transferred this species to *Phlebia* on the basis of its subwaxy to waxy sporophores. Donk (1962) has, however, argued that the large size of the basidiospores (8–11 μ long against 3·5–7 μ long for most of the species of *Phlebia*) and loosely interwoven hyphae in the basal layer of the fruit body are more typical of *Hyphoderma* rather than of *Phlebia*.


Sporophores annual, resupinate, floccose, adnate, widely effused often following the contours of the substratum, up to 75 μ thick in section; hymenial surface cream-coloured changing to light ochraceous on drying, discontinuous, pruinose, smooth to hairy due to the projecting out cystidia;
margin thinning out, concolorous, adnate. *Context* composed of few loosely arranged hyphae; hyphae 3–5 μ wide, hyaline, branched, thin-walled, nodose-septate. *Basidia* 22–25 × 5–6 μ, hyaline, clavato-cylindrical to flexuous, 4-spored, sterigmata up to 6 μ long. *Cystidia* 70–110 × 7.5–13 μ, subhyaline, subulate, slightly thick-walled, unincrusted, projecting a greater part of their length out of the hymenium. *Basidiospores* 7.5–8.5 × 4.2–4.6 μ, hyaline, broadly ellipsoid, thin-walled, smooth, shortly apiculate, non-amyloid (Plate XIII, Fig. 6) Text-Fig. 5).

**Text-Fig. 5.** *Hyphoderma argillaceum*. A. Vertical section through sporophores, × 1,250. B. Basidiospores, × 1,250.

*Substratum.*—On wood of gymnosperms.

*Collection examined.*—On a rotten stump of *Cedrus deodara*, Kalatope, Dalhousie, H.P., July 30, 1966, 5121.
Distribution.—North America, Europe, India.

It is characterised by its floccose context, subulate, thin-walled and non-septate cystidia.


*Sporophores* annual, resupinate, subpelliculose to membranous, adnate, often arising as small colonies which fuse later and become widely effused, up to 300 μ thick in section; hymenial surface white to deep cream, smooth to somewhat odontoid due to the projecting cystidia, even when young, becoming irregularly cracked at maturity; margin thinning out, adnate, concolorous to paler concolorous. *Context* subhyaline in section, composed of a basal zone of few repent hyphae and an intermediate zone of semi-erect hyphae, mostly hyphae are loosely arranged in the lower part of the context but are more compact in the upper part and subhymenial zone; hyphal system monomitic, hyphae 2·5-5·5 μ wide, hyaline, branched, septate, clamped, thin to slightly thick-walled, wall up to 0·8 μ thick. *Basidia* 30-35 ×5-5·5 μ, hyaline, clavate, 4-spored, sterigmata up to 5·5 μ long. *Cystidia* 70-180×8·5-10 μ, hyaline, cylindrical, septate, some septa with clamps, slightly thick-walled, wall up to 1·5 μ thick, immersed or projecting up to 60 μ, apex obtuse and often incrusted with crystals. *Basidiospores* 8-10 ×3-4 μ, hyaline, cylindrical, thin-walled, smooth, non-amyloid, shortly apiculate (Plate XIII, Fig. 5; Text-Fig. 6).

Substratum.—On wood of conifers.

Collection examined.—On bark of *Cedrus deodara*, Ardu, Pehalgam, J & K., September 1, 1967, 5271.

Distribution.—North America, Great Britain, Europe, India, Australia and New Zealand.

It appears to be uncommon in India. Only one collection has been made from Kashmir so far. It can be easily recognised by the transversely septate, slightly incrusted cystidia and long ellipsoid to cylindrical basidiospores. The hymenial surface shows a great deal of variation. It may be smooth to tuberculate to almost odontoid. The odontoid feature is in fact due to the spore deposit as well as the tissue growth around the bases of cystidia. Miller and Boyle (1943) and Nikoljeva (1961) have treated this species under *Odontia* (Hydnaceae) while Rogers and Jackson (1943), Slysh (1960) and Cunningham (1963) maintain that it truly belongs in *Peniophora* (Thelephoraceae). Donk (1957) transferred it to *Hyphoderma* Wallr. emend Donk which includes members both from Hydnaceae and Thelephoraceae,

Sporophores annual, resupinate, floccose, adnate, arising as small colonies which may become widely effused later, up to 250 μ thick in section; hymenial surface white to cream, discontinuous, finely hispid due to the projecting cystidia, somewhat farinaceous; margin thinning out, adnate, paler concolorous. Context subhyaline in section; hyphae loosely arranged, finely incrusted especially in the subhymenial zone; hyphal system monomitic, hyphae 4–8 μ wide, hyaline, branched at wide angles, thin to slightly thick-walled, nodose-septate. *Basidia* 25–30 × 5–6 μ, subclavate but often flexuous, hyaline, 4-spored, sterigmata up to 4 μ long. *Cystidia* up to 250 μ long and 6–11 μ broad, subhyaline, abundant, cylindrical, transversely septate, with or without clamps, often arising from the base of the sporophores, immersed or projecting to 125 μ, slightly thick-walled, wall up to 1.5 μ thick, finely incrusted. *Basidiospores* 7–8 × 4.5–5.5 μ, broadly ellipsoid, subhyaline, smooth, thin-walled, non-amyloid (Plate XIII, Fig. 7; Text-Fig. 7).

Substratum.—On rotten wood of conifers.

Collections examined.—On a stump of *Cedrus deodara*, Lakkarmandi, Dalhousie, H.P., July 21, 1966, 5101; on a fallen log under a coniferous forest, Narkanda, Mahasu, H.P., October 5, 1967, 5335.
Distribution.—North America, Europe, India.

This species does not appear to be common in the North-Western Himalayas. It is characterised by its floccose texture, large and transversely septate cystidia and ellipsoid basidiospores (7–8 × 4·5–5·5 μ).

Text-Fig. 7. Hyphoderma polonense. A. Vertical section through sporophores, × 500. Basidiospores, × 1,250.

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