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BOTANICAL SURVEY OF INDIA
जहाँ है हरियाली
वहाँ है खुशहाली

Date: 25th January, 2021

## OFFICE MEMORANDUM

**Subject: – Submission of revised project report entitled *'Revision of Indian Stereaceae'* - reg.**

The undersigned is directed to state that the final project report submitted by Dr. Deepa Mishra, RA-I, BSI on the project entitled ***'Revision of Indian Stereaceae'*** under the AJCB Post-Doctoral Fellowship has been reviewed by the subject expert in this regard. The observation of the reviewer is reproduced below:

The manuscript entitled REVISION OF INDIAN STEREACEAE is well presented in 14 chapters/sections namely, Introduction, Classification History, Work Done in India, Macro and Micromorphological Characters, Diversity, Economic Importance, Presentation of Data, Family Stereaceae, Key to Genera, Description of 14 Genera, Conclusion, References and Index.

In the Introductory part family Stereaceae is introduced with its morphology-based traditional classification. Classification History is focused on the taxonomic work undertaken till date (Hemchander et al. 2017) from different parts of the globe and India. The section Macro and Micromorphological Characters gives details of all the morphological features included in describing 71 species. Diversity states the variability among the group in terms of their ecology and hosts. But following discrepancies are noted while describing 71 species belonging to 14 genera.

**a)** Macromorphological description is very short and not up to the mark. Uniformity of description is also needed.

**b)** Generic description is not matching with key (as for example please see taxon description in page no. 44).

**c)** Scale bar is either missing or mismatching (in drawings) with description: page nos.- 47, 50, 53, 59 (drawings of spores missing as well), 63, 70, 75, 79 (fig. 24), 94, 101 (fig. 35), 104, 115 (fig. 43), 118, 122, 127, 130 (fig 50 scale mismatches with description), 135 (fig 52 scale mismatches with description), 138, 151, 154, 159 (fig 63), 162, 164 (fig 66 scale mismatches with description), 167 (fig 68), 172, 176, 182 (fig. 74), 185.

**d)** Clamped Gloeocystidia is missing (page182, fig 74) in the drawing (as per description of page 181).

**e)** Skeletal hyphae are missing in the drawing of fig 76.

**f)** In reference section, uniformity of entire references is needed.

**g)** Some references like, Percival (1902) and Williams & Cameron (1956) in page no. 72; Hagstrom (1977) in page no. 87; Freeman (1978) in page no. 91 are missing from the reference section.

**h)** In index, the pagination of *dimiticum Stereopsis* 32, 146 and *dimiticum Stereum* 146 should be checked.

i) It is a morphology-based taxonomic treatment of the family Stereaceae. Therefore, coloured photograph (showing habit and habitat) must be provided for all the species for their easy identification.

j) Keeping in view the present scenario, dealing a family only with morphotaxonomy (morphological resemblance) and naming a species after its lookalike (which is originally reported from a different continent) will definitely mislead scientific community. Most of the species described here were originally described earlier from different continents. Only considering the morphological similarity (without considering phylogenetic data) Indian collections are named after their counterpart. But, in macrofungi, cryptic species (species complexes) are very common. Based on the several instances it is now evident that only the combination of morphology and phylogeny clearly demarcates Asian lookalikes as distinct species and intercontinental conspecificity can hardly be possible among them. Therefore, phylogenetic confirmation is much needed for identification of the species included here.

2. In this connection, Dr. Deepa Mishra, RA-I is hereby instructed to resubmit the revised project report after incorporating the observations made by the reviewer on the above project report. It is also to inform that her pending fellowship under the said project will be processed after receiving the desired revised project report.

3. This issues with the approval of Director, Botanical Survey of India.

25/01/2021

**(एस. एस. दाश / S. S. Dash)**
वैज्ञानिक ई / Scientist 'E'
प्रभारी, तकनीकी अनुभाग / Incharge, Technical Section

**To,**

**Dr. Deepa Mishra, RA-I, BSI-NRC, Dehradun.**

*Copy to:*

1. Dr. S. K. Singh, Scientist E & H.o.O., BSI-NRC, Dehradun for information.
2. Dr. Kumar Avinash Bharati, Scientist C, BSI-CNH, Howrah – It is requested to upload the soft copy of the above project report in the webportal of BSI.

O/C.

Tech - 113-115
Shivam 25/01/2021

# Revision of Indian Stereaceae

**Deepa Mishra**
**Acharya Jagdish Chandra Bose Project 2017-2020**

Botanical Survey of India
Ministry of Environment, Forest & Climate **Change**

## ACKOWLEDGEMENTS

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Lastly, I thank my Parents, husband and my son for always providing their motivation and moral support.

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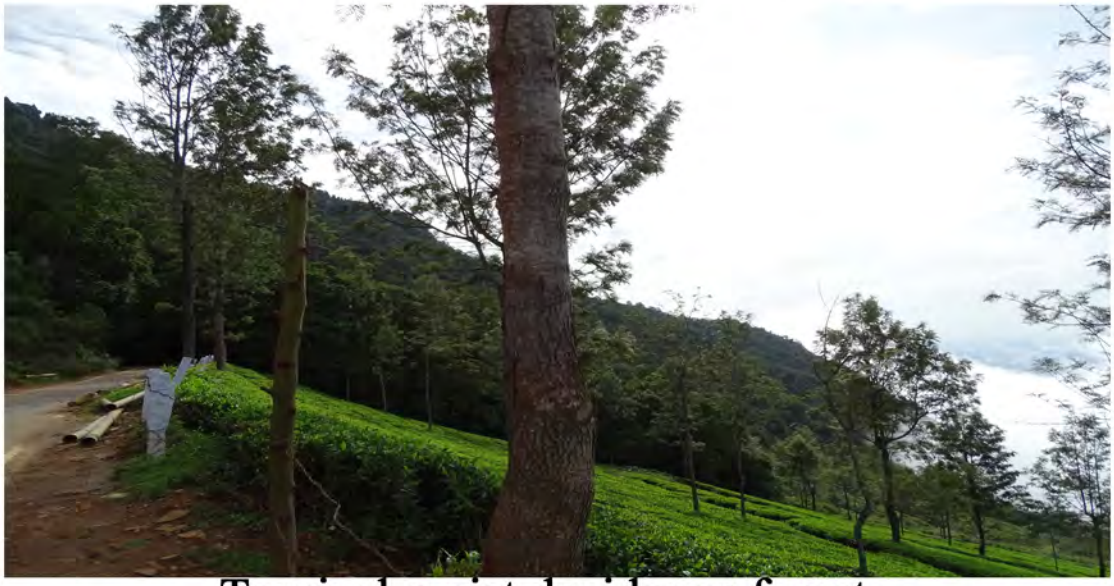

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# INTRODUCTION

The subject of this report is the stereoid fungi and is primarily concerned with Indian species. The family of stereoid fungi is essentially equivalent to the order *Thelephorei* (Fries, 1874); series *Stereums* of the subtribe *Odontinae* tribe *Porohydnae,* family Aphyllophoraceae (Patouillard, 1900); family Stereaceae (Pilat 1930) and subdivision Stercines of (Bourdot & Galzin, 1928). Several hundred species of these fungi have been described but there are not more than 200 good species. Nearly 71 species of *Stereum* or *Stereum*-like fungi are recognised in India as occuring in all the phytogeographical zones of the country.

The taxonomic study of corticioid and stereoid fungi has been stimulated during recent years by increased use of genetics, cytology, physiology, histrochemistry and micromorphology as tools for determination of their relationships. This has resulted in the recognition of many similarities among species previously regarded as belonging to different genera or families and of many differences among species heretofore regarded as forming homogeneous groups. As a result of applying recently devised criteria many genera have been redefined to form presumably natural groups with unrelated species excluded. For example the limitation of *Stereum* to include only those species obviously related to *S. hirsutum* (Willd.) Pers.

Knowledge and techniques have developed enough to permit removal of various others species from *Stereum* if one wishes to make that genus homogeneous rather than merely comprehensive. But after all of the previously mentioned species have been resituated, most of the other seem isolated from any existing genera. However, the incomplete system resulting from various monotypic genera will still induce many mycologists to be rather conservative as to the taxonomy of stereoid fungi. Probably future work will show that these fragmentary genera may include additional species or that the species now assigned to them may be referred to still other genera.

Authentic and type specimens of many species were examined in detail from various Indian herbaria AHMA, AMH, DD, HCIO, PAN BSA, BSIS, CAL, MH, BSD, BSHC, PBL, BSI, ASSAM, TBGT and PUN during the preparation of this report. In many instances, some specimes were found having no affinity with fungi under review while some others were found to be synonyms of taxa considered in this report. Dichotomous keys are provided to both genera and species for easy identification. Each taxon is fully described and illustrated with details of gross morphology and microscopic charaters based on examination of the authentic materials and type wherever possible and supplemented by study of additional collections from the entire phytogeographical zones of the country. Account of each species has been concluded with the discussion.

As the study of various species has progressed, certain ones have been found to differ from the basic concept of the genus *Stereum*. These have been accordingly placed in one of the other genera included in this treatise following Donk (1964) with the addition of

*Gloeocystidiellum* and *Aleurodiscus* to the core concept (Chamuris 1988). All the stipitate species (Podoscyphaceae) have also been included.

The author's main objective is to present the specific composition of stereoid fungi and also possibly to give full information about morphology, biology, distribution and systematization of all the species occurring in India. The need for such a work seemed necessary in the light of the profusion of the names, synonyms, poorly understood species concepts and misidentified or unidentified material of these fungi lying in various Indian herbaria. Further, during this study, new data on distribution and variability of macroscopic and microscopic features was also added to many rare and poorly known species. Presented here is the systematized data for 71 species. The stereoid fungi under consideration of this report have been assigned to 14 genera namely ***Aleurodiscus*** Rab. : Schroet. (10), ***Amylostereum*** Boid. (2), ***Aquascypha*** Reid (1), ***Chondrostereum*** Pouz. (2), ***Cotylidia*** Karst. (2), ***Cymatoderma*** Jungh.(1), ***Cystostereum*** Pouz. (1), ***Gloeocystidiellum*** Donk emend. Donk (22), ***Hjortstamia*** Boidin & Gilles (4); ***Lopharia*** Kalchbr. & MacOwan (3), ***Podoscypha*** Pat. (6), ***Stereopsis*** Reid (3), ***Stereum*** Hill : Pers. (11), ***Xylobolus*** Karst. (3), and 71 species.

## CLASSIFICATION HISTORY

Persoon (1801) in his monumental work: "Synopsis Methodica Fungorum" laid the foundation of fundamental taxonomic framework for the classification of fungi. He placed the basidiomycetes (except Gasteromycetes) in the order Hymenothecii and divided it into six subdivisions each of which included part of Aphyllophorales except the last one. Among the vast array of mycologists produced in the nineteenth century, Elias Fries was the most prominent and rightly became to be known as the Linnaeus of Mycology. His first work of importance was the 'Systema Mycologicum' (1821-1832) in which the known fungi were arranged in order.

In the last of his major works i.e "Hymenomycetes Europaei" (1874), adopting Persoon's system, following is the summary of his classification:

A. Hymenio effigurato
   - I. Lamellato = Agaricini (20 genera)
   - II. Poroso = polyporei (10 genera)
   - III. Aculeato = Hydnei (11 genera)

B. Hymenio laevigato
   - IV. Horizonatali infero = Thelephorei (5 genera)
   - V. Verticali amphigeneo = Clavariei (7 genera)
   - VI. Supero; gelatinosi = Tremellinei (8 genera)

Historically, stereoid fungi were first described as a tribe resupinatae (order: Thelephorei) of the genus *Thelephorus* by Fries (1874) for a group having smooth hymenophore. Fries concept of Stereum also included species of *Hymenochaete* and *Dendrothele*, and dominated the classification system until the early twentieth century (Chamuris, 1988) however, the concept of *Stereum* was increasingly narrowed as microscopic characters became extensively studied since the mid-twenties. Pouzar (1959) narrowed the concept of *Stereum* and segregated *Hematostereum*, *Laurilia, Lloydellopsis, Columnocystis, Chondrostereum,* and *Cystostereum* from *Stereum*. The truly stipitate genera such as *Podoscypha, Aquascypha, Cotylidia, Cyphellostereum, Inflatostereum, Stereopsis* and *Cymatoderma* were excluded from *Stereum* and elevated to a family level by Reid (1971). *Laxitextum* was segregated from *Stereum* due to differences in sterile elements, asperulate spores, and hyphal construction (Chamuris 1988; Reid,

1971). *Boreostereum* was separated from *Stereum* by the green reaction of the hyphal encrustation in KOH, a slightly folded rusty brown black subiculum in section. Chamuris (1985) divided *Stereum* into three subgenera, *Stereum*, *Aculeatostereum*, and *Acanthostereum*, based on the presence or absence of acanthohyphidia and pseudoacanthohyphidia.

As the use of microscope, the number of described species increased and these limited genera became bulky and heterogeneous (Donk, 1971). To help the growing situation, some authors like Quelet (1889); Gillet (1878); winter (1884); Killermann (1928); Karsten (1889); Murrill (1907) and Schroeter (1888) introduced changes in the Friesian system.

Around the turn of 20$^{th}$ century, revision of the Friesian system was initiated by Patouillard (1900). In his "Essai Taxonomique sur les families et les generes des Hymenomycetes" Patouillard discarded the configuration of hymenophare as the basis of classification of Hymenomycetes. He started to draw up a natural classification system. He laid great emphasis on the consistency of basidiocarp and microscopic details of hymenophore with special reference to the sterile parts, to delimit taxa of higher fungi for the first time and divided the Basidiomycetes into Heterobasidies with secondary spores and the Homobasidies without secondary spores. The latter was divided into four families. The family Aphyllophoraceae included 81 genera and was classified as below:

A. Tribu des Clavaries
    a. Serie des Thelephores (4 genera)
    b. Serie des Clavaires (7 genera)
    c. Serie des Physalacries (2 genera)
    d.
B. Tribu de Porohydnes
    1. Sous tribu: Cyphelles (6 genera)
    2. Sous tribu: Odonties
        a. Serie des Odonties (5 genera)
        b. Serie des Corticies (6 genera)
        c. Serie des Stereums (7 genera)
    3. Sous Tribu: Pores
        I. Groupe: Les Polypores vrais

a. Serie des polypores (2 genera)
b. Serie des Leucopores (4 genera)
c. Serie des Leptopores (4 genera)

II. Groupe: Les Fomes
a. Serie des Trametes (6 genera)
b. Serie des Igniaires (5 genera)
c. Serie des Placodes (3 genera)

III. Groupe: Les Merules (6 genera)

IV. Groupe: Les Fistulines (1 genus)

4. Sous tribu: Hydnes
a. Serie des Mucronelles (1 genus)
b. Serie des Hydnes (4 genera)
c. Serie des Echinodonties (1 genus)
d. Serie des Phylacteries (5 genera)
e. Serie des Astrostromes (2 genera)

5. Tribu des Cantherellus (5genera)

The special significance attached to characteristics such as consistency of the basidiocarps was difficult to determine. Patouillard (1900) considered this characteristic fundamental for division into genera and sections, whereas little value or none at all was accorded to the microscopic features. After the publication of "Essai taxonomique", Patouillard (1900) continued to develop and improve his concepts on the classification of these fungi in accordance with the new discoveries. Patouillard's, classification had many followers; the most prominent among them were Bourdot and Galzin, authors of the fundamental work "Hymenomycetes de France" (Bourdot and Galzin, 1928). They not only adopted the classification but also introduced in Patouillard's system several essential corrections on the basis of microscopical examinations of their own material.

Fries's Thelephorei was conceived as the receptacle for those Hymenomycetes in which the dorsiventral fruitbody (irrespective of its shape) was provided with a smooth hymenophore, although the type species of *Thelephora* (viz. *T. terrestris* Ehrh. ex Fr.) had a warted hymenium

(hence the generic name). Patouillard preferred to call the genus Thelephora (emended, but inclusive of its type species) by the name of *Phylacteria*, and reserved the name *Thelephora* for a group of species around *Thelephora pallida* Pers. ex Pers. (type species of Bresadolina W. Brinkm.) was a taxon that comprised not only genera with smooth, but also with toothed, hymnophore, and later on other authors added a polyporoid and a cantharelloid elements. The correct name for this taxon, raised to the rank of a family, is Thelephoraceae, but the first few mycologists to treat Patouillard's series in the rank were loath to use this nane because of its traditional implications and for time they preferred the designation Phylacteriaceae. When finally the nomenclatural consequences were accepted and the Phylacteriaceae correctly called Thelephoraceae, a huge portion of the Friesian Thelephoraceae became deprived of this family name because only some of its genera went into the emended family. It has now become customary to call a good portion of what remained Corticiaceae. Moreover, it also had become customary to restrict this latter family in some respects, and thus most of the traditional Thelephoraceae became distributed over the Corticiaceae, Cyphellaceae, Stereaceae, and Thelephoraceae, while the last name gradually loses its mental association with 'smooth hymenium'.

The spreading of much of the residue over Corticiaceae and Stereaceae has no sound basis and has not led to even rational artificial families, for no clear-cut differences between the two can be given. The basic idea was that the Corticiaceae included the strictly resupinate groups and the Stereaceae those that were at least capable of producing caps (although completely resupinate individual fruitbodies might occur). This distinction cannot be upheld, but it sorts out at least the great majority of the contents of the two 'families' which are here maintained to comply with current usage for the lack of a better solution.

John Hill in 1751 was the first person to use the name *Stereum* in a generic sense (Chamuris, 1988). It was Persoon (1794) who republished the genus, without reference to Hill, as a post-Linnean name, citing as example "Thaelaephora hirsute; mesenteriformis Willd. [= *T. terrestris*]; *Th. striata*; Schrader", and at the same time describing three of his own new species, two of which were the now familiar *S. purpureum* and *S. rugosum*. Later, Persoon (1801) reduced his genus to a subdivision of *Thelephora*, while broadening its scope to cover such species as *T.rubiginosa* and *T.ferruginea* [=*T.tabacina*] with cospicuous setae projecting from the hymenium, which are now placed in *Hymenochaete* Lev.

*Stereum* Pers. (1794) was a validly published generic epithet, but when the international Botanical Congress of 1910 decided that the nomenclature of fungi caeteri should date from January Ist 1821, with the publication of the "Systema Mycologicum" by Fries, it became a devalidated name. S. F. Gray (1821) revalidated the generic name in his "Natural Arrangement of British plants."His classification of the fungi followed very closely that of Persoon's Synopsis fungorum," but was only concerned with the species then known to occur in Britain. These species were listed in the same order as they appeared in Persoon's Work.

Meanwhile, Link (1809) had emended *Stereum* Pers. by restricting it to those species which possessed conspicuous cystidia or setae, and among the examples listed were *Stereum damicorne* Link and later (Link 1809 b) *Thelephora pallida* Pers. The inclusion of these two species is of interest, as they were the first truly stipitate species to be assigned to *Stereum*. As the publication of Fries have had such a profound influence on Mycologists, it is desirable to consider his delimitation of the genus. Fries first adoted the generic name in 1825, without mentioning any species, and followed the interpretation of Link (1809), whom he erroneously cited as the author of the genus. When Fries (1828) next used the name it was as a subtribe of *Thelephora*, and all the species which he listed are now placed in *Hymenochaete* Lev. Later Fries (1836) altered his delimitation of taxon to include not only species with setae, but those possessing cystidia and in addition others which lacked both stuctures. He had virtually returned to Persoon's original concepts of *Stereum*, although it was not until 1874 that he finally acknowledged Persoon as the author of the genus.

The genus *Stereum* Pers. ex S. F. Gray rapidly became a rather large and unwieldy genus, consisting of many diverse groups of species. When Saccardo (1888) compiled his sylloge fungorum vol.6, the genus included 200 species, and this after certain of the more distinctive elements had been removed to other genera such as *Hymenochaete* etc. Since the publication of Saccardo's work many more species have been described.

Faced with such a rapidly expanding genus Fries (1838) divided it into the following five section:- Mesopus, Pleuropus, Merisma, Apus and Resupinate. In this he was followed by Saccardo (1888) with the modification that the section Merisma was abandoned and its species distributed between Mesopus and Pleuropus. However Even these sections were far from being natural groupings of species.

In the view of Fries *Thelephora* and *Stereum* were closely related genera, which usually followed each other closely in his publications. When he (Fries 1838) divided the latter into the sections indicated above, he treated *Thelephora*, which had also became a very large genus, in exactly the same manner using the same five sectional names.

Gradually a tradition became established whereby *Thelephora* was restricted to those pileate species with brown, angular, warty or spiny spores, while *Stereum* included only those with hyaline spores. Thus, although *Thelephora* emerged as a well defined natural genus, *Stereum* became even more heterogeneous as many hyaline spored species previously placed in the former genus were transferred to it. However, in both Europe and North America the effuse-reflexed species of *Stereum* are by far the most common and consequently they have come to be regarded as the typical element of the genus. Mycologists have tried to maintain these traditions when they typified the two genera. The type species of *Thelephora* is now widely accepted as being *T. terrestris* Ehrh. ex Fr. while that of *Stereum* is generally agreed to be *S. hirsutum* (Willd. ex Fr.) S. F. Gray [Donk (1933, 1949, 1957); Rogers (1950); Talbot (1954); Lentz (1955)].

Between 1955 and 1968 the generic limits of *Stereum* were more precisely defined as a result of a shifting emphasis towards the use of microscopic characters (Chamuris, 1988; Lentz, 1955; Boidin, 1958; Pouzar, 1959 and Parmasto, 1968) played a major part in this circumscription by including only those species which were obviously closely related to the type species, *S. hirsutum*. The genera *Laxitextum, Cryplochaete, Amylostereum, Boreostereum. Chondrostereum. Cystostereum, Laurilia, Dendrocorticium, Dendrophora. Lopharia, Peniophora* and *Phanerochaete* were either erected or utilised to accommodate the many species segregated from the genus *Stereum sensu lato*. These include all the stipitate forms (Reid 1965) as well as those effuso-reflexed, dimidiate or resupinate forms that posses cystidia (encrusted, gloeocystidia or sulfocystidia) or vesicles as well as the species in which the basidiomata posses clamps (on hyphae or as a basal clamp of a basidium).

Thus, by 1968, *Stereum* represented a homogenous group of species that could be interpreted as comprising a natural or monophyletic group (Chamuris, 1988). Today the genus *Stereum* is restricted to species having smooth, amyloid, binucleate spores, dimitic basidiomata without clamps and with pseudocystidia. It is also characterised by holocoenocytic nuclear behaviour and sparse, opposite or verticillate clamps on the broader hyphae of monosporous as well as polysporous cultures (Boidin *et al*. 1979). The closely related genus *Xylobolus* is

maintained as a distinct genus in the same evolutionary line as *Stereum* (Chamuris 1988). The genus is now well defined (Chamuris 1988; Hjortstam & Ryvarden 1989).

The selection of *S. hirsutum* as the type species of *Stereum* has been a fortunate choice, for apart from maintaining the genus in its traditional form, it also typifies the name by a member of one of the largest and most clearly defined groups within it. The species of this group have effused-reflexed pilei, with the upper surface usually covered by a thick tomentum. They have, without exception, a dimitic hyphal structure, consisting of very thick-walled, hyaline, unbranched skeletal hyphae, some of which curve down through the flesh and into the thickening hymenium where they terminate as modified conducting organs while others curve upward to form the surface tomentum of the pileus, and thin-walled, branched, septate, hyaline generative hyphae which normally lack clamp-connexions. The spores are smooth, hyaline and elliptical, subcylindrical or somewhat allantoids in shape. Boidin (1950, 1958, and 1960) has shown that the spores of *S. hirsutum* and a number of allied species are amyloid. It soon becames obvious after studying fungi currently placed in the genus that many can no longer be retained in *Stereum* sensu stricto and will have to be transferred to other genera. Clearly a revision of the whole genus was urgently required.

Karsten (1881) was one of the first mycologists who attempted to split the large Friesian genera into smaller taxa, and described a new genus *Cotylidia* Karst. to accommodate the only stipitate stereoid fungus then known to occur in Finland-*Thelephora undulata* Fr. As a result the species of *Cotylidia* were characterized by having white or ochraceous spores and a tough pileate, stipitate fruitbody.

Later Patouillard (1900) also tried to break the Friesian genera into smaller and more natural units and recognized the stipitate stereoid fungi as forming a distinct genus which he named *Podoscypha* Pat. In addition to the details of external morphology he also stated that the species had projecting, hyaline, cylindrical or pointed, delicate thin-walled cystida, and smooth ovoid spores. It is obvious that Patouillard considered his genus to consist mainly of tropical fungi and indeed all the examples cited were from the tropics, with the exception of *Podoscypha sowerbeji* (Berk.) Pat. which is anomalous in several ways. *Podoscypha elegans* (G. F. W. Meyer ex Fr.) Pat. has been selected as the type species of the genus by W. B. Cooke (1953). It was the only species fiqured and in addition was the first of the examples listed by Patouillard.

Another genus considered in connexion with the stipitate stereoid fungi was *Cymatoderma* which was described by Junghun (1840) and based on his own species *C. elegans* Jungh. He gave an adequate generic description and an excellent account of the only species, which was figured. Junghuhn noted the peculiar radiating; almost dendroid, folding of the hymenial surface and observed that it was covered by conical wart-like processes. In addition he mentioned the presence of conspicuous raised knife-edged crests and the thick tomentum of the upper surface of the pileus. However, Junghuhn's name was never accepted by Fries, and consequently it was amost forgotten. Fries used the generic name *Cladoderris* Pers. ex Berk. for those species allied to *Cymatoderma elegans*, and all mycologist subsequently followed him in adopting this name. Thus, *Cymatoderma*, until very recently, contained only the one species while *Cladoderris* grew to include about twenty. Donk (1941) therefore proposed *Cladoderris* as a nomen conservandum against *Cymatoderma*, but the proposal was rejected by the special committee for Fungus Nomenclature (taxon 2, 31, and 1953). Thus *Cymatoderma* is the correct generic name for these fungi. However, several species in which the hymenium is devoid of warts and shows only slight radial grooving have been described in or transferred to *Stereum* and *Thelephora*. In view of this and the close relationship existing between the species of *Cymatoderma* and those of *Podoscypha* has been included in the present study.

The first contribution towards the classification of stipitate stereoid fungi was the publication of two papers by C. G. Lloyd (1913 a & b) entitled "Synopsis of the genus *Cladoderris*" and "Synopsis of the stipitate *Stereum*" respectively. These publications were notable since they were the first to deal with this group of fungi as a separate entity and also because they dealt with them on a world-wide basis and included most, but not all of the then known species; they came very near to being complete monographs. Lloyd travelled widely and visited most of the larger European herbaria and so his observations were often based on a personal study of type material. His works are abundantly illustrated with photographs, and these too, in many instances, depict type specimens some of which were subsequently destroyed in the 1939-1945 war. Unfortunately Lloyd showed very little regard for microscopic characters in his classification of this group of fungi. In his description of the species he frequently omitted to give details of spores size and shape and when he published microscopic data it was often inaccurate or distinctly misleading. He repeatedly stated that cystidia were absent from species in

which they are a marked features. His division of the stipitate *Stereum* into eleven sections was highly unsatisfactory and often unworkable, but it nevertheless formed a basis for further study.

The next important work concerning this group of fungi was that of Burt (1920) who published a monograph of the species of *Stereum* occurring in North America, which included descriptions of 28 stipitate species. This publication was notable since the author examined type material whenever possible and gave fairly detailed and accurate accounts of spores and cystidia. However, in his key he divided the stipitate species into four sections based on the presence and position of the stipe, which has already been shown to be unreliable characters. Later Burt (1924) wrote an account of two species of *Cladoderris* occurring in the same region.

Following the works of Lloyd and Burt a number of accounts of species of *Stereum* occurring in local geographical areas were published. Meanwhile, in Europe mycologists were beginning to adopt the generic epithets *Cotylidia* and *Podoscypha*. However, until very recently these genera were published and these often included description of stipitate species. Meanswhile, in Europe mycologists were beginning to adopt the generic epithets *Cotylidia* and *Podoscypha*. However, until very recently these genera were applied very loosely to the stipitate stereoid fungi in general, exclusive of those which had traditionally been referred to *Cladoderris*. Thus workers of those which had traditionally been referred to *Cladoderris.* Thus workers such as Maire (1909), Bourdot and Galzin (1928), Pitat (1930) and Skovsted (1956) used the generic name *Podoscypha* for such European species as *Thelephora* undulata (Fr.) Fr. And *T. pannosa* [Sow.] Fr.[=*T. sowerbeji* (Berk.) Berk.; *T.pallida* (Pers.) Pers. which in fact belongs in *Cotylidia*. Then again Lundell and Nannfeldt (1947) used the generic name *Cotylidia* and transferred to this species shows differences from the true members of this genus and cannot be grouped with them.

It was Donk (1931) who first pointed out that *Cotylidia* and *Podoscypha* were distinct genera and that the European species which had been placed in the latter should be referred to *Cotylidia*. Despite this the two genera, although rarely used, were still often treated as synonyms. Even quite recently Lentz (1955) adopted the generic name *Cotylidia* for three species of stipitate stereoid fungi occurring in the Mississippi Valley and listed *Podoscypha* in a wide sense to cover all such fungi occurring in Japan, exclusive of those usually referred to *Cladoderris*. So it was that these genera came to be frequently misapplied.

The misapplication of these two names was largely due to lack of knowledge of the differences existing in hyphal structure between the species of these genera. It was Banerjee

(1935) who first attempted to analyse the hyphal anatomy of species of *Stereum*. In this paper he gave details of hypal analysis using Corner's terminology for five stipitate species, but unfortunately his interpretations of the hyphal structures are at variance with those of later workers. However, almost 20 years later Talbot (1954) published a paper on the genus *Stereum* in South Africa in which he gave accounts of eight stipitate species. This paper contained the first accurate data on the hyphal anatomy of these stipitate stereoid fungi. Later in the same year Welden (1954) published an account of some stipitate *Stereum* occurring in tropical America, and he too gave details of the hyphal structure. It should be noted; however, that both Talbot and Welden retained theses stipitate fungi in the genus *Stereum s. l.*

The next event in the study of these fungi was the publication by Welden (1958) of a contribution towards a monograph of the genus *Cotylidia*. In this paper, which included accounts of five species, the author failed to make full use of hyphal anatomy as a means of characterizing The genus, but he did restrict it to those species lacking in clamp-connexions. In the same year Talbot (1958) wrote an account of *Cymatoderma* in South Africa, recognizing only one species. The following year Reid (1959) published a preliminary monograph of the genus on a world-wide basis and by using a combination of macroscopic and microscopic data was able to define the genus in such a way that the species were clearly separated from the other stipitate stereoid fungi.

Another important event in the classification of the stipitate *Stereum* was the publications by Boidin (1959) of a survey of these fungi based in part on a study of the literature but also including observations based on an examination of some type specimens. In this paper the author recognized the genera *Cymatoderma, Cotylidia* and *Podoscypha* and characterized them very largely by reference to microscopic data, including hyphal anatomy in such a way that they correspond closely with the generic limits as accepted in this study. Nevertheless, as proposed by Boidin these genera still contained certain discordant elements.

According to Chamuris (1988), *Stereum* and *Xylobolus* form a core among genera that have been included in Stereaceae. However, many genera of the family show distinct characters of their own, different from those of *Stereum*, and were often regarded as distantly related to *Stereum* by many authors. For instance, members of *Amylostereum* with amyloid spores and a dimitic hyphal system consisting of skeletal hyphae have similar characters, which are closely related to those of *Stereum*, but they differ by the brown colour of the entire basidiocarp caused

by intramembranal pigmentation of skeletal hyphae and cystidia Pouzar (1959). *Chondrostereum* differ from *Stereum* in its cartilaginous consistency of trama, vesicular bodies, and inamyloid spores Pouzar (1956).

As many genera of the Stereaceae are so different to one another as stated above, various controversies existed on the familial assignment of genera among taxonomist (Chamuris (1988), Donk, 1964; Julich, 1981; Nakasone, 1990; Talbot, 1973; Donk, 1964) included *Chondrostereum* in the Stereaceae, while Parmasto (1968) and Talbot (1973) included it in the Corticiaceae. Laxitextum was included in the Hericiaceae by Donk (1964) but was later placed in the Corticiaceae by Parmasto (1968) and Talbot (1973). Julich (1981) suggested a new family Chaetodermataceae that includes *Chaetoderma* of the Corticiaceae and also *Columnocystis* which was classified in the Stereaceae by Donk (1964), Talbot (1973), and Parmasto (1968).

Recently phylogenetic studies using molecular markers have been applied to various taxonomic situations for solving taxonomic problems, and molecular techniques are becoming increasingly important as a means to obtain appropriate characters and to study taxonomic and phylogenetic relationships among fungi (Barr, 1992; Berbee and Taylor 1992; Bruns *et. al.* 1992; Hibbett *et al*. 1997; Hong *et al*. 2000, Kim *et al*. 2001]. Some species in the Stereaceae have been sequenced as part of phylogenetic studies on the Aphyllophorales. Hibbett and Donoghue (1995); Hibbett (1996) and Hibbett *et al*. (1997) have determined sequences of nuclear and mitochondrial ribosomal RNAs from some stereoid fungi. Boidin *et al.* (1998) extensively studied internal transcribed spacer (ITS) region of numerous genera and species in the Aphyllophorales, including phylogenetic conclusion have been made on the systematic of the Aphyllophorales, but few facts have yet been established about the relationship of taxa in the Stereaceae. Wu *et al*. (2001) recently analyzed *Aleurodiscus* s. l., taxonomically equivalent to *Aleurodiscus* sensu Nunez and Ryvarden [1997], using nuclear large subunit ribosomal DNA data, and discussed the phylogenetic relationships of aleurodiscoid fungi in relation to stereoid fungi.

Based on the results inferred from nuclear small subunit ribosomal RNA gene sequences, it became clear that the Stereaceae *s.l* was phylogenetically polyphyletic and its genera were scattered into many group, each of which was comparable or equal to a family level or a new family ranks Group A is composed of *Stereum*, *Xylobolus*, *Gloeocystidiellum* and *Aleurodiscus* and, based on most recent phylogenetic studies, constitutes the core group of stereoid fungi. In

terms of bootstrap values, Group A froms a clade at significant confidence level, and is possibly composed of phylogenetically homogeneous taxa.

The results of the Kishino & Hasegawa test (1989) confirmed the monophyletic circumscription of the Stereaceae assigned to Group A. In the studies by Hibbett *et. al* (1997) and Hibbett and Thorn (2001), the Stereaceae was included in the russuloid clade where most of its families have distinct characters and are probably monophyletic. With the addition of two more genera, *Gloeocystidiellum* Donk and *Aleurodiscus* Rabenh., to the core concept of Chamuris (1988), it is taxonomically essential that the traditional Stereaceae should be evaluated in a strict sense as a phylogenetically distinct taxon based on the members of Group A [Kim & Jung 2000] and those of Hibbett *et al.* (1997) and Wu *et al* (2001). In the present study the family Stereaceae has been treated following Donk (1964) for easy references to the workers. I have treated all the genera occurring in India following Donk (1964) plus the genera forming the core group of the Stereoid fungi in the above studies.

**Work done in India:**

The earlier reports of stereoid fungi from India date back mainly to Montagne (1842, 1846); Berkeley (1844- 1856), Hennings (1900, 1901) Theissen (1911) and Lloyd (1898-1925). However Bagchee *ET al (1954), Bagchee & Bakshi (1954), Bagchee & Singh (1960), Banerjee (1935, 1947), Natrajan & Kolandavelu* (1985, 1998) were among the pioneer workers giving account of several Indian stereoid fungi. More serious contributions have also been made Rehill & Bakshi (1965, 1966), Thind & Adlakha (1956), Reid *et al* (1958), Thind & Dhingra (1985), Khara (1968) Thind & Rattan (1968-73). The first serious study was made by Bagchee and Bakshi (1954) who described 14 species. Six more species were described by Thind and Adlakha (1956). Reid *et al.* (1958) and Rehill and Bakshi (1966) in their generic monographs recognised 18 species of *Stereum* as validly reported from the India, while four more species were added by Thind and Rattan (1971 a, b). Thind and Rattan (1968 - 1973) described 59 species (under Thelephoraceae) including 36 new records and 6 new species. The major contributions by Rattan (1977) and Sharma (2012) have delt in detail on the stereoid fungi from North Western Himalaya. Recently some checklists giving complete Aphyllophoralceous diversity data from Western Ghats of Maharashtra State has been done by Ranadive *et al.* (2013). Similarly,

checklists of these fungi for Himachal Pradesh also by Prasher & Deepali (2013) Himalaya & adjoining areas by Dhingra (2014) and Hemchander *et al* (2017) have been published.

## MACRO AND MICROMORPHOLOGICAL CHARACTERS

**Basidiocarp:**

The basidiocarps may spread over the substratum and make a resupinate form and become firmly attached to the substratum by its abhymenial surface or rather loosely attached by means of its subicular extension. Sometimes it may become partially appressed and partially reflexed from the substratum at its margin, such basidiocarps is called *effused-reflexed*. The term pileate is used to oppose the term resupinate. A fungus may develop several forms as it transforms from a resupinate to effused-reflexed to pileate form. The pileate basidiocarps may be centrally, laterally or centrally stalked. The stalk may be reduced to a knob or disc or otherwise very short **(Fig. 1).**

External morphological characters of the upper surface of the pileus are of value only in the genera *Cymatoderma* Jungh., and *Podoscypha* Pat. All the species belonging to the remaining genera have a smooth or minutely radially wrinkled surface. Members of the genus *Cymatoderma* have the surface of both pileus and stipe covered by a tomentum, but the degree of development varies with the species. In *C. elegans* it forms a very thick spongy layer near the base of the pileus which may reach a thickness of 1 cm in striking contrast to the very thin flesh, but in other species it is poorly developed. The appearance of the actual surface of the pileus beneath the tomentum is a taxonomic characters of importance in this genus for in most species it bears prominent radiating knife-edged crests of varying length; a feature unique among this group of fungi. These crests can usually be seen near the margin of the basidiocarp where the tomentum is thinner, and are responsible for irregularities in this felt-like covering. Species of *Podoscypha* differ considerably in the appearance of their upper surface. Some appear minutely pulverulent under a lens owing to the presence of pilocystidia, while there is a well developed tomentum or peculiar in having small branched processes arising from near the base of the upper surface of the pileus. Microscopic examination shows that the surface 'hairs' of various species are frequently formed of characteristic hyphal elements.

While the above characters appear to have considerable taxonomic value, their reliability in routine determinations depends on the state of preservation of the collection. While still in the

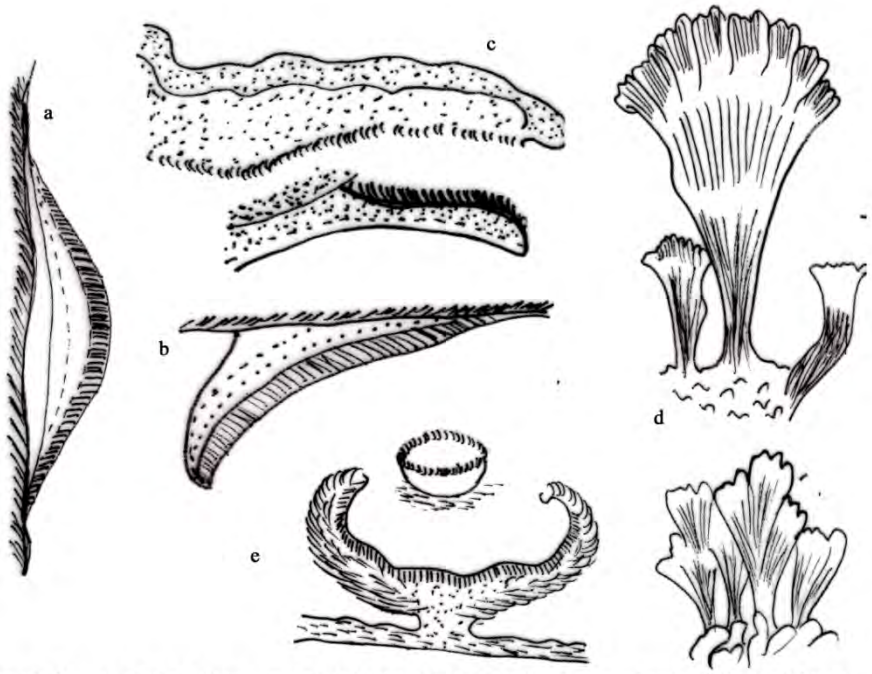


**Fig. 1: Types of basidiocarps and their attachment:** a) resupinate, b & c) effused-reflexed, d) infundibuliform.

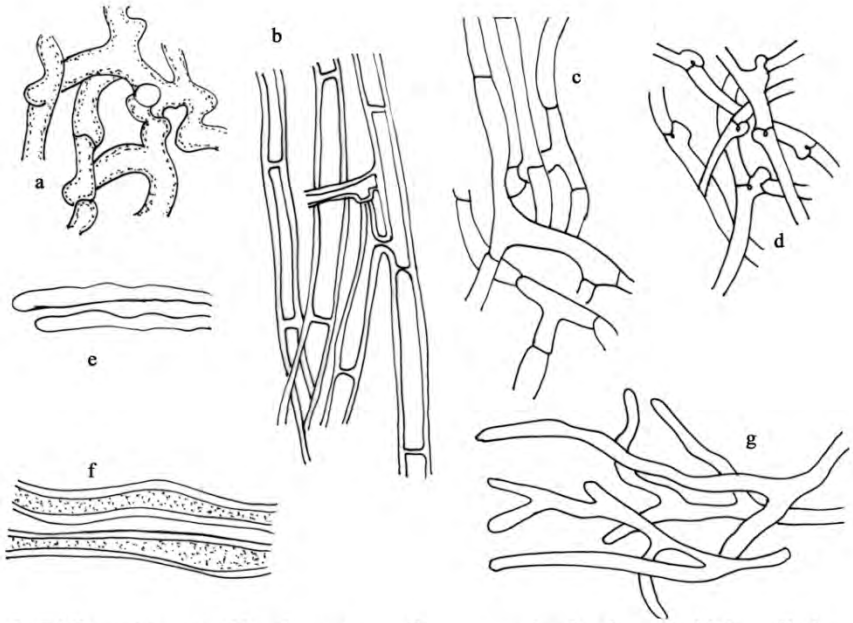


**Fig: 2: Different types of hyphae:** a) swollen generative hyphae, b) thick-walled septate generative hyphae, c) thin walled septate generative hyphae, d) thin-walled clamped generative hyphae, e) paraphysoid hyphae, f) skeletal hyphae.

field, fungus basidiocarp are subject to weathering which may lead to almost complete disappearance of tomentum from the surface of old specimens.

The consistency of basidiocarp can vary from very loose to almost hard and horny on drying. Highly organised tissue may built a coriaceous, gelatinous, cartilaginous, succulent, corky or woody texture. The texture of the actively growing tissues is modified with age and drying. The margins of resupinate basidiocarps are frequently pruinose or furfuraceous, arachnoid to fibrillose, fimbriate to byssoid or even rhizomorphic.

**Colour:**

The colour of living basidiocarps in stereoid fungi is a reasonably constant features of great taxonomic value. However, this cannot be fully utilized as key characters as so many collections in herbaria lack the requisite data, and most tropical species have been described without reference to fresh material. Considerable colour changes may occur during drying and the final shade is influenced by a number of factors such as the age of the sporophores when gathered, the lapse of time between collecting and drying, and the speed and method used. The pileus of dried specimens is usually some shade of brown or buff above and cream with ochraceous or greyish tints below.

**Habitat:**

The majority of the fungi under discussion are lignicolous and in many instances even those species which are said to be terrestrial probably grow from buried wood. Nevertheless, the differences in habitat favoured by the various species would seem to be of some taxonomic importance. Thus it appears that species which normally grow from buried wood seldom occur on rotting trunks and other woody debris above ground or vice versa. However, the usefulness of this character in the taxonomy of the group is somewhat limited since exsiccati all too frequently lack this information.

**Hymenophore :**

It is that portion of the basidiocarp which is directly adjacent to the hymenium and usually responsible for the various hymenial configurations. The vast majority of stereoid fungi possess a smooth hymenium which may become minutely radiately wrinkled in dried material. Members of genus *Cymadoderma* Jungh. and *Lopharia* Kalchbr. & MacOwan however, have the hymenial surface thrown into folds or a complex system of radiating ribs. Examination of both dried and

preserved material and reference to published descriptions show conclusively that this is a feature of the living plants. Each species although minor changes due to shrinkage undoubtedly occur during herbarium specimens of any one species appear remarkably uniform. The configuration of the hymenium is therefore of limited importance in the taxonomy of these fungi.

The hymenial surface of certain species of *Cymatoderma,* in addition to being folded or ribbed, may also be covered with warts or spines. Thus herbarium material of *C. elegans* usually has a densely warted hymenium but in some collections warts are scanty and in others lacking. Dried specimens of *C. dendritricum* have a hymenium which is normaly devoid of warts or spines, but occasionally sporophores are found with a warted or densely spiny hymenial surface. The presence of such warts or spines is thus not a reliable taxonomic characters but may be used in a preliminary sorting of collections after which the identity of doubtful specimens must be confirmed by microscopic examination. Lloyd (1913) also concluded that the presence or absence of papillae was an inconstant character.

**Hyphae :**

The classical study of (Corner, 1932) on hyphal characters has since become a useful tool to describe fruitbody structure and is now essential to an understanding of the taxonomy of aphyllophorales. The hyphal systems are fairly consistent to the species and are applied on a wide scale to characterize genera and even taxa of higher ranks.

The basidiocarps consist of two general types of hyphae i.e. generative and vegetative. The generative hyphae are the basic units of any basidiocarp and are always present. They are always septate and vary from one species to another and even within the same fruitbody as to the width, wall thickness, type of septa, clamps, contents, branching and colour The vegetative hyphae develop from the generative hyphae and are never septate and have distinctly thicker walls than the generative hyphae. The skeletal hyphae normally are very long and straight, unbranched, hyaline or coloured while the binding hyphae are much branched, solid to very thick-walled and of limited growth with tapering hyphal ends.

In the trimitic basidiocarps three systems of hyphae are encountered. Two types of vegetative hyphae i.e. skeletal and binding hyphae arise from the basic type *i.e.* generative

hyphae. The generative hyphae are thin-walled, branched and septate with clamps. Typical skeletal hyphae are unbranched, narrow, aseptate or very rarely with secondary septa. The binding hyphae are much branched, narrow, aseptate to very rarely septate, thick-walled and of very limited and intricate growth. The basidiocarp is called dimitic, if only two of the above mentioned systems of hyphae are present. The two types are; (a) generative hyphae combined with skeletals and (b) generative hyphae combined with binding hyphae. **(Fig.2)**

The basidiocarps of species belonging to genera *Aleurodiscus* Rabenh. *Gloeocystidiellum* Donk, *Stereopsis* D.A. Reid and *Chondrostereum* Pouzar are simple built and composed of monomitic generative hyphae. These hyphae are thin-walled, septate, branched, little differentiated and always identical in their manner of growth but sometimes may be modified into other types of hyphae (Corner, 1953).

However, until the commencement of the present study very little was known of the hyphal structure of stereoid fungi. Banerjee (1935) following the techniques and terminology of Corner, was the first to publish a detailed account of the hyphal anatomy of members of Thelephoraceae. This included descriptions of five species of *Stereum* (*S. elegans*, *S. nitidulum, S. petalodes, S. crenatum,* and *S. glabrescens*). Unfortunately hyphal analysis was then in its infancy and the delimitation of the various types of the hyphae was, perhaps, not fully understood. Banerjee (loc. cit.) clearly confused generative and binding hyphae in a number of species as can be seen from his figures and text. As a result Banerjee's conclusions on the number of hyphal systems involved in the formation of the fruitbodies of certain species cannot be accepted today. This is particularly true of his observations on the hyphal structure of the stipitate species indicated above, for he stated that *S. elegans*, *S. nitidulum* and *S. petalodes* had a trimitic construction, while the present investigations and those of other workers have shown them to be dimitic. Talbot (1954) investigated the hyphal anatomy of species of *Stereum* in South Africa and the Upper Mississippi Valley respectively, but relatively few stipitate species were involved. Welden (1954) in a paper entitled "Some tropical American stipitate *Stereums*" used hyphal structure as the primary character in a key for the identification of the 11 species described. However, as he worked with so few species his conclusions could not be applied to the entire group without further extensive study. Cunningham (1956) published an account of the

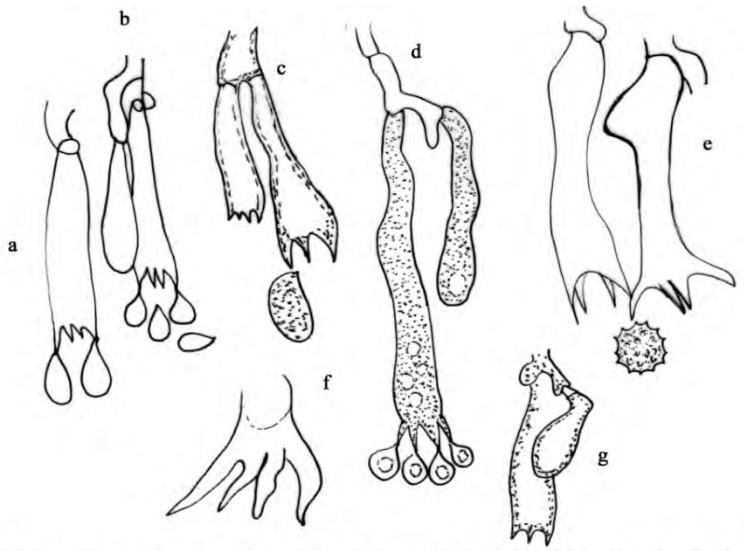


**Fig. 3: Types of basidia:** a) pleural, b) 4- spored, c) tubular, d) clavate, e) constricted, f) utriform without stalk, g) utriform with stalk.

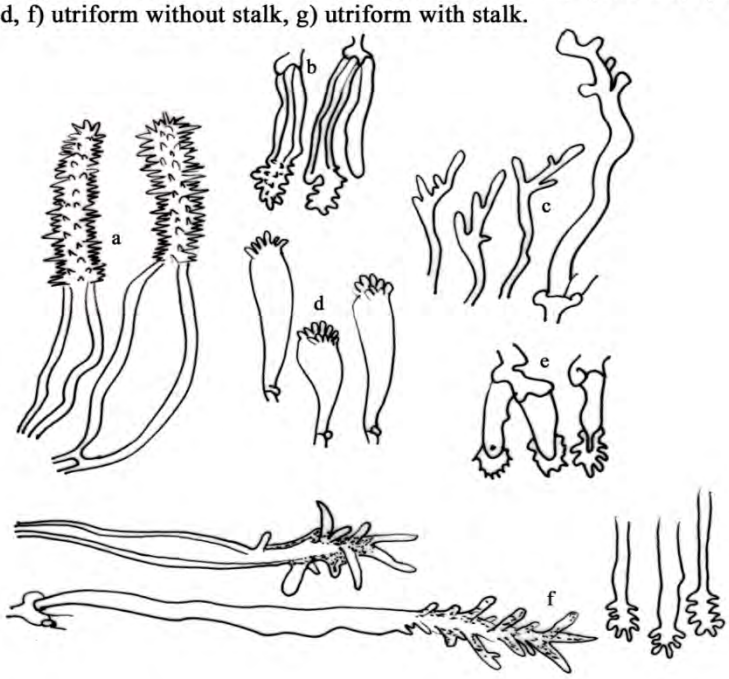


**Fig. 4: Different shape of hyphidia:** a to f) acanthohyphidia or acanthophyses, c) paraphyses

New Zealand species of *Stereum* giving details of hyphal structure, but only four stipitate species were included. However, he worte of the stipitate species of the genus as a whole.

In view of these statements special attention was given to hyphal structure of the sporophore during the present study, in the hope that it would reveal natural relationships fungi it is now clear that hyphal analysis is of immense value in demonstrating such affinities and in defining generic limits. The group includes species with monomitic, dimitic, and trimitic construction, which can readily be assigned to genera with the aid of additional microscopic characters.

The presence or absence of a distinct cuticle may be a character of value in helping to distinguish between species. In most of the stipitate stereoid fungi there is no such well defined layer and the upper surface of the pileus is either formed of more or less parallel, longitudinally orientated hyphae, with obtuse adpressed or free endings as in monomitic species, or of slightly more densely compacted hyphae in many dimitic and trimitic species. However, the majority of stereoid fungi with a surface tomentum have a distinct cuticular layer of variable thickness. This is formed of densely compacted hyphae which may be somewhat agglutinated, but even when teased apart can be seen to consist of skeletal hyphae intimately bound together by modified thick-walled coralloid generative hyphae.

Another feature of the hyphal structure which may be of assistance in classification is the nature of the surface tomentum. In species of *Cymatoderma* this layer is particularly well developed and is formed of very elongated hyphae with thick walls and narrow lumena, at least in their basal portion, though they may be thin-walled towards their obtuse apices. These hyphae in addition to being pseudo-septate also develop septa with clamp-connexion at intervals along their length and must therefore be regarded as modified generative hyphae. Such a structure is unique among these fungi. In species of *Podoscypha* with a distinct tomentum this layer is formed of hyphae similar to those of Cymatoderma, but always lacking in clamp-connexions at the primary septa.

In many basidiocarps, additional kind of hyphae called pseudocystidial and gloeocystidial hyphae commonly are encountered. These types of hyphae are not taken into account in defining the hyphal construction of the basidiocarps but are regarded as a type of their own. In the genus *Stereum,* pseudocystidial hyphae which are commonly thick-walled, with oily contents, aseptate,

very long without branching and morphologically similar to skeletal hyphae are present throughout the context and the hymenium. The gloeocystidial hyphae are thin-walled, aseptate, often long and tortuous without branching and with refractive contents. These hyphae are present in genera like *Gloeocystidiellum.*

**Hyphidia:**

These belong to the generative hyphal system and are produced in advance of basidia (Donk, 1964). The main types of hyphidia found are (a) dendrohyphidia (irregularly and strongly branched); (b) dichohyphidia (dichotomously branched); (c) asterohyphidia (with stellate branching) and (d) acanthohyphidia (with a bottle brush appearance) **(Fig. 4).**

**Cystidia:**

The term cystidium has been widely used to describe various types of cells found in Basidiomycetes, which are morphologically and sometimes chemically differentiated from the basidia, psudeo-paraphysis and hyphal endings in the hymenium or from other elements forming the sterile surfaces of the sporophores. These variously shaped cells arise in different ways, have thin or thicked walls which are either hyaline or coloured, and may or may not be incrusted with mineral matter. The term gloeocystidium was subsequently introduced for those deeply staining, thin walled, hyaline, cylindrical, flexuous or moniliform cystidia with highly reflective oily contents, originating in the trama and which although curving into the hymenium rearly project beyond the basidia.

According to the location, cystidia are hymenial (originating in the hymenium or subhymenial layer) or tramal (originating in the subiculum or trama and projecting into the hymenium. The hymenial cystidia become embedded far below the fertile basidial layer by the increasing hymenial tissue, so these terms are sometimes misleading and of little practical use (Price, 1973). Morphologically, cystidia may be divided into classes based on various sets of characters like hyphae-like, projecting beyond hymenium (Hyphocystidia); shape (club shaped, fusiform, capitate, utriform, etc.); thickness of walls (Leptocystidia with thin to moderately thick-walls and Lamprocystidia or Metuloids with thick glassy and often breakable walls); oily

contents (Gloeocystidia). Apical or heavy encrustations are common in Lepto and Lamprocystidia. **(Fig. 5)**

Some other sterile elements which are sometime diagnostic at species level are: basidioles (immature and eventually sterile basidia) and cystidioles (smooth bottle shaped or clavate, often pointed and tapering). The cystidioles differ from immature basidia by being pointed and tapering at apices as compared to widened and rounded top of basidia. In *Stereum,* the cystidioles may appear as acutocystidia or acanthocystidia and arise from the same hymenial level as basidia.

Gloeocystidia are the other characteristic type of cystidia found in these fungi with distinct oily contents. They are usually more or less of vesicular, tubular in shape or often sinuous or with constrictions. The oily contents are often refractive and somewhat yellowish. They differ from the hyphae (gloeocystidial hyphae) from which they originate both in diameter and shape. In certain species belonging to genera *Gloeocystidiellum,* the contents may stain bluish black with sulpho-vanilline (aldehyde-reaction).

The most frequent type is the gloeocystidium, which is characteristic of the genera *Cymatoderma*, *Podoscypha* and many species of *Stereopsis*. In the latter genus there are species lacking gloeocystidia, but in the majority they are present although poorly differentiated. Poorly differentiated gloeocystidia occur in *S. mussooriensis* (Henn.) Reid. These are long cylindrical organs showing very little, if any, swelling in the basal portions, and in which the contents contract and appear as a spiral worm-like thread examined in 10% potassium hydroxide solution. This latter feature is probably not a constant character as it has been observed in gloeocystidia of other fungi on rare occasions. In the genus *Podoscypha* the gloeocystidia tend to be more highly differentiated, although in a few species such as *P. molleri* (Bres. & Henn.) Reid they are narrow cylindrical bodies and closely resemble those found in *Stereopsis*. In the majority of species, however, the gloeocystidia have distinctly swollen bases, taper gradually to an obtuse or acute apex, and are frequently constricted at irregular intervals. Very similar gloeocystidia occur in the genus *Cymatoderma* but the constrictions are often sufficiently numerous to give these organs a moniliform appearance.

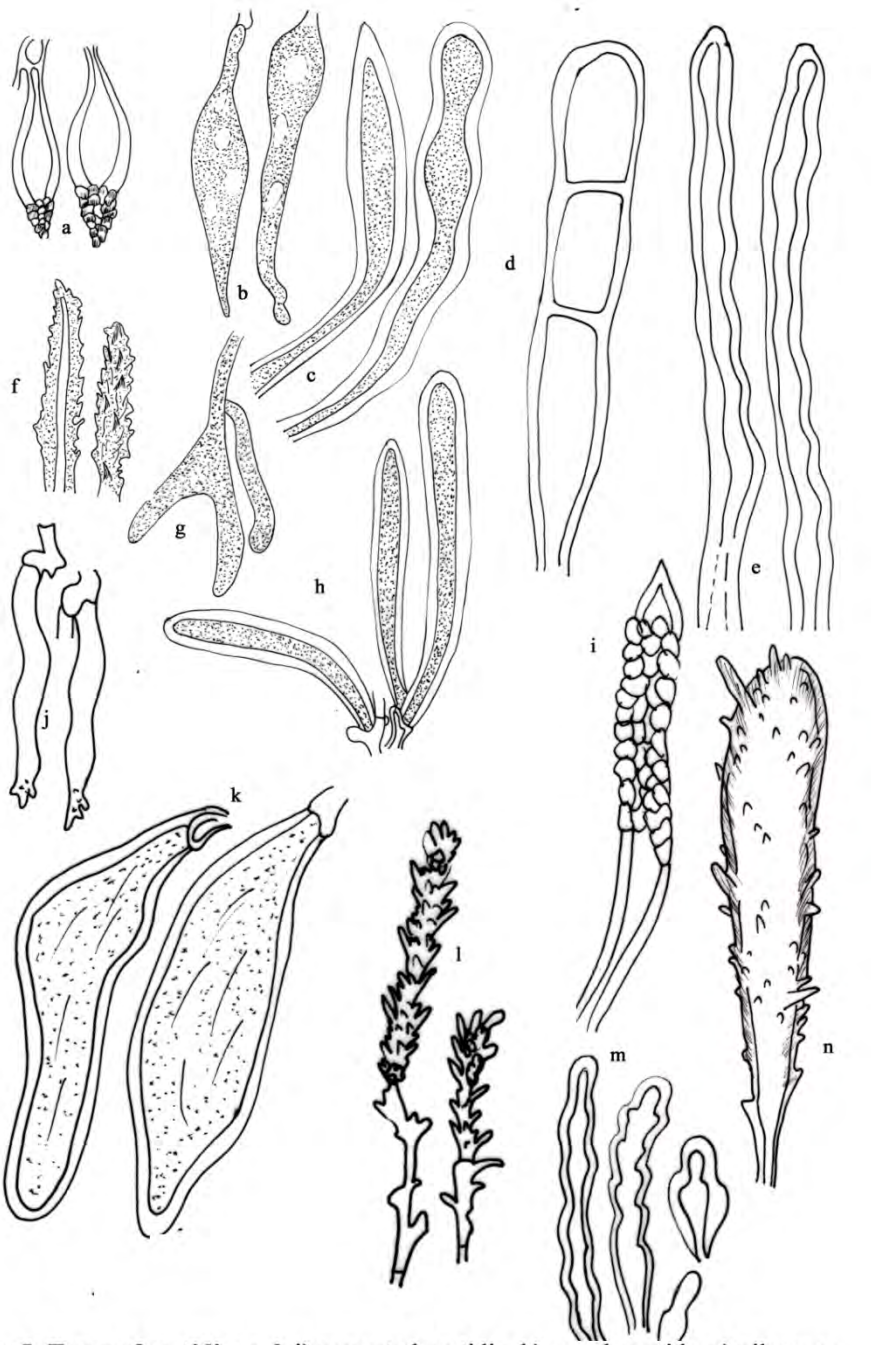


**Fig. 5: Types of cystidia:** a & i) encrusted cystidia, b) pseudocystida, c) pileocystidia, d) leptocystidium, e) skeletocystidia, f) rough cystidia, g) branched gloeocystidium, h) caulocystidia, k) gloeocystidia, l) acanthocystidia, m) moniliform cystidia, J & n) ornamented gloeocystidia

The gloeocystidia of the stipitate *Stereum* have certain features in common. They are thin-walled, arise from conducting hyphae in the trama, have contents which stain deeply in aniline blue in lactic acid, rarely project more than 10-15µ above the basidia, and continue to grow at the same rate as the hymenium thickness. As a result of continued growth these organs may reach several hundredµ in length and may extend throughout the total thickness of the hymenium. Should the hymenium reach a very great thickness, however, the first formed gloeocystidia cease to grow and become buried while new ones are produced at various levels to replace them. It is clear, therefore, that the length of these organs varies with the age of the fruitbody and their position on the sporophore. Because of this variation little taxonomic importance can be attached to the size of gloeocystidia. As there is also considerable variation in shape between the gloeocystidia of an individual fructifiction they are of relatively little help in distinguishing between related species. They are, however, of great importance in the definition of genera but there is one disadvantage in using the presence or absence of gloeocystidia as a major key character. Because of their thin walls these organs tend to collapse rather readily and in old or poorly collected material it may be difficult or even impossible to demonstrate their presence.

In addition to gloeocystidia certain species of *Cymatoderma* possess thick-walled, lanceolate, and obovate or obpyriform cystidia metuloids which project beyond the basidia and are usually apically encrusted with mineral matter soluble in 10% potassium hydroxide solution. These organs, which may become secondarily septate, arise from thin-walled tramal hyphae, often at considerable depth, and are on rare occasions found totally immersed in the flesh just above the hymenium. They are of limited growth, and so become buried as the hymenium increases in thickness, but new ones are produced at various levels. Initially they are thin-walled but gradually the wall thickens, with the result that the first formed and most deeply buried metuloids eventually become almost soild. Such organs are conspicuous, especially in hymenial squashes, and provide a very reliable character for the recognition of certain species.

A third type of cystidium is characteristic of the genus *Cotylidia*. These arise from tramal hyphae and protrude beyond the basidia as much as 100µ to form thin-walled cylindric or subcylindric bodies with broadly obtuse or gradually tapering apices. In *C. aurantiaca* (Pers.) Welden the cystidia may become septate and all gradation occurs between large globose structures and typical cylindrical cystidia. As with the gloeocystidia and metuloids discussed

above so these organs may become buried in the thickeninig hymenium and be replaced by others. The exact level of origin of this type of cystidium is still uncertain. In species of *Stereopsis* and *Podoscypha* there occur gloeocystida on the upper surface of the pileus, which are very like those found in the hymenium.

However, in certain species of *Podoscypha* there are sterile morphologically differentiated cells on the surface of the pileus and stipe which have no analogue in the hymenium. These have been recorded throughout the present work as pilocystidia and caulocystidia respectively. The caulocystidia are typically long, cylindrical, secondarily septate structures with strongly thickened hyaline or yellowish-brown walls, and arise from generative hyphae deep in the tissue of the stipe. Where these organs emerge to form the stiff bristle like covering of the stipe they increase markedly in width. They can, however, be traced back for considerable distance into the flesh, as unlike the surrounding hyphae, their contents stain deeply in aniline blue in lactic acid. They also penetrate the tissues at right angles to the surface in contrast to the longitudinal orientation of the other hyphae. Sometimes these caulocystidia may fork unequally or became variously constricted, especially towards the apex.

Pilocystidia are found in most species of *Podoscypha* possessing caulocystidia. They are particularly abundant nearest the stipe and become increasingly scanty towards the margin. These organs differ from the caulocystidia only in their smaller size and more superficial origin. Those nearest the margin are often very small, thin-walled, clavate or cylindrical structures with deeply staining hyaline contents, but nearer the stipe they are larger and develop thicker walls except in the apical portion. Like the caulocystidia they arise from thin-walled generative hyphae to which they are joined by a clamp-connexion. Pilocystidia and caulocystidia are constant features of certain species of *Podoscypha* they are a character of considerable taxonomic importance in this genus.

In the family *Stereaceae* the gloeocystidia sometimes enter into the hymenium as thick-walled cystidia-like organs and they are called pseudocystidia (Singer, 1975). Though, they resemble the skeletocystidia morphologically but the latter originate from skeletal hyphae and not the oleiferous hyphae.

**Basidia:**

They are the hymenial cells in which several important functions in the life cycle of Basidiomycetes are performed. These functions are the karyogamy, meiosis, production of spores and their voilent discharge. The basidia in stereoid fungi are holobasidia i.e. they are one celled and not divided by cross walls as in Heterobasidiomycetes. **(Fig. 3)**

Palisades of basidia mixed with sterile elements are steadily replaced by new ones with age. Thus the hymenium gradually increases in thickness and becomes layered where revived growth has occurred. The thickening hymenia are typical of stereoid fungi with a possible exception of species of *Stereopsis*. The basidia of thickening hymenia are typically clavate and mostly produce 2-8 (usually 4) sterigmata. The size of the basidium may be small to medium and rather constant according to the species.

The typical sterigmata originate as minute, more or less rounded buds which soon grow out into a tapering, slender tip producing spores. The bud has been termed protosterigmata and the pointed tip spiculum (Donk, 1954). The number of sterigmata in most genera is normally four. The number is normally constant for a species and is in several cases diagnostic for genera.

**Spores:**

The study of the spores has become an integral part of the specific descriptions. Such familiar characters as the colour of spores, size, shape and ornamentation and chemistry form important key to the identification **(Fig.6)**. During the present study spores characters have proved extremely useful for separation of species and also for characterization of genera. Within certain limits spores size and shape is remarkably constant for each species and is therefore of great taxonomic importance.

The spores of stereoid fungi, presently under study are smooth, hyaline, thin-walled and amyloid to non-amyloid, except in *Aleurodiscus* where they are finely echinulate to warted. They vary is size from very small [3x2µm in species of *Podoscypha*] to large [20-25 x 17-20µm in *Aleurodiscus*] and in shape from cylindrical, elliptical, or ovate, to subglobose.

One of the disadvantages of using spore characters in a key for the identification of species is that in certain genera such as *Cymatoderma* spores are rarely found on dried specimens. This may be due to the thin-walled spores are rarely found on dried specimens. This may be due to the thin-walled spores collapsing during drying and not swelling to their original size in potassium hydroxide or other solutions. It could also be caused by very few basidia maturing at any one time so that spores are produced over a long period but never in quantity. A third possibility is that spores are produced and shed at night as in some other tropical fungi so that no spores remain on collections made in the day time or finally spores production may be intermittent as a response to certain climatic conditions.

Another problem concerning the use of spores characters is to ensure that dimensions refer to mature spores. This is particularly difficult when working with dried material of species represented by a single collection. Normally measurements of spores from a number of collections, when available, should give a fairly reliable indication of the true range in size. The ideal solution would be to measure spores from spores from the fresh material.

Most spores are hyaline, subhyaline or minutely tinted under the microscope. The chemical nature of the spore wall has become important feature in stereoid fungi. It has become essential to establish whether a spore wall is amyloid or nonamyloid. The differential affinity shown for certain chemicals due to their different composition has also become fundamental in the taxonomy.

*Chemical tests:* Some chemical tests have attained the reputation of being high taxonomic standing in the systematics of aphyllophorales. Usually following chemicals are required during the studies.

1. Melzer's reagent: 0.5 gm iodine; 1.5 gm KI, 22 gm

Chloral hydrate and 20 gm distilled water.

2. Cotton blue: 0.1 cotton blue in 60% lactic acid.

3. KOH: 3-5% KOH in water

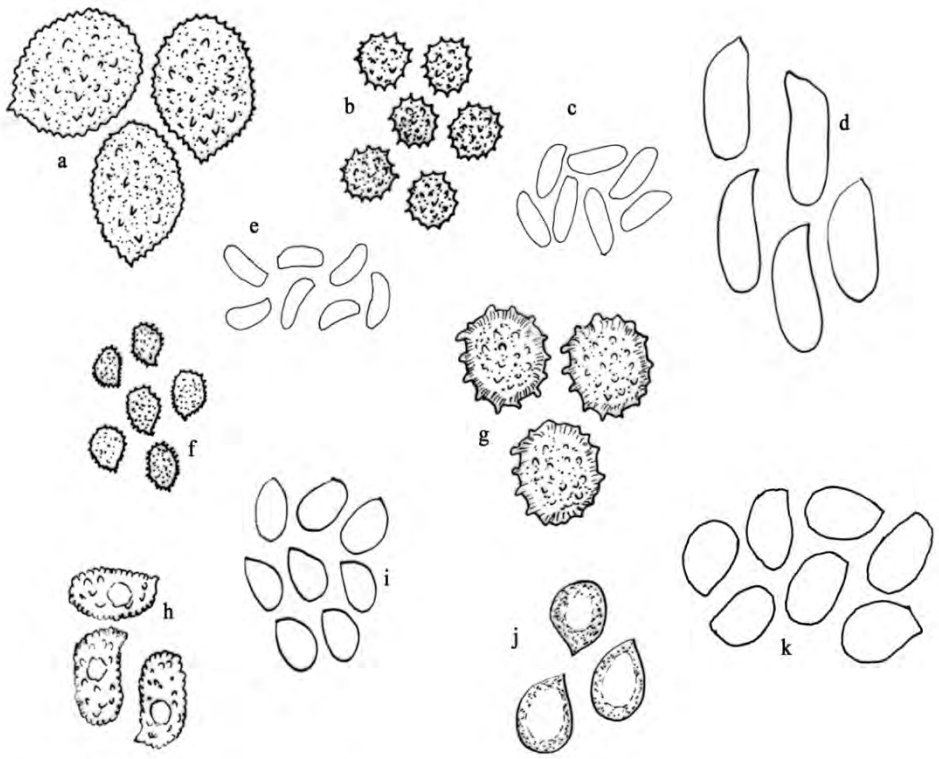


**Fig. 6: Shapes and ornamentation of spores:** a) Ovoid-ellipsoid warted, b) asperulate, cylindrical, d) navicular, e) allantoid, f) echinulate, g) ellipsoid with blunt spines, h) globose with apicules, i) ellipsoid, j) globose.

4. Phloxine: 1 gm phloxine in 100 ml water

5. Sulphovanilline: 25 gm vanilline; 2ml conc. sulphuric acid and 2 ml water

6. Ferric sulphate: 10% solution in water

Melzer's reagent has been a standard solution to test the amyloidy of the spore wall. Positive reaction with Melzer's reagent will either be amyloid or dextrinoid. The spores and/or hyphae will be coloured bluish black in amyloid reaction while dextrinoid reaction gives reddish to brown colour to the affected parts. This test is used to specify certain families, genera and species but in other groups the test is unreliable above the specific level. The taxa with positive reaction are very less as compared to taxa with negative reaction.

Cotton blue gives the cyanophilous reaction if positive in walls of spores, basidia, cystidia and hyphae. Sulphovanilline is used to colour the contents of gloeocystidia and if positive, gives a blackish colour. This reaction was considered of general importance for gloeocystidial groups, but its value is now questioned because of the inconsistent results (Larsen & Budstall, 1976).

Potassium hydroxide solution is also used in both specimens and sections to test the xanthochroic reaction. Its positive reaction permanently darkens the brown hyphae. The Calcium oxalates crystals including cystidial encrustations, walls of certain cystidia and coloured contents of hyphae/cystidia and spores are apt to change their morphology and colour in contact with KOH. Phloxine or Congo red always stain the cytoplasm within the hyphae bright red and is routinely used in microscopic examinations.

## DIVERSITY

The distribution of the genera of stereoid fungi with respect to the type of basidiocarps, hymenial configuration and approximate number of species in each habitat in India is summarized in Table-1. A total of 71 species belonging to 14 genera have been recorded from all types of forests in India as compared to c 22 genera and 125 species in the world (Kirk *et al* 2008) *i.e* 64% of genera and 57% species are represented here. *Gloeocystidiellum* with about 22 species is the largest and widely distributed genus in India followed by *Stereum* (11) *Aleurodiscus* (10), *Podoscypha* (6) *and Hjortstamia* (4).

Nearly 04 species (c 6 %) grow on ground, while the remaining 67 species (c. 94 %) are lignicolous. Both angiospermic and coniferous woods provide the major hosts for these fungi. Out of the 67 lignicolous species, 44 (*c*. 66%) grow on angiosperms, 9(*c*. 13%) on conifers while the remaining 14(*c*. 21%) prefer both type of woods. All the lignicolous species grow on the woody substrate lying on the ground.

Through, the order of frequency of occurrence may vary slightly between different phytogeographical zones of the country, but irrespective of the hosts, following are among the most frequently seen species of these fungi in India: *Stereum hirsutum* (Willd).: Fr, *Xylobolus subpileatus* (Berk. & Curt.) Boidin. *Stereopsis dimiticum* (Rehill & Bakshi) Sharma, *Cystostereum murrayi* (Berk. & Curt.) Pouz, *Stereum versicolor* (Sw.) Fr., *Aleurodiscus amorphous* (Fr.) Schroet., *Hjortstamia crassa* (Lev.) Boidin, *Lopharia cinerascens* (Schw.) Cunn., *Stereum thindii* A.B. De, *Xylobolus frustulatus* (Pers.) P. Karst., *Hjortstamia papyracea* (Jungh.) Mishra comb. nov., *Stereum peculiare* Parmasto, Boidin & Dinghra, *Stereum rimosum* Berk., *Stereum rugosum* Pers.,

Out of 44 species which grow exclusively on angiosperms, the following species are more prevalent: *Alerodiscus oakesii* (Berk. & Curt.) Hoehn. & Litsch., *Stereopsis dimiticum* (Rehill & Bakshi) Sharma, *Stereum sparrassoides* (P. Henn) Reid, *Stereum acanthophysatum* Rehill & Bakshi, *Stereum guassapatum* (Fr.) Fr. *Stereum rimosum* Berk, *Stereum hirsutum* (Willd).: Fr., *Stereum rugosum* Pers., *Stereum thindii* A. B. De, *Xylobolus subpileatus* (Berk. & Curt.) Boidin.

The lignicolous species which prefer coniferous woods, more frequently found are: *Amylostereum chailletii* (Fr.) Boidin, *Aleurodiscus amorphous* (Fr.) Schroet, *Aleurodiscus taxicola* Thind & Rattan, *Gloeocystidiellum lactescens* (Berk.) Boidin, *Stereum sanguinolentum* (Alb. & Schwein.) Fr.

The forests rich in dead woods provide adequate environment for ligicolous Stereaceous fungi. When trees are alive, one can hardly expect them because wood-rotting fungi selom fruit on the surface until their host trees die (Eriksson, 1958). These fungi usually occur when the forest sites are disturbed to some extent. When trees are broken or damaged, tree-days are

exposed and the fungi fruit. The secondary growth forest sites formed frequently at edges of the forests consist of vigorously growing young trees and also the virgin forest sites which mostly consist of healthy mature trees, practically do not support any of these fungi on living trees.

Forest sites of naturally disturbed or slash dumped areas consisting of dead trees in all stages of decomposition play an important role in ecology of wood-rotting fungi. Wind breaks and wind throws occurs where trees are weakened by decay fungi or when they are shallowly rooted on exposed sites. The most favorable condition is achieved when fallen trees and slash are dumped or stacked together on the forest floor. More then 70% of the wood-rotting fungi collection occurred in such type of sites. When the trees die and defoliate, the over storey canopy is extensively opened. Increased penetration of direct sunlight down to the forest floor depletes the moisture of the forest. Substrates for fungi are abundant all over but fungal growth is quite limited because of less moisture. Then such sites, the fungal fruiting become dramatically decreased except when the forest floor remains wet during rainy days.

In the tropical areas species of *Terminalia, Mesua, Lagerstroemia, Tectona, Shorea, Acacia, Mangifera, Swietenia, Cassia, Bombax, Populus, Dalbergia, Prosopis, Dipterocarpus, Acrocarpus, Albizia, Anogeis*, Cedrella, *Morus, Cinnamomum*, *Capparis*, *Mallotus* and *Melia* are the major host for these fungi. The most commonly found of these fungi found in these areas belongs to: *Aquascypha vibrans* (Berk. & M.A. Curtis) A.L. Welden, *Gloeocystidiellum fistulatum* (G. Cunn.) Boidin, *Gloeocystidiellum flammeum* Boidin, *Gloeocystidiellum irpicescens* Boidin, *Gloeocystidiellum kenyense* Hjortstam, *Gloeocystidiellum lacticolor* (Bres.) Stalpers & Hjortstam, *Gloeocystidiellum luteocystidiatum* (P.H.B. Talbot) Boidin *Gloeocystidiellum porosellum* Hjortstam, Hjortstamia fulva (Lev.) Mishra Comb. Nov, *Podoscypha venustula* s. sp. *cuneata* Reid, *podoscypha petalodes* (Berk.) Pat.

In the temperate zones, species of *Quercus, Rododendron, Alnus, Aesculur, Juglans* and *Schima* from the important and major hosts for these fungi. Both living and dead fallen trees support a rich hymenochaetaceous fungus flora and a rich species diversity. Some species which frequently share *Quercus* as one of their hosts are: *Aleurodiscus himalaicus* Man. Kaur, Singh, Dhingra & Ryv. A. oakesii (Berk. & Curt.) Hoehn. & Litsch., *Stereum versicolor*, *Stereum peculiar*, *Xylobolus frustulatus*

Among the conifers, species of *Abies Pinus, Picea, Laryx* and *Cedrus* also from important hosts for these fungi. *Aleurodiscus amorphus* and *Amylostereum chailletii* (Fr.) Boidin have been recorded exclusively on *Abies* at higher altitudes.

Near the timberline *Betula utilis* is also a common host. *Aleurodiscus lapponicus* Litsch, *Gloeocystidiellum convolvens* (Karst.) Donk, *Stereum princeps* (Jungh.) Lev. grows exclusively on *Betula. Rhododendron* thickets both on exposed slopes or in the shaded areas are very poor sites and *Rhododendron* itself is the poorest host for these fungi. However, the extensive

Rhododendron thickets in the shaded areas retain some moisture and in such areas, few species like *Aleurodiscus indicus* and *Stereum subtomentosum* grow only on them.

Species like *Stereum sanguinolentum* (Alb. & Schwein.) Fr., and *Xylobolus subpileatus* (Berk. & M.A. Curtis) Boidin, are responsible for significant heart-rots and weaken the tree trunks, thus making them subject to wind breaks.

**Table-I: Distribution of basidiocarps, hymenophore and habitat over genera of Indian Stereaceae.**

1-Effused, 2- Reflexed, 3- Pileate, 4-Stipitate, 5- Smooth, 6 Warted or tuberculate, 7- Humicolous, 8- Lignicolous, C- Coniferous wood, B- Both woods, A- Angiospermic wood, X- A common features, (-) A rare or unumal features.

| | | Basidiocarp | | | | Hymenial configration | | Habitat | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 C | 8 B | 8 A |
| 1. | **Aleurodiscus (10)** | x | - | - | - | x | - | - | 3 | 1 | 6 |
| 2. | **Amylostereum (2)** | x | x | x | - | x | - | - | 2 | - | - |
| 3. | **Aquascypha (1)** | - | x | x | x | - | - | - | - | - | 1 |
| 4. | **Chondrostereum (2)** | x | x | x | - | x | - | - | 1 | - | 1 |
| 5. | **Cotylidia (2)** | - | - | x | x | x | - | 1 | - | - | 1 |
| 6. | **Cymatoderma (1)** | - | - | x | x | - | x | - | - | 1 | - |
| 7. | **Cystostereum (1)** | x | x | x | - | - | x | - | - | 1 | - |
| 8. | **Gloeocystidiellum (22)** | x | - | - | - | x | x | - | 2 | 6 | 14 |
| 9. | **Hjortstamia (4)** | x | x | x | - | x | x | - | - | 1 | 3 |
| 10. | **Lopharia (3)** | x | x | x | - | x | x | - | - | 1 | 2 |
| 11. | **Podoscypha (6)** | - | - | x | x | x | - | 2 | - | - | 4 |
| 12. | **Stereopsis (3)** | - | - | x | - | x | - | 1 | - | - | 2 |
| 13. | **Stereum (11)** | x | x | x | - | x | x | - | 1 | 2 | 8 |
| 14. | **Xylobolus (3)** | x | x | x | - | x | x | - | - | 1 | 2 |
| | **Total** | | | | | | | **4** | **9** | **14** | **44** |

## ECONOMIC IMPORTANCE

The stereoid fungi cause white rots and play an important role in degradation of wood material and thus take part in carbon recycling of the forest ecosystem. Most of *Stereum* species cause white rot on hardwoods but certain species like *S. gausapatum, S. striatum* and *S. sanguinolentum* have various degrees of substratum affinities and are specialized for the growth on coniferous trees (Chamuris, 1988).

The xerophilic habit makes the genus *Stereum* a highly characteristic indicator for arid mycotas. This genus includes white-rot fungi inhabiting fallen or standing branches, trunks and stumps representing a broadly diverse selection of broadleaved and coniferous trees. Their economic importance lies in their wood-destroying properties and carbon recyling of arid forest ecosystem (Overholts, 1939; Woon & Jung, 1999). Nearly all species of *Stereum* discussed here are active in decomposing dead timber. In addition, several species attack living trees and some may be serious pathogens. Among the most important of pathogens are *S. gausapatum* and *Xylobolus subplileatus.* Others, in some cases probably of less importance, include *S. frustulatum*, *S. hirsutum*. Recognition of the importance of *Stereum* as pathogens has been facilitated recently by the use of refined isolation and inoculation techniques.

Probably the best known disease caused by a species of Chondro*stereum* is silver leaf. This disease has been studied throughly by Brooks and his associates (1911, 1913, 1919, 1923, 1926, 1929, 1931a, 1931b), and there is no doubt that it is caused by *S. purpureum*. Silver leaf disease is especially prevalent among woody Rosaceae, particularly plums and apples. The fungus enters the host through wounds, causes a silver-like appearance of the leaves, kills the branches in the immediately vicinity of its entry, and ultimately causes the death of the tree. Reports of the pathogenicity of *S. purpureum* on hosts in families other than the Rosaceae have also been made. Beaumont (1935), for example, reported silver leaf disease of black and red current and gooseberry, all in the Grossulariaceae.

Another serious disease of tree is the red heart rot which *S.sanguinolentum* cause in various conifers. Bier (1949) reported that red heart rot is common in fir, pine, and spruce in British Columbia. He also found that *S. sanguinolentum* may occur as a root-rotting organism which kills trees in coniferous plantations. Mielke and Davidson (1947) also have called attention to the importance of *S. sanguinolentum* as a cause of disease of spruce and Fir.

Enterance of the fungus was through wounds of the top caused by snow, or through wounds of the trunk or less often through wounds of the roots. Peace (1938) has isolated *S. sanguinolentum* from European larch in Great Britain and found that it was the cause of staining as well as of a soft brown or streaked rot.

Among the numerous species of *Stereum* commonly associated with oaks, several are known to cause rots in living trees. Culture studies by Davidson (1934) have shown that *S. gausapatum* is a common cause of heart rot in living trees.

Davidson, Campbell and Vaughn (1942) showed that in the eastern United States *S. gausapatum* was the most important species causing butt-rot in young oak stands where parent stumps were the main source of infection, and was also important as a top –inhabiting species in mature-or old growth stands. According to Wakefield and Dennis (1950), this fungus enters the host through branch stubs and then attacks the heartwood, causing long pipes of rot that spread up and down the trunk. Overholt (1939) also has called attention to the extensive and destructive heart rot of living oak trees caused by *S. gausapatum*.

*Xylobolus subpileatus* also causes a heart rot of oak trees. Long (1917), found that this fungus is among the most important of the organisms that cause heart rots of living oaks and then continue to grow in the infected wood after the trees are felled. Butler (1918) relates that the fungus gains entrance to the host tissues through wounds and insect burrows. According to Boyce (1923), the destruction of host tissues start with the appearances of water-soaked areas; this is followed by delignification and the appearances of honeycomb-like pits and finally by destruction of the cellulose lining of the pits. Freeman (1905) has stated that *S. frustulatum* is also able to attack living trees. The two species are closely related, and the progress of the disease is very much the same in the both instances.

All the *Stereum* species previously discussed continue to grow on dead wood and help to bring about its disintegration. Most species are commonly found on rotting twigs, branches, stumps, and logs of forest trees, but sometimes they may cause serious damage to wood product. *S. abietinum* produces an intensive and often harmful dirty-whitish rot of wood structures, such as bridges and buildings in mountainous regions (Pilat, 1930). In addition, it has been found on decaying coniferous fencing material (Lundell and Nannfeldt, 1937) and on mine timber (Pilat 1930). *S. hirsutum* also has frequently been reported to cause serious damage to mine timber (Gillot, 1882; Roumeguere, 1886; Bourdot and Galzin, 1928; Doidge, 1950). Other species that have been found on mine timbers include *S. gausapatum* (Maize, Scheffer, and Greenwald, 1941) and *S. sanguinolentum* (Harz, 1888; Pilat, 1930; Moller, 1945).

In the forests, various species of *Stereum* are very prominent in decomposing dead timber. In general, the fungi of this genus occupy wood while it is still in a reasonable sound condition and are among the earlier links in the chain of humus-producing organisms. *S. ostrea*, *S. gausapatum*, *S. complicatum* and *S. frustulatum* are common in the woodlands of the temperate Himalayas forests and must account for a very large proportion of the decomposition of dead trees in that region.

The foregoing survey of the economic significance of *Stereum* as known at the present time is only a small part of the story. Poorly understood is the fact that the relatively small size of

the *Stereum* basidiocarp has no relation to its activity within the host. When so many of the most familiar species are shown to cause disease of living trees, there is reason to believe that study of the more unfamiliar species will reveal equally active pathogens. It is significant that the limited number of isolated studies made up to the present time have so often evoked from the investigators expressions of surprise that cause of serious rots of living trees. *Stereum* is still a moderately difficult genus taxonomically, few mycologist attempting to recognise more than a few of the more common species. Isolation studies from rots of living trees are very few indeed; correlation of the characteristic of cultures obtained from wood-rot isolations with those of cultures obtained from named basidiocarps is a very promising but relatively unworked field. Serious study of rots caused by tropical *Stereum* is practically nonexistent. The work of assessing the true economic significance of *Stereum* has only begun.

## PRESENTATION OF DATA

The characteristic features of the family are followed by a key to all the genera occurring in India. The genera are treated alphabetically. The description of each genus is followed by separate keys for determination of the species included in the genus. For easy consultation, the specific taxa within each genus are also recorded and arranged alphabetically with their correct latest name and basionym. The synonyms, which have been recorded from India by earlier workers or for which the type materials could be arranged and studied or those which are well known traditional synonyms have been given. For each taxon, the accepted name has been recorded with authority, its date and place of publication. The abbreviation of the name of author follows Hawksworth (1980). Herbarium name used follow Holmgren *et al* (1990). Quotient (Q=L/W) was calculated considering the mean value of length and width of 20-25 spores over number of field collections. The description of each species contains the characteristics of macroscopic and microscopic structures of the basidiocarp. After the description of each genus and species, special remarks are given. The final notes of each description present the most typical features of the basidiocarp with which the latter may be readily distinguished from those of similar species. It is supplemented by other biological data important for identification of a species indicating the frequency of occurrence (very rare, rare, common, abundant) their habitat, life form (saprophyte or parasite) and the kind of rot. Studied specimens are listed following the description of each species and localities, substrate and other collection data including collecting year and collector and numbers are supplied for each taxon.

**STERECAEAE** Pilat
Hedwigia 70: 34. 1930.

Basidiocarps appressed or effused-reflexed, often occurring in resupinate condition, sessile or stalked, usually flattened throughout with strictly one-sided hymenophore; cap often zoned, also sulcate; context in the majority of species in section showing an abhymenial darker crust-like layer, often bearing a hairy or spongy indumentum, an intermediate layer and the hymenium which may be layered, usually leathery, corky, to woody; hymenophore smooth or flabellately ribbed, exceptionally more or less 'irpicoid" .

Hyphal system dimitic with skeletal hyphae, exceptionally trimitic, and rarely monomitic; generative hyphae thin-to somewhat thick-walled, with or without clamps; skeletal hyphae nearly thin- to very thick-walled, the lumina may be filled with coloured sap, typically many curving towards the hymenium and terminating in the hymenium or more rarely in the subhymenium, with little, modified, uninflated ends or with more or less strongly modified and inflated ends (skeletocystidia); setae lacking, hymenial cystidia of various types may be present; basidia club-shaped; chiastic, 2-4-spored; spores colourless, white in a print; wall smooth, echinulate to rarely warted, usually thin amyloid or non-amyloid; Lignicolous, or terrestrial in a number of stalked species.

## KEY TO GENERA

1. Basidiocarps resupinate; spores amyloid; gleocystidia mostly present……**2**

1. Basidiocarps effused-reflexed to pileate-stalked; spores amyloid to non-amyloid; gleocystidia rarely present……..**3**

2. Basidiocarps disc-like to corticiod; spores large up to 25um broad; hyphae mono to dimitic; sterile elements like acanthophysis, dendrohyphidia present……..……...***Aleurodiscus***

2. Basidiocarps resupinate-adnate; spores smooth, up to 7um broad; hyphae monomitic; hymenial sterile elements absent……..…..***Gloeocystidiellum***

3. Basidiocarps more or less typically stalked; spores non-amyloid……..……..…**4**

3. Basidiocarps effused-reflexed to pileate stalked; spores amyloid or non-amyloid…….**8**

4. Hyphae monomitic; cuticle absent…….…….5

4. Hyphae dimitic or trimitic; cuticle present or absent…….…….**6**

5. Hymenial cystidia present; spores up to 9um long; clamps absent…….……..…***Cotylidia***

5. Hymenial cystidia absent; spores up to 6um long; clamp present or absent…… ***Stereopsis***

6. Mesopodal, reddish brown, coriaceous felty; pileus multizonate and unicolorous with prominent branching spicules at base on abhymenial surface; skeletal hyphae brown; cystidioles thick walled brown; gloeocystidia absent…….…....***Aquascypha***

6. Pleuro- or Mesopodal or merismatoid, coriaceous; tomentose, spiculose or glabrous; thick walled brown cystidioles absent; gloeocystidia present……..7

7. Basidiocarps large, robust; hymenial surface thrown into undulating folds; pilear surface with knife edged crest; caulo and pileocystidia absent; hyphae trimitic……..…….***Cymatoderma***

7. Basidiocarps usually smaller, thin and translucent; hymenial surface smooth; pilear surface with out knife-edged crests; caulo and pileo cystidia usually present; hyphae dimitic…….

……***Podoscypha***

8. Spores amyloid……..……**9**

8. Spores non-amyloid throughout……**11**

9. Basidiocarps often becoming woody; mycelium causing a white pocket rot of substrate; oxidase reaction negative on gallic acid agar; acanthocystidia present…….***Xylobolous***

9. Basidiocarps usually remaining flexible or soft; mycelium causing a diffuse rot; oxidase reaction positive; acathocystidia absent or scarce…….**10**

10. Hymenial cystidia present, cystidia with brown and rough or encrusted walls...***Amylostereum***

10. Hymenial cystidia absent or cystidia having pale wall if present……..***.Stereum***

11. Basidiocarps leathery coriaceous; cystidia pedicellate; clamps present or absent……..12

11. Basidiocarps corky or woody coriaceous, hymenial cystidia absent or sparse and with colourless walls if present; clamps present…….13

12. Generative hyphae simple septate; basidiocarps usually brown to dark greyish to dark pinkish; skeletocystidia present……...……..…***Hjortstamia***

12. Generative hyphae with clamps; basidiocarps usually greyish white to pale brown; skeletocystidia usually absent……...***Lopharia***

13. Basidiocarps corky or woody; hymenial surface smooth, context zoned into layers; hyphae monomitic; gloeocystidia absent; subhymenial vesicles present……..……***Chondrostereum***

13. Basidiocarps woody-coriaceous; hymenial surface strongly tuberculate; context not zoned into layers; gloeocystidia present; hyphae dimitic; subhymenial vesicles absent ……..…….……....***Cystostereum***

**Aleurodiscus** Rab. : Schroet.
Cohn Krypt.- Fl. Schles. 3: 429, 1888

Basidiocarps variable in appearance, discomycete-like or corticioid; margin distinctly delimited, sometimes reflexed; hymenial surface smooth, white to grey; hyphae mono or dimitic, hyphae with or without clamps; basidia medium to large, 4-sterigmate, hymenium includes several sterile elements such as acanthophysis, dendrohyphidia, gloeocystidia and paraphysoid hyphae, gloeocystidia darkening in sulfovanillin; spores amyloid, warted or echinulate, comparatively very large.

**Type species :** *Aleurodiscus amorphus* (Fr.) Schroet.

*Aleurodiscus* in a very broad sense, includes species with several sterile elements (acanthophyses, dendrophyses, paraphysoid hyphae, etc.), hyphae clamped or simple-septate, gloeocystidia absent or present and amyloid basidiospores both smooth or ornamented. Even if we feel *Aleurodiscus* s.l. as a useful concept to quickly identify a group of species, morphological as well molecular evidences seem indicate that *Aleurodiscus* should be split into more homogeneus groups. However, further molecular studies with more species and specimens, included those from tropics and southern hemisphere are needed to clarify the taxonomic situation of *Aleurodiscus* s.l. A detailed information is provided in Lemke (1964), Oberwinkler (1965), Parmasto (1967), Boidin *et al* (1985), Wu *et al* (2001), Larsson & Larsson (2003) and Larsson *et al* (2004).

The genus is characterized primarily by microscopic characters. The main characters are the larger basidia and echinulate spores. The presence of sterile hymenial elements and the aldehyde reaction by the gloeocystidia further mark this genus.

**Key to species**

1. Basidiocarps discomycete-like…….**2**

1. Basidiocarps corticioid; ……..***3***

2. Hymenial surface pinkish grey to orange red; on Conifers……..……..***A. amorphous***

2. Hymenial surface grayish brown; on Oaks……..……..……***A. oakesii***

3. Spores echinulate……..……...…**4**

3. Spores smooth……**6**

4. On *Taxus*; spores 15-18 x 11-14 µm……..……***A, taxicola***

4. On hardwoods……..……..…**5**

5. Spores 12-15 x 7-10 µm……***A. apricans***

5. Spores 25-42 x 16-24 µm……***A. himalaicus***

6. Hymenial surface white to cream……..……**7**

6. Hymenial surface coloured……..……**8**

7. Spores 6-8 x 3.5-4.5 µm……..……***A. cremeus***

7. Spores 8-10 x 4-5 µm……..***A. aberrans***

8. Hymenial surface dark grayish blue; spores 7-8 x 2.5-3 µm……..……***A. lividocoeruleus***

8. Hymenial surface not as above; spores larger……9

9.Hymenical surface ochraceous buff; spores 10-12 x 6-7 µm……....***A.lapponicus***

9. hymenial suface grayish to brownish orange; spores 12-14 x 4.5-5 µm……***A. indicus***

**Aleurodiscus aberrans** G. Cunn.

Trans. Roy. Soc. N.Z. 84(2): 257, 1956.

**Type locality:** New Zealand **(Fig. 7** )

Basidiocarps stereoid, at first appearing as small linear patches 2-5 x 1-2 cm, later more effused, ceraceous-cretaceous; margin white, fibrillose, hymenophore white becoming cream to sulphur-yellow with age, usually distinctly rimose.

Hyphal system monomitic, generative hyphae simple-septate; acanthophyses mostly clavate or fusiform, upto 8 µm diam., apically with blunt processes, 2-3 µm long; gloeocystidia fusiform or flexuous-cylindrical usually mammillate, contents grainy and pale yellowish when mature, 45-80 x 8-10 µm; basidia subclavate, 16-25 x 5-6 µm, with 4 sterigmata, up to 6 µm long; dendrohyphidia subclavate, simple or forked, occasionally more branched, 12-28 x 4-5 µm; spores elliptic-oblong to subcylindrical, (7.8-) 8.1- 10 (-10.2) x 4-5µm, L= 9.2 µm, W= 4.6 µm, Q= 2.01, (n=20/2) smooth, inamyloid .

**Specimens Examined:** (UK) Champawat hardwood stump, 16 Sept. 2011 JRS (BSD) 2432; (HP) Kullu, Sariakot, on rotting trunk of *Pinus*, 12 Sept. 2006, JRS 3025; Sikkim, Gangtok, Near BSI campus, fallen deciduous trunk, 28 Sept. 2012, DM 3012; Maharashtra, Bhimashankar, Baneshwar, On dead stump of *Capparis zeylanica* and *Mangifera indica*, 22 Aug. 2018, DM 641.

**Habitat & dsitibution:** Effused on bark of dead stems and branches on different deciduous trees, rarely also recorded on *conifers.*

**Geographical distribution:** New Zealand, India.

**India:** Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh & Maharashtra

**Remarks:** Separated from other species by the clavate acanthophyses, abundant gloeocystidia, small basidia, and elliptical smooth spores and effused resupinate hymenophore with a well developed intermediate layer. Arrangement of the context is similar to that of most species of *Corticium*, and the small basidia and spores strengthen the resemblance. As acanthophyses are present, and spores amyloid, the species has been treated as an *Aleurodiscus.*

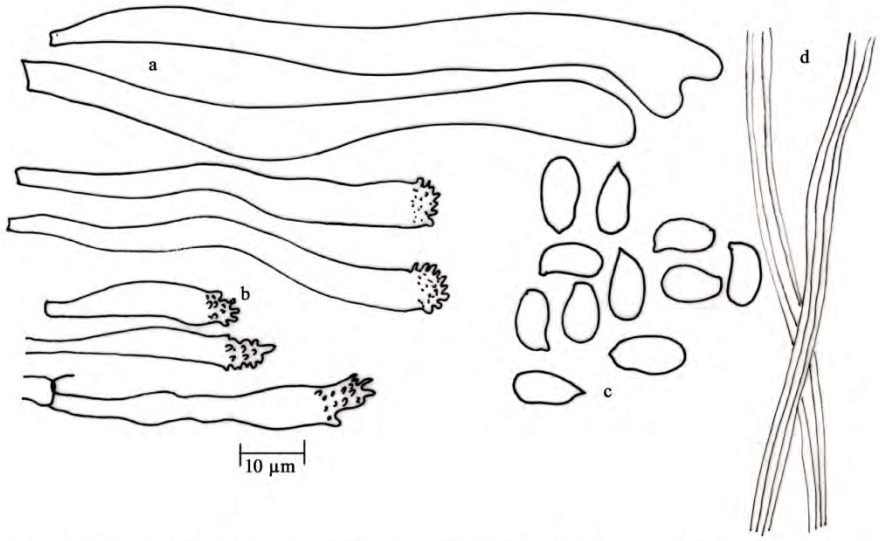


**Fig. 7:** *Aleurodiscus aberrans:* a) gloeocystidia, b) acanthophyses, c) spores, d) hyphae from the subiculum.

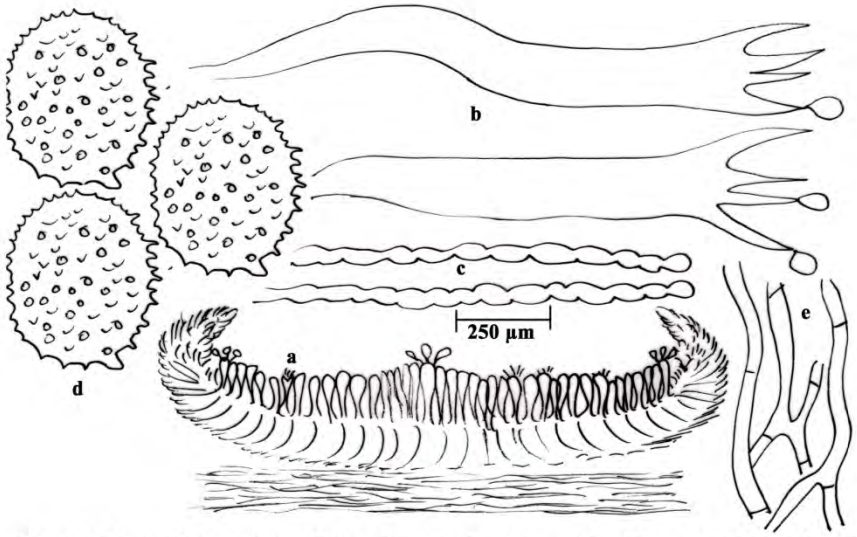


**Fig. 8: Aleurodiscus amorphus:** a) vertical section of basidiocarp, b) basidia, c) moniliform cystidia, d) spores, e) hyphae.

**Aleurodiscus amorphus** (Fr.) Schroet.

Krypt.-Fl. Schles. **3**: 429, 1888; *Thelephora amorpha* Fr., Elench. Fung. **1**: 183, 1828.

**Type locality:** Sweden (Fig. **8** )

Basidiocarps flat and rounded, slightly convex and discomycete-like, up to 1 mm thick, margin narrow and distinctly determinate; hymenial surface ochraceous, pinkish grey to orange-red; firm, subcoriaceous.

Hyphal system monomitic, hyphae, 2-4 µm wide, septate; basidia very large, about 100 x 25µm or even larger, with four sterigmata, 15-25µm long; paraphysoid hyphae present between the basidia, moniliform and not projecting; spores subglobose to broadly ellipsoid, (20.2-) 21-25 (-25.6) x 17-20µm, L = 23.46 µm, W = 18.9 µm, Q = 1.24, (n=20/2) amyloid, densely covered with fine, cylindrical to slightly conical and abruptly cut spines.

**Specimens examined :** (UK) Chamoli, Mondal, on dead *Abies* branch woods, 15 Sept. 1991, JRS 153; *ibid,* Tehri, Khirsoo, on dead stump of conifereous woods, 14 Aug. 1992, JRS 306; *ibid*, Uttarkashi, Taluka, on dead *Abies* wood, 20 Aug. 1993, JRS 680; *ibid,* Bageshwar, Dhakuri, rotting trunk of *Pinus*, 28 Sept, 2011, DM 20068.

**Habitat & Distribution:** Most common on dead, attached branches of *Abies*, but also rather common on *Picea.* Usually it grows on nearly or recently dead, but still attached lower branches. The basidiocarps are annual, developing during humid periods, and fertile specimens can even be found throughout the winter. Widespread in the temperate northern hemisphere. Throughout the northern boreal zone, common in areas with *Abies*, more scattered in other coniferous areas.

**Geographical distribution:** North America, Siberia, Japan Europe: Poland, Estonia, France, Germany, United Kingdom, Russia, Slovenia, Romania, Bulgaria, Italy, Denmark, Norway, Finland, Spain, Ukraine, Netherlands, and the Caucasus and China

**India:** Uttarakhand, Arunachal Pradesh, West Bengal, Himachal Pradesh.

**Remarks:** The discomycete-like appearance and the large, echinulate spores make *A. amorphus* easily recognised.

**Aleurodiscus apricans** Bourdot

Rev. Sci. Bourb. Centr. Fr. 23(1): 7, 1910.

**Type locality:** Netherland (**Fig. 9**)

Basidiocarps corticioid, effused, forming small, irregular colonies, 3-30 mm long, margin arachnoid, adherent, concolorous with the white to cream hymenophore.

Hyphal system monomitic, hyphae simple septate, 2.5-4 µm diam; acanthophyses ovate, obovate or fusiform, 16-24 x 8-12 µm, upper part covered with numerous protuberances up to 4 µm long; a very few bulbuous cystidia with scattered short protuberances are also present; gloeocystidia yellow with a grainy content, 30-60 x 8-12 µm; basidia cylindrical with slightly inflated bases, or subclavate, 20-24 x 8-10 µm, bearing 2-4 sterigmata; paraphyses subclavate or oval, 16-40 x 6-8 µm, some looking almost like cystidia; spores pip-shaped, oval, obovate or elliptical, some flattened adaxially, with oblique or central apiculi, (11.8-)12-15 (-15.6) x 7-10µm, L= 14.26 µm,, W=8.76 µm, Q= 1.62, (n=20/2) finely verruculose.

**Specimens examined:** Maharashtra, Kankeshwar, on *Mangifera indica*, 28 Aug. 2018, DM 637, 611; Tamil Nadu, Coimbatore, Kaller, 03 Dec. 2012, JRS (10224 BSD); *ibid,* Nilgiri Biosphere Reserve, on a rotting hardwood stump, 28 Nov. 2012, JRS (10139, BSD); *ibid*, Coimbatore, Kavai Courtalum, on a rotting hardwood stump, 29 Nov. 2012, JRS (10146, BSD)

**Habitat & Distribution.** A rare species on dead wooden branches of *Rubus, Rosa, Viburnum, Calluna, Mangifera, Pteridium* and dead sheaths of living stems of *Arundinaria macrosperma* and unidentified dead hardwood.

**Geographical distribution:** France, British Isles (Channel Islands), Spain, and New Zealand.

**India:** Maharashtra, Tamil Nadu.

**Remarks:** Bourdot (1910) stated that both smooth and asperulate spores were present. I have found all spores to be asperulate in the Indian collections while Boidin *et al*. (1985) and Telleria & Melo (1995) report, the spores to be smooth in collections from France and Spain respectively.

This species has been treated as ***Acanthophysium apricans*** (Bourdot) G. Cunn., *Bull. N.Z. Dept. Sci. Industr. Res., Pl. Dis. Div.* **145**: 155, 1963

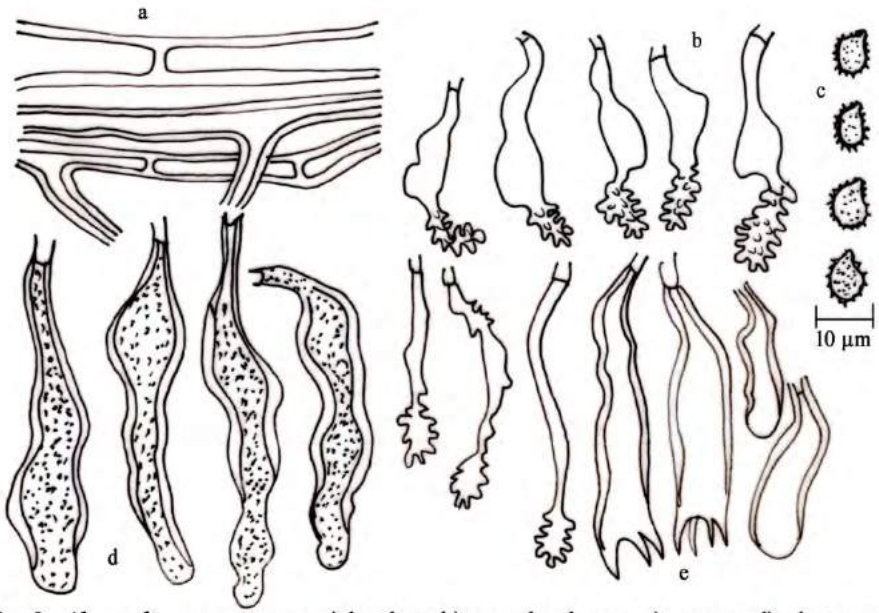


**Fig. 9:** *Aleurodiscus apricans:* a) hyphae, b) acanthophyses, c) spores, d) gloeocystidia e) basidia & basidioles.

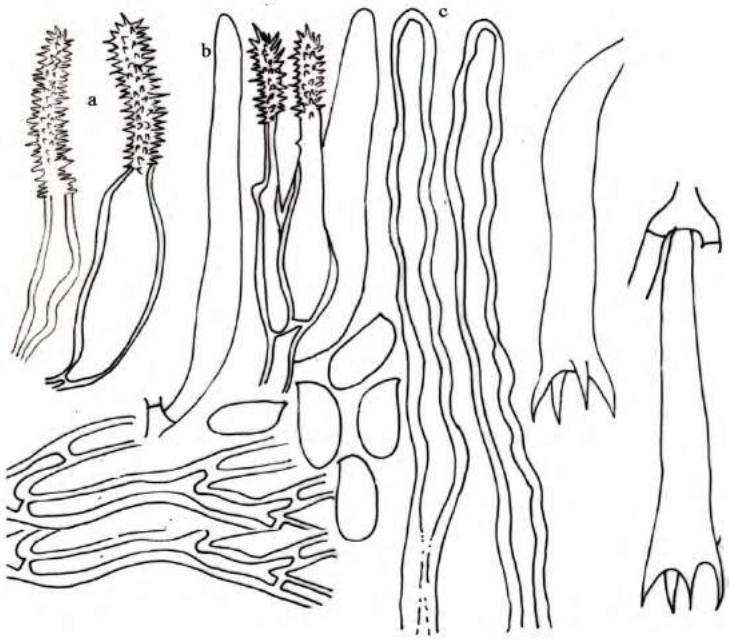


**Fig. 10:** *Aleurodiscus cremeus:* a) acanthophyses, b) skeletocystidia, c) hyphae from the subiculum, e) basidium, f) spores.

**Aleurodiscus cremeus** Pat.

Bull. Soc. mycol. Fr. 31: 73, 1915

**Type Locality:** New Mexico (Fig. **10**)

Basidiocarps initially pulvinate, readily confluent, effused; margin determinate, adnate; 500-700 µm thick in cross section, texture compact-farinose to subceraceous; hymenial surface cream-buff colored, rimose.

Hyphal system monomitic, obscured by abundant crystallization, hyphae of branched, irregular, clamped, 3-4 µm in diameter; basal hyphae measuring up to 4.5 µm in diameter with partially thickened walls, generative; catahymenium composed of numerous acanthophyses, pseudocystidia, and basidial elements; acanthophyses thin-walled, cylindrical to subclavate, 20-30(-35) x 4.5-6(-6.5) µm, aculeate to acicular-pronged on the apical one-third, pronged portion thick-walled to semisolid, measuring up to 4 µm in diameter; pseudocystidia (macrocystidia) embedded-cylindric, at length emergent-ampulliform with an apical bulb; pseudocystidia measure (30-)40-60(-80) x (7-)8.5-12(-14) µm; contents yellowish-refractile in KOH, darkening in sulphobenzaldehyde; basidioles 20-30(-40) x 5-5.5(-6.5) µm, clavate, abundant; spores (5.8-) 6-8 (-8.3) x 3.5-4.5µm, L= 7.80 µm, W= 4.2 µm, Q = 1.89, (n=20/2) adhering adaxially in groups of four, thin-walled, smooth, amyloid.

**Specimens examined:** (AP), Tirup, Jairampur on dead hardwood log, 10 Oct. 1996, JRS (7569, CAL); (HP), Kullu, Manikaran, on living Oak, 15 Aug. 2009, DM (0133, CAL); (UK), Rudraprayag, Maggu, on living Oak, 10 Sept. 2014, (DM 4015); Sikkim, Gangtok, on dead wooden log of *Eriodendron,* 14 Sep. 2011, JRS (6006, CAL); Maharashtra, Guhar, on the branches of *Mallotus philippinensis*, 24 Aug. 2018, DM 625.

**Habitat & distribution:** On decorticated hard wood trees particularly on *Quercus* trunks

**Geographical distribution:** New Mexico (Temperate species)

**India:** Arunachal Pradesh, Uttarakhand, Himachal Pradesh, Sikkim and Maharashtra.

**Remarks:** White to creamish rimose hymenophore, corticoid basidiocarp, smooth and larger spores distinguishes this species. It is much thicker than other species found in India. The margins sometimes get reflected. The paraphyses with moniliform tips are absent.

**Aleurodiscus himalaicus** Man. Kaur, Avn.P. Singh, Dhingra & Ryvarden

Syn. Fung. (Oslo) 32: 5, 2014

**Type locality:** India, Himachal Pradesh **(Fig. 11)**

Basidiocarps resupinate, effused, adnate, up to 700 µm thick in section; hymenial surface smooth, orange red to grayish red when fresh, becoming brownish orange to light brown on drying; margin thinning, paler concolorous, generally reflexed; abhymenial surface yellowish white, velvety due to projecting basal hyphae.

Hyphal system monomitic, generative hyphae branched, septate; basal hyphae next to substrate up to 4.3 µm wide, thick-walled, horizontal, dense, with or without clamps, somewhat projecting out in the reflexed region; followed by another zone of parallel hyphae with clamps and oily contents; subhymenial hyphae up to 3.1 µm wide, thin-walled, vertical, loose interwoven, with clamps and oily contents; gloeocystidia 48.0–83.0 × 6.0–10.0 µm, subfusiform, moniliform towards apical region; dendrohyphidia scattered in the hymenium, irregularly branched; acanthophyses 32.0–50.0 × 8.0–10.0 µm, abundant in the hymenium, with oily contents and protuberances at the tip, with basal clamp, non-amyloid; basidia up to 140 × 30 µm, clavate, 4–sterigmate, with basal clamp, filled with oily contents, sterigmata up to 25.0 µm long; spores (24-) 25-42 (-43.1) x 16-24 (-24.5) µm, L= 38.5 µm, W= 22 µm, Q=1.83 (n=20/2) ovoid to subfusiform, thick-walled, echinulate (spines visible only in Melzer's reagent), amyloid, apiculate with prominent apiculus, acyanophilous.

**Specimens Examined:** (HP) Shimla, Narkanda, on twigs of *Berberis* sp., 28 June 1999, JRS (13003 BSD); *ibid*, Chamba, Khajjiar, on thin twigs of hardwoods, 11 Aug. 2004, JRS (12028, BSD); (UK), Chamoli, Chopta, on dead thin branches of Oak, 20 Aug. 2011, DM 1072.

**Habitat & distribution:** It is a common species found growing on dead thin branches of hardwoods in the temperate Himalayan forests.

**Geographical distribution:** India

**India:** Himachal Pradesh, Uttarakhand

**Remarks:** It resembles *A. gigasporus* Ginns & Bandoni known only from China in having large sized spores, basidia, gloeocystidia and dendrohyphidia. However, it is different from the same in the color of the hymenial surface (orange red to grayish red in comparison to ochraceous), ovoid to subfusiform basidiospores in comparison to broadly ellipsoid, spines visible only in Melzer's reagent, different looking acanthophyses with protuberances only at the tip and its association with angiosperms only.

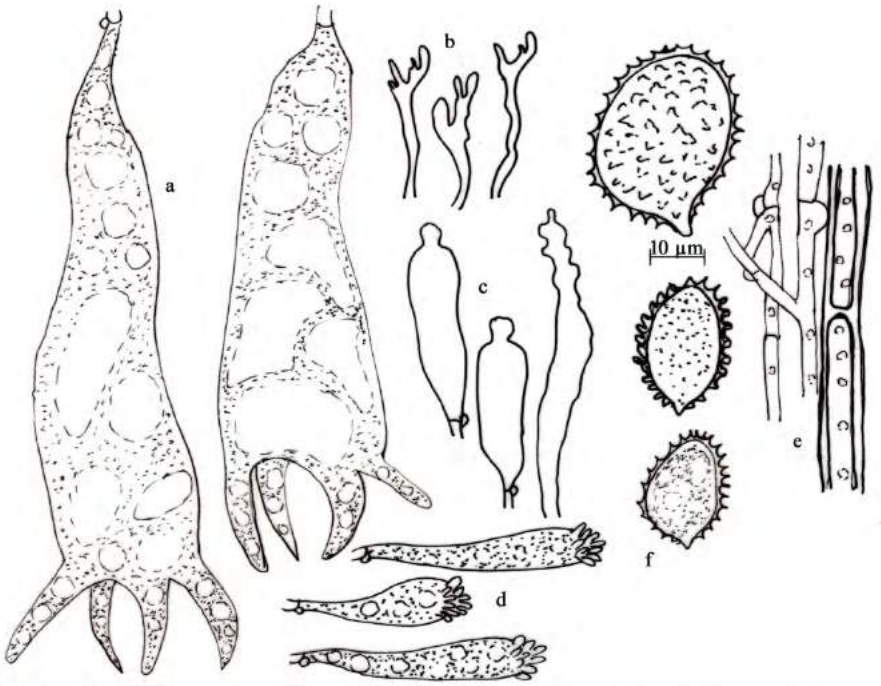


**Fig. 11:** *Aleurodiscus himalaicus:* a) basidia, b) dendrohyphidia, c) gloeocystidia, d) basidia, e) hyphae, f) spores.

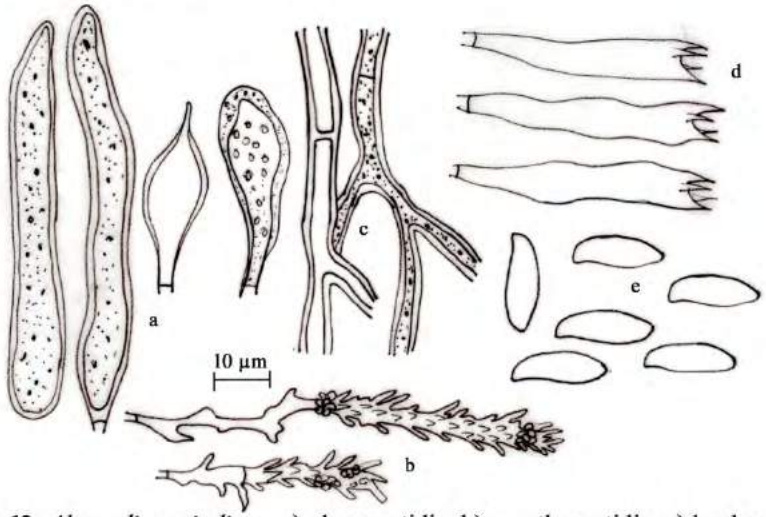


**Fig. 12:** *Aleurodiscus indicus:* a) gloeocystidia, b) acanthocystidia, c) hyphae (septate generative hyphae), d) basidia, e) spores.

**Aleurodiscus indicus** Ryvarden, Sanyal & Dhingra

Syn. Fung. (Oslo) 30: 14, 2012

**Type locality:** India, Uttarakhand, Uttarkashi, Chaurangi Khal. **(Fig. 12)**

Basidiocarps resupinate, adnate, effused, up to 1 mm thick in section; hymenial surface smooth to somewhat tuberculate, grayish orange to brownish orange when fresh, somewhat fading on drying; margin thinning, paler concolorous, indeterminate.

Hyphal system monomitic; generative hyphae up to 6 µm wide, branched, septate, without clamps; basal zones of brownish, horizontal, loosely arranged hyphae; followed by a zone of somewhat thick-walled more or less horizontal hyphae with oily contents which gradually became thin-walled and vertical; subhymenial hyphae vertical, thin-walled, compactly arranged; acanthophyses common in hymenium, branches irregular with blunt endings; gloeocystidia 51-11 x 11-20 µm, abundant, bladder shaped to almost tubular, thin-to somewhat thick-walled, without basal clamp, positive to sulphovanilline; basidia 28-31 x6-6.5µm, clavate, 4-sterigmate with a basal simple septum; sterigmata up to 4 µm long; basidioles rich in oily contents; spores (11.6-)12-14(-14.5) x 4.5-5 (-5.3)µm, L=13.8µm, W= 4.8µm, Q= 2.8 (n=20/4) narrowly ellipsoid to sub-cylindrical, smooth, thin-walled, amyloid, acyanophilous

**Specimens examined:** (UK), Chamoli, Chopta, on dead thin branches of *Rhododendron aboreum*, 20 Aug. 2010, DM 1075; *ibid,* Uttarkashi, Mangi, on dead branches of *Rhododendron aboreum*, 19 Sept. 1996, JRS (13506, BSD); *ibid*, Pithoragarh, Shandev forest, on branch of an Oak tree, 25 Oct. 2007, JRS (2099, CAL); *ibid*, Champawat, Munch, on dead hardwood, 19 Oct. 2007, JRS (2103, CAL); (HP), Chamba, Khajjiar, on thin twigs of *Rhododendron sp.*, 11 Aug. 2014, DM 2086.

**Habitat & distribution:** Usually on dead branches of *Rododendron arboreum* and rarely also on dead Oak twigs in the temperate Himalayan forests.

**Geographical distribution:** India

**India:** Himachal Pradesh, Uttarakhand

**Remarks:** Microscopically *A. indicus* comes close to *A. bergrenii* (Cooke) G. Cunn. known only from New Zealand, but this species has strongly pulvinate basidiocarps besides having shorter spores, i.e 9-12µm long.

**Aleurodiscus lapponicus** Litsch

Ann. mycol. 42:11, 1944.

**Type locality:** Sweden **(Fig.13)**

Basidiocarps corticioid, variable but usually as longitudinally extended patches on the wood, often not more than about 10 mm long and 2-4 mm wide, more rarely coalesced into larger fruitbodies; margin without distinct characters; hymenial surface smooth to finely verrucose, greyish to ochraceous buff, when dry usually finely cracked or rimose; consistency subcoriaceous to crustose.

Hyphal system monomitic, generative hyphae thinwalled, hyaline and narrow, 2-4 µm, with clamps, usually in a dense structure; basidia clavate and scattered, about 50-60 x 10 µm, with four sterigmata; acanthophyses abundant, basally smooth, apically with numerous protuberances; cystidia (or pseudocystidia) usually numerous, embedded, up to 80 µm long, frequently moniliform at the apex, thin-walled, smooth, content granular; paraphysoid hyphae often present; spores ellipsoid, thinwalled, hyaline, smooth, amyloid, (9.6-)10-12 (-12.8) x 6-7 µm, L = 11.98 µm, W = 6.60 µm, Q = 1.80, (n=20/2).

**Specimens examined:** (UK) Bageshwar, Phurkia, decorticated wood of *Salix* tree, 30 Aug. 1999, JRS 6222; *ibid*, Uttarakashi, Hanuman Chatti, on the twigs of *Betula*, 12 Oct. 2011, DM 1033; *ibid,* way to Gaomukh, on *Betula* tree trunk, 07 Oct. 2011, DM 1043; (HP) Kinnaur-Sangla, Kuppa, on decaying wood of *Betula* 23 Aug. 2017, DM 2057.

**Habitat & distribution:** Usually on dry, hard and naked wood, preferably on *Betula* spp., but also noted from *Salix.*

**Geographical distribution:** Norway, Manitoba, Missouri, Sweden, North America, India

**India:** Himachal Pradesh, Uttarakhand, Sikkim.

**Remarks:** The cream to grayish buff hymenophore, cystidia with monoliform apices and smooth spores are the identifying features of this species. *A. lapponicus* is closely related to *A. cerussatus* and the only character separating the two species seems to be the acanthophyses, which are slightly larger and more prominently spiny in *A. cerussatus* than in *A. lapponicus*.

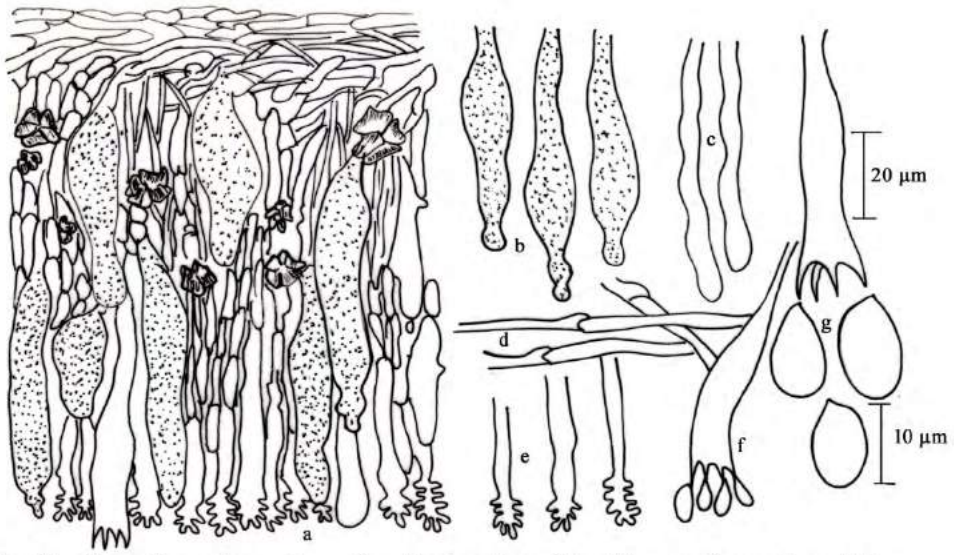


**Fig. 13:** *Aleurodiscus lapponicus:* a) vertical section of basidiocarp, b) pseudocystidia, c) paraphysoid hyphae, d) hyphae, e) acanthohyphidia, f) basidia, g) spores.

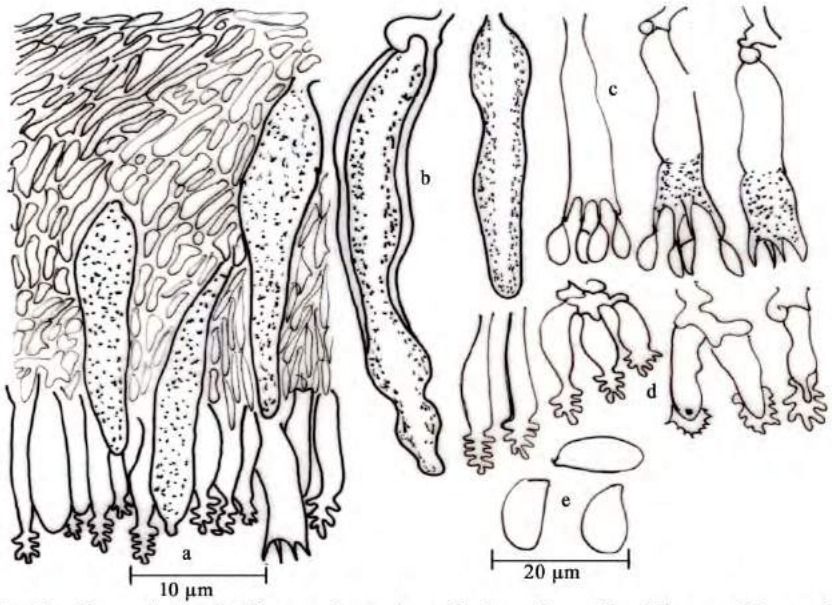


**Fig. 14:** *Aleurodiscus lividocoeruleus:* a) vertical section of basidiocarp, b) pseudocystidia, c) basidia, d) acanthohyphidia, e) spores.

**Aleurodiscus lividocoeruleus** (Karst.) Lemke

Can. J. Bot. 42:252, 1964; *Corticium lividocoeruleum* Karst., Not.Soc.Fauna Fl. Fenn. Förh. 5:370, 1868.

**Type locality:** Sweden **(Fig. 14)**

Basidiocarps corticioid, effused and without differentiated edge, adnate, when older somewhat loosened from the substrate; hymenium smooth, dark blue to greyish blue, often somewhat more pale when dry or even yellowish with a bluish tinge or a few scattered bluish patches; young specimens are often weakly pigmented; consistency dense and firm.

Hyphal system monomitic with thinwalled generative hyphae, usually densely interwoven and fused to an almost pseudo-parenchymatic structure in which distinct hyphae may be difficult to demonstrate; elements in the hymenium (basidia and acanthophyses) may be fused; In between the hyphae irregular and amorphic grains of a dark blue pigment present Calcium-oxalate crystals present in varying degrees; basidia, 20-25 x 5 µm with four sterigmata; acanthophyses numerous, 15-25 x 4-5 µm with short apical protuberances; cystidia (pseudocystidia) numerous, often apically moniliform developed, 40-70 x 8-12µm, protoplasm granular; spores subcylindrical, (6.8-) 7-8 x 2.5-3 µm, L= 7.60 µm, W= 2.9 µm, Q=2.85 (n=20/2) smooth, amyloid.

**Specimens examined:** (HP), Manali, Kothi, on branch of *Abies*, 08 Oct 2017, DM 3061; (UK) Bageshwar, way to Dhakuri forest, decorticated wood of *Pinus* tree, 28 Aug. 2010, DM 2083.

**Habitat & distribution:** On coniferous woods (fallen trees, fencing logs, usually in open, sunny and dry localities.

**Geographical distribution:** Fennoscandia, Sweden.

**India:** Himachal Pradesh, Uttarakhand

**Remarks:** The species is easy to recognize because of the strong blue to greyish colour of the hymenial surface. The parasitic *Tremella subencephala* Bandoni & Ginns is specific to *A. lividocoeruleus* producing small, pustular to discoid, gelatinous outgrowths (Bandoni & Ginns 1993).

**Aleurodiscus oakesii** (Berk. & Curt.) Hoehn. & Litsch.

Sitz. Kais. Akad. Wiss. Wein. Math-Nat. Klasse 116: 802,1907; *Corticium oakesii* Berk. & Curt., Grevillea **1**: 166, 1873; *Aleurodiscus oakesii* (Berk. & Curt.) Cooke, Grevillea **3**: 172, 1875.

**Type locality:** Ravel**,** United States **(Fig.15)**

Basidiocarps disc shaped, pezizae form, scattered or confluent, 1-2mm in diameter, scattered or confluent, up to 20 x 20 mm masses; margin narrow and determinate, free, incurved; hymenial surface greyish brown, concave, pulverulent, smooth, abhymenial surface white, tomentose; context subhyaline, up to 500 µm thick, hyphae longitudinally arranged and interwoven next to the substratum.

Hyphal system monomitic, hyphae septate, thin-walled, 2-4 µm wide; basidia 90-135 x 20-25 µm, 4-sterigmate; acanthophysis clavate, 5-10 µm wide, thin-walled, echinulate, spines confined to the upper part; gloeocystidia absent, paraphysoid hyphae filiform, up to 4 µm broad; spores subglobose to broadly ellipsoid, (19.2-) 20-25(-25.5) x 13-18µm, L=24.2µm, W=16.2 µm, Q=1.6 (n=20/2) amyloid, densely covered with fine, cylindrical, slightly conical spines, spines up to 2 µm long.

**Specimens examined**: (UK) Uttarkashi, Datmer, on dead Oaks, Sept. 23, 1993, JRS 652; (HP), Shimla, Jalori, on dead Oaks, Aug. 24, 1994, JRS 853; *ibid,* Chamba, Kalatope, Oak stump under mixed forest, 02 Oct. 2014, BSD, DM 2057; *ibid,* Manikaran, way to Nanhan, on dead Oak wood, Sept, 2014, DM 2045.

**Habitat & Distribution:** Normally on dead wood and bark of living deciduous trees in temperate Himalayan forests.

**Geographical distribution:** North America, eastern Asia, and the Pyrenees in Europe, Ontario, Quebec, Nova Scotia; New England to Alabama and Mississippi, westward to Iowa, Missouri, Minnesota, Nebraska, and Wisconsin; Great Britain; China; Japan.

**India:** Uttarakhand, Himachal Pradesh.

**Remarks:** The discomycete-like appearance of the basidiocarps, greyish brown hymenial surface, white tomentose abhymenial surface and large, echinulate, amyloid spores make this species easily recognized. It has always been collected from Oak trees particularly in open and sunny places. This species tends to become more effused and confluent than *A. amorphus*. *Aleurodiscus oakesii* is readily distinguished from the *A. amorphus* by its yellow basidiomata, habitation of hardwoods, and by the presence of acanthohyphidia.

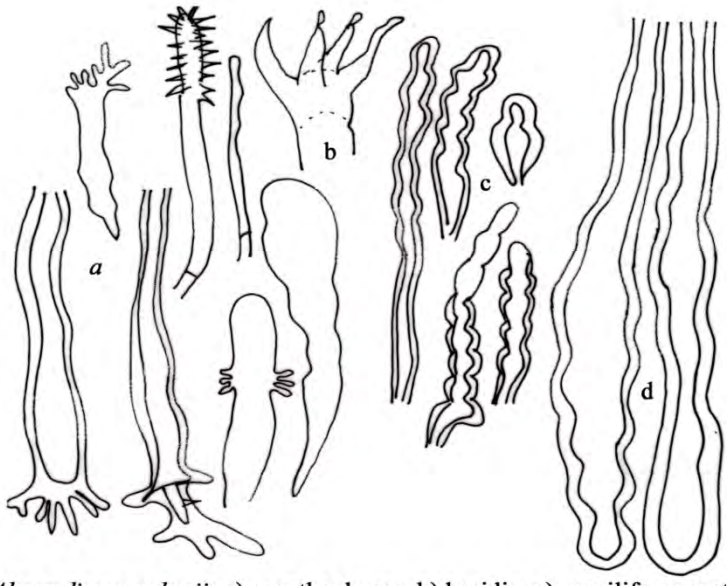


**Fig. 15:** *Aleurodiscus oakesii:* a) acanthophyses, b) basidia, c) moniliform cystidia, d) paraphysoid hyphae.

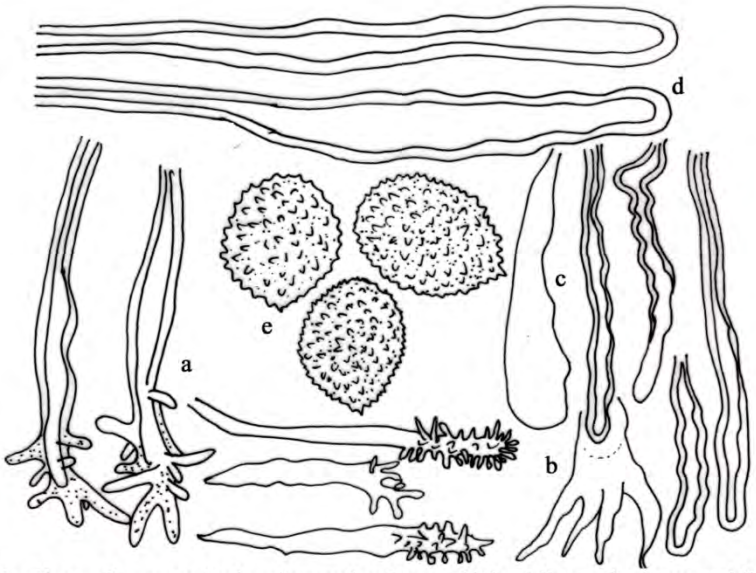


**Fig. 16:** *Aleurodiscus taxicola:* a) acanthophyses, b) basidium, c) gloeocystidia, d) paraphysoid hyphae, e) spores.

**Aleurodiscus taxicola** Thind & Rattan

Mycologia **65**: 1255, 1973

**Type locality:** Baghi, Mahasu, Himachal Pradesh, India. **(Fig. 16)**

Basidiocarps resupinate, membranous, adnate, effused up to 25 x 20 mm; up to 500 µm thick in section; hymenial surface white to cream, smooth; context composed of repent to semierect hyphae, densely impregnated with crystalline granules which obscure the hyphal details; margin thin, determinate.

Hyphal system monomitic, hyphae up to 3µm wide, septate, clamped, branched, thin-walled; basidia 60-90 x 12-18µm, clavate, 4-sterigmate, stergmata up to 15 µm long; gloeocystidia variable in shape, narrowly paraphysoid with rounded apex, protoplasm darkening in sulfovanillin; acanthophysis clavate to subcylindrical, thin-walled, echinulate in the upper part, spines up to 4 µm long, often collapsing in older specimens; spores (14.6-) 15-18(-18.2) x 12-14µm, L= 16.89 µm, W= 13.5 µm, Q= 1.25, (n= 20/2) broadly ellipsoid to ovoid, thin-walled, amyloid, finely echinulate up to 1 µm long.

**Specimens examined:** (UK) Rudraprayag, Maggu, on dead wood of *Taxus wallichiana,* 08 Aug. 1995, JRS 4112; *ibid,* Uttarkashi, Puncdodi, on dead wood of *Taxus wallichiana,* 10 Sept. 10, 1998, JRS 6150; *ibid,* Chamoli, Chopta, rotting trunk of *Taxus wallichiana*, 29 Sept., 2011, DM 1063; (HP), Shimla, Bagi, on bark of *Taxus wallichiana* Oct. 13, 1967, PAN 5352.

**Habitat & Distribution:** On bark of *Taxus wallichiana*, known only from North western Himalaya.

**Geographical distribution:** India.

**India:** Himachal Pradesh, Uttarakhand

**Remarks:** The whitish, adnate and resupinate fruitbodies, presence of clamped, monomitic hyphae, gloeocystidia and broadly ellipsoid, echinulate spores are the chief diagnostic features of this species. The species is close to *A. penicillatus*, sharing the coniferous host, clamped hyphae, ornamented basidiospores, and clavate acanthophyses. However, the spores of the latter species are wider than in *A. taxicola* and this species lacks moniliform cystidia.

**Amylostereum** Boid.
Revue Mycol. 23: 345, 1958.

Basidiocarps resupinate to effused-reflexed or pileate, coriaceous to cartilaginous; pilear surface smooth to finely tomentose; hymenial surface smooth, light brown; context light brown; hyphae dimitic, generative hyphae with clamps, skeletal hyphae brown, thick-walled; cystidia brown and encrusted; spores cylindrical to narrowly ellipsoid, smooth, thin-walled, distinctly amyloid; lignicolous.

**Type species:** *Amylostereum chailletii* (Fr.) Boidin

The genus is recognized by clamped generative hyphae, small amyloid spores and cystidia with brown and heavily encrusted walls. It is undoubtedly related to the genus Stereum, but easily separated from it by numerous encrusted cystidia and the clamped generative hyphae.

**Key to species**

1. Hymenial cystidia 32-37 x 4-5µm……*A. ferreum*

2. Hymenial cystidia 50-100 (-120) x 4-6 µm……..……..*A. chailletii*

**Amylostereum chailletii** (Fr.) Boidin

Rev. Mycol. **23:** 345, 1958**;** *Thelephora chailletii* Fr., Elench. Fung. **1:** 188, 1828; *Stereum chailletii* Pers., Myc. Eur. **1**: 125, 1822.

**Type locality:** Europe **(Fig. 17)**

Basidiocarps coriaceous, nearly always resupinate, widely effused, occasionally reflexed, resupinate specimens up to 20mm in diam., up to 100 x 20mm after becoming laterally confluent, reflexed portion up to 10mm broad and 1-3mm thick; upper surface tomentose, more or less concentrically sulcate, dark-brown; margin entire, finely tomentose; hymenial surface ochraceous to avellaneous to wood brown, usually cracking on drying; context light brown with hyphae arranged parallel to the substrate.

Hyphal system dimitic, generative hyphae richly branched, hyaline, clamped, skeletal hyphae straight, brown, sparsely branched, without clamps; subhymenial hyphae dominated by vertically arranged, thin to thick-walled generative hyphae, 2-2.5 µm wide; cystidia brown, thick-walled, apically encrusted, 50-100(120) x 4-6 µm, emerging up to 20 µm beyond the hymenium, slender, pointed; young cystidia subulate, thinwalled and smooth; a few larger, thinwalled, rounded to subulate cystidia often containing oily drops or resinous grains are

seemingly of gloeocystidial character, and apparently remain thinwalled; basidia narrow, club-shaped, 16-22 x 4-5 µm, 4-spored; spores cylindrical or narrowly ellipsoid, (5.9-)6-7(-7.5) x 2-3 µm, L=6.7 µm, W= 2.75 µm, Q=2.81 (n=20/2) smooth, distinctly amyloid.

**Specimens examined:** (UK) Champawat Mount Abbot, rotting stump of *Cedrus deodara,* 27 Aug. 2002, JRS 8712; *ibid,* Mundali, Chakrata forest, on dead twigs of *Picea smithiana;* 11 Sept. 2012, DM 3012; *ibid,* Bageshwar Dhakuri, rotting log of *Abies pindrow,* 10 Sept. 2003, JRS 9012; (HP) Chamba Kalatope, rotting stump of *Pinus wallichiana,* 05 Oct. 2004, JRS 12028; *ibid,* Shimla, rotting trunk of *Cedrus*, 09 Sept. 2017, DM 5100.

**Habitat & Distribution:** *Amylostereum chailletii* grows on *Picea* or cultivated species of *Abies*. It occurs mainly in somewhat richer spruce forests. Most collections have been made on not too much decayed trunks of a certain diameter (10-25 cm) but collections from thinner branches are known. Common in the coniferous zone, on *Abies alba* and *Pinus* spp.

**Geographical distribution:** Europe: Switzerland, Poland, Russia, Estonia, France, Germany, Czech Republic, Belarus, Hungary, Ireland, Croatia, Macedonia, Slovenia, Bosnia and Herzegovina, Belgium, United Kingdom, Slovenia, Romania, Turkey, Sweden, Denmark, Norway, Switzerland, Finland, Italy, Spain, Ukraine, Netherlands, and the Caucasus. Very common species in Italy, recorded from Piemonte, Trentino Alto-Adige, Friuli Venezia-Giulia, Veneto, Emilia-Romagna, Toscana, Basilicata and Calabria.

**India:** Uttarakhand, Himachal Pradesh, Arunachal Pradesh, Meghalaya, Jammu & Kashmir.

**Remarks:** *Amylostereum chailletii* grows on coniferous woods preferably *Abies* and *Cedrus* throughout the zone of coniferous forests. Its regular occurrence on conifers, avellaneous and velvety hymenial surface with a uniform appearance help in its easy recognisation in the field. Other diagnostic features include dimitic hyphal system, coloured apically encrusted cystidia and distinctly amyloid spores. The closely related species *A. areolatum* (Fr.) Boid, has a distinct duplex-structure and is in addition usually pileate. The upper layer is darker (in KOH almost black) and of an open structure. Between this and a lower denser layer, there is a thin very dense layer, in section almost like a black line. The hymenium in *A. areolatum* is darker than in *A. chailletii* and the fruitbodies usually thicker, i.e. about 2-3 mm.

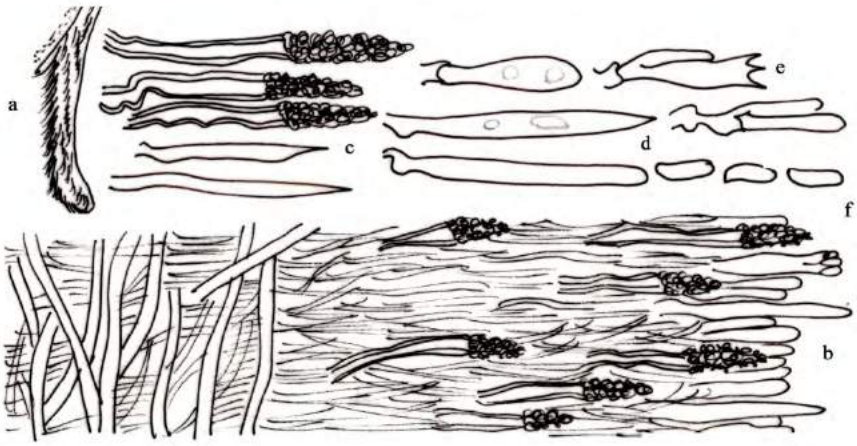


**Fig. 17:** *Amylostereum chailletii:* a) section of basidiocarp, b) section showing subiculum & hymenium, c) encrusted and smooth cystidia, e) basidia, f) spores.

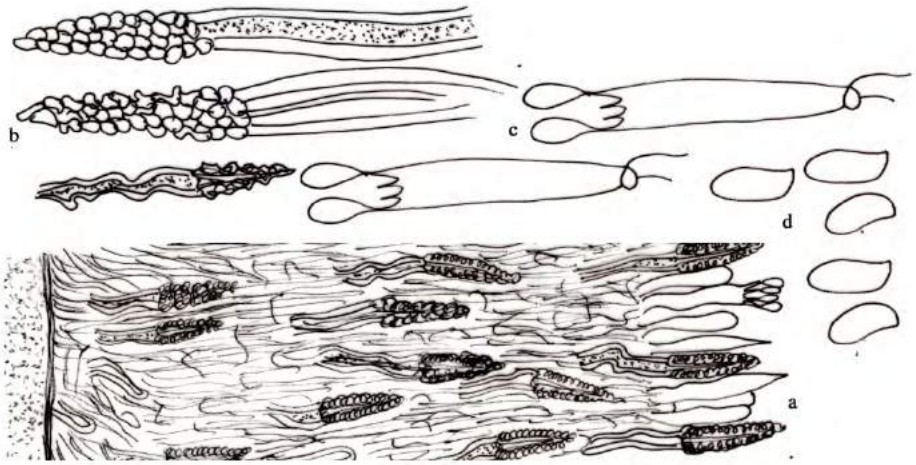


**Fig. 18:** *Amylostereum ferreum:* a) section of basidiocarp showing subiculum and hymenium, b) cystidia, c) basidia, d) spores.

**Amylostereum ferreum** (Berk. & Curt.) Boidin & Lanq.

Bull. Mycol. Soc. France 100: 217. 1984; *Stereum ferreum* Berk. & Curt., J. Linn. Soc. Bot. 10: 332. 1868.

**Type locality:** Cuba. **(Fig. 18)**

Basidiocarps resupinate to resupinate-reflexed, corky to woody, dull, dark ochraceous, cracked, spreading over sub strate, temporarily darkened with KOH; margin slightly raised; hymenophore ± even and smooth, drab; context radially parallel.

Hyphal system dimitic, generative hyphae 3 um wide, inflating to 8 um wide, profusely branched, hyaline, clamped; skeletal hyphae thick-walled to solid, brown, unbranched, entering into hymenial area; hymenial area filled with dark brown cystidia 32-37 x 4-5 µm, often incrusted with hyaline crystalline matter and obscuring other hymenial elements, becoming em bedded as hymenium thickens; cystidioles hyaline, thin-walled, with long tapering apices, variable in length, obscure; basidioles with obtuse apices, mostly 10-11 x 4-5 µm, hyaline; basidia not observed; spores (5.8-) 6-7 (7.2) x 3-4 (-4.1) µm, L= 6.95 µm, W=3.8 µm Q= 1.91 (n=20/2) walls slightly brown.

**Specimens examined:** (HP) Kullu, Pulga, dead branch of *Taxus wallichiana,* 20 Sept. 1994, JRS 4023; *ibid,* Bashahr, Khanote forest, on dead branch of *Coniferous* tree, 22 Sept. 2015, DM 2033; (UK) Chakrata, way to tiger fall, on hard wood stump, 02 Oct. 2006, JRS 13622.

**Habitat & Distribution:** This species appears to be rare and found growing on coniferous woods in the temperate to subalpine himalayan forests

**Geographical distribution:** Cuba, Jamaica, Guadeloupe, Brazil, Borneo and New Zealand.

**India**: Himachal Pradesh, Uttarakhand,

**Remarks:** There is a paucity of specimens of *Amylostereum ferreum* and those we do have are unsatisfactory. Macroscopically *Amylostereum ferreum* strongly resembles *Stereum frustulatum var. subpileatum*, and there may well be a number of collections of this taxon filled in herbaria under that name. The initial recognition of the two is rather easy microscopically: the former has the dark brown encrusted cystidia which occur either in the hymenium or directly below it, the latter lacks these dark cystidia and produces, in most forms, characteristic acanthophyses. Also, *Amylostereum* species are reported to attack gymnosperms, and several species are associated with wasps, which carry fragments of the fungi in their mycangia. *Amylostereum ferreum* and the other species of *Amylostereum*, *A. chailletii* (Pers.: Fr.) Boidin, *A. laevigatum* (Fr.) Boidin, and *A. areolatum* (Chaill.: Fr.) Boidin, have a similar appearance macroscopically and their spores

are similar in size and shape. I have not been able to determine the reaction to Melzer's reagent of the very few spores observed in *A. ferreum*, but Boidin (1958) reported them as amyloid.

**Aquascypha** DA. Reid,
Beih. Nova Hedwigia 18: 51. 1965.

Basidiocarps stipitate and infundibuliform or sessile and umbonate to reflexed, coriaceous, felty, darkening in KOH solution; abhymenial surface narrowly zonate, dark brown, with or without purple tints, velvety to velvety-tomentose; hymenial surface concolorous, purple fuscous, or white, smooth or cracked, even; margin even, undulate, or lobed; stipe concolorous, velvety, somewhat swollen at base; pileus surface of obliquely erect, unbranched, thick-walled, deeply reddish brown hyphae arising from a nearly black zone, easily seen at 10X, composed of densely compact similar hyphae subtended by an interwoven context and a hymenium; hyphal system trimitic, generative hyphae clamped, hyaline to pale yellowish brown; skeletal hyphae with thick walls or solid, deep yellowish or reddish brown; basidia cylindrical-clavate with 4 needle-like sterigmata; hymenial cystidia with thick hyaline to dark yellowish brown walls; spores elongate oval to cylindrical, smooth, thin-walled, hyaline, may be slightly curved, apiculate, inamyloid.

**Type species:** *Stereum hydrophorum* Berk.

*Aquascypha* has been reported as trimitic (Reid, 1965; Welden, 1954, 1967). The hyaline, solid generative hyphae are unbranched and often without clamps for considerable distances. They give rise to branches along their length, in a manner not yet satisfactorily re solved, which form short-branched masses. These could be interpreted as binding hyphae. The branched parts often occur in clusters, particularly in the lower part of the basidiocarp. It is difficult to trace their ori gins in dried material, for they break easily, even after soaking in KOH solution; their bits and pieces are very prominent in mounts.

**Aquascypha vibrans** (Berk. & M.A. Curtis) A.L. Weiden,
J. Tennessee Acad. Sei. 42: 81. 1967

*Stereum vibrans* Berk. & MA. Curtis, J. Linn. Soc. Bot. 10: 332. 1868.

**Type locality:** Cuba. **(Fig. 19)**

Basidicarps sessile, attached by an attenuated base, umbonate or reflexed, 10-70 x 30-40 mm, felty-tomentose, without prominent spicules, closely zonate; margin lobate; tomentum hyphae 5-6 µm wide; thin-walled and solid.

Hyphal system trimitic, generative hyphae with clamps, hyaline, 2-5 µm wide, skeletal hyphae dominating the basidiocarp, brown, solid to thick-walled, 3-6 µm wide, from the subhymenium bending into the hymenium as smooth hyphal ends forming a catahymenium;

binding hyphae few, sparingly branched, pale brown and apparently solid 2-4 µm wide. skeletal hyphae 4-7 µm wide; cystidia 34-65 x 4.5-8 µm; basidia 29 33 x 4-5 µm, sterigmata 4-5 µm long; spores (4.95-)5 -6 (6.2) x 2-3 µm, L= 5.97 µm, W= 2.98 µm, Q= 1.02 (n= 20/2) inamyloid.

**Specimens examined: (**WB), Darjeeling, Pashok forest, 07 Jul. 1974, JRS (2179, CAL); *ibid,* Sevok, base of a hardwood stump, 15 Sept. 1988, JRS (61461, CAL); *ibid*, Darjeeling, on a hard wood log, 13 Nov. 1990, JRS (19140, CAL)

**Habitat & Distribution:** Rare tropical species, on fallen hardwoods. There are two species. One appears to be strictly Neotropical; the other may also occur in India and Japan.

**Geographical distribution:** Central America and northern South America, West Indies, Jamaica, Ecuador, Costa Rica, Trinidad, Guatemala, Brazil and Colombia and Japan.

**India:** West Bengal

**Remarks:** There are comparatively few collections of these fungi, most of which, unfortunately, are sterile. Despite the fact that they grow in areas that are not regularly visited by mycologists, their rarity in herbaria may not be an artifact of collection. Both species are of a fairly large size and striking appearance and are unlikely to be missed when present. Superficially they resemble *Hymenochaete*, but the lack of setae and the presence of clamps on the generative hyphae quickly disabuse the investigator of that suspicion.

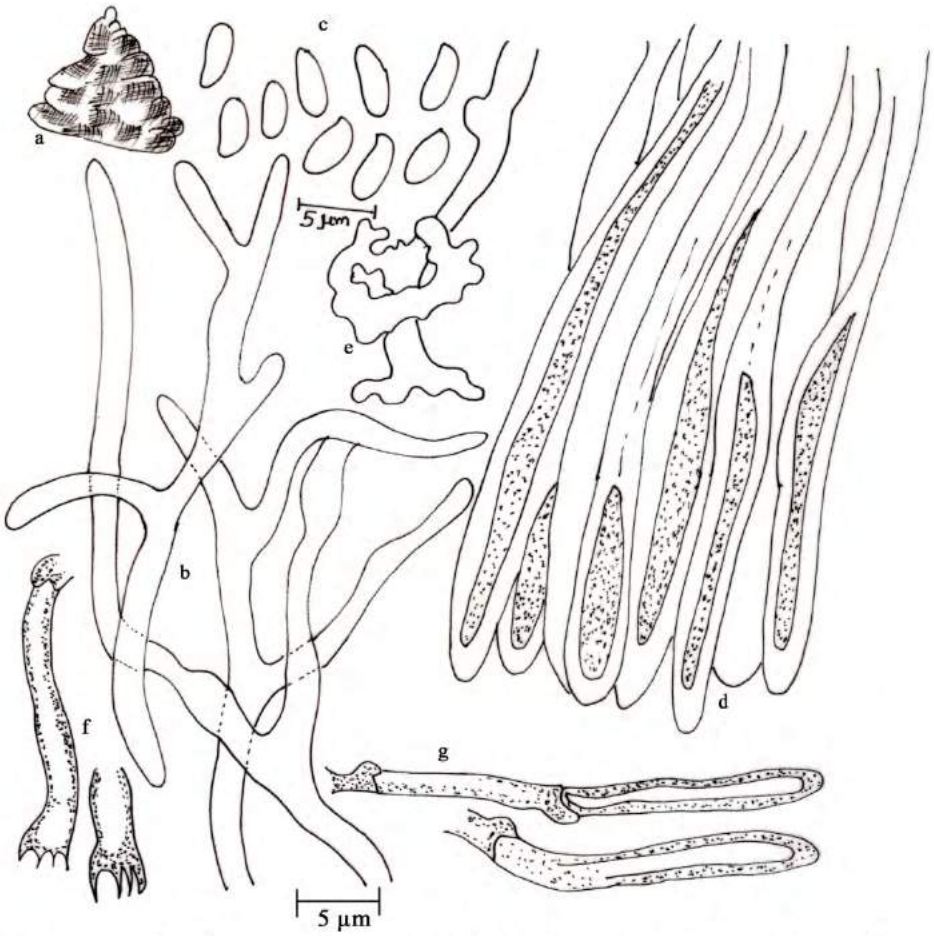


**Fig. 19:** *Aquascypha vibrans:* a) basidiocarp, b) hyphae from context, c) hymenial cystidia, d) section through basidiocarp, e) binding hyphae, f) basidia, g) hymenial cystidia.

**Chondrostereum** Pouz.
Ceska Mykol. 13: 7, 1959.

Basidiocarps pileate to resupinate, soft and flexible when fresh, horny and brittle on drying composed of several distinct hyphal layers: 1) a whitish tomentum of hyphae on abhymenial side; 2) a dark horny layer composed of dense parallel hyphae; 3) a white contextual layer of dense and parallely arranged hyphae; 4) a vesicular layer composed of loosely arranged hyphae with numerous vesicules or interhyphal empty spaces; 5) a sub-hymenial layer of densely interwoven vertical hyphae; 6) hymenium forming a dense and ceraceous layer of basidia and sparse cystidia; hymenial surface smooth or wrinkled, margin thin; hyphae monomitic, clamped; spores ellipsoid-cylindrical, thin-walled,inamyloid.

**Type species:** *Chondrostereum purpureum* (Fr.) Pouz.

The waxy-ceraceous texture of fruitbodies, smooth hymenial surface, characteristic zonation into several hyphal layers, monomitic hyphae and cylindrical spores are the chief features of this genus. Both *Merulius* and *Phlebia* are very close but the former possesses wrinkled or merulioid hymenial surface while the latter is totally resupinate, and also lacks the characteristic zonation of the context. Eriksson and Ryvarden (1973) have remarked that *Chondrostereum* is more akin to *Phlebia* rather than *Stereum* (Donk, 1964) or *Merulius* (Parmasto, 1968).

**Key to species**

1. Basidiocarps resupinate; vesicles absent though empty space may be present; leptocystidia slightly thickl-walled, clavate-cylindrical……***C. himalaicum***

1. Basidiocarps substereoid to stereoid; vesicles present; leptocystidia thin-walled, sub-cylindrical to fusiform……..***C. purpureum***

**Chondrostereum himalaicum** (Thind & Rattan) Rattan

Bibliotheca Mycol. 60: 274 (1977); *Phlebia himalaica* Thind & Rattan, Trans. Brit. Mycol. Soc. **59:** 123. 1972.

**Type locality:** Uttar Pradesh, India. **(Fig. 20)**

Basidiocarps resupinate, membranous-ceraceous, arising in small patches, which later grow up to 400 µm thick; hymenial surface smooth to faintly tuberculate, light to reddish brown, continuous; margin thin, determinate, minutely fimbriate; context subhyaline, two layered.

Hyphal system monomitic, hyphae clamped, thin-walled, up to 4 µm wide, freely branched; cystidia subulate, 25-30 x 5-8.5 µm, clavate- cylindrical with acute apices, smooth;

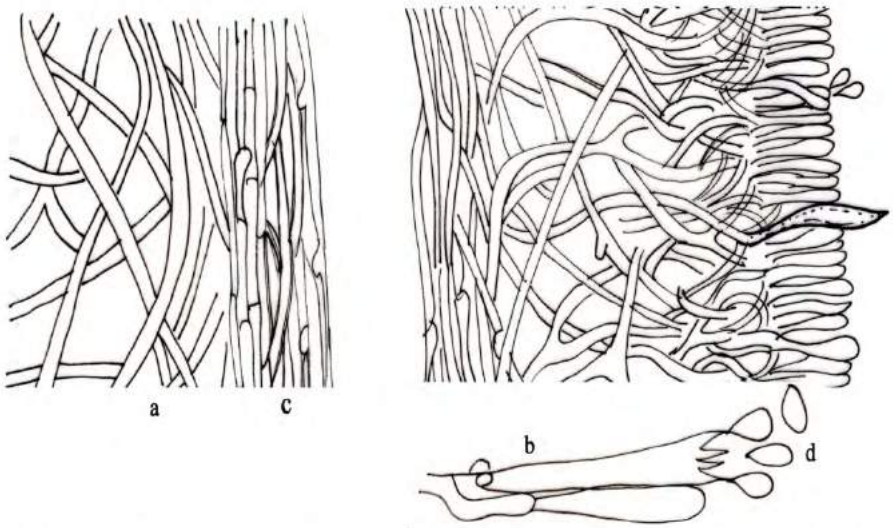


**Fig. 20:** *Chondrostereum himalaicum:* a) vertical section of basidiocarp, b) basidium, c) hyphae from context, d) spores.

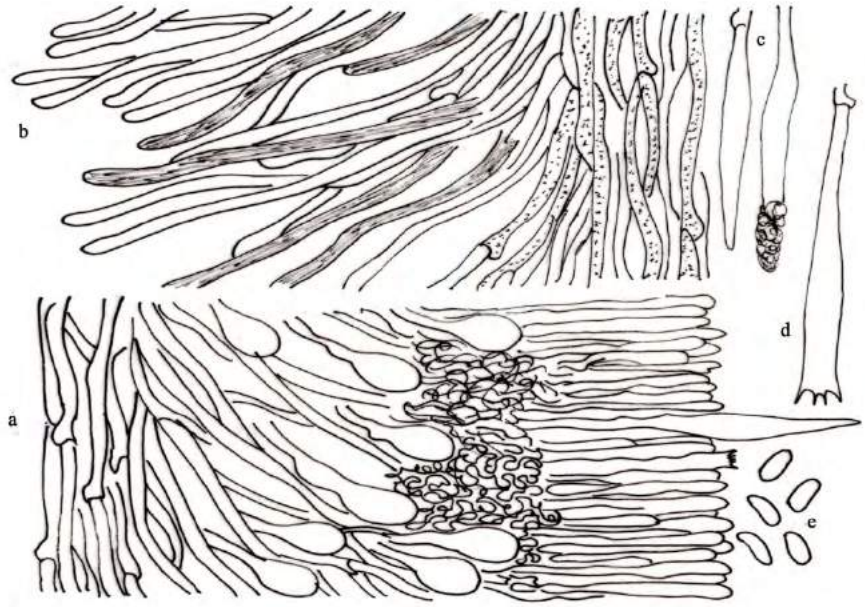


**Fig. 21:** *Chondrostereum purpureum:* a) section through the hymenium, b) section through the tomentum, c) cystidia, d) basidium, e) spores.

basidia 20-30 x 3-4 µm, clavate, 4-sterigmate; spores (3.9-)4-5 (5.2) x 2-3µm, L= 4.89 µm, W= 2.7 µm, Q=1.81, (n= 20/2), ellipsoid, thin-walled, smooth, inamyloid.

**Specimens examined**: (HP) Kinnaur, Nichhar, on twigs under coniferous forests, 04 Sept. 1965, PAN 5020 (type); *ibid,* Narkanda, Shimla, on the fallen log, 10 Sept. 2015, DM 437; (UK) Phurkia, Bageshwar, on thin branches of coniferous trees, 30 Aug. 1999, JRS 6252; *ibid,* Uttarkashi, Hunuman Chatti, on the twigs, 04 Oct. 2012, DM 1019.

**Habitat and Distribution:** Rare and found only in temperate coniferous forests

**Geographical Distribution:** Rare species reported only from India

**India:** Himachal Pradesh, Uttarakhand

**Remarks:** This species grows on coniferous woods and is recognized by smooth to faintly wrinkled, brown to reddish brown hymenial surface, subulate thick-walled, smooth cystidia and ellipsoid inamyloid spores.

**Chondrostereum purpureum** (Fr.) Pouz.

Ceska Mykol. **13:** 17, 1959; *Thelephora purpurea* Fr., Syst. Mycol. **1:** 440,1821; *Stereum purpureum* Pers., Roemer Neues Mag. Bot. **1**: 110, 1794; Fries, epicr. 548, 1838; *Stereum rugosiusculum* Berkeley & Curtis, Grevillea 1:162. 1873.

**Type locality:** U.S.A.: Massachusetts **(Fig. 21)**

Basidiocarps coriaceous-soft, drying rigid, sometimes resupinate, usually more or less reflexed, reflexed portion up to 30mm long, 20mm broad and up to 1 mm thick; upper surface villose-tomentose, palebuff; margin entire; hymenial surface smooth, purplish brown to violaceous brown, paler after drying, upper tomentum is separated from the lower layer by a dark line; context up to 800 µm thick, composed of: 1) tomentose layer of loosely arranged hyphae; 2) cuticular layer of agglutinated and tinted hyphae; 3) lower context layer of compactly arranged hyphae; 4) a layer of loosely arranged hyphae enclosing numerous thin-walled vesicles; 5) subhymenium and hymenium forming a ceraceous and pellicle-like layer.

Hyphal system monomitic, septate, clamps prominent, thin-walled in sub-hymenium, slightly thick-walled in subiculum and tomentum, 1.5-3 µm wide; cystidia sparse, fusoid to obtuse, 60-85x6-9 µm, projecting up to 50 µm out of hymenium, thin-walled, with or without crystalline deposits; basidia long and narrow, 16-25 x 3-4 µm, 4-spored; vesicles 10-20 µm in diameter, subglobose to pyriform, abundant only in the vesicular layer; upper part of context distinctly observed in young specimens, usually collapsing and gelatinising in mature fruitbodies leaving an empty space in place of vesicles; spores (4.2-) 4.5-5.5 (-5.60) x 2-3 µm, L= 5.34 µm, W= 2.87 µm, Q= 1.86 (n=20/4), thin-walled, hyaline, inamyloid.

**Specimens examined:** (UK) Chamoli, Gobind dham, hardwood stump, 15 Sept. 1968 PAN 5432; (HP) Kullu Sariakot, on rotting trunk of Oak, 10 Sept. 2006, JRS 13625; *ibid*, Kullu, Manali, Solang Valley, on fallen angiospermous log, Jaspreet 4845 (PUN), 28 Oct. 2008; *ibid*, Chamba, Dalhousie, Kalatop, on decaying gymnospermous stump, 18 Sept. 2014, DM 2067; Sikkim, Gangtok, Near BSI campus, fallen hardwood trunk, 27 Sept. 2012, DM 30052.

**Habitat & Distribution:** Saprophytic or parasitic on stumps, branches or trunks of deciduous trees, rarely on coniferous substrates. Infected living trees, e.g. fruit-trees, develop a characteristic change of the leaf-epidermis the so-called "silver leaf" disease.

**Geographical distribution: Europe:** Austria, Estonia, France, Germany, Czech Republic, Belarus, Bulgaria, Poland, Ireland, Bosnia and Herzegovina, Montenegro, Croatia, Macedonia, Slovenia, Serbia, Belgium, United Kingdom, Slovenia, Netherlands, Russia, Romania, Bulgaria, Portugal, Turkey, Sweden, Italy, Denmark, Norway, Switzerland, Finland, Spain, Ukraine, and the Caucasus. Very frequent species in all European countries, common in Italy and often overlooked.

**India:** Uttarakhand, Himachal Pradesh, Sikkim.

**Remarks:** This species is easily recognized in the field by its usual habitation of living or recently dead, corticate hardwood limbs and trunks; by its effuso-reflexed, coriaceous-ceraceous basidiomata; and by its yellowish brown to violaceous hymenial surface. Microscopically the vesicles in the subhymenium and the acute, thin-walled cystidia are distinctive; however, the cystidia may be rare or apparently absent in some specimens. *Chondrostereum purpureum* is the causal agent of silver-leaf disease of rosaceous fruit trees, particularly those species in Malus and *Prunus*. The disease was first reported by Prillieux (1885) who described silvered foliage of plum trees in France. Leaves appear silvered because of air spaces created by the separation of the mesophyll cells from each other and from the epidermis (Tetley, 1932). Separation is caused by an endo-polygalacturonase produced by the fungus in the wood and translocated to the leaves (Miyairi *et al*., 1977). Other symptoms include leaf yellowing, browning, necrosis, malformation and size reduction. Also, the wood of infected limbs develops a brown stain, attributable in part to the action of extracellular laccase (Miyairi *et al*., 1982). Affected limbs drop their flowers, fruits and leaves prematurely and eventually die. Death of the tree can occur in severe cases.

**Cotylidia** Karst.
Rev. Mycol., Toulouse 3: 22, 1881

Basidiocarps pileate, infundibuliform, light-coloured, ochraceous with orange tint, stipitate; pileus thin, radially fibrillose, zonate; stipe up to 10 mm long, 1-2 mm wide, central, whitish velutinous, with bulbous base; hymenophore smooth, pale ochraceous; hyphal system monomitic; generative hyphae without clamps, thin-walled, hyaline; hymenial cystidia of tramal origin, scattered, projecting above hymenium, smooth, occasionally minutely incrusted, obtuse, hyaline; basidia slightly clavate, 4-sterigmate; spores ellipsoid with prominent apiculus, hyaline, smooth, thin-walled, inamyloid.

The genus *Cotylidia* Karst. includes some less known species of both interesting and beautiful stipitate stereoid fungi. Reid (1965) monographed stipitate stereoid species including *Cotylidia* which resembles two other genera, namely *Podoscypha* Pat. and *Stereopsis* D. A. Reid. However, these genera differ mainly in microscopic features. While *Podoscypha* species are dimitic and moreover possess generative hyphae with clamps, those of the genus *Stereopsis* do not have any cystidia. In addition, as shown by recent studies based on molecular taxonomy (Sjokvist *et al*, 2012), both genera belong to groups unrelated to *Cotylidia*. For the coherence, the species of the genus *Stereum* Hill ex Pers. are dimitic fungi without a stipe and with amyloid spores belonging to the russuloid clade (Larsson & Larssoon (2003).

The Indexfungorum database (www.Indexfungrum.org ) contains about eleven accepted species of the genus *Cotylidia* in the world. *Cotylidia* species occur abundantly in the tropic, but only two species are known from India. The genus is marked by coriaceous, spathulate to infundibuliform fruitbodies, monomitic septate hyphae, thin-walled, ellipsoid and nonamyloid spores and presence of cystidia projecting markedly beyond the basidia. This pileate genus is referred to Podoscyphaceae by Reid.

The genus was formerly placed in Aphyllophorales (Vesterholt 1997) but current phylogenetic studies (Moncalvo *et al* 2002, Sjokvist *et al* 2012) exclude *Cotylidia* from its traditional position in the Podoscyphaceae family (Polyporales) and place it together with the agaricoid genus *Rickenella* Raithelh. in the hymenochaetoid clade. Despite the external differences, the genera are connected by at least their bryophilous ecology (Larsson *et al*, 2006, Redhead *et al* 2002).

**Type species:** *Cotylidia undulata* (Fr.) Karst.= *Thelephora undulata* Fr., Elench. fung. (Greifswald) 1: 164, 1828.

**Key to species**

1. Basidiocarps thick, forming complicated compound rosettes; upper surface fibrillose, white to pale brown; cystidia non-septate; mostly terrestrial ……***C. pannosa***

1. Basidiocarps not as above; upper surface bright yellow to yellowish white; some cystidia with 1-3 septa; usually on woody debris ……***C. aurantiaca***

**Cotylidia aurantiaca** (Pers.) Welden

Lloydia **2**: 40, 1958; *Thelephora aurantiaca* Pers., Gaudi., Voy. Uran. Bot. p. 176, 1827

**Type locality:** Argentina **(Fig. 22)**

Basidiocarps 6-30 mm high, 2-30 mm wide, solitary or gregarious, papyraceous, spathulate, ligulate, flabellate or reniform, confluent, but not forming large complicated fruitbodies; pileus bright yellow, straw-coloured on drying, indistinctly zonate; in dried specimens, the upper surface has a distinct silky sheen and appears to be minutely radiately striate, but under a lens is seen to be formed of numerous radiating fibrils; margin fimbriate, pileus splitting radially into a number of segments; hymenial surface bright yellow, yellowish brown on drying, setulose due to protruding cystidia; stipe up to 10 mm long, 10-15 mm in width, surface tomentose; flesh thin; cuticle absent; hymenium thickening, up to 70 µm thick.

Hyphal system monomitic, generative hyphae branched, 3-8 µm wide, lacking clamp connections; thin to thick-walled; cystidia cylindrical, clavate or capitate-subglobose to pyriform, some cystidia with 1-3 transverse septa, thick-walled, 110-130 x 6-20 µm, projecting beyond the hymenium, up to 60 µm; basidia cylindrical to clavate, 25-40 x 3-6 µm, 4-sterigmate; spores (5.8-) 6-9 (-9.2) x 3-4 µm, L= 8.2 µm, W=3.98 µm, Q = 2.07 (n=20/4) thin-walled, hyaline, immature spores are narrowly subcylindric to slightly curved, hyaline broadly ellipsoid, non-amyloid.

**Specimens examined:** (HP), Chamba, Kalatope, fallen hardwood, 22 Sept. 2014, DM 3037; (UK), Rudraprayag, Ransi, on ground from buried root, 10 Aug. 1997, JRS 5103; Pithoragarh, Thal, buried wood log 15 Sept. 2001, JRS 8011; *ibid,* Chamoli, way to Tungnath, on rotting trunk of Oak, 23 Sept. 2011, DM 2085.

**Habitat & Distribution:** On trunks, debris and possibly also on the ground**,** most frequent on woody substrates but also terrestrial.

**Geographical Distribution:** Argentina, Bolivia, Mexico, Costa Rica, Jamaica, Trinidad, Panama, Colombia, Venezuela, Brazil.

**India:** Uttarakhand, Himachal Pradesh, Jammu & Kashmir

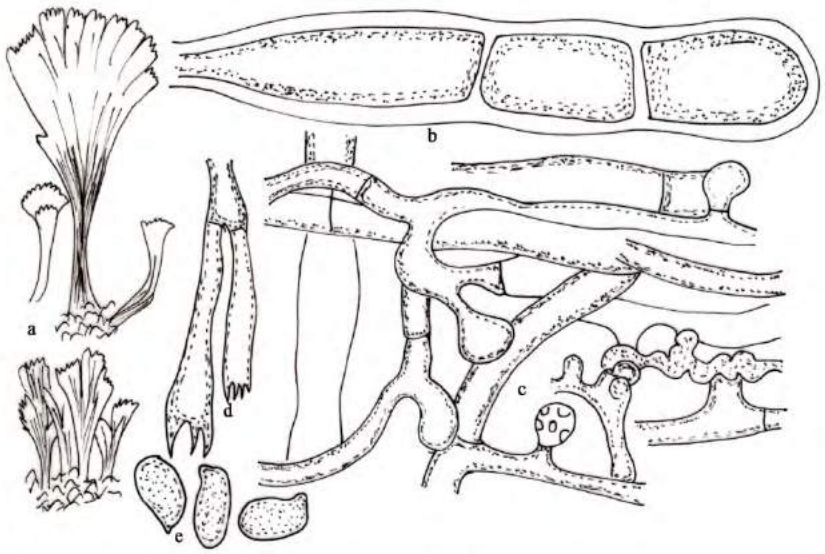


**Fig. 22:** *Cotylidia aurantiaca:* a) basidiocarp, b) leptocystidium with septa, c) generative hyphae, d) basidia, e) spores.

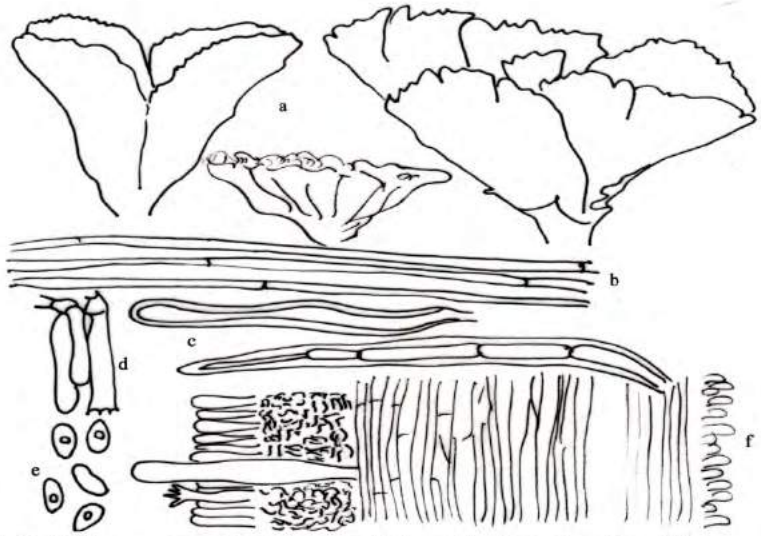


**Fig. 23:** *Cotylidia pannosa:* a) basidiocarps, b) tramal hyphae, c) caulocystidia, d) basidia, e) spores, f) section through pileus showing its construction.

**Remarks :** The spathulate to flabellate bright yellow basidiocarps, large thick walled, 1-3 septate cystidia and larger spores mark the species.

**Cotylidia pannosa** (Sow.: Fr.) Reid

Monogr. Stip. Stereoid Fungi p. 81, 1965; *Helvella pannosa* Sowerby, Col. fig. Engl. Fung. Mushr. (London) 2(no. 14): tab. 155 (1799) ; *Thelephora pannosa* Sow. : Fr., Syst. Mycol. **1:** 430, 1821; *Stereum sowerbeii* Berk., Bot. Ant. Voy. in Hook. II Fl. Nov. Zeland. **2** : 182, 1855.

**Type locality:** Great Britain **(Fig. 23)**

Basidiocarps 10-50 mm high, gregarious, confluent, forming compound rosette-like fruitbodies of variable dimensions; pileus white to yellowish brown, dark brown in old specimens, fibrillose; hymenial surface smooth, concolorous with pileus undulating or slightly folded, hispid due to the projecting cystidia; stipe usually rudimentary, when present short and stout, whitish, tomentose; cuticle absent; hymenium thickening, up to 170µm thick.

Hyphal system monomitic, hyphae branched, hyaline, 3-5 µm wide, clamp connections absent, thin to thick-walled; cystidia cylindrical or slightly clavate, 8-12 µm wide, projecting up to 70 µm beyond the hymenium, thin to slightly thick-walled, septa absent; basidia 35-50 x 6-8 µm, subcylindrical to clavate, 2-4 sterigmate; spores (5.8-) 6-8.50 (-8.57) x 3.5-4 µm, L= 8.30, W= 3.95, Q= 2.11 (n=20/4) thin-walled, hyaline, broadly ellipsoid, with a distinct lateral apiculus.

**Specimens examined:** (UK) Rishikesh, on soil under hardwood tree, 20 Sept. 2002, JRS 9115; *ibid* Chamoli, way to Chopta, on hardwood, 03 Oct. 2011, DM 1064 ; (HP) Kangra, Tanda, on soil from buried root, 10 Aug. 2004, JRS 12722.

**Habitat & Distribution:** On base soil in mixed forests. *Cotylidia pannosa* is a rare species.

**Geographical Distribution:** Poland, Russia, France, Germany, Bosnia and Herzegovina, Croatia, Slovenia, Belgium, United Kingdom, Netherlands, Bulgaria, Sweden, Italy, Denmark, Spain, Ukraine, and the Caucasus. Infrequent species in Italy with few known collecting areas in Piemonte, Liguria, Trentino Alto-Adige, Veneto, Emilia-Romagna, and Toscana.

**India:** Himachal Pradesh, Uttarakhand.

**Remarks:** The thick, rosette-like light coloured, fibrillose fruitbodies, and nonseptate cystidia are the important separating characters of this species.

**Cymatoderma** Jungh.
Tijdschr. nat. Gesch. 7: 290, 1840

Basidiocarps coriaceous, dimidiate, flabellate, confluent; upper surface ornamented with radiating knife-edged ridges; hymenial surface thrown into complex system of folds, ridges or undulations; hyphae trimitic, generative hyphae with clamps, skeletal hyphae very thick-walled to solid, binding hyphae thick-walled, with numerous branches of limited growth; cystidia present in few species; gloeocystidia always present, having a distinctly swollen base, narrowing above to an obtuse apex; basidia 4-sterigmate; spores ellipsoid to subglobose, thin-walled, inamyloid; lignicolous.

**Type species:** *Cymatoderma elegans* Jungh.

The genus is mainly differentiated on the basis of large, robust fruitbodies with undulating folds of hymenial surface, knife-edged crests on the pilear surface and absence of caulo-and pilocystidia.

**Cymatoderma dendriticum** (Pers.) Reid

Kew Bull. **13**: 523, 1958; *Thelephora dendritica* Pers., Gaudi. Voy. Uran. Bot. p. 176, 1826; *Cladoderris dendritica* (Pers.) Berk., Hook. Lond. J. Bot. **1**: 152, 1842.

**Type locality:** New Guinea, Rawak **(Fig. 24)**

Basidiocarps up to 100 x 250 mm, thin, pliable, coriaceous-membranous, dimidiate to flabellate, often deeply lobed, narrowing down to a short lateral stipe, imbricate; pileus usually covered with very well developed felt-like tomentum which is 5-8 mm thick, surface with knife-edged ridges, fawn, cinnamon-fawn to dark ochraceous brown, darker towards the base; margin lacerate-spiculose; hymenial surface cream coloured, reddish to purplish brown in older specimens, surface is thrown into a complex system of densely crowded, branched radiating ribs; stipe lateral, usually short and stout or rudimentary, reaching up to 40 mm x 10 mm, covered with a dense reddish brown tomentum; flesh thin, greyish white to wood-coloured; hymenium thickening, up to 90 µm thick.

Hyphal system trimitic, generative hyphae 3-5µm wide, thin-walled, skeletal hyphae 4-5µm wide, unbranched, binding hyphae 2-2.5µm wide, branched, hyphae often more densely arranged towards the surface of the pileus, tomentum hyphae thick-walled; cystidia absent; gloeocystidia abundant, undulating, thin-walled, with swollen bases, narrowing above to broad obtuse or subacute apices; hyphae toward the surface of the pileus are often more densely compacted; tomentum is formed of thick-walled hyphae, (2-5-)3-5(-7) mm in diam., with thin or thick-walled, obtuse or slightly narrowed apices caulocystidia and pilocystidia absent; basidia clavate, 20-25 x 4-5µm, 4-sterigmate; spores (2.8-) 3-4 (-3.95) x 2.5-3.4µm, L= 3.90, W= 2.80, Q= 1.39 (n=20/4) uniguttulate, subglobose, inamyloid.

**Specimens examined:** (UK), Dehradun, Dhanaulti, rotting stump of Oak, 17 Aug. 1992, JRS 2180; *ibid,* Chamoli, way to Chopta, rotting trunk of *Cedrus deodara*, 27 Sept. 2011, DM 1066; (HP) Kullu, Sainj, rotting stump of *Psidium,* 25 Sept. 1994, JRS 1136;

**Habitat & Distribution:** On dead stumps, trunks, fallen branches of hardwood and coniferous woods.

**Geographical distribution:** Pantropical. From Mexico to Brazil, and on the Caribbean islands. South and North America, Africa, Philippine Islands, Sumatra, Australia.

**India:** Uttarakhand, Himachal Pradesh

**Remarks :** The robust fruitbodies, with undulating folds of hymenial surface, knife-edged crests on pilear surface and small globose spores mark this species.

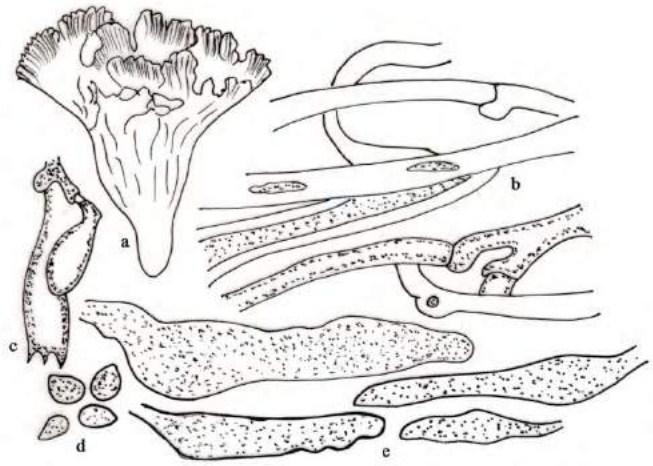


**Fig. 24:** *Cymatoderma dendriticum:* a) basidiocarp, b) generative and skeletal hyphae, c) basidium & basidiole, d) spores, e) gloeocystidia.

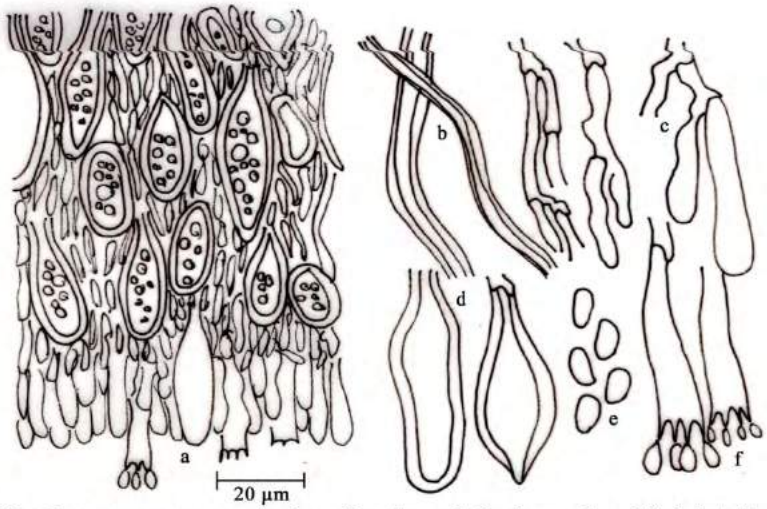


**Fig. 25:** *Cystostereum murrayi:* a) section through the hymenium, b) skeletal hyphae, c) generative hyphae, d) gloeocystidia, e) basidia e) spores.

**Cystostereum** Pouz.
Ceska Mykol. 13: 18, 1959

Basidiocarps perennial, pileate or mostly resupinate, often stratose, membranous-ceraceous to corky or woody; hymenial surface pale coloured; densely and prominently tuberculate, cracking on drying, fruitbody consisting of two layers, a subiculm of manily horizontal hyphae and subhymenial trama of vertical hyphae; hyphae dimitic, generative hyphae with clamps; gloeocystidia present both in the hymenium and subhymenium and subiculum; basidia narrowly clavate, 4-spored; spores narrowly ellipsoid or subcylindrical, inamyloid, smooth.

**Type species:** *Cystostereum murraii* (Berk. & Curt.) Pouz.

The genus is separated mainly on the basis of woody-coriaceous effused-reflexed, two layered fruitbodies, strongly tuberculate hymenial surface, abundant gloeocystidia and innamyloid, subcylindrical spores.

**Cystostereum murrayi** (Berk. & Curt.) Pouz.

Ceska Myk. **13:** 18, 1959; *Thelephora murraii* Berk. & Curt., J. Linn. Soc. Lon. **10:** 329, 1869.

**Type locality:** Cuba **(Fig.25)**

Basidiocarps perenninal, corky to woody-ceraceous, adnate, usually resupinate and broadly effused, rarely reflexed; upper surface black and hard with a horny crust, uneven, not shinning, concentrically sulcate, fuscous black; margin entire; hymenial surface, tuberculate, light brown to pale greyish when young, dark avellaneous with age or on drying, deeply cracking on drying; context up to 500 µm thick, becoming stratose and thickening up to 2mm; composed of densely interwoven hyphae, hyphae suberect, hyaline, up to 4 µm wide.

Hyphal system dimitic, generative hyphae thin-walled, clamped, richly branched, densely agglutinated, skeletal hyphae sparse, 1.5-3 µm wide; cystidia absent, gloeocystidia numerous in the subhymenium, 30-50 x 7-15 µm, cylindrical to clavate, empty or with yellowish granular contents, distinct in young specimens but with age they are seen as rounded gloeocystidial vesicles; basidia narrowly clavate, 25-30 x 5 µm, 4-spored, basal clamp present; spores narrowly ellipsoid to subcylindrical, smooth, thin-walled, (3.95-) 4-5(-5.5) x 2-2.5 (-2.6) µm, L= 5.2 µm, W=2.4 µm, W= 2.4 µm, Q= 2.16 (n= 20/2) innamylod.

**Specimens examined:** (HP) Shimla, Sariatop, rotting stump of *Abies pindrow,* 05 Oct. 2006, JRS 13508; *ibid,* Pithoragarh Askot, rotting trunk of *Cedrus deodara,* 20 Sept. 2007, JRS 1355; *ibid,* Dehradun, Dhanaulti, rotting stump of *Psidium*, 07 Sept. 2010, DM 027; Maharashtra, Film Institute, Pune, on *Delonix regia*, 24 Sept 2018, DM 638; (TN), Coimbatore, Sandhyalare, base

of hardwood of tree, 07 Dec. 2013, JRS (10141, BSD); (HP), Chamba, Khajjiar, on thin twigs of hardwoods, 12 Aug. 2004, JRS (12018, BSD);

**Habitat & Distribution:** *Cystostereum murraii*, also widely known as *Stereum murraii* (Berk. & Curtis) Burt, is associated with a white rot (Lindsey & Gilbertson 1978; Ginns 1986) of living or dead angiospermous, rarely gymnospermous, trees. It is common throughout northeastern U. S. A. and eastern Canada (Burt 1920; Overholts 1939; Davidson *et al.* 1942; Ginns 1986) cosmopolitan or nearly so. In culture, *C. murraii* produces a distinctive odor that has been described by various researches at rotting apples, coconut, or vanilla. It is closely related to *C. australe* which also develops chlamydospores in culture.

**Geographical distribution:** USA, Cuba, Jamaica, Puerto Rico, Eastern Canada

**India:** Uttarakhand, Maharashtra, Tamil Nadu, Himachal Pradesh

**Remarks :** The thickness in the resupinate specimens, pallid to avellaneous hymenial surface, strongly tuberculate and deeply cracked hymenium, abundance of gloeocystidial vesicles throughout the whole thickness of the fruitbodies, usual occurrence on coniferous woods are the distinguishing characters of the species. The horny crust, forming the upper side of the pileus is a unique character and help in the recognition of the species in the reflexed specimens.

**Gloeocystidiellum** Donk Emend. Donk
Fungus 26: 8, 1956

Basidiocarps annual or perennial, resupinate, thin to thick up to 1 mm, ceraceous when fresh, firm to hard, membranacous to coriaceous when dry, adnate, thin to thick; hymenial surface smooth to tuberculate, often cracked; hyphal system monomitic, generative hyphae hyaline, thin-walled, septate, with or without clamps; gloeocystidia cylindrical, usually submerged, with granular oily orange to yellowish contents reacting positively with sulfovanilline in most cases; encrusted cystidia mostly lacking; basidia narrowly clavate, 4-sterigmate; spores hyaline, ellipsoid to varying in shape, smooth, amyloid; lignicolous.

**Type species :** *Gloeocystidiellum porosum* (Berk. & Curt.) Donk

The genus is characterized by the presence of gloeocystidia and amyloid spores. If the varying features of basidiocarps, presence of clamps, sulfoaldehyde reaction of the gloeocystidia, shape of spores and the reaction of hyphae with cotton blue are considered, the genus is rendered heterogeneous (Eriksson & Ryvarden, 1975).

**Key to species**

1. Hyphae with simple septa ……..…**2**

1. Hyphae with clamps ……..……**12**

2. Spores globose to subglobose ……..……**3**

2. Spores ellipsoid ……..**6**

3. Spores smooth; hymenial surface yellow ……..……..…..**4**

3. Spores verrucose to warted; hymenial surface white to pale cream ……..…..……..***5***

4. Hymenial surface yellow; spores 5-6.5 µm……..…..…***G. citrinum***

4. Hymenial surface orange to ochraceous buff; spores 6-7.5 µm……..…..***G. turpe***

5. Gloeocystidia 50-175 µm; spores 4.5-5 µm diam. ……***G. lacticolor***

5. Gloeocystidia 50-100 µm; spores 5-6 µm diam.……***G. donkii***

6. Gloeocystidia 50-250 long; spores 5-6.5 µm long……..……..……....**7**

6. Gloeocystidia up to 100 µm; spores upto 5.5µm diam.-……..…….……....***9***

7. Hymenial surface orange brown; gloeocystidia 150-250 (-400) µm long…..…***G. flammeum***

7. Hymenial surface white to grayish; gloeocystidia smaller…….…….**8**

8. Spores verrulose; hymenial surface white to yellowish……***G. lactescens***

8. Spores smooth; hymenial surface white to grayish……..……..***G. irpiscescens***

9. Spores verrucose to warted……..…**10**

9. Spores smooth……..…..…..**11**

10. Gloeocystidia 50-100 µm long; spores 4-5 x 2.5-3.5 µm…….….***G. convolvens***

10. Gloeocystidia 50-60 µm long; spores 5-5.5 x 2.5-3.5 µm ……..….***G. porosellum***

11. Hymenial surface cream coloured; gloeocystidia upto 110 µm long……..….***G. insidiosum***

11. Hymenial surface white to greyish orange; gloeocystidia upto 70 µm long……***G. ochraceum***

12. Hymenial surface orange; gloeocystidia with orange coloured contents ……..……**13**

12. Hymenial surface cream coloured to ochre brown; gloeocystidia not with orange content ……..……..……..……..**15**

13. Spores cylindrical, 7.8-10 µm long……..….***G. luteocystidiatum***

13. Spores ellipsoid, up to 6.5 µm long…….**14**

14. Gloeocystidia 50 -110 µm long; spores 4.5-6.5 (8.5) x 4-4.5.....
……***G. luteocystidium var brevisporum***

14. Gloeocystidia 80-180 µm long; spores 5-6 x 3-3.5 µm……..……...***G. fistulatum***

15. Spores smooth ……**16**

15. Spores verrucose ……..…….…..…..…..**18**

16. Spores ellipsoid, 8-10 x 4.5-5.5 µm ……..…….***G. luridum***

16. Spores allantoid to cylindrical …….…….....…..**17**

17. Spores allantoids, 12-20 x 4-6.5 µm……..…....***G. leucoxanthum***

17. Spores cylindrical, 7-8.5 x 2-3 µm……..***G. sulcatum***

18. Hymenophore odontoid; spores 6.6-8.6 x 4-5.6 µm……***G. odontoides***

18. Hymenophore smooth; spores smaller…….....**19**

19. Gloeocystidia 35-85 x 7-16 µm; spores up to 5µm long…….…..…...**20**

19. Gloeocystidia up to 150 µm long; spores longer than 5 µm ….……..……**21**

20. Gloeocystidia often with monoliform apical appendices; lacking sulphoaldehyde reaction
…….……***G.kenyense***

20. Gloeocystidia without monoliform apical appendices; positive sulphoaldehyle……***G. clavuligerum***

21. Hymenial surface dark reddish brown on bruising; spores globose to subglobose …… ……..……***G. furfuraceum***

21. Hymenial suface unchanging; spores ellipsoid to subcylindrical ……..***G. porosum***

**Gloeocystidiellum citrinum** (Pers.) Donk

Fungus 26 p. 9, 1956; *Thelephora citrina* Pers., Mycol. Europ. 1 p. 136, 1822

**Type locality:** Europe **(Fig. 26)**

Basidiocarps resupinate, adnate, orbicular to confluent and widely effused, up to 100 x 50mm and 0.1-0.5 mm thick, ceraceous when fresh, membranaceous on drying; hymenial surface smooth to more or less tuberculate, cream yellow to bright yellow, ochraceous in dried specimens, often cracking on drying; margin thinning, white, fibrillose; context subhyaline, cretaceous, texture loose in young specimens, denser in mature ones.

Hyphal system monomitic, generative hyphae up to 2.5 µm wide, septate, clamps absent, thin-walled; gloeocystidia vesicular, tapering apically, 50-80 x 10-15 µm, thin-walled, empty or with a number of oil drops; basidia narrowly clavate, 4-sterigmate, 30-45 x 5-7.5 µm, without a basal clamp, oildrops of varying sizes present; spores globose to subglobose, smooth, thin-walled, with one to more oil drops, (4.9-)5-6.5 (-6.7) x 5-6 (-6.2) µm, L=6.35 µm, W= 6.20 µm, Q=1.02 (n=20/4), amyloid.

**Specimens examined :** (UK) Chamoli, Rudranath, on a stump of Oak, 23 Sept. 1990, JRS 182; (UK) Uttarkashi, Hanuman chatti, on a rotting log of *Abies*, 17 Aug. 1992, JRS 782; (HP) Shimla, on soil under hardwood tree, 23 Sept. 2014, DM 2065; Maharashtra, Pune, Panchwati, on *Dalbergia melaoxylon*, 19 Aug. 2019, DM 713; (TN) Nilgiri, Burliyar, on a rotting tree trunk, 06 Dec. 2019, DM 722; Maharashtra, Bheed, base of hardwood of tree, 09 June 2012, JRS (13311, BSD).

**Habitat & Distribution:** Generally on deciduous woods, rich in humus. It is most often seen in the wetter and richer communities, where herbs are mixed.

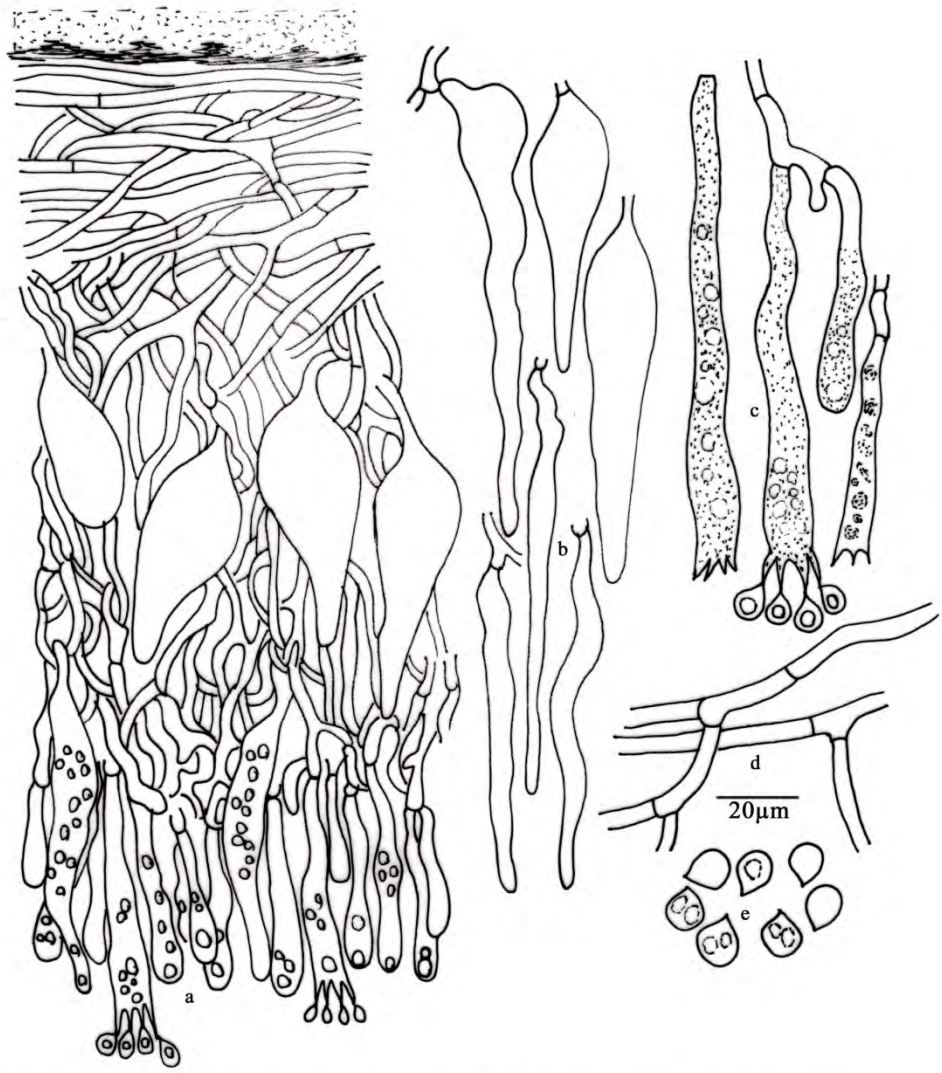


Fig. 26: *Gloeocystidiellum citrinum*: a) section through hymenophore, b) gloeocystidia, c) basidia, d) hyphae, e) spores.

**Geographical distribution:** Europe: Switzerland, Poland, Russia, Turkey, Estonia, Germany, Hungary, Bosnia and Herzegovina, Croatia, Macedonia, Slovenia, Serbia, United Kingdom, Slovenia, Netherlands, Belarus, Switzerland, France, Turkey, Sweden, Italy, Denmark, Norway, Finland, Spain, Ukraine, and the Caucasus. Common and widespread species and sometimes the more frequent species in coniferous forests.

**India:** Uttarakhand, Himachal Pradesh, Maharashtra, Tamil Nadu

**Remarks:** The yellow colour of the hymenial surface, empty vesicle-like gloeocystidia and smooth, globose, amyloid spores are the distinguishing features of this species. *Gloeocystidiellum citrinum* is associated with a white rot (Gilbertson 1974; Ginns 1986) of gymnospermous and angiospermous wood throughout North America.

**Gloeocystidiellum clavuligerum** (Höhn. & Litsch.) Nakasone

Mycotaxon 14 (1): 320 (1982); *Gloeocystidium clavuligerum* Höhn. & Litsch., Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften Math.-naturw. Klasse Abt. I 115: 1603, 1906

**Type locality:** Canada **(Fig.27)**

Basidiocarps effused, adnate, rather large, the pieces seen were up to 90mm x 25mm and 90-260 µm thick, often stratose; margin white to pallid, sparse, indistinct, 1 (-2) mm wide; hymenial surface smooth, cracked extensively in some specimens, pale yellow or pastel yellow, or some with a tan tint, crustose; subiculum thin, white.

Hyphal system monomitic; subiculum typically a very thin, indistinct layer next to the substrate, however as the basidiomes thicken a horizontally arranged hyphal layer develops over the surface of the current hymenium and it gives rise to the new basidial layer; hyphae 2-3 m diam, with a clamp connection at each septum, the walls hyaline, thin, innamyloid; gloeocystidia 40-75 x 6-12 µm, typically flask shaped with an elongated neck, others tubular to fusoid, sulfo-positive; four sterigmata; spores mostly broadly ellipsoid, some subglobose and some ellipsoid, (3.5-) 3.8-4.8(-5.0) x (2.6) 2.8-3.2µm L=4.4µm, W=3µm, Q=1.4 (n = 20/2), the walls hyaline, thin, amyloid, verrucose, sometimes appearing smooth, with a small blunt apiculus.

**Specimens examined:** (HP), Chamba, Sara, on twigs of *Quercus incana*, 04 Oct. 2014, DM 2066; *ibid,* Chamba, Dalhousie, Dainkund on twigs of *Betula utilis,* 25 Sept. 2003, JRS (4022, BSD); *ibid,* Chamba, Dalhousie, on twigs of *Cedrus deodara*, 28 Sept. 2018, DM 568; Sikkim, North Sikkim, on dead wood, 15 Oct, 1993, JRS (1480, CAL).

**Habitat and Distriution:** Associated with a white rot of decorticated hardwood, slash and logs, rarely found on coniferous.

**Geographical Distribution:** Widely distributed in North America and Europe: Germany, Russia, Austria, Turkey, Belgium, United Kingdom, Slovenia, Spain, Italy, Norway, Switzerland, France, and the Caucasus. Uncommon species and very rare in Italy, recorded only from Veneto Region, Eastern Canada, and British Columbia, also in the mountains of Arizona, Colorado and New Mexico, and in Louisiana and Mississippi.

**India:** Himachal Pradesh, Uttarakhand, Sikkim

**Remarks:** *Gloeocystidiellum clavuligerum* was evidenced as a different species, distinct from the *Gloeocystidiellum porosum* complex. *G. clavuligerum* differs from *G. porosum* in the ellipsoid to subglobose basidiospores and shorter gloeocystidia with apical constrictions. G. porosum has longer gloeocystidia and subcylindrical to ellipsoid basidiospores.

**Gloeocystidiellum convolvens** (Karst.) Donk

Fungus 26 p. 9, 1956; *Corticium convolvens* Karst., Bidr. Känn. Finl. Nat. Folk 37 p. 148, 1882; *Peniophora lundellii* Litsch. ap. Lund. & Nannf., Fungi exs. suec. n. 573, Sv. bot. tidskr. 32 p. 288, 1938.

**Type locality:** Finland **(Fig. 28)**

Basidiocarps resupinate, effused but moderately large, 100-500 µm thick, at first adnate, later detachable, white to yellowish, as old pale ochraceous, ceraceous when young and fresh, membranaceous when dried; hymenial surface smooth to tuberculate, not cracked or extensively fissured; bearing dense, semiglobose warts, which under the lens (50 x) are velvety by the projecting cystidia; margin variable, in young specimens more or less fibrillose and often with narrow, white, radiating hyphal strings.

Hyphal system monomitic, hyphae 2-3 µm wide, without clamps, non-cyanophilous; young fruitbodies consisting of a layer of parallel hyphae next to the substrate, ab. 50 µm thick, and a layer of densely united, vertical hyphae and cystidial elements; old specimens stratified (2-3 layers), with thin horizontal layers of hyphae between the strata; in the inner of the hymenial papillae a number of strongly encrusted hyphae (or cystidia) filling the context with crystal matter; encrusted cystidia numerous, conically tapering, 40-50 x 6-10 (-12) µm, first naked and

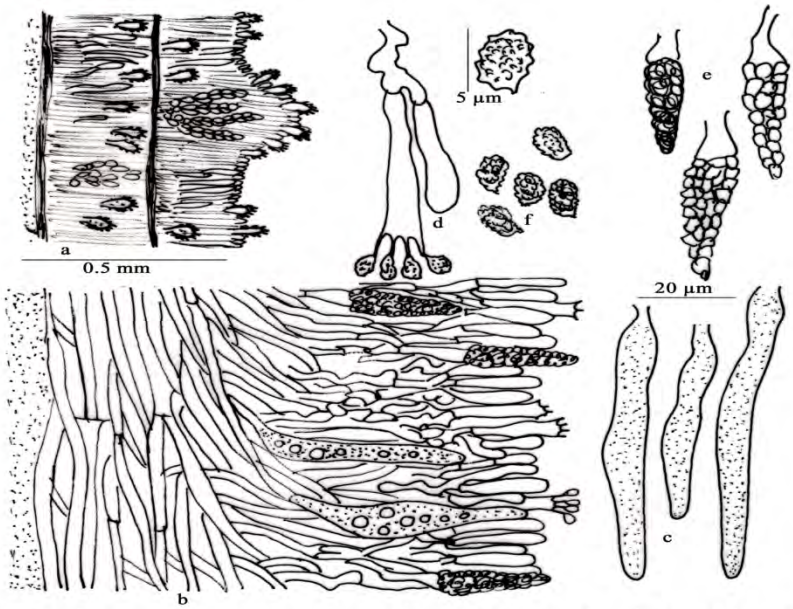


**Fig. 28:** *Gloeocystidiellum convolvens:* a) section through basidiocarp, c) gloeocystidia d) basidia, e) incrusted cystidia, f) spores.

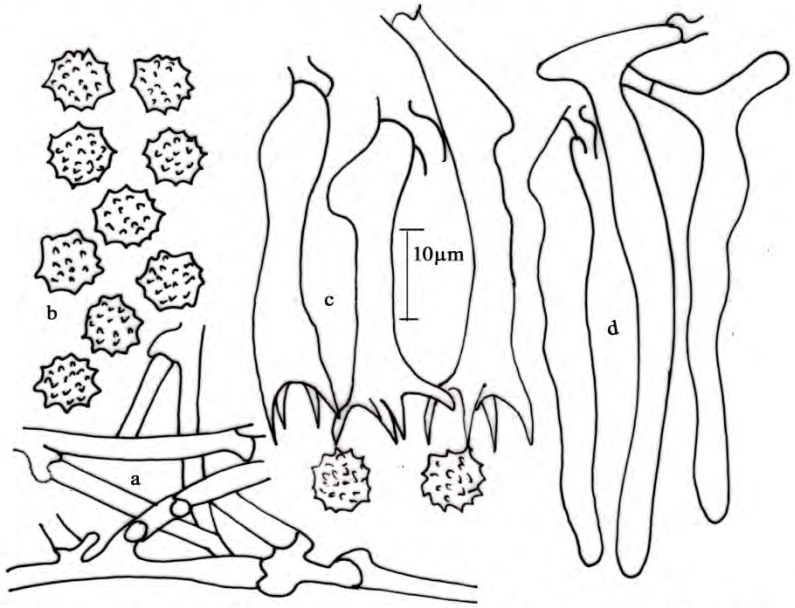


Fig. 29: *Gloeocystidiellum donkii* : a) hyphae, b) spores, c) basidia, d) gloeocystidia.

thinwalled, then apically encrusted with a layer of right-angled crystals, the encrustation sometimes disappearing from cystidia in old strata; gloeocystidia numerous, sinuose, thinwalled, 50-100 x 7-10 (-15) µm, filled with oily, granular, yellowish protoplasm with positive reaction to sulfovanilline; basidia narrowly clavate, 20-25 (-30) x 4-5 µm, with 4 sterigmata, no basal clamps; spores ellipsoid, verrucose, amyloid, (4.2-) 4.5-5 (5.2) x2.5- 3.5 µm. L= 4.98 µm, W= 3.01 µm q= 1.66 (n=20/4)

**Specimens examined:** (HP), Chamba, Dalhousie, Dainkund on twigs of *Betula utilis,* 24 Sept. 2003, JRS (4300, BSD); (UK), Chamoli, Khatti, on a dead branch of *Picea spp.,* 28 Sept. 2014, JRS (40031, BSD); *ibid,* Chamoli, Bedini, on a dead branch of *Salix*, 23 Sept. 2015, JRS (16043, BSD); *ibid,* Chamoli, Chopta, on the twigs of *Quercus*, 17 Sept. 2011, DM 1078; (AP), Tirup, Pangsoo pass, on dead hardwood log, 20 Oct. 1989, JRS (4409, CAL)

**Habitat and Distriution:** *Gloeocystidiellum convolvens* occurs on fallen trunks and branches of both conifers and deciduous trees. In India most collections are made on conifer wood or on trees like *Betula, Salix,* and *Populus tremula*.

**Geographical Distribution:** Norway, North Scandinavia, Sweden, Uppland.

**India:** Uttarakhand, Himachal Pradesh, Arunachal Pradesh.

**Remarks:** Being the only species of the genus with encrusted cystidia, it is easily recognized. The verrucose spores are sometimes inconspicuous and difficult to observe.

### **Gloeocystidiellum donkii** Rattan

Resup. Aphyll. N.Western Him. p. III, 1977.

**Type locality:** Kathmandu, Nepal (PAN) **(Fig. 29)**

Basidiocarps resupinate, effused; moderately large, up to 0.2 mm thick, adnate, ceraceous when young and fresh, membranaceous on drying; hymenial surface white to pale cream when fresh, deep cream to brownish on drying; hymenial surface white to pale cream when fresh, deep cream to brownish on drying, smooth, cracking on drying; margin determinate, more or less fibrillose in young specimens, often with narrow, white, radiating hyphal strings; context subhyaline.

Hyphal system monomitic, generative hyphae 2-3.5 µm wide, septate, without clamps, thin-walled; gloeocystidia 50-100 x 6-10 µm, subfusiform to cylindrical, empty but more often

with granular contents, staining deeply with phloxine, immersed or projecting beyond the hymenium; basidia 20-35 x 5-7 µm, clavate-cylindrical, 4-sterigmate; spores (4.7)- 5-6 (-6.2) x 4.5-5 (-5.1) µm, L= 5.85 µm, W= 4.8 µm, q= 1.21 (n =20/4) globose to subglobose, thin-walled, verrucose to warted, amyloid.

**Specimens examined:** Nepal, Kathmandu, Hathi Ban, on rotten bamboo sticks, 21 Aug. 1969, PAN 5488 (type); (UK), D. Dun, Kalsi, on bark of hardwoods, 20 July 1992, JRS 853; *ibid,* Almora, Near College Campus, on bark of hardwoods, 08 Oct. 2013, DM 2063.

**Habitat & Distribution:** Temperate and rare species found on rotten bamboo stick and bark of hard wood trees.

**Geographical distribution:** Nepal, India

**India:** Uttarakhand, Himachal Pradesh

**Remarks :** The white to cream coloured, smooth hymenial surface, lack of clamp connections and warted, subglobose spores are the main separating characters of this species. *Gloeocystidiellum donkii* was treated as a synonym of *Boidinia propinqua*, but was treated by Hjortstam (1987) as conspecific with *B. lacticolor*. Few workers reported that gloeocystidia from the isotype of *B. donkii* have a weakly positive reaction (reddish) in sulphoaldehyde.

**Gloeocystidiellum fistulatum** (G. Cunn.) Boidin

Cahiers de La Maboké 4(1): 13 (1966); *Corticium fistulatum* G. Cunn.,Trans. Roy. Soc. N.Z. 82: 292, 1954.

**Type locality:** Auckland: New Zealand **(Fig. 30)**

Basidiocarps annual or perennial, adnate, ceraceous-coriaceous, effused, forming linear areas to 280mm x 20mm., or irregular areas with a few outlying islands. surface white, becoming cream or alutaceous, sometimes tinted reddish-buff, laterally closely creviced; margin thinning out, white or tinted brown, abrupt, sometimes receding, membranous, adnate; context white, 200-400 µm thick, of 1-3 obscure layers, defined partly by masses of crystals and tinted hyphae, mainly by rows of gloeocystidia, each layer composed of a narrow base of parallel hyphae, and an intermediate layer of compact vertical hyphae.

Hyphal system monomitic, generative hyphae 4-5 µm diameter, wall 0.5 µm thick, naked, hyaline, branched, septate, with clamp connections; hymenial layer to 50 µm deep, of basidia, paraphyses and gloeocystidia; basidia subclavate, 12-16 x 4-5 µm, 2-4-spored, sterigmata slender, to 5 µm long; paraphyses subclavate, similar to but smaller than the basidia;

gloeocystidia long, narrow, flexuous-cylindrical, regularly spaced, and extend from the base to the surface of the hymenium, some projecting up to 30 µm, filled with granular orange contents, conspicuous and readily seen in sections; even in old specimens they are conspicuous, for they either retain the orange colour or contents appear dark-brown and resinous; crystals may be confined to the base, scattered through the context, or absent. 80-180 x 5-8 µm, wall 0.5-0.75 µm thick, contents densely granular and orange; spores elliptical, some apiculate, (4.95-)5-6 (-6.2) x 3-3.5µm, L= 5.95 µm, W= 3.2 µm, Q= 1.86 (n= 20/4) wall smooth, hyaline.

**Specimens Examined:** Maharashtra, Pune University Campus, on *Bauhinia purpurea*, 25 Aug. 2018, DM 640; *ibid,* Film industry, on dead bark of wood, 28 Aug. 2018, DM 614; (TN), Coimbatore, near BSI campus, on a stump of *Ficus* spp. 27 Aug. 2019, 714; *ibid*, Ooty, on dead hardwood trunk, 05 Dec. 2013, JRS (12041, BSD)

**Habitat and Distriution:** A widely distributed species on dead bark or decorticated hardwoods in tropical zones.

**Geographical Distribution:**

**India:** Maharashtra, Tamil Nadu.

**Remarks:** *G. leucoxanthum* Bres., *C. luridum*, Bres. have also gloeocystidia containing bright orange context. This species is separated mainly on the basis of having stratose context, singularly even spacing of gloeocystidia, small basidia and spores.

### **Gloeocystidiellum flammeum** Boidin

Cahiers de La Maboké 4(3): 7, 1966

**Type locality:** South Africa. **(Fig. 31)**

Basidiocarps resupinate, adnate, effused ceraceous to carnose; hymenial surface smooth to more or less tuberculate, deeply rimose, orange brown when fresh, ochraceous brown on drying; margin byssoid, whitish; context subhyaline.

Hyphal system monomitic, generative hyphae thin to moderate thick-walled, 2-3.5 µm, wide, septate subhymenial layer hyphae in a denser layer; gloeocystidia abundant, tubular, 150-250 (-400) x 10-15 µm, thin-walled, with yellowish granular contents, moniliform appendices

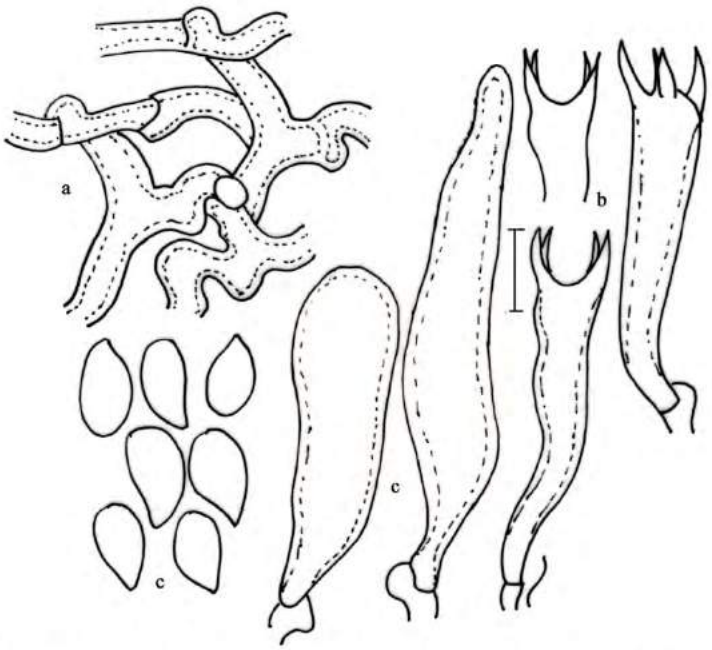


**Fig. 30:** *Gloeocystidiellum fistulatum:* a) hyphae, b) basidia, c) gloeocystidia, d) spores.

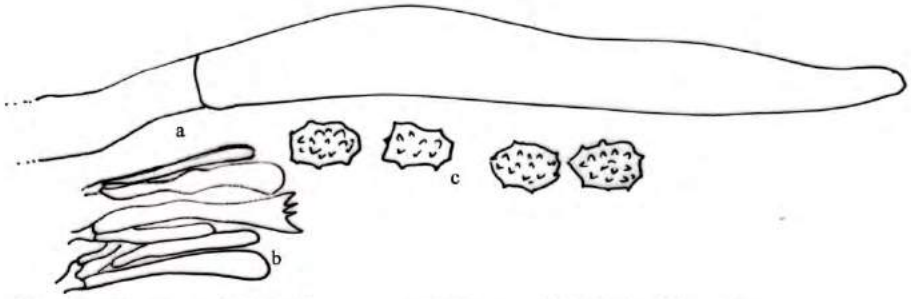


**Fig. 31:** *Gloeocystidiellum flammeum:* a) gloeocystidia, b) basidia, c) spores.

often present; basidia clavate, 30-50 x 5-7 µm, 4- sterigmate, septate at the base; spores oblong ellipsoid, thin-walled (3.9-) 4-6 (-6.2) x 3-4 µm, L=5.60 µm, W=3.75 µm Q=1.55 (n=20/2) verrucose amyloid.

**Specimens examined:** (TN), Kaller, on a standing tree, 03 Dec. 2012, JRS (10033, BSD); Coimbatore, Sandhyalare, base of hardwood of tree, 06 Dec. 2012, JRS (10044, BSD) ; *ibid*, Ooty, Carrot shola, base of a rotting hardwood tree, 08 Dec. 2012, JRS (10036, BSD); Andaman Islands, Rutland, base of a rotting stump of *Swietenia,* 23 April 2013, JRS (20056 BSD); *ibid*, Ross island, base of a living tree of *Swietenia,* 24 April 2013, JRS (20104, BSD); Maharashtra, Pune, near BSI Campus, on *Drypetes* spp. 04 Oct. 2011, DM 2105.

**Habitat & distribution:** It is widely distributed species on hardwoods trees in tropical areas

**Geographical distribution:** South Africa, India.

**India:** Maharashtra, Tamil Nadu, Kerela, Andaman and Nicobar Islands

**Remarks:** The orange brown hymenial surface, larger gloeocystidia, septate hyphae and oblong ellipsoid, verrucose spores are the main identifying features of this species.

**Gloeocystidiellum furfuraceum** (Bres.) Donk

Fungus 26: 9, 1956; *Hypochnus furfuraceus* Bres., Fung. trident. 2(11-13): 97, 1892

**Type locality:** Italy **(Fig. 32)**

Basidiocarps resupinate, effused, 70–90mm x 20-35mm, arachnoid-pellicular to soft membranaceous, often rimose, separable; hymenial surface even, somewhat farinaceous, whitish to cream-coloured when fresh, becoming pale ochraceous with age; margin indistinct.

Hyphal system monomitic, generative hyphae hyaline, thin-walled, 2-3.75 µm wide, with clamps; gloeocystidia cylindrical, often flexuous or somewhat swollen at the base, thin-walled, typically with yellowish contents, 60-110 ×6-10 µm, sulphopositive; thin walled cystidia 50-60 µm; basidia subcylindrical and often flexuous to clavate, 25-30 × 5-6 µm, with 4 sterigmata; spores hyaline, thin to somewhat thick-walled, globose to subglobose, echinulate, (4.9-) 5-6.5 (-6.6) x 5-6.6µm, L= 6.1 µm, W=5.56 µm, Q=1.08 (n=20/2), strongly amyloid.

**Specimens examined:** (UK), Champawat, Tigerhill, Munch, on dead decaying wood of *Pinus*, 20 Oct. 2001, JRS (12076, BSD); Mahrashtra, near Pune University, on dead sticks of

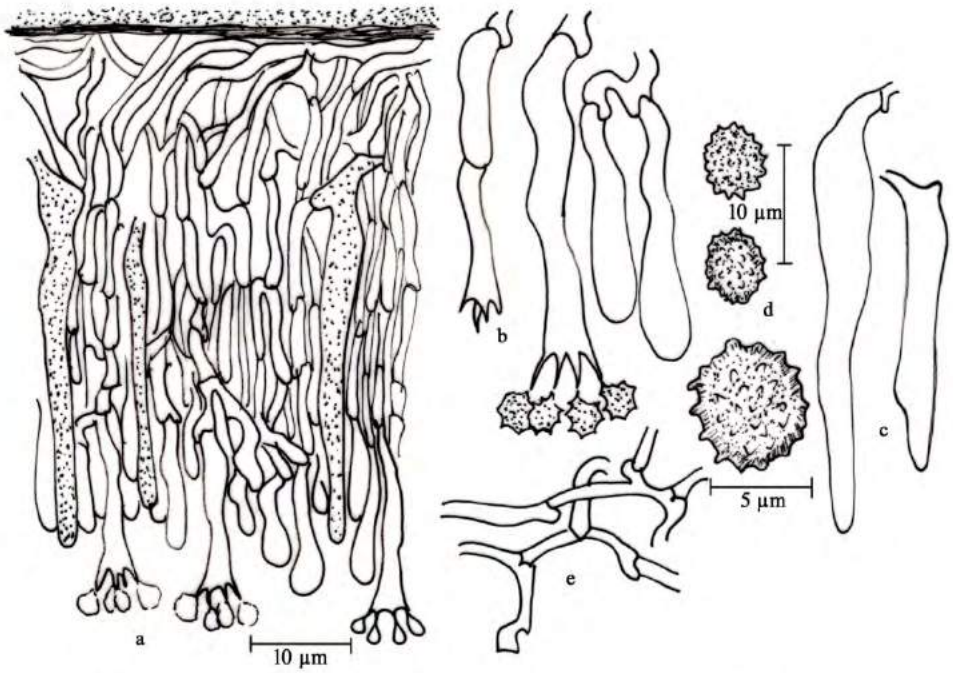


Fig. 32: *Gloeocystidiellum furfuraceum:* a) section through basidiocarp, b) basidia, c) gloeocystidia, d) spores, e) hyphae

angiosperms, 02 Oct. 2012, DM 6030; *ibid,* Beed, on dead hardwood, 07 June 2011, JRS (60116, BSD & AMH): A & N Islands, MKG marine National Park, on dead wood, 15 Dec. 2013, JRS (20120, BSD)

**Habitat & Distribution:** On decayed wood of angiosperms and rarely on conifers prefers dead and, still attached branches of substrates. In India favoured by suboceanic or otherwise coastal climates.

**Geographical Distribution:** Europe, North, South America, Japan.

**India:** Maharashtra, Uttarakhand, Andaman and Nicobar Islands

**Remarks:** Smooth hymenial surface, globose to subglobose vessucose spores are the microscopic characters of this species. The turning of hymenial surface to dark reddish brown on brushing is a good field character.

**Gloeocystidium insidiosum** Bourdot & Galzin

Bull. Soc. mycol. Fr. 28(4): 370, 1913.

**Type locality:** France **(Fig.33)**

Basidiocarps resupinate, effused, adnate, hard-crustaceous when dry, stratified, 50-500 µm thick; hymenophore smooth to tuberculate, sometimes cracked, cream-coloured to light ochraceous; margin more or less abrupt.

Hyphal system monomitic, hyphae without clamps, moderately thick-walled, 2-3 µm wide densely united, hyphal direction vertical, subiculum inconspicuous or absent; hyphal walls stained by cottonblue; scattered crystal aggregates in the context; cystidia tubular, sinuose, thin to thick-walled, 30-70 x 3.5 -5 µm, embedded, often growing through the whole fructification, content granular with positive reaction to sulfovanilline; basidia clavate, thin-walled, 22-30 x 3.8-4 µm, 4 sterigmate, without basal clamp; cell walls are strongly cyanophilous and in some collections also dextrinoid; spores subcylindrical to ellipsoid, adaxial side straight or a little concave, smooth, thin-walled, (3.9-) 4-5 (5.2) x 2-2.5 µm, L= 4.50 µm, W= 2.25 µm, Q= 2.04 (n=20/2), amyloid.

**Specimens examined:** Maharashtra, Amba Ghat, Satara, on dead sticks of angiosperms, 02 Oct. 2012, DM 6021; (TN), Nilgiri Biosphere Reserve, on a rotting hardwood stump, 28 Nov. 2012, JRS (20139, BSD); A & N Islands**,** MKG marine National park, on dead angiospermic wood, 23 April 2013, JRS (20020, BSD).

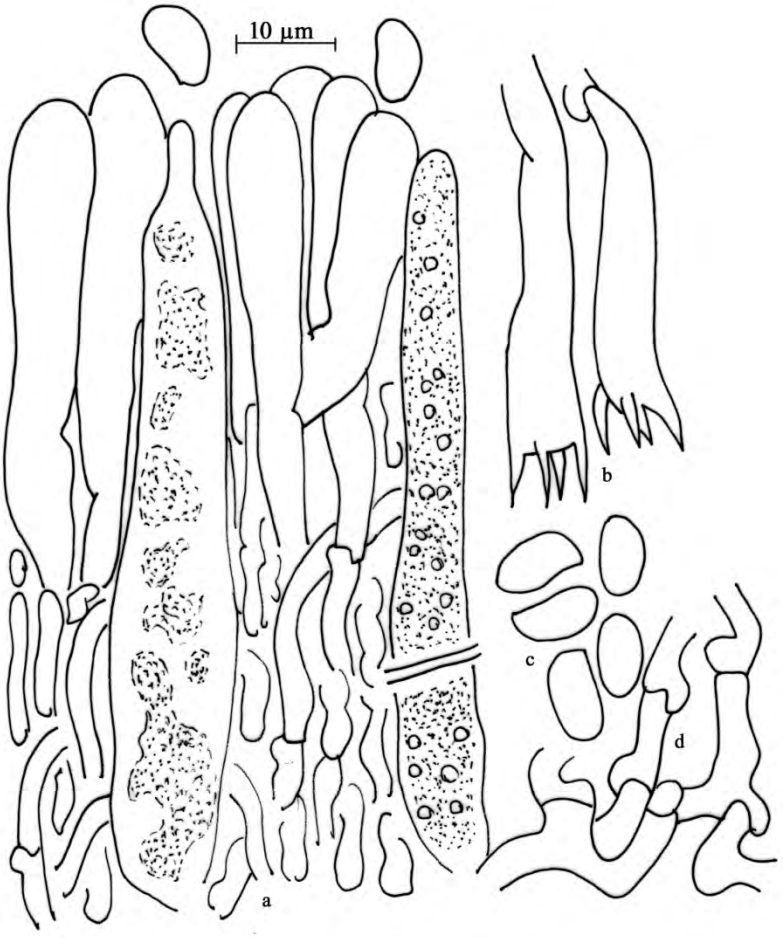


**Fig. 33:** *Gloeocystidium insidiosum:* a) section through basidiocarp, b) basidia, c) spores, d) hyphae.

**Habitat and Distribution:** On fallen logs and trunks of deciduous trees.

**Geographical distribution**:

**India:** Maharashtra, Tamil Nadu, Andaman Islands

**Remarks:**

**Gloeocystidiellum irpiscescens** Boidin

Cahiers de La Maboké 4(1): 13, 1966

**Type locality:** South Africa **(Fig. 34)**

Basidiocarps resupinate, adnate, effused, 150-200 µm, thick at maturity ceraceous hymenial surface smooth, whitish or watery grey when fresh, grayish brown on drying, cracked with scattered or with numerous deep furrows, subdividing the hymenium into a net-like manner; margin, byssoid in young specimens; context subhyaline.

Hyphal system monomitic, generative hyphae up to 2.5 µm wide, septate, without clamps, thin-walled, more densely arranged in subhymenial layers; gloeocystida tubular, abundant, 80-160 x 11-16 µm thin-walled, oily granular contents yellowish, reacting positively with sulfovanilline; basidia narrow, cylindrical, 30-60 x 5-7 µm, 4-sterigmate, without a basal clamp, numerous oil drops in the protoplasm; spores (4.9-) 5-7 (-7.1) x 4- 4.5 (-5)µm, L= 6.5 µm, W=4.1, Q= 1.58 (n=20/2) broadly ellipsoid, with granular oily contents or irregular oily bodies, smooth, thin-walled, amyloid.

**Specimens examined:** Maharashtra, Pune University campus, on rotting wood, 06 June 2017, DM 6018; (TN), Coimbatore, Carrot shola, on dead hardwood stump, 08 Dec. 2012, JRS (10052, BSD); Andaman & Nicobar Islands, Rut island, base of hardwood of tree, 26 April 2013, JRS (20079, BSD)

**Habitat and Distribution:** It is found frequently on dead deciduous woods in the tropical areas

**Geographical distribution:** South Africa, India

**India:** Maharashtra, Tamil Nadu, Andaman and Nicobar Islands

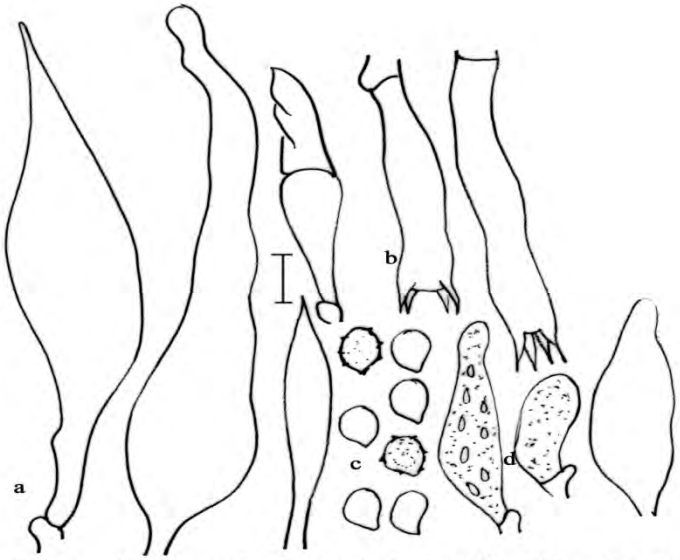


**Fig. 34:** *Gloeocystidiellum irpiscescens:* a) gloeocystidia, b) basidia, c) spores.

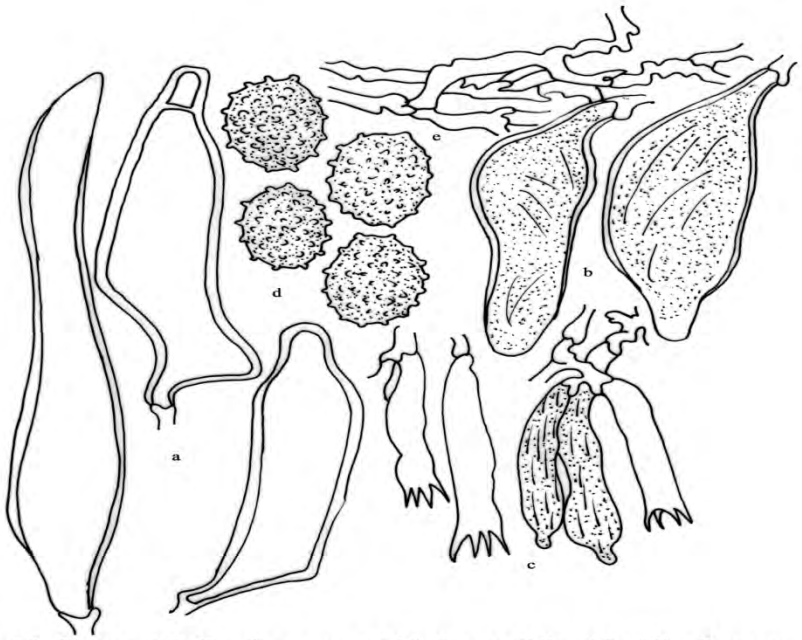


**Fig. 35:** *Gloeocystidiellum kenyense:* a + b) gloeocystidia, c) basidia, d) spores, e) hyphae.

**Remarks:** The watery grayish hymenial surface, layered gloeocystidia, septate hyphae, oblong ellipsoid, smooth spores are the main identifying features of this species

**Gloeocystidiellum kenyense** Hjortstam

Mycotaxon 28: 29, 1987.

**Type locality:** Africa, Kenya. **(Fig. 35)**

Basidiocarps resupinate, closely adnate, ceraceous, thick and hard with a smooth cream to ochraceous hymenophore, cracked when dried; margin undifferentiated.

Hyphal system is monomitic with densely interwoven, richly branched, thin-walled hyphae and clamped at all septa; gloeocystidia are variable, originate from all levels, 35–85 × 7–16 µm, often with moniliform apical appendices, sulphoaldehyde -ve;. basidia are cylindrical, (13–) 21–27 × 4–5µm, with four sterigmata; spores subglobose to ellipsoid, 3.5-5 -5.1) x 3-3.5 µm, L= 4.1µm, W=3.1µm, Q=1.36 (n=20/2) amyloid, ornamented.

**Specimen examined:** (TN) Coonoor, 05 Dec. 2012, JRS (10707, BSD); Maharashtra, Pune University Campus, 19 Sept. 2018, DM 6024 BSD; Andaman Nicobar Island, MKG marine National Park, on dead wood, 12 March 2013, JRS 30056; Maharashtra, Beed, on dead hardwood, 07 June 2011, JRS (60116, BSD & AMH);

**Habitat and Distribution:** Mostly found on dead woods of angiosperms, widly distributed species in tropical areas.

**Geographical distribution**: *Gloeocystidiellum kenyense* is widely distributed and known from Europe, North America, Africa, and Taiwan on decaying angiosperm wood (Larsson & Larsson 2002).

**India:** Maharashtra, Andaman Island, Tamil Nadu.

**Remarks:** *Gloeocystidiellum kenyense* is very characteristic and easily separated from *G. porosum* (Berk. & Curt.) Donk by smaller spores and commonly terminal gloeocystidia which lack a sulphoaldehyde reaction. The spores of *G. porosum* are usually up to 5.5-6 µm long, and

the warts are hardly observable in KOH. The gloeocystidia are commonly lateral and with strongly sulphoaldehyde reaction. *G. kenyense* and *G. clavuligerum* differ in their spore sizes, as well as in gloeocystidial contents, which are sulphoaldehyde–ve.

**Gloeocystidiellum lactescens** (Berk.) Boidin

C.R. Acad. Sci. Paris **233**: 1668, 1951; *lactescens* Berk., in Smith, Engl. Fl., Fungi (Edn 2) (London) 5(2): 169 (1836)

**Type locality:** Clifton, Notts., England. **(Fig. 36)**

Basidiocarps resupinate, adnate, effused, up to 1mm thick at maturity, ceraceous; hymenial surface smooth, whitish or watery grey when fresh, yellowish to reddish on drying, cracked with scattered or with numerous deep furrows in all directions, subdividing the hymenium into a net-like manner; margin byssoid in young specimens; context subhyaline.

Hyphal system monomitic, generative hyphae up to 2.5 µm wide, septate, without clamps, thin-walled, more densely arranged in subhymenial layers; gloeocystidia tubular, abundant, 150-200 x 8-10 µm, thin-walled, oily granular contents yellowish, reacting positively with sulfovanilline; basidia narrow, cylindrical, 30-60 x 5-7 µm, 4-sterigmate, without a basal clamp, numerous oil drops in the protoplasm; spores (4.9-) 5-6.5 (-6.7) x 3-4.5(-4.6) µm, L= 6.51 µm, W= 4.3 µm, q=1.51 (n=20/2) broadly ellipsoid, with granular oily contents or irregular oily bodies, smooth, thin-walled, amyloid.

**Specimens examined:** (HP) Chamba, Lakarmandi, on a rotten coniferous branch, 26 Aug. 1992, JRS 12401; *ibid,* Naldehra, Shimla, on a rotten coniferous stump, 20 Aug. 2005, JRS 12860; (UK) Uttarkashi, Hanuman chatty, rotting stump of Oak, 22 Sept. 2012, DM 1015; Maharashtra, Guhagar, on the bark of *Acacia nilotica*, 21 July 2011, DM 6009; (TN) St. Kalakad Sanctuary, on dead thin twigs of hardwoods, 13 Feb.1982, JRS (2157, BSD)

**Habitat and Distriution:** On coniferous woods throughtout the temperate himalayan zone. The substrate of the type collection is, however found on bark of *Pinus silvestris*. This species is widely distributed in many temperate and subtropical regions of the world.

**Geographical Distribution: Europe:** Switzerland, Russia, Estonia, France, Germany, Czech Republic, Belarus, Poland, Ireland, Croatia, Macedonia, Slovenia, Belgium, United Kingdom,

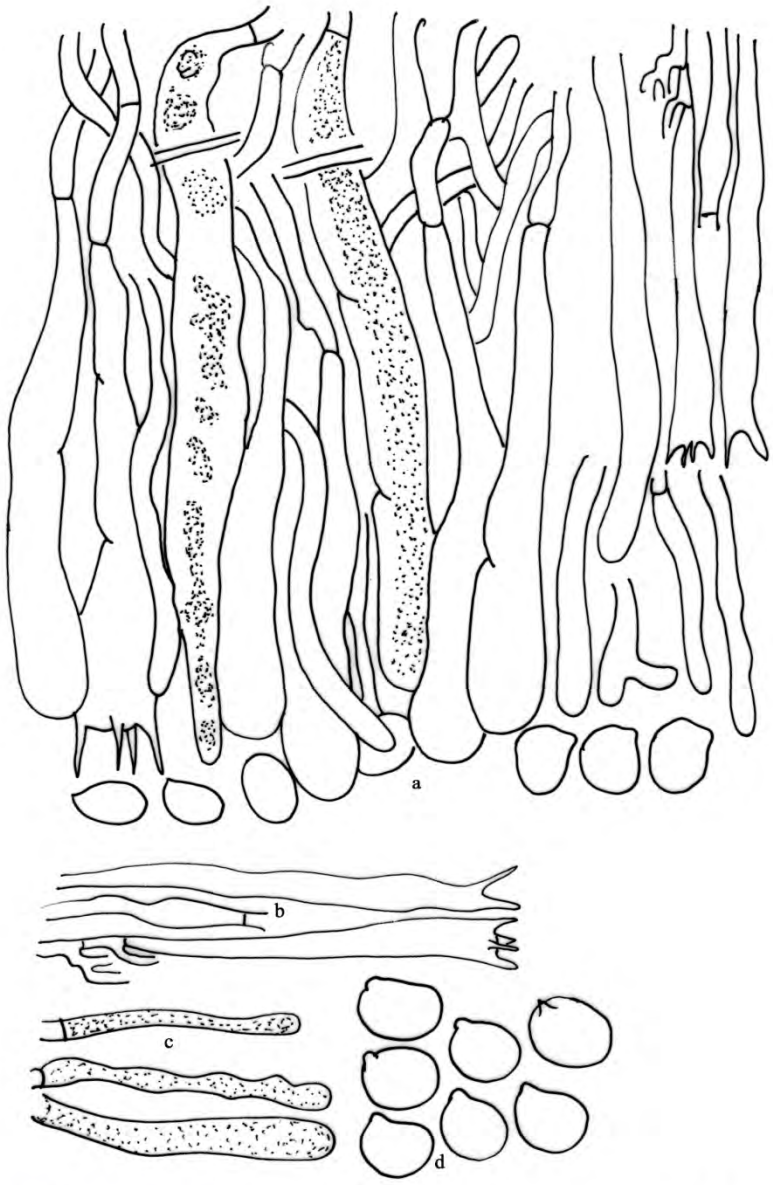


**Fig. 36:** *Gloeocystidiellum lactescens:* a) section through basidiocarp, b) basidia, c) gloeocystidia, d) spores.

Slovenia, Netherlands, Norway, Sweden, Finland, Ukraine, and the Caucasus. Common and widely distributed species, with presences in many Italian Regions, often overlooked.

**India:** Himachal Pradesh, Uttarakhand, Maharashtra.

**Remarks:** The characteristic cracking of the hymenial surface on drying leads to the easy recognition of the species in the field. The abundant cylindrical gloeocystidia, smooth, broadly ellipsoid spores are the other distinguishing characters of the species. The bleeding, which is reported by Berkeley in a convincing way, makes the species differ from the other species of the genus as well as of the whole family. The milk must be the excreted contents of the gloeocystidia which are larger and more numerous than in the other, non-bleeding species.

**Gloeocystidiellum lacticolor** (Bres.) Stalpers & Hjortst.

*Mycotaxon* **14**(1): 77 (1982); *Gloeocystidium lacticolor* Bres., Hedwigia 56(4,5): 303, 1915

**Type locality:** Philippines **(Fig. 37)**

Basidiocarps resupinate, effused, pellicular to soft membranaceous, often rimose, separable, up to 200 µm thick; hymenial surface even, somewhat farinaceous at first, continuous, whitish to cream-coloured when fresh, becoming pale ochraceous or alutaceous when old; margin indistinct.

Hyphal system monomitic; subicular hyphae loosely interwoven, hyaline, thin- to somewhat thick-walled 2.5-4(-5) µm wide, typically regular, subhymenial hyphae thin-walled, (2-)2.5-4 µm wide, septa without clamps; gloeocystidia terminal, cylindri-cal and flexuous to subclavate, vesicular or obtuse subfusoid, sometimes with basal swelling, 50-175(-200) x (6-) 710(-16) µm, thin-walled, sulpho-positive; basidia terminal, cylindrical to subclavate, 20-30 x 4-6 µm, typically with 4 sterigmata; spores hyaline, thin- to somewhat thick-walled, globose to subglobose, 4.5-5 µm diam, or more rarely broadly ellipsoid, (4.2-) 4.5-5 x 4-4.5µm, L= 4.95 µm, W= 4.3µm, q=1.1 (n=20/2) aculei up to 0.5 µm long, strongly amyloid, with prominent apiculus; ornamentation immediately disappearing in KOH.

**Specimens examined:** Kerala, Tirunelveli, Mundanthurai Sanctuary, fallen twig of a hardwood, 16 Feb. 1999, JRS (11987, BSD); (TN), Coimbatore, Pykara, base of a dead hardwood tree, 07 Dec. 2012, JRS (10050, BSD)**;** Maharashtra, Pune University Campus, on the branch of *Ficus benghalensis,* 22 July 2011, DM 6025.

**Habitat & Distribution:** On dead branches and tree trunks of angiosperms; a rare species in the tropical forests.

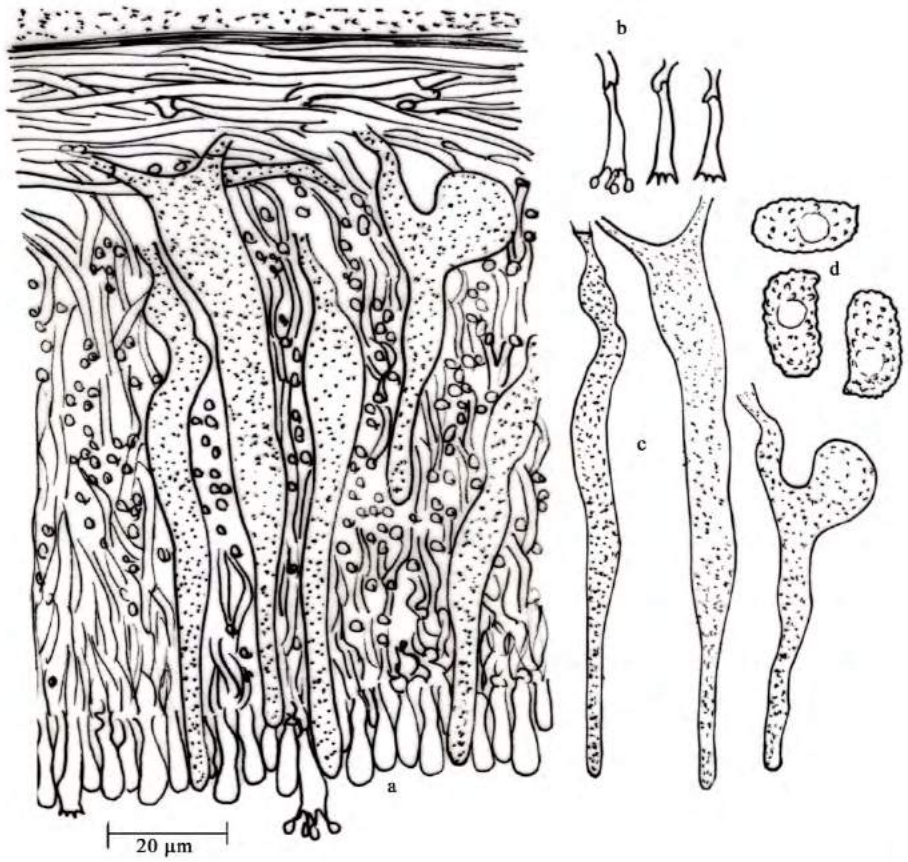


**Fig. 37:** *Gloeocystidiellum lacticolor:* a) section of basidiocarp, b) basidia, c) gloeocystidia, d) spores.

**Geographical distribution:** Kenya, Malawi, India.

**India**: Maharashtra, Kerela, Tamil Nadu.

**Remarks:** The larger gloeocystidia, globose to subglobose, verucose spores are the main distinguishing features of this species, with white to creamish, rimose hymenial surface are characteristics in the field.

**Gloeocystidiellum leucoxanthum** (Bres.) Boidin

C.R. Acad. Sci. Paris **233**: 825, 1951; *Corticium leucoxanthum* Bres., Fungi. trid. **2**: 166, 1898

**Type locality:** Italy **(Fig. 38)**

Basidiocarps resupinate, effused, adnate, up to 1 mm thick, orbiculate when young, becoming confluent at maturity; hymenial surface tuberculate, deeply rimose, white to pale creamish when young slowly ochre brown in matured specimens; margin byssoid, undifferentiated in older specimens; context subhyaline, dense in subhymenial layers.

Hyphal system monomitic, generative hyphae moderately thick-walled, 2-3.5 µm wide, septate, with clamps, arranged loosely in the basal layers, compact and denser in the subhymenial trama; gloeocystidia numerous, tubular, thin-walled, 90-120 (150) x 8-15 µm, with yellowish oily granular contents, apices round or moniliform; basidia clavate, 35-50 x 6-7 µm, 4-sterigmate, with a basal clamp; spores (11.5-)12-20 (20.2) x 4-6.5(-6.7)µm, L=19.9 µm, W= 5.85 µm, Q=3.40 (n=20/2), oblong to suballantoid, adaxial side somewhat concave, smooth, thin-walled, amyloid.

**Specimens examined:** (HP) Shimla, Kufri, on a rotting stump of *Cedrus deodara,* 20 Aug. 2014, DM 2063; *ibid* Kullu, Saria top, on a coniferous stump, 05 Oct. 2006, JRS 13506; (UK) Chopta, Chamoli, on a freshly fallen trunk of *Pinus* spp., 23 Sept. 2011, DM 1074; Ramnagar, Corbett National Park, on dead wood of *Alnus* spp., 29 July 2013; DM 5032; Tamil Nadu, Silent valley Santuary, on dead thin twigs of hardwoods, 16 Feb. 1982, JRS (26250, BSD).

**Habitat and Distriution:** The main substrates are dead branches of deciduous as well as coniferous woods. In all cases there is a preference for subalpine habitats, montane-subalpine boreo-subalpine. It's a characteristic species in the subalpine region.

**Geographical Distribution:** Denmark, Sweden, Japan, Africa, Europe & North America

**India:** Himachal Pradesh, Uttarakhand, Maharashtra and Tamil Nadu.

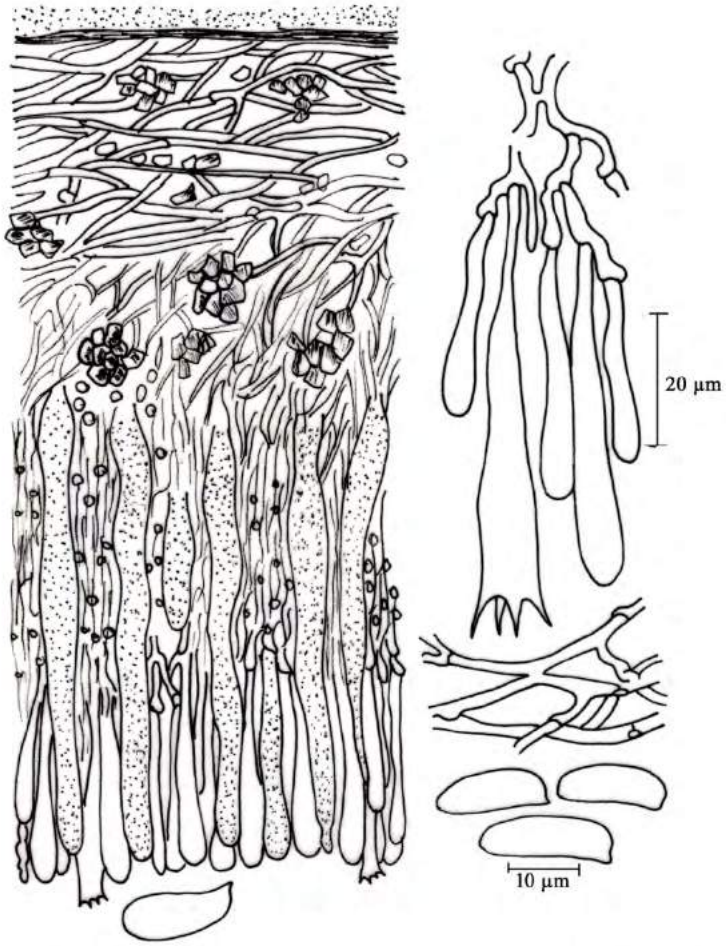


**Fig. 38:** *Gloeocystidiellum leucoxanthum:* a) section through basidiocarp, b) basidia, c) hyphae, d) spores.

**Remarks :** The ochraceous brown hymenial surface and very large oblong to suballantoid spores make this species easily recognised.

**Gloeocystidiellum luridum** (Bres.) Boidin

C.R. Acad. Sci. Paris **233**: 1668; 1951; *Corticium luridum* Bres., Fungi trid. **2**: 59, 1892

**Type locality:** NRM Stockholm. **(Fig. 39)**

Basidiocarps resupinate, adnate, effused, ceraceous to carnose; hymenial surface smooth to more or less tuberculate, deeply rimose, whitish to creamish when young, ochraceous brown at maturity; margin byssoid, whitish; context subhyaline.

Hyphal system monomitic, generative hyphae thin to moderately thick-walled, 2-3.5 µm wide, septate with clamps, subhymenial layer hyphae in a denser layer; gloeocystidia abundant, tubular, 60-150 x 6-10 µm, thin-walled, with yellowish granular contents, moniliform appendices often present; basidia clavate, 30-50 x 5-7 µm, 4-sterigmate, basal clamp always present; spores ellipsoid, thin-walled, (7.5-) 8-10 (10.2) x 4.5-5.5µm, L= 9.78 µm, W=5.4 µm, Q=1.81 (n= 20/2), smooth, amyloid.

**Specimens examined:** (HP) Kullu Sairopa, on a coniferous log 28 Sept. 2006, JRS 13801; (UK) Pithoragarh Askot, on a freshly fallen trunk of *Pinus wallichiana,* 16 Oct. 2007, JRS 1352; *ibid,* Bageshwar, Dhakuri forest, on stump of *Alnus*, 29 Sept. 2010, DM 2066; Sikkim Gangtok, on fallen trunk of *Picea* spp., 21 Sept. 2010, DM 3007; (TN), Ooty, Pykara, on dead angiospermic wood, 07 Dec. 2012, JRS (120042, BSD); *ibid,* Nilgiri Biosphere Reserve, on a rotting hardwood stump, 28 Nov. 2012, JRS (12039, BSD); Maharashtra, Beed, on dead hardwood, 07 June 07, 2011, JRS (6006, BSD & AMH)

**Habitat and Distriution:** On all kinds of deciduous woods very rarely on conifers. It is mainly collected in the herb-rich deciduous forests, in which it is one of the more important wood-decaying species, causing an active white decay. Most of the collected specimens grow on decorticated wood, but it is also now and then seen on bark.

**Geographical Distribution:** In Europe: Russia, Estonia, France, Germany, Belarus, Poland, Croatia, Macedonia, Slovenia, Belgium, United Kingdom, Slovenia, Netherlands, Portugal, Turkey, Sweden, Italy, Spain, Ukraine, and the Caucasus. Known from Lombardia, Trentino Alto-Adige, Emilia-Romagna, Calabria, Sicilia, North America China, Japan and Sardegna.

**India:** Himachal Pradesh, Uttarakhand Maharashtra, Tamil Nadu.

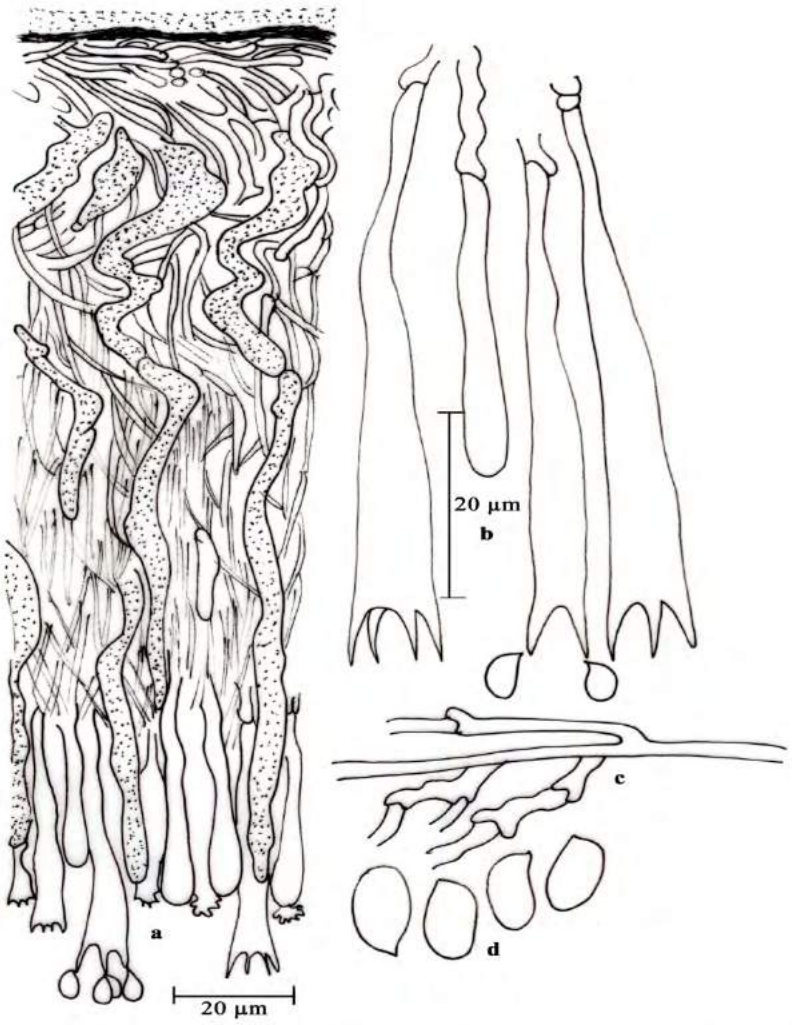


**Fig. 39:** *Gloeocystidiellum luridum*: a) section through basidiocarp, b) basidia, c) hyphae, d) spores.

**Remarks:** The ceraceous to carnose fruitbodies with ochraceous brown hymenial surface and fairly larger, ellipsoid, smooth spores are the main identifying features of this species.

**Gloeocystidiellum luteocystidiatum** (P.H.B. Talbot) Boidin

Cahiers de La Maboké 4(1): 9 (1966); *Corticium luteocystidiatum* P.H.B. Talbot, Bothalia 4(4): 941, 1948

**Type locality:** Town Bush, Pietermaritzburg, South Africa. **(Fig. 40)**

Basidiocarps annual, thin, membraneous, resupinate, effused, small portions separable when moist, basidiocarp may peel off when dry, arising at first as small circular or irregular colonies which later on coalesce to form linear areas up to 220 x 70mm, thickness up to 450 µm; hymenial surface pinkish yellow-"Capucine Buff', "Pinkish Buff", rough, sometimes cracked; margin concolorous, thinning out, serrate, raised or adnate; context hyaline, to 400 µm thick, composed of a basal layer of somewhat compactly arranged horizontal hyphae and an intermediate layer of vertical or ascending hyphae.

Hyphal system monomitic, generative hyphae hyaline, thin-walled, branched, septate, clamp connections abundant, 1.7-3.3 µm thick; masses of hyaline crystals also present in the context; hymenium to 45 µm deep, composed of a palisade layer of basidia, paraphyses and gleocystidia; basidia clavate or subclavate, 11.7-16.7 x 4.5-8.3 µm, 4-spored, sterigmata erect, upto 7.4 µm long; paraphyses cylindric, narrower and shorter than the basidia; gleocystidia abundant, 60-100 x 6-10 µm present usually in the hymenium but also sometimes in the context, arise from the context hyphae, run obliquely through the context and become erect in the hymenial layer, orange-coloured with granular contents, clavate, fusiform or cylindrical, embedded, not projecting; spores hyaline, oval or cylindrical, apiculate, strongly amyloid, thin-walled, smooth, (8.5-) 10-11(-11.2) x 3.7-5.4 µm, L= 10.9 µm, W= 5.2 µm, q= 2.09 (n=20/2).

**Specimens examined:** Maharasthra, Beed, on dead hardwood, 12 June 2011, JRS (20013, BSD & AMH); *ibid*, Mahabaleshwar, Ligmala, on dead branch of *Rosa,* 08 June 2012, JRS (10826, BSD); (TN), Coonoor, on fallen twigs, 05 Dec. 2012, JRS (10507, BSD); *ibid,* Tirunelveli, Mundanthurai Sanctuary, fallen twig of a hardwood, 18 Feb. 1999, JRS (10977, BSD)

**Habitat & Distribution:** On dead hardwoods in tropical areas.

**Geographical distribution:** South Africa, India.

**India:** Maharashtra, Tamil Nadu.

**Remarks**: *C. luteocystidium* has bright yellow or orange-coloured gleocystidia and is distinguished especially by its hymenial colour and spores.

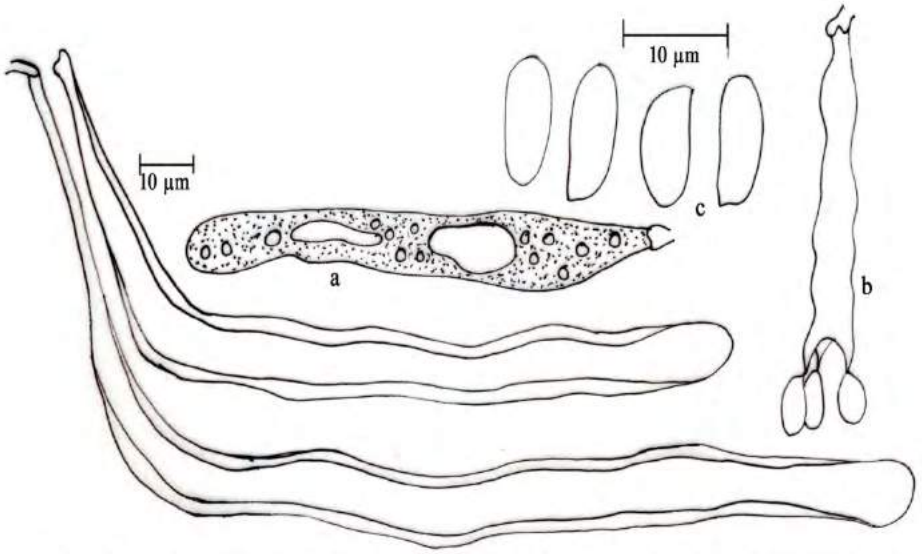


**Fig. 40:** *Gloeocystidiellum luteocystidiatum:* a) gloeocystidia, b) basidia c) spores.

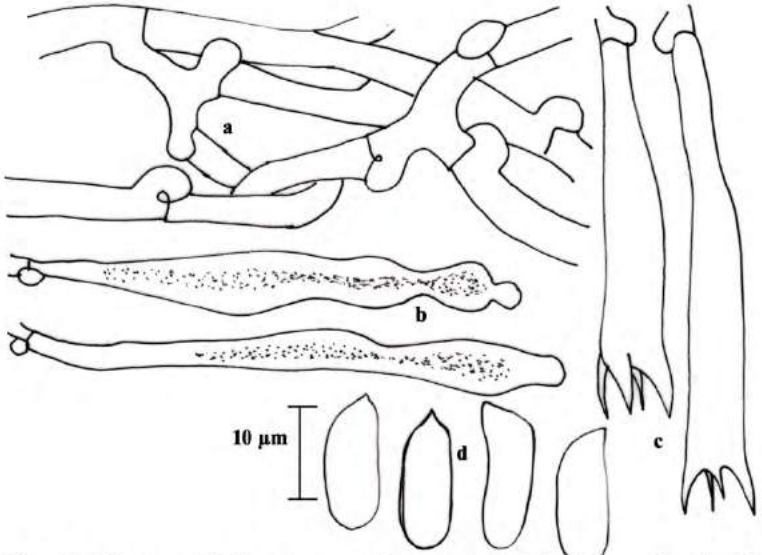


**Fig. 41:** *Gloeocystidiellum luteocystidium var. brevisporum:* a) hyphae, b) gloeocystidia, c) basidia, d) spores.

**Gloeocystidiellum luteocystidium** var. *brevisporum* Rattan

Resup. Aphyll. N.Western Him. p. 103, 1977;*Corticium luteocystidium* (Talbot : Wakf. & Talbot) Boid., Cah. Maboke **4**: 9, 1966;*Corticium luteocystidium* Talbot : Wakf. & Talbot, Bothalia **4**: 941, 1948.

**Type Locality:** India **(Fig. 41)**

Basidiocarps resupinate, adnate, stratose, membranous-ceraceous, when old partly detachable and specimens curling away from the substratum, often arising in small circular colonies which may coalesce later and become widely effused, up to 1 mm thick; hymenial surface deep orange, yellowish orange in mature specimens, smooth to finely granulose; margin determinate, adnate to separable; context stratose, subhyaline.

Hyphal system monomitic, generative hyphae thin to moderately thick-walled, 2-4 µm wide; gloeocystidia 50-110 x 5-10 µm, clavate-cylindrical, contents orange-coloured, immersed or projecting slightly beyond the hymenium; basidia 25-40 x 4-6 µm, clavate, 4-sterigmate; spores (4.5-) 5-6.5 (-7.1) x 4-4.5 µm, L=6.4 µm, W= 4.1 µm, Q=1.56 (n=20/2) narrowly ellipsoid, minutely apiculate, thin-walled, smooth, amyloid.

**Specimens examined**: (UK) Chamoli, Tungnath, on stump of Oak, 04 Sept. 1990, JRS 261; *ibid,* Chamoli, Mandol, on hardwood log, 02 Oct. 2011, DM 1079; *ibid,* Dehradun, Chakrata, Deoban forest, on a coniferous log, 23 Aug. 2018, DM 435; (HP) Shimla, Narkanda, on logs under *Abies pindrow,* 27 July 1994, JRS 827.

**Habitat and Distriution:** A common species on all type of woods in the temperate Himalayan forests.

**Geographical Distribution:** India

**India:** Uttarakhand, Himachal Pradesh

**Remarks:** The thick, stratose fruitbodies with orange coloured hymenial surface and narrowly ellipsoid spores are the main separating characters of this taxon.

**Gloeocystidiellum ochraceum** (Fr.) Donk

Fungus **26**: 9, 1956; *Thelephora ochracea* Fr., Syst. Mycol. **1**: 446, 1821

**Type locality:** India **(Fig. 42)**

Basidiocarps effused, broadly confluent, ceraceous when fresh, hard on drying, closely adnate when young, somewhat detachable at the margin when old, thick up to 3 mm; hymenial surface yellowish white to pale yellow to light yellow, slowly light to greyish orange, smooth to finely tuberculate, deeply rimose with age; margin pruinose, thinning out, short fibrillose to almost entire with age; context layered with narrow and brown bands.

Hyphal system monomitic, hyphae 2.5-3.5 µm, thin to somewhat thick-walled, septate, without clamps, main context vertical, parallel, densely agglutinated, or united in a pseudoparenchymatous tissue; gloeocystidia numerous, cylindrical, often sinuous, thin to moderately thick-walled, 40-70 x 4-6 µm, with oily granular contents, with positive reaction to sulfovanilline, submerged or little projecting; basidia subclavate, 18-28 x 4-6.8 µm, 4-sterigmate; spores (3.1-) 3.5-5.5 (-5.6) x 2-2.5µm, L= 4.25µm, W= 2.2µm, Q= 1.94 (n= 20/2), narrowly ellipsoid, smooth, amyloid.

**Specimens examined :** (UK) Tehri, Kharsoli, on a coniferous stump, 27 Aug. 1991, JRS 356, *ibid*, Rudraprayag, Mansoona, on a coniferous log, 15 Sept. 1997, JRS 5504; *ibid,* Bageshwar, Dhakuri forest, on stump of Oak, 03 Oct. 2017, DM 340; (HP) Renuka forest, on logs under *Abies pindrow*, 26 Sept. 2018, DM 570; Sikkim, Singba Rhododendron Sanctuary, dead rotting log of *Rhododendron*, Sept.21, 1982, JRS (610, 624 ,CAL); Meghalaya, Dowki, Jaintia hills, Tura Biosphere reserve, on dead standing hard wood tree, 10 Sept. 1988, JRS (6303, CAL)

**Habitat and Distriution:** It occurs on woods of conifers but occasionally also found on angiospermic woods.

**Geographical Distribution:** Western Canada, USA, India

**India:** Uttarakhand, Himachal Pradesh, Sikkim, Assam.

**Remarks:** The yellowish white to greyish orange hymenial surface and small, smooth spores make it distinct and separate it from the closely related *G. karstenii.*

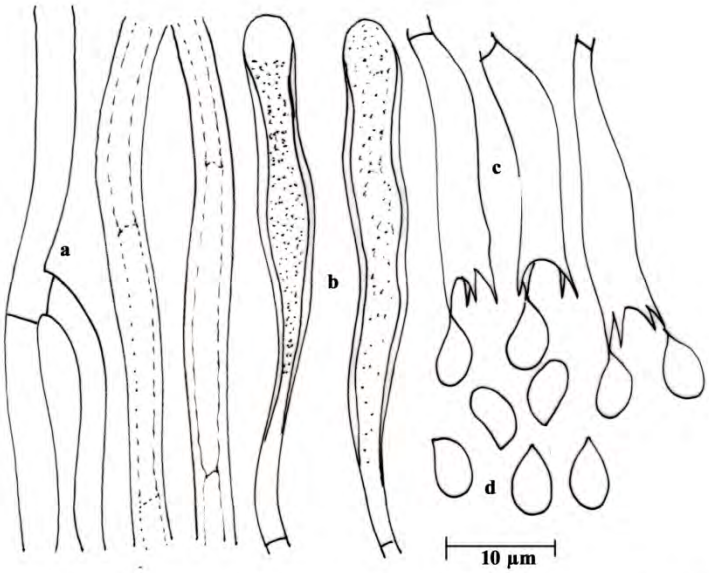


**Fig. 42:** *Gloeocystidiellum ochraceum:* a) hyphae, b) gloeocystidia, c) basidia, d) spores.

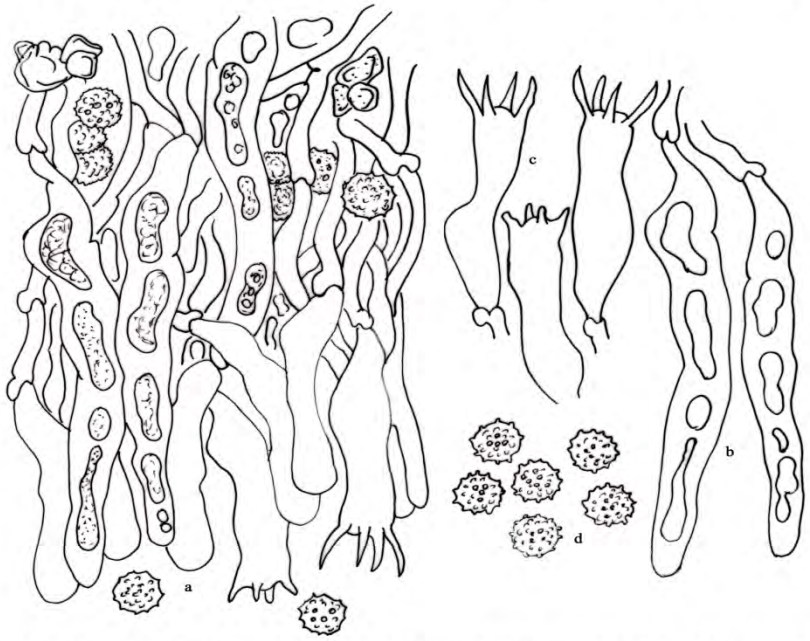


**Fig. 43:** *Gloeocystidiellum odontoides:* a) section of hymenophore, b) gloeocystidia, c) basidia, d) spores.

**Gloeocystidiellum odontoides** Khara

Ind. Phytopathology 41(1): 35, 1988.

**Type locality:** India **(Fig. 43)**

Basidiocarps resupinate, widely effuced, adnate, sub-membranous; hymenial surface white at first, changing to creamish buff (yellowish), smooth to tuberculate or papillose, margin indeterminate, byssoid; context 100-250 µm thick, composed of a few repent hyphae at the base and loosely interwoven hyphae above.

Hyphal system monomitic, hyphae 3-5 µm wide, thin to slightly thick-walled, subhyaline, branched, septate, clamped; gloeocystidia 30-50 x 6.5-8.5 µm, abundant in hymenium, slightly projecting out, long cylindrical, often with swollen base, originate at different levels, thin-walled, filled with shining oily contents, some with very lightly encrusted walles; basidia 20-30 x 5-6.5 µm, clavate, 4-spored, sterigmata upto 5 µm long; spores (6.5-) 6.6-8.6 (-8.8) x 4-5.6 µm, L= 7.4 µm, W= 5.2 µm, Q=1.42 (n=20/2), broadly ellipsoid to ovoid, subhyaline, thin walled, warty, amyloid.

**Specimens examined:** Punjab, Hoshiarpur, Bhunga, on wood of dying *Eriobotrya japonica* Lindl. 12 Sept. 1975. Khara, HCIO-39225; (UK) Dehradun, Rajaji National Park, wounds on *Sweitenia* tree, 21 Aug. 1994, JRS (1807, BSD); *ibid,* Udhamsingh Nagar, Corbett National Park, on dead trunk of *Cedrella toona* 25 Aug. 2002, JRS (7605, BSD).

**Habitat & Distribution:** on rotting hardwood in hotter areas

**Geographical distribution:** India

**India:** Punjab, Uttarakhand

**Remarks:** This species shows close resemblance to *Gloecystidiellum donkii* Rattan in the ornamentation of spores, colour of hymenial surface and in the nature of gloeocystidia. It differs in having odontoid hymenial surface, clamped hyphae, smaller gloeocystidia and bigger spores. It causes soft spongy white rot.

**Gloeocystidiellum porosellum** Hjortstam

*Mycotaxon* **19**: 505, 1984.

**Type locality:** Sweden. **(Fig. 44)**

Basidiocarps resupinate, effuse, cream-coloured, when dried ceraceous or submembraneous, smooth, fairly thin, about 0.10.2 mm thick; margin thinning out or indeterminable, rarely farinaceous or byssoid.

Hyphal system monomitic, hyphae thinwalled, 2-2.5 µm wide, richly branched, irregularly arranged next to the substratum, in the subhymenial layer more dense but well separable in a crush-preparation; sulphocystidia numerous, subfusiform and provided with one or more rarely two outgrowths (schizopapillae), thin-walled, with oily inclusion in the protoplasm. 50-60 x 7-8 µm, with distinct reaction to sulphovanillin; basidia narrowly subclavate, often with median constriction, (15-)20-25 x 3.5-4 µm, 4-sterigmate, without a basal clamp; spores ellipsoid, finely verrucose, with warts easily observed in both KOH and Melzer's reagent, (4.9-)5-5.5 (-5.8) x 3-3.5µm, L= 5.3 µm, W=3.35 µm, Q=1.58 (n=20/2), strongly amyloid.

**Specimens examined:** (TN) Nilgiri Biosphere Reserve, on a rotting hardwood stump, 28 Nov. 2012, JRS (12009, BSD); Maharashtra, Bheed, base of hardwood of tree, 08 June 2012, JRS (17310, BSD); A & N Islands**,** MKG marine National park, on dead angiospermic wood, 23 April 2013, JRS (20020, BSD).

**Habitat & Distribution:** Common on hardwood in the tropical forests.

**Geographical distribution:** Africa, India

**India:** Maharashtra, Tamil Nadu, Andaman and Nicobar Island

**Remarks:** *Gloeocystidiellum porosellum* is readily recognized by its clampless hyphae, relatively loose tissue, sulphocystidia, and rough, amyloid spores. It is evidently similar to *G. porosum* and *G. clavuligerum* but it is easily separated from both of them as these fungi possess clamps at every septa. *Gloeocystidiellum heimii* (Boidin, 1966), originally described from Africa, is also similar to this species. The cystidia in that species are, however, distinctly broader and schizopapillae have not been observed. Furthermore, the hymenium is dotted by reddish excretion, seemingly arisen from the cystidia, which cannot be seen in *Gloeocystidiellum porosellum.* Though *G. porosellum* and *G. convolvens* have similarities such as clampless hyphae and rough spores but larger spores and smaller gloeocystidia separate *G. porosellum* from *G. convolvens*.

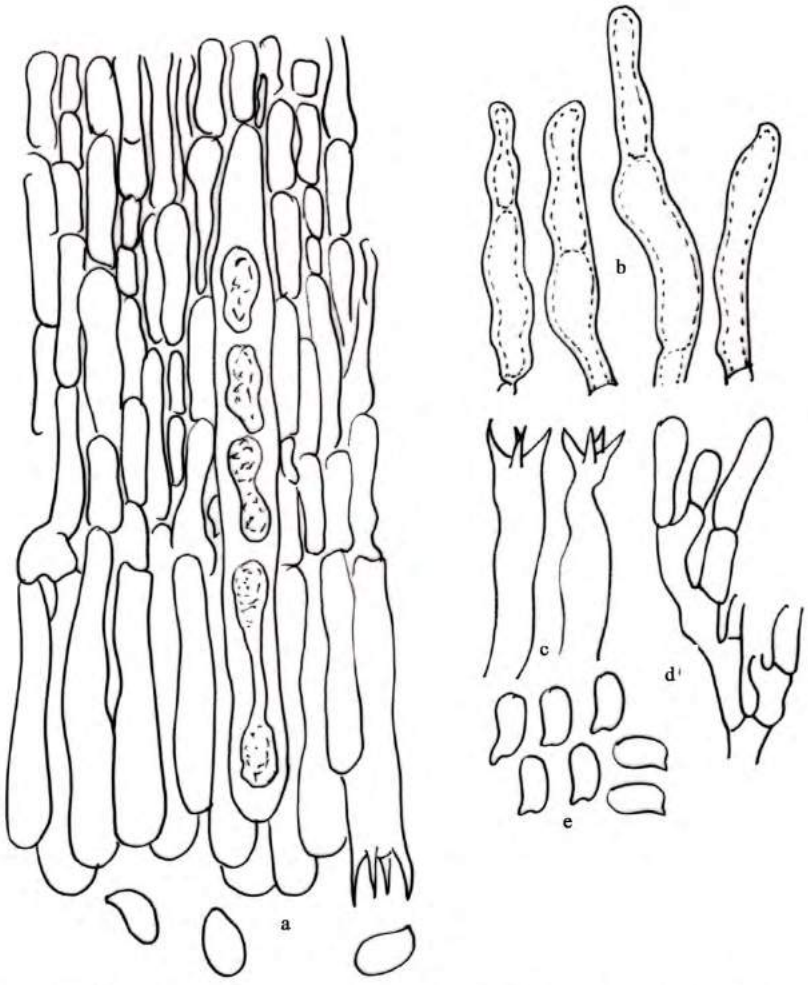


**Fig. 44:** *Gloeocystidiellum porosellum:* a) section through basidiocarp, b) gloeocystidia, c) basidia, d) branching pattern of subhymenial hyphae, e) spores.

**Gloeocystidiellum porosum** (Berk. & M.A. Curtis) Donk

Medded. Nedl. Mycol. Ver. 18-20: 156, 193; *Corticium porosum* Berk. & M.A. Curtis, Ann. Mag. nat. Hist., Ser. 5 3(no. 15): 211, 1879.

**Type locality:** England **(Fig. 45)**

Basidiocarps effused, rather large, upto 80 x 40mm, 70-350 µm thick, orbicular soon coalescing; hymenial surface ceraceous, "Cream-Buff' to "Pale Ochraceous-Buff', "Light Ochraceous-Buff' or "Ochraceous-Buff' when dry, smooth, some cracked extensively; margin abrupt to pruinose, white to pallid, to 1 mm wide.

Hyphal system monomitic, subiculum a basal layer up to 100 µm thick of woven but essentially parallel and horizontally arranged hyphae, hyphae 2.0-3.5 µm diam, with clamp connections, the walls thin, hyaline, nonamyloid; gloeocystidia arising either in the hymenium or from the basal hyphal layer, 50-90 (-170) x 8-12 (-14) µm, numerous, tubular, fusoid, or flask shaped, some with an elongated neck, some with a long narrow base, thin-walled, the contents yellowish-green in KOH, granular, sulfo-positive; basidia 17.0-28.0 x (3.6-) 4.0 (-4.4) µm narrowly clavate to almost cylindric, with four sterigmata, each up to 4.0 m long; spores ellipsoid to nearly cylindrical, (4.4-) 4.8-5.2 (-6.1) x (2.6-) 2.8-3.2µm, L=5µm, W= 3.14µm, Q=1.61 (n=20/2) the walls hyaline, thin, verrucose to minutely verrucose, some appearing smooth, amyloid, with a small blunt apiculus.

**Specimens examined :** Andaman & Nicobar Island, Baratang, on the bark of dead angiospermic tree, 24 April 2013, JRS (20367, BSD); (TN) Ooty, Pykara, on dead angiospermic wood, 07 Dec. 2012, JRS (10042, BSD); (UK), Pithoragarh, Tanakpur, on a living trunk of *Anogiessus,* 29 Aug. 2007, JRS (19057, BSD); Maharastra, Mahabaleshwar, Ligmala, on dead branch of *Rosa,* 09 June 2019, DM 732.

**Habitat & Distribution:** On a variety of woody angiosperms and conifers. Mostly found on bark of dead twigs and branches on the ground, associated with a white rot.

**Geographical distribution:** Europe: Switzerland, Russia, Turkey, Estonia, France, Germany, Czech Republic, Belarus, Poland, Ireland, Bosnia and Herzegovina, Croatia, Macedonia, Slovenia, Serbia, Belgium, United Kingdom, Netherlands, Russia, Norway, Sweden, Italy, and the Caucasus.

**India:** Maharashtra, Uttarakhand, Tamil Nadu, Andaman and Nicobar Island.

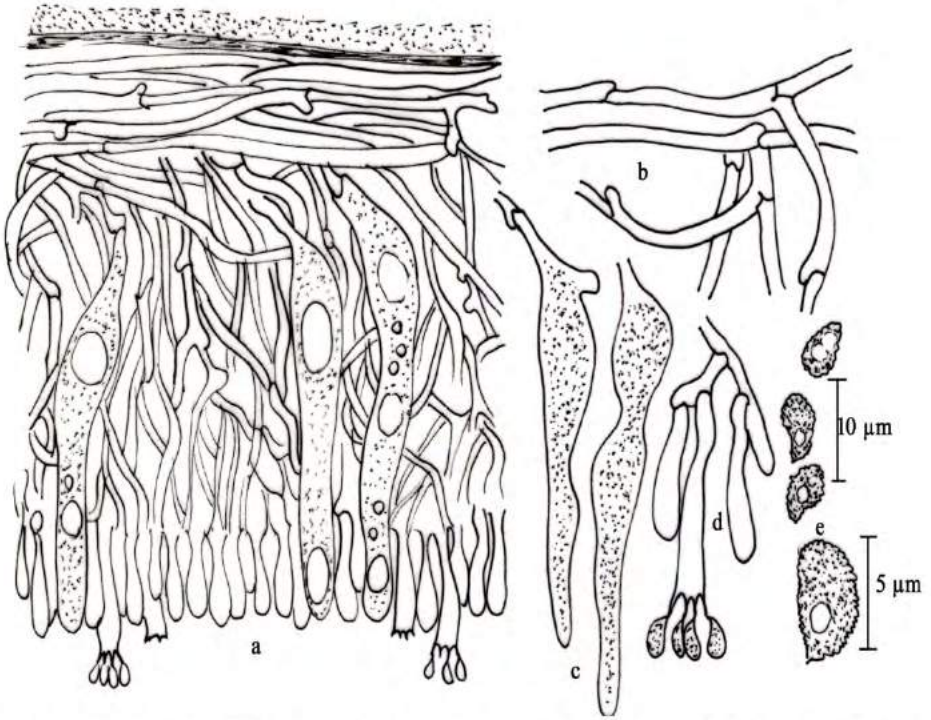


Fig. 45: Gloeocystidiellum porosum: a) section through basidicarp, b) hyphae, c) gloeocystidia, d) basidia, e) spores.

**Remarks:** *Gloeocystidiellum porosum* is widely distributed on angiospermous and gymnospermous branches. It is associated with a white rot. The cream to ochraceous hymenophore, large identifying features of this species.

**Gloeocystidiellum sulcatum** (Rehill & Bakshi) Boidin

Cahiers de La Maboké 4: 10, 1966; *Corticium sulcatum* Rehill & B.K. Bakshi, Forest Bull., Dehra Dunn, n.s. 242: 15, 1965; *Gloeocystidiellum sulcatum* (Rehill & Bakshi) Boid., Cah. Maboke **4**: 10, 1966.

**Type locality:** Mundali, Chakrata Forest Division, Uttarakhand, India **(Fig. 46)**

Basidiocarps annual to perennial, resupinate, adnate, membranous-ceraceous, somewhat brittle, stratose, widely effused, up to 2 mm thick in section; hymenial surface cream to cream-yellow when young changing to yellowish brown, brown to finally greyish brown or cream grey with age, ail colours may be present in a single patch, smooth to prominentely tuberculate, young patches are continuous but thicker ones crack deeply and areolately often exposing the substratum below; margin thinning to abrupt, paler concolorous to concolorous, adnate; context subhyaline to light brown in section, full of crystalline matter,stratose with overlapping rows of successive hymenia.

Hyphal system monomitic, hyphae 2-3(4.5) µm wide, branched, septate, clamps absent, the walls thin, subhyaline, often collapsing and agglutinating and thus indivisual hyphae are difficult to discern in older parts of the context; cystidia absent; gloeocystidia 35-85 x 4-8.5 µm, abundant, clavate-cylindrical to cylindrical with obtuse apices, empty but more often with shinny granular contents staining deeply with phloxine, thin to slightly thick-walled especially in the basal part, immersed or projecting up to 15 µm out of the hymenium; basidia 15-25 x 3.5-4.5 µm, clavate, 4-spored, sterigmata up to 6 µm long; spores (6.9-)7-8.5(-8.6) x 2-3µm, L=8.25 µm, W=2.7 µm, Q= 3.05 (n=20/2) cylindrical, minutely apiculate, the walls thin, subhyaline, smooth, amyloid.

**Specimens examined:** Maharashtra, Pune university campus, on rotting wood, 8 Aug. 2018, DM 720; (TN), Coimbatore, Pykara, base of a dead hardwwod tree, 07 Dec. 2012, JRS (10670, BSD); *ibid,* St. Kalakad Sanctuary, on dead thin twigs of hardwoods, 13 Feb. 1982, JRS (20050, BSD); (AP) Tirup, Pangsoo pass, on dead hardwood log, Oct. 10, 1986, JRS (3068,CAL); (HP) Kulu, Pulga, on twigs under mixed forest, 20 Sept. 2014, DM 2077; (UK) Chamoli, Mondal, base of a dead trunk of Oak tree, 23 Aug. 1999, JRS (8066, BSD)

**Habitat & Distribution:** Common and widely distributed species on dead deciduous wood.

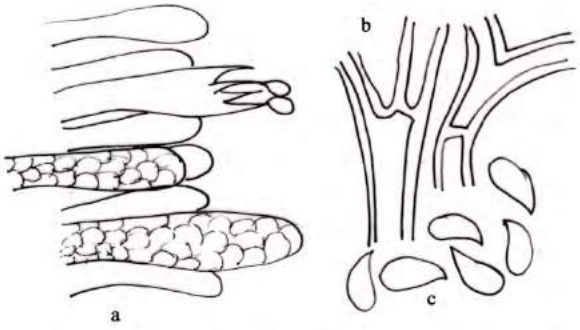


**Fig. 46:** *Gloeocystidiellum sulcatum:* a) section through basidiocarp, b) hyphae, c) spores.

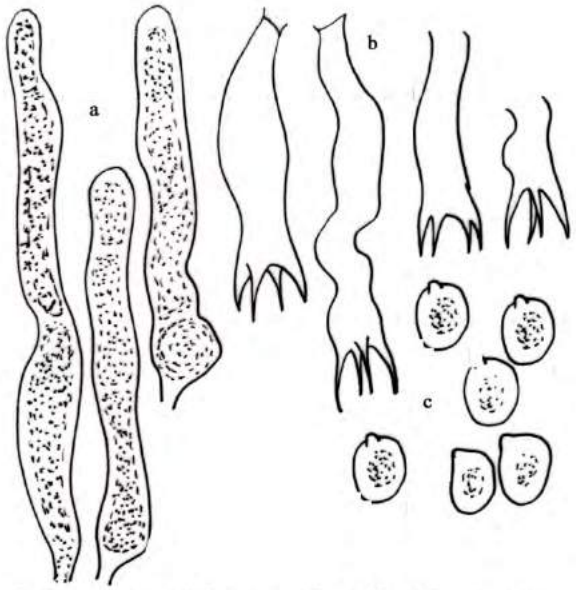


**Fig. 47:** *Gloeocystidiellum turpis:* a) gloeocystidia, b) basidia, c) spores.

**Geographical distribution:** India

**India:** Maharashtra, Uttarakhand, Himachal Pradesh, Tamil Nadu.

**Remarks:** This species is among the commonest resupinate fungi in the coniferous forests and has been collected from most of the localities in the North Western Himalayas. It shows a great deal of variation in the morphological features. *G. sulcatum* may be recognised from its whitish sporophores which are very closely adnate and strongly creviced. Colour varies from cream to cream-grey or brown to greyish brown.

**Gloeocystidiellum turpe** G.W. Freeman

in Burdsall, Nakasone & Freeman, Syst. Bot. 6(4): 430, 1981

**Type locality:** United States: Florida **(Fig. 47)**

Basidiocarps broadly effuse, up to 250 µm thick, membranous, adherent, hymenial surface "Pale Yellow-Orange" to "Light Ochraceous-Buff" when dry, smooth, not cracking to slightly areolate in places; margin abrupt, pruinose, concolorous or nearly white; subiculum very thin, indistinct.

Hyphal system monomitic. subiculum a very thin layer of parallel hyphae next to substrate, hyphae compact, agglutinated, indistinct; hyphae 2.0-3.2 m diam, lacking clamp connections, frequently branched, long celled, walls thin, hyaline, nonamyloid; gloeocystidia arising at various levels in the basidiocarp, 36-150 (-200) x 8-10 (-15) µm, numerous, sinuous, cylindric or clavate, the wall thin at first, then up to 1.6 µm thick, the contents globular to granular or crystalline, sulfoaldehyde-positive; hyphidia lacking; basidia 27-35 x 5-9 µm, nearly clavate with a median constriction or swelling near the base, the wall thin, hyaline, 4-sterigmate, each 5.0 µm long; spores (5.9-) 6-7.2 (-7.4) x 4.8 -5.2µm, L=7.1µm, Q=1.40 (n=20/2) subglobose, thin walled hyaline, smooth, weakly amyloid in a mottled pattern, acyanophilous, with a small, rounded, distinct apiculus.

**Specimens examined: (**TN) St. Kalakad Sanctuary, on dead thin twigs of hardwoods, 13 Feb. 2012, JRS (10050, BSD); Maharashtra, Pune, Panchwati, on rotting wood, 12 June 2017, JRS (10024, BSD).

**Habitat & Distribution:** On thin rotting twigs of hardwoods in the tropical areas.

**Geographical distribution:** USA, India

**India:** Maharashtra, Tamil Nadu.

**Remarks:** *Gloeocystidiellum turpis* resembles *G. lactescens*, especially in spore characters, but differs in the color of the basidiocarps the lack of hyphidia, and in possessing shorter, somewhat thick-walled gloeocystidia which often have adventitious septa. The reactions of the gloeocystidia to sulfobenzaldehyde are confusingly varied.

**Hjortstamia** Boidin & Gilles
Bull. Soc. mycol. Fr. 118(2): 99, 2002

Basidiocarps resupinate, effused-reflexed to distinctly pileate, broadly attached to dimidiate or fanshaped, upper surface tomentose to felty, often zonate, geyish to deep brown; hymenium smooth to tuberculate, smooth to cracked with age, ochraceous, grayish to pinkish or dark brown; hyphal system di-or trimitic, generative hyphae with simple septa; skeletal hyphae (when present) pale to dark brown; preudocystidia present or absent, pale brown, encrusted or smooth, hymenial cystidia mostly metuloid, hyaline to brown; basidia narrowly clavate with 4 sterigmata; spores cylindrical to ellipsoid, smooth, hyaline, acyanophilous and inamyloid; Tropical to warm temperate zones; causing a white rot in hardwoods.

**Type species:** *Thelephora friesii* Lev.

*Remarks:* Reminiscent of *Porostereum* but separated from it by simple septate generative hyphae.

**Key to species**

1. Basidiocarps distinctly pileate, sessile to fan-shaped; hymenial suface beige to pinkish brown; hymenial cystidia ventricose, pseudocystidia absent……***H. papyrina***

1. Basidiocarps effused-reflexed-reflexed; hymenial surface darkgrey to darkgrey to dark vinaceous brown, to purplish; hymenial cystidia subulate, skeletocystidia usually abundant....2

2. Dark brown cuticle present on the abhymenial side; spores broadly ellipsoid, upto 6µm wide…….***H. papyracea***

2. Dark brown cuticle absent; spores narrower…….3

3. Thick walled cystidia absent……..…….***H. fulva***

3. Thick walled cystidia present, 80-150 x 7-11.5µm, cylindrical……..…..***H. crassa***

**Hjortstamia crassa** (Lev.) Boidin

Bull. Soc. Mycol. France **74:** 479, 1958; *Thelephora crassa* Lev., Ann. Sci. Nat., Bot., **2:**209, 1844; *Stereum umbrinum* Berk. & Curt., Grevillea **1**: 164,1873.

**Type locality**: Europe **(Fig. 48)**

Basidiocarps resupinate, effused, often becoming reflexed, coriaceous spongy, loosely adnate, resupinate, 10-30mm in diameter, becoming laterally confluent up to 80-150mm; reflexed portion up to 10mm broad, up to 800 µm in thickness; upper surface finely tomentose, deep to greyish brown; margin thick, entire, concolorous or lighter; hymenial surface even, smooth, light vinaceous brown, rarely cracking on drying; context up to 500 µm thick, composed of loosely interwoven and light brown hyphae.

Hyphal system monomitic, hyphae up to 5 µm wide, branched at wide angles, septate, clamps absent, thin-walled, more pigmented towards abhymenial side, tomentum hyphae unbranched, aseptate, brown; cystidia 80-150 (180)x 7-11.5 µm, cylindrical to subfusiform, immersed or projecting up to 80 µm out of hymenium, thick-walled, brown at lower half, heavily incrusted in the upper two-third part; basidia narrowly clavate, 18-25 x 5-7 µm, 4-spored; spores ellipsoid, thin-walled, smooth, (5.9-)6-8(-8.5) x 3-4µm, L= 7.55µm, W= 3.70µm, Q=2.04 (n=20/2) inamyloid.

**Specimens examined :** (UK) Dehra Dun, FRI, stump of *Shorea robusta,* 10 Sept. 1992, JRS 884; *ibid,* Mandoli, Rudraprayag, rotting trunk of hardwood, 25 Aug. 1993, JRS 298; *ibid,* Rajaji National Park, on rotten hardwood log, 24 Sept. 2011, DM 147.

**Habitat and distribution**: Mostly found on hardwoods and grows frequently in subtropical areas.

**Geographical distribution:** Widespread in both hemisphers; Eastern North America, Mexico, Guatemala, Cuba, North Carolina to Texas and southward from Ohio and Illinois, in Arizona, West Indies, and Central America; occurs also in Poland, Cochin China, and Australia.

**India:** Uttarakhand, Himachal Pradesh

**Remarks :** This species is recognized by the presence of a vinaceous tinge in the fruitbodies and large, coloured encrusted cystidia protruding into the hymenium.

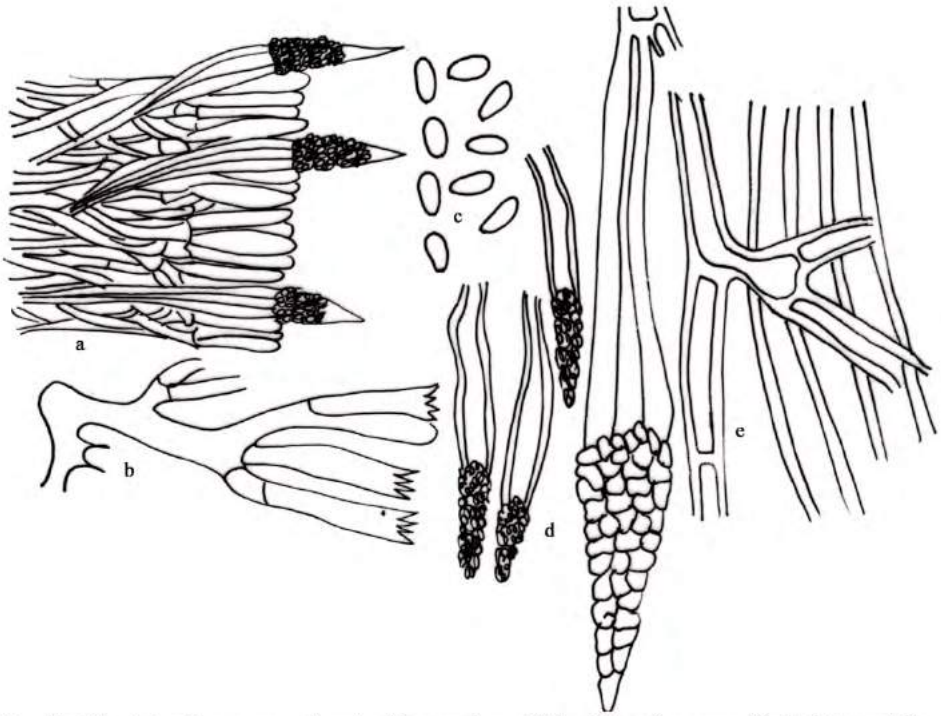


**Fig. 48:** *Hjortstamia crassa:* a) part of hymenium, b) basidia, c) spores, d) skeletocystidia, e) generative hyphae.

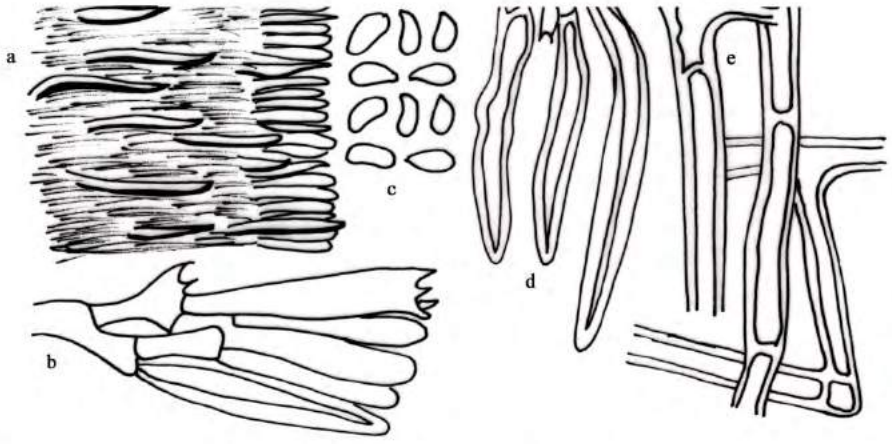


**Fig. 49:** *Hjortstamia fulva:* a) part of hymenium, b) basidia, c) spores, d) cystidia, e) generative hyphae.

**Hjortstamia fulva** (Lev.) Mishra Comb. Nov.

*Thelephora fulva* Lev., Ann. Sci. Nat. Bot. **5:** 149, 1846; *Stereum schomburghii* Berk., J. Linn. Soc. Bot. **13**: 168, 1873; *Lopharia fulva* (Lev.) Boidin, Bull. Soc. Linn. Lyon **28:** 213, 1959

**Type locality:** France **(Fig. 49)**

Basidiocarps annual, resupinate, effused-reflexed to pileate, membranous, adnate, resupinate patches often arising as small orbicular colonies which may coalesce later and become widely effused, up to 1mm thick, reflexed portion up to 20 mm long and broad, flabelliform to umbonate; upper surface camel brown to medium brown, tomentose, azonate to concentrically zonate; hymenial surface greyish brown, smooth to somewhat rough; context pale brownish, composed of compactly arranged hyphae, not forming cuticle on the abhymenial side.

Hyphal system dimitic, generative hyphae up to 4.5 µm wide, branched, septate, thin-walled, hyaline, skeletal hyphae 5-6 µm wide, unbranched, walls brownish, thick-walled; cystidia absent, skeletocystidia present as the prolongations of skeletal hyphae curving into the hymenium, smooth or minutely incrusted especially near the apices only; basidia 30-40 x 6-7 µm, clavate, 4-spored; spores (6.7-) 7-7.5 (-8) x 3-4µm, L= 7.4 µm, W= 3.7 µm, Q=2.01 (n=20/2) ellipsoid, thin-walled smooth inamyloid.

**Specimens examined :** (UK) D. Dun, Dhanaulti, dead branch of Oak, 30 Aug. 1992, JRS 878; (HP) Kullu, Jibi, dead thin branch of Oak, 20 Sept. 1994, JRS 1105; *ibid,* on way to Jalori pass, rotting trunk of Oak, 06 Oct. 2018, DM 567; Maharashtra, Sangli, Miraj, on branch of *Dalbergia* spp. 27 Aug. 2018, DM 612; (TN) Nilgiri Biosphere Reserve, on a rotting hardwood stump, 27 Nov. 2012, JRS (12138, BSD)

**Habitat and distribution:** A common species found growing widely throughout the country.

**Geographical distribution:** France, Africa, Reunion, India, Pakistan, Nepal, Philippines, Australia, New Zealand and Siberia.

**India:** Uttarakhand, Himachal Pradesh, Mahrashtra, Tamil Nadu.

**Remarks:** The absence of the cuticle on the abhymenial surface, absence of thick-walled cystidia and presence ellipsoid spores are the main features of this species.

**Hjortstamia papyracea** (Jungh.) Mishra Comb. Nov.

*Thelephora papyracea* Jungh., Prae. Fl. Crypt. Javae Ins. **36**: 1838; *Stereum percome* Berk. & Br., J. Linn. Soc. Lond. **14**: 65, 1873; *Lopharia papyracea* (Jungh.) Reid, Kew Bull. p. 131, 1957

**Type locality:** Java **(Fig. 50)**

Basidiocarps coriaceous, resupinate to effused-reflexed, widely effused, up to 150 x 50 mm, 300-600 µm thick; upper surface yellowish to cinnamon brown, smooth, occasionally cracking irregularly on drying; hymenophore reddish brown, cracking with age, furning violet with KOH solution; margin thick, loosely adnate to often reflexed, concolorous; context light brown, composed of compactly arranged parallel hyphae, forming a dark brown cuticle on the abhymenial surface.

Hyphal system dimitic, generative hyphae up to 4 µm wide, branched, septate, thin-walled, hyaline, skeletal hyphae up to 4 µm wide; cystidia 40-90(100) x 10-15 µm, subfusiform, projecting up to 45 µm out of the hymenium, thick-walled, heavily incrusted; skeletocystidia present as the elongations of the skeletal hyphae which curve into hymenium, light brown, thick-walled; basidia not seen; spores (6.9-) 7-8.5(-8.7) x 4-6µm, L=8.01µm, W= 5.02 µm, Q=1.60 (n=20/2) ovoid to broadly ellipsoid, thin-walled, smooth, non-amyloid.

**Specimens examined :** (HP) Hamirpur, rotting hardwood stump, 10 Sept. 2004, JRS 12721; (UK) D. Dun, Kalsi, rotting trunk of *Shorea robusta,* 15 Sept. 1992, JRS 877; *ibid*, Bageshwar, on way to Dhakuri Forest, on coniferous branch, 10 Oct. 2010, DM 2082; Maharashtra, Beed, on dead hardwood, 08 June 2011, JRS (6016, BSD & AMH); *ibid*, Pune University campus, on rotting wood, 25 Aug. 2018, DM 613; Tamil Nadu, Ooty, Sandhyalare, on rotting hardwood stump, 06 Dec. 2012, JRS (1144, BSD)

**Habitat and distribution:** A common species on all types of woods throughout all the phytographical zones.

**Geographical distribution:** This fungus is distributed throughout south-west Asia and Australasia There is collections at Kew from Australia, India, Java, Malaysia, Papua New Guinea and Sri Lanka.

**India:** Himachal Pradesh, Uttarakhand, Maharashtra, Tamil Nadu.

**Remarks:** The tomentose to strigose abhymenial surface in fully grown specimens, dimitic hyphae, thick-walled, heavily incrusted cystidia and ovoid spores are the principle features of this species. The species is very distinctive due to the reddish-brown hymenophore and the strong violet colour which develops in KOH and ammonia. Indeed this is the only known species of the genus in which the hymenophore stains violet with alkali. The hyphae lack clamp-connexions. More often than not collections of this species prove to be sterile, and there are few descriptions of basidia and spores in the literature.

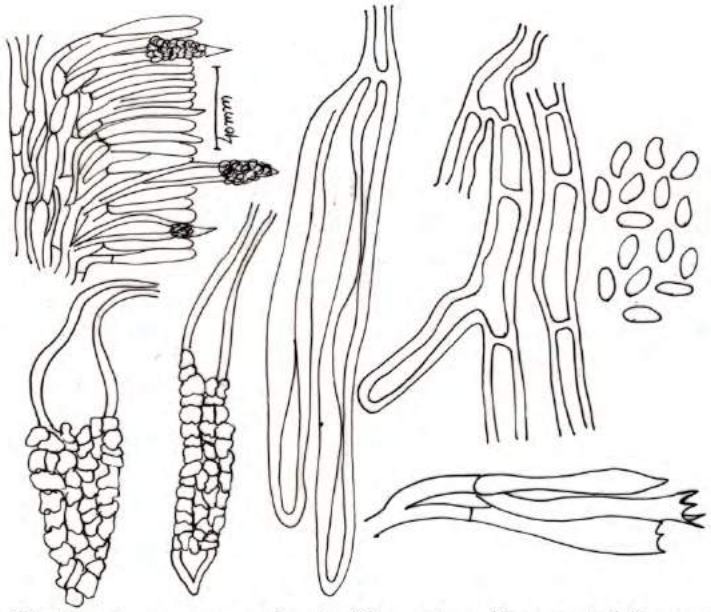

**Fig. 50:** *Hjortstamia papyracea:* a) part of hymenium, b) encrusted & smooth cystidia, c) generative hyphae, d) basidia, e) spores.

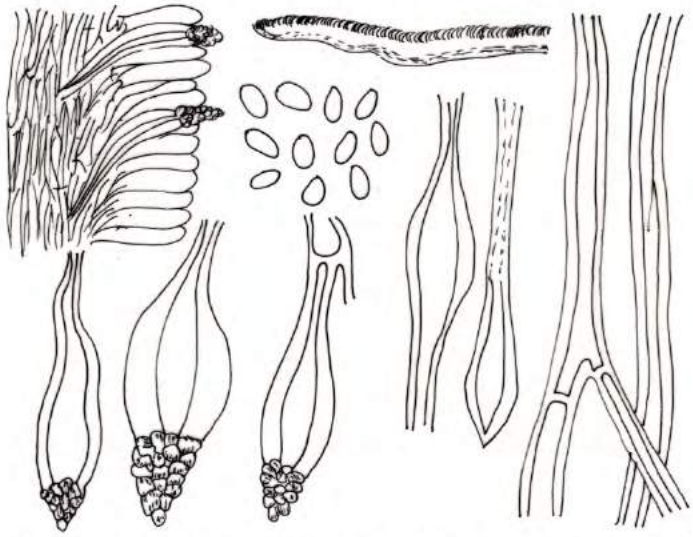

**Fig. 51:** *Hjortstamia papyrina:* a) section of basidiocarp, b) part of hymenium, c) cystidia, d) spores, e) generation hyphae.

**Hjortstamia papyrina** (Mont.) Boidin & Gilles

Bull. Soc. mycol. Fr. 118(2): 99 (2002); *Stereum papyrinum* Mont., in Sagra, Annls Sci. Nat., Bot., sér. 2 17: 125 (1842); *Lopharia papyrina* (Mont.) Boidin, Bull. *Mens. Soc. linn. Soc. Bot.* Lyon 28(7): 210 (1959).

**Tpye locality:** Cuba. **(Fig. 51)**

Basidiocarps resupinate and widely effused, sometimes reflexed up to 30mm, coriaceous-papery, thin, adnate, up to 250 x 40mm and 600 µm thick, rarely umbonate, sessile; upper surface tomentose, concentrically sulcate zones of erect and appressed tomentum, snuff brown; margin entire, thick; hymenial surface dark brown or snuff brown, smooth, not creviced; context yellowish-brown, composed of loosely woven hyphae.

Hyphal system dimitic, hyphae up to 4 µm wide, branching at wide angles, septate, clamps absent, moderately thick-walled, tinted yellowish brown; skeletal hyphae 4-8µm wide, hyaline or yellowish, solid to thick–walled, unbranched; cystidia abundant to scattered, subfusiform, 30-75 x 8-20 µm, projecting up to 30 µm into the hymenium, thick-walled, heavily incrusted especially in the apical part, light brown, confined to the hymenium; basidia narrowly clavate, thin-walled, 25-35 x 5-4 µm, 4-spored; spores ellipsoid, shortly apiculate, thin-walled, smooth, 5-8(-8.5) x 3-4.5 (-4.7)µm, L= 6.98 µm, W=3.85 µm, Q=1.81 (n=20/2) non-amyloid.

**Specimens examined :** (UK) D. Dun, Kalsi, rotting log of *Shorea robusta,* 25 Aug. 1992, JRS 873; (UK) Rudraprayag, Tharali, branches of dead hardwood tree, 05 Sept. 1993, JRS 355; *ibid,* Chopta, Chamoli, rotting hardwood stump, 04 Sept. 2012, DM 1073.

**Habitat and distribution:** A rather common species on dead and rotting hard wood in temperate forests.

**Geographical distribution:** Neotripics, in the lowlands, and in Florida, U.S.A., Costa Rica, Panama, Cuba, Windward Islands, Suriname, Boidin and Gilles (2002) report this species from Argentina on *Pinus*.

**India:** Uttarakhand

**Remarks :** Widely effused and broadly reflexed fruitbodies growing on the underside of rotting logs, heavily incrusted cystidia and snuff brown hymenial surface characterise this species. It differs from *L. crassa* in having a more broadly reflexed and concentrically sulcate surface, broader and shorter cystidia with comparatively heavier incrustations

**Lopharia** Kalchbr. & MacOwen emend. Cunn.
Trans. Roy. Soc. N.Z. 83: 621. 1956.

Basidiocarps resupinate, effused-reflexed to pileate, orbicular and confluent, greyish brown, leathery; upper surface tomentose to strigose, more or less zonate; hymenium smooth, tuberculate or veined; context light brown, composed of loosely to compactly arranged hyphae; hyphal system dimitic, generative clamps; skeletal hyphae hyaline, abundant in the context and tomentum; hymenial cystidia or apically encrusted skeletocystidia present; basidia narrowly clavate, 4-spored; spores subglobose to ellipsoid, cylindrical to fusiform, thick-walled, hyaline to light brown, inamyloid.

*Lopharia* differs from *Porostereum* in the lighter basidiocarps, hyaline skeletocystidia and larger basidiospores, usually more than 10 µm long, with distinct guttulate content. *Hjortstamia* differs from both *Lopharia* and *Porostereum* in the clampless generative hyphae (Hjorstam & Ryvarden 1990, Boidin & Gilles 2002). *Lopharia* belongs to the Polyporaceae according to molecular data (Larsson 2007).

**Type species:** *Lopharia lirellosa* Kalchbr. & MacOwen (= *L. mirabilis* (Berk. & Br.) Pat.

**Key to Species**

1. Both thin-walled and thick-walled cystidia present; hyphae clamped and branched at acute angles ……..…….***L. rhodocarpa***

1. Only thick-walled cystidia present; hyphae branched at wide angles, clamped …….. ….2

2. Hymenium stratose, irregularly cracked; cystidia coloured; spores upto 8.5 µm long ..……..….***L. cystidiosa***

2. Hymenium not stratose, not cracking; cystidia not coloured; spores upto 12µm long …….……...……..….***L. cinerascens***

**Lopharia cinerascens** (Schw.) Cunn.

*Trans. Roy. Soc*. N.Z. **83**: 622, 1956; *Thelephora cinerascens* Schw., *Trans. Amer. Phil. Soc*. **4:**167,1832.

**Type locality:** New Zealand. **(Fig.52)**

Basidiocarps coriaceous, often resupinate and effused up to 120 x 30mm, sometimes reflexed, reflexed portion 2-10mm; upper surface strigose hairy, brownish grey to greyish black, concentrically sulcate, often laterally confluent; margin thin, loosely adnate, paler, entire; hymenial surface cinnamon to violaceous brown, smooth to somewhat rough with cystidia; context up to 500 µm thick, excluding the hairy covering, sub-hyaline to pale ferruginous, cuticle bearing tomentum on the abhymenial side, hyphae longitiudinally interwoven, thick-walled, developing, zone with numerous cystidia.

Hyphal system dimitic, generative hyphae up to 4 µm wide, with clamps, thin-walled, sub-hyaline, skeletal hyphae up to 5 µm wide, thick-walled, unbranched, brown, tomentum hyphae unbranched, dark brown, thick-walled; cystidia large, subconical to subfusiform, thick-walled, 100-150(200) x 12-20 µm, emerging up to 70 µm beyond hymenial layer, heavily encrusted, often brownish at the base; basidia 12-20 x 4-6 µm, 4-spored; spores (9.8-)10-12 (-13) x 6-7(-7.2) µm, L= 11.89 µm, W= 6.9 µm, Q= 1.72 (n=20/2) white, broadly ellipsoid, smooth, thin-walled, inamyloid.

**Specimens examined:** (JK) Bisaran on coniferous branch, 20 Aug. 1996, JRS 1384; (UK) Madmaheshwar, Rudraprayag rotten coniferous log, 25 Aug. 1997, JRS 5460; (HP) Hattu Peak, Narkanda, on angiospermic branch, 02 Oct. 2018, BSD, DM 566.

**Habitat and distribution:** *Lopharia cinerascens* occurs on coniferous woods. It has been reported on hard woods especially *Ulmus* and *Morus*, from North America (Burt, 1920; Overholts, 1939; Lentz, 1955; Ginns, 1986). It is associated with a white rot (Gilbertson & Lombard 1976). Although relatively unique when all mat and microscopic characters are present.

**Geographical Distribution:** North and South America, Mexico, Cuba, Jamaica, Venezuela, Africa, Asia and Australasia; apparently infrequent in Europe and South America, China.

**India:** Jammu & Kashmir, Uttarakhand, Himachal Pradesh.

**Remarks:** The fully mature specimens of *Lopharia cinerascens* may be recognized in the field by their narrowly reflexed, strigose hairy pilear surface and somewhat pruinose hymenial surface due to large thick-walled cystidia. The cystidia are tinted brown at the base and larger than all other species of *Lopharia.* The spores are broadly ellipsoid and larger.

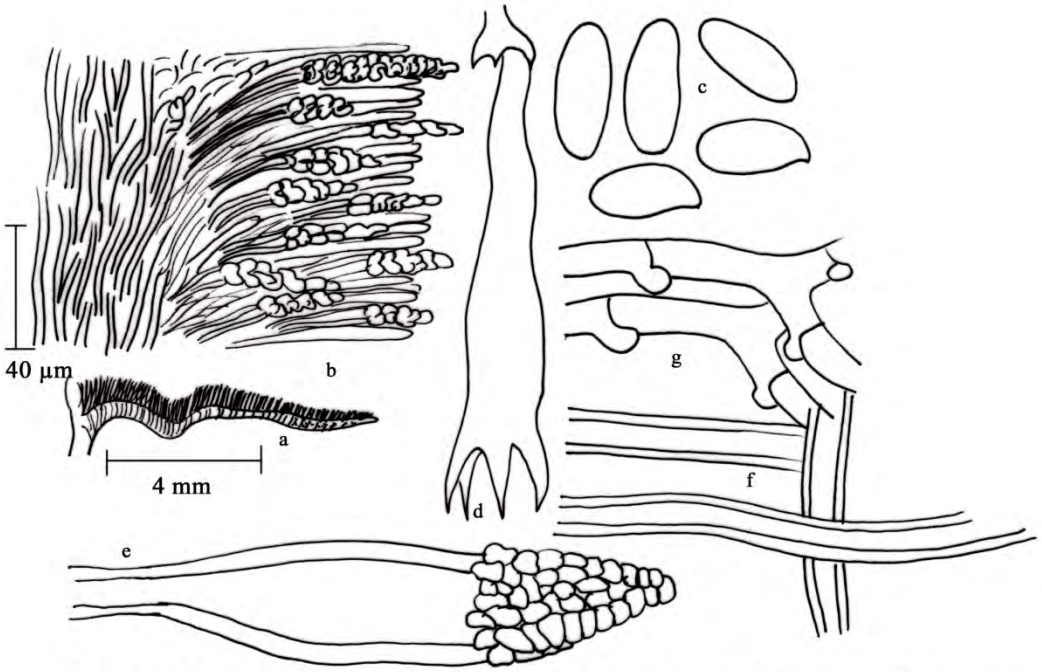


**Fig. 52:** *Lopharia cinerascens:* a) section of basidiocarp, b) part of hymenium, c) spores, d) basidia, e) encrusted cystidia, f) skeletal hyphae, g) generative hyphae.

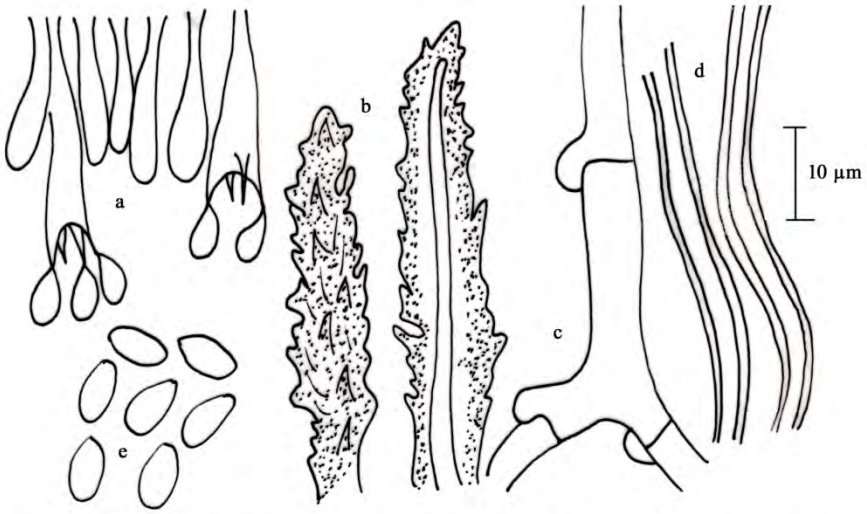


**Fig. 53:** *Lopharia cystidiosa:* a) hymenium showing basidia, & paraphyses, b) generative hyphae, c) skeletal hyphae, d) spores, e) cystidia.

**Lopharia cystidiosa** (Rehill & B.K. Bakshi) Boidin

Revue de Mycologie (Paris) 34 (2-3): 191 (1969); *Peniophora cystidiosa* Rehill & B.K. Bakshi, Forest Bull., Dehra Dunn, n.s. 242: 4 (1965)

**Type locality:** India, Burguri range, S. Raipur Division, Madhya Pradesh. **(Fig. 53)**

Basidiocarps thick, hard and brittle when dry, resupinate, closely adnate, not separable, 20-200 mm long, 15-60 mm. broad and up to 700 µm. thick; hymenial surface brownish white to dark gray - "Bister", "Benzo Brown", "Drab", "Ecru Drab", "Neutral Gray", "Dusky Neutral Gray" - uneven, irregularly cracked; margin thinning out, whitish to pale brown, adnate; context hyaline or subhyaline to yellowish brown, up to 400 µm. thick; composed of a narrow basal layer of compactly arranged longitudinal hyphae and an intermediate layer of loosely arranged ascending and vertical hyphae with scattered cystidia.

Hyphal system dimitic, generative hyphae hyaline to subhyaline, branched and septate, clamp connections present, wall thin or slightly thick, 1.75-5 µm in diameter; skeletal hyphae 4-6 µm wide, hyaline to yellowish, solid to thick-walled, unbranched; hymenium stratose, hymenial layers of different ages in older portions, each hymenial layer to 60 µm deep, of basidia, paraphyses and cystidia; basidia clavate-cylindric, 13-17 x 4-3.4 µm. 4-spored; sterigmata 3.3-5 µm. long and 1.3 µm broad at the base; paraphyses clavate to cylindric, narrower and shorter than the basidia; cystidia abundant, present both in the context and hymenium, yellowish brown to light brown, colour residing in the walls, broadly fusiform or long cylindric with conical or acute apices, thick-walled with very narrow and uniform lumen, heavily incrusted usually throughout the whole length, sometimes only at the upper portion, cystidia in the hymenial region are smaller(30-36.3 x 6.6-8.3 µm) than those of the intermediate region (60-130 x 10-13 µm), embedded or projecting up to 45 µm beyond the hymenium; spores hyaline, oval to elliptical, apiculate, thin-walled, smooth, (6.5-) 6.6-8.0(-9.2) x 4.5-5.8µm, L= 8.50 µm, W=5.30 µm, Q=1.60 (n=20/2).

**Specimens examined : (**UK) Dehradun, FRI campus, bark of dead standing *Shorea* spp., 23 Aug. 2008, JRS (8064, BSD); *ibid.* Rishikesh, on stump of *Shorea robusta*, 18 Aug. 2012, DM 333; Maharashtra, Pune University campus, on rotting wood, 10 June 2013, JRS (12114, BSD)

**Habitat and distribution**: On dead thin branches of hardwoods; causing a white rot of wood; a rare species in the subtropical Himalayan forests.

**Geographical distribution:** India

**India:** Madhya Pradesh, Uttarakhand, Maharashtra

**Remarks :** *P. cystidiosa* is differentiated by the irregularly cracked, brownish-white to dark gray hymenial surface, coloured cystidia and nodose-septate hyphae. The fungus closely resembles *Lophoria crassa* (Lev.) Boidin but differs from it in having nodose-septate hyphae.

**Lopharia rhodocarpa** (Rehill & Bakshi) Rattan

Resup. Aphyllo. N.W. Him. p. 172, 1977; *Peniophora rhodocarpa* Rehill & Bakshi, Ind. For. Bull. **242**: 6, 1965.

**Type locality:** Dehra Dun, Uttarakhand. **(Fig. 54)**

Basidiocarps resupinate, membranous to membranous - ceraceous widely effused, up to 300 µm thick; hymenial surface pinkish brown, fading with age and on drying, smooth to finely tuberculate, not creviced; margin thinning, adnate, concolorous; context light brown, bounded on the abhymenial side with a thick-brown cuticle carrying tomentum, composed of basal zone of repent hyphae and semierect hyphae in the upper zone.

Hyphal system dimitic, hyphae branched, up to 4 µm wide, clamped, thin to slightly thick-walled, subhyaline to light brown; skeletal hyphae 3-5µm wide, thick walled, hyaline, unbranched, straight or sinuous; cystidia of two types: thin-walled cystidia 50-90 x 6-10 µm, clavate to cylindrical, hyaline to sometimes tinted in the basal part, projecting up to 10 µm into the hymenium, smooth or rarely with a fine coating at the apex; thick-walled cystidia 50-110 x 10-15 µm, fusiform to cylindrical, heavily impregnated with sub-hyaline crystals covering at least the upper two-third part, rarely projecting into the hymenium; basidia 20-25x3-5.5 µm, cylindrical, 4-spored; spores suballantoid, (4.9-) 5-8.5 (8.7) x 2 -2.5µm, L=7.5µm, W=2.3 µm, Q=3.16 (n=20/2) minutely apiculate, thin-walled, hyaline, smooth, in-amyloid.

**Specimens examined:** (UK) Dehradun on dead twigs of *Castanea sativa* (K) 6569; (HP) Kullu, Patlikool, rotting hardwood branch, 10 Sept. 2004, JRS 12609; *ibid,* Chamba, rotting hardwood log, 04 Sept. 2014, DM 2062.

**Habitat and distribution:** Common on thin and dead twigs of hard woods in temperate forests.

**Geographical distribution:** India

**India:** Uttarakhand, Himachal Pradesh.

**Remarks:** *P. rhodocarpa* belongs to the "cinerea" group. The fungus can be identified from the light pink colour of the hymenial surface presence of thick cuticle on the abhymenial surface, and the presence of two types of cystidia. The cystidial character also distinguishes *P. rhodocarpa* from other members of this group.

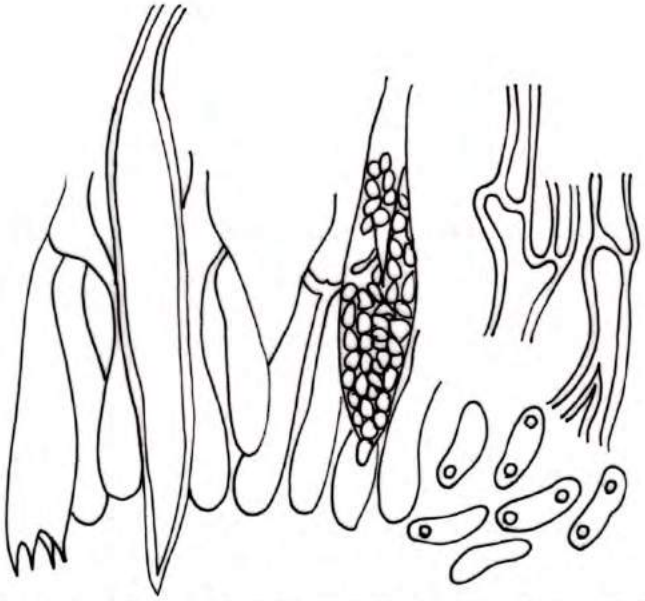

**Fig. 54:** *Lopharia rhodocarpa:* a) hymenium showing a basdium, paraphyses and two types of cystidia, b) generative hyphae, c) spores.

**Podoscypha** Pat.
Essai taxon. sur les familes et les genres des
Hymenomycetes 70-71, 1900.

Basidiocarps small, often very thin and translucent, spathulate or flabellate to infundibuliform, laterally confluent and often forming rosette-like fruitbodies; upper surface glabrous to tomentose, brown to golden brown, concentrically zonate; hymenial surface smooth, cream, bay coloured to dark smoky grey-brown; context thin; margin entire to fimbriate or laciniate; hyphae dimitic, generative hyphae with clamp connections, skeletal hyphae thick-walled to almost solid; clamp connections absent in the hyphae of tomentum; caulocystidia, pilocystidia and metuloids usually present; gloeocystidia always present; basidia 2-4 spored; spores smooth, inamyloid, subcylindrical to broadly ellipsoid; lignicolous or terrestrial.

The genus is mainly recognised by its thin, translucent basidiocarps, smooth hymenophore, frequent presence of cystidial organs and small ellipsoid to subcylindrical spores. The knife-edged crests present on the pilear surface of *Cymatoderma* are absent in this genus. Further, in tomentose species, the hyphae of tomentum do not bear clamp connections as found in *Cymatoderma.*

**Type species:** *Stereum surinamense* Lev.

**Key to species**

1. Surface of pileus lacking all trace of hairs; pilocystidia or pilogloeocystidia; basidicarps truely infundibuliform ……..……..……..……**2**

1. Surface of pileus covered with undifferentiated hairs or bearing well differentiated pilocystidia; basidiocarps flabellate or spathulate ……**3**

2. Pilear surface dirty white with concentric zones; hymenophore grayish brown with blackish zones towards the margin ……...….***P. nitidula***

2. Pilear surface bay to tobacco brown, concolorous without any zonations; hymenophore pallid to ochraceous……..……..***P. elegans***

3. Basidiocarps rather thick, opaque; pileus narrows down to a very short, broad flattened, stipe-like portion; hymenium decurrent, ochraceous cream; pilear surface radiately wrinkled ……...……...***P. glabrescens***

3. Basidiocarps not with above characters ……4

4. Basidiocarps thicker, not diaphanous; lacking a conspicuous basal mycelial disc; caulocystidia thin-walled ……***P. petalodes***

4. Basidiocarps thin, more or less diaphanous; conspicuous mycelial disc present; stipe expanding above into a small cuneate or ligulate pileus; caulocystidia with strongly thickened walls ……**5**

5. Margin of basidiocarps not conspicuously fringed; stipe 5-45mm long..... ……..…..…. ***P. venustula*** s.sp. ***cuneata***

5. Margin of basidiocarps very deeply lacinate giving pileus a raagged fringed appearance; stipe 5-10 mm long……..***P. venustula s.sp. cuneata*** var. ***malabarensis***

**Podoscypha elegans** (Meyer) Pat.

Essai Tax. Hyménomyc. (Lons-le-Saunier): 71 (1900); *Thelephora elegans* Meyer (Fl. Esseq. 305, 1818) ex Fr., Syst. Myc. s : 430. 1821; *Stereum elegans* (Meyer) Fries. Epicr. Syst. Mycol sou Syn. Hym, 545, 1838; *Stereum sowerbeii* Berk. Fi. N.Z., 2 : 182. 1855; *Stereum floriforme* Bres., ex Lloyd., Syn. Stipitate *Stereum*, 24, 1913; Bres. Ann. Myc. 18 : 44, 1920; *Stereum incisum* Lloyd, Myc. Notes, No. 64: 988, 1920; *Stereum bombycinum* Lloyd., Myc. Notes., No. 64: 1336, 1925

**Type locality:** India **(Fig. 55)**

Basidiocarps coriaceous, gregarious or caespitose; pilei flabelliform, rosetted, infundibuliform or split on one side to the stem apices, stems usually discrete with confluent apices, 20-80mm long and 15-40mm wide; pileus surface glabrous, bay brown to tobacco brown, concolorous or with darker zones oriented laterally, radiately plicate; hymenial surface pallid, ochraceous or gray, irregularly fluted; margin thinning out, concolorous, crenate, lobed or incised; stem up to 25mm long and up to 5mm thick, arising from a mycelial pad, usually single, sometimes fused, finely velutinate, concolorous; context brownish, up to 500 µm thick, composed of a layer of parallely arranged compact hyphae with yellow cortex on the upper side.

Hyphal system dimitic; generative hyphae hyaline, branched, septate with clamp connections, thin-walled, 2.5-3.5 µm thick; skeletal hyphae hyaline, non-septate, sparsely branched, thick-walled with very narrow lumen, 2.5-3.15 µm thick, hymenial layer to 120 µm deep, a dense palisade of basidia, paraphyses and gleocystidia; basidia subclavate 25-35 x 3.5-5 µm, 4-spored; sterigmata slender, straight, up to 6 µm long. Paraphyses subclavate to subcylindric, shorter and narrower than the basidia; gleocystidia arising in the subhymenium and traversing the hymenium but not projecting, flexuous, cylindrical or sub-ventricose, up to 110 x 7 µm; spores hyaline, broadly elliptical or oval, apiculate, thin-walled, smooth, (4.5-) 4.6-6.1(-6.3) x 2.3- 3.8µm, L=5.85µm, W= 3.50µm, Q=1.67 (n=20/2).

**Specimens examined:** (UK), Dehradun, Lacchiwala forest, base of rotting *Shorea robusta* stump, 13 Oct. 1995, JRS (3078, BSD); *ibid,* Forest Research Institute, rotting stump bases of bamboos, 16 July, 1988, JRS (851, CAL); Dehradun, on way to Survey of India, base of rotting *Mangifera* stump, 28 Aug. 2010, DM 82.

**Habitat and distribution:** On dead branches buried in the humus on the forest floor.

**Geographical distribution:** America, West Indies, Australia, Tasmania, New Zealand, China, Cuba, Colombia, Brazil, Burma, Japan, Madagascar, Nigeria, Panama, Philippine Islands, Porto Rico, Sudan, Tasmania, Uganda, United states, Venezuela.

**India:** Uttarakhand.

**Remarks:** *Podoscypha elegans* can easily be recognised by its habitat, gregarious or caespitose appearance, confluent pilei, and with abundant gleocystidia and broadly ellipsoid or oval spores. The species is very close to *Stereum affine* Lev. differing in pilcus shape, habitat and slightly larger spores. *Podoscypha crenatum* Lev. also grows from buried wood but has no gleocystidia and clamp connections.

**Podoscypha glabrescens** (Berk. & Curt.) Boidin

Rev. Mycol. Paris **24**: 210-211, 1959; *Stereum glabrescens* Berk. & Curt. J. Linn. Soc. **10**: 330, 1869.

**Type locality**: Cuba. **(Fig. 57)**

Basidiocarps 15-25 mm high, 10-30 mm wide, spathulate to flabellate, narrowed to a short, flattened stipe-like base; pileus dark chestnut brown, zonate with darker and paler zones, glabrous, covered with pruina near the stipe, minutely radiately wrinkled, sometimes spiculose towards the base; hymenial surface smooth, pale ochraceous cream; brownish and finally grey

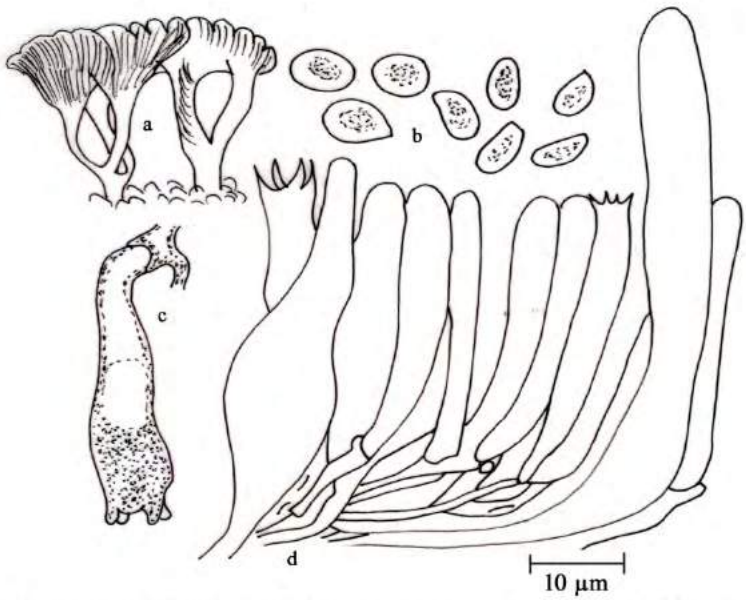


**Fig. 57:** *Podoscypha nitidula:* a) basidiocarp, b) spores, c) basidium, d) hymenium with gloeocystidia.

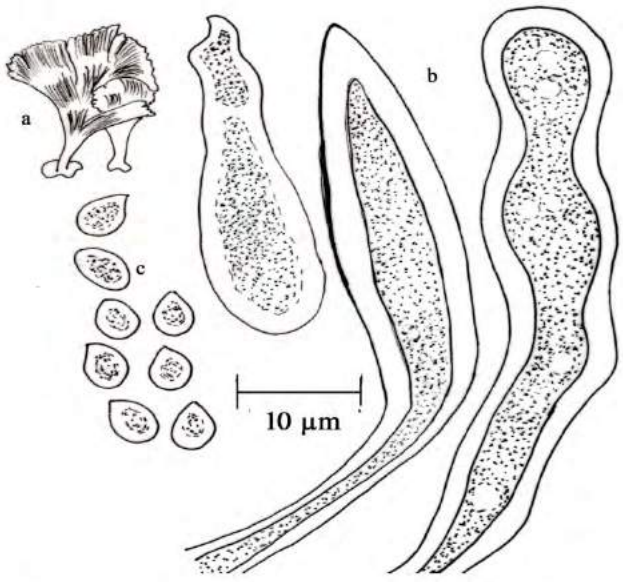


**Fig. 58:** *Podoscypha petalodes:* a) basidiocarp, b) pileocystidia, c) spores.

towards the stipe, extending into stipe for some distance; stipe very short and flattened to rudimentary, without any distinct cuticle; hymenium thickening, up to 70 µm thick.

Hyphal system dimitic, generative hyphae 2-4 µm wide, thin-walled, hyaline, branched freely, septate with clamp connections, skeletal hyphae 3-5 µm wide, thick-walled to almost solid; pilocystidia well defined, 70-90 x 7-10µm, cylindrical to clavate with rounded apices; caulocystidia larger, 100-140 x 7-15 µm, deep seated, arising in the trama and grow out in right angles; hymenial cystidia absent; gloeocystidia abundant, as long, thin-walled, undulating bodies, tapering towards an obtuse or pointed apex; basidia not seen; spores (3.50)3.75-4.75(-4.6) x 2.5-3.5µm, L= 4.5µm, W= 3.2 µm, Q= 1.40 (n=20/2) thin-walled, hyaline, uniguttulate, oval to broadly ellipsoid, inamyloid.

**Specimens examined:** Meghalaya, Shella, Garo hills, on fallen hardwood trunk, 5 Sept. 1986, CAL 513; (AP), Manmao, Tirup rotting hardwood log, 20 Sept. 1988, JRS (CAL 1262); (UK), Chamoli, Chopta, dead branch of Oak, 07 Aug 2017, DM 3078; (HP), Way to Chamba distt. Near road side on twigs of tree, 29 Sept 2014, DM 2066.

**Habitat and distribution:** on deadwood, spreaded from Eastern to Westen Himalayan

**Geographical distribution:** Cuba, Ecuador, Jamaica, Java, Panama, South Africa.

**India:** Meghalaya, Arunachal Pradesh, Uttarakhand, Himachal Pradesh

**Remarks:** The thick flabelliform or spathulate fruitbodies with short, flattened stipe-like base, decurrent hymenium, radiately wrinkled pilear surface are the important features of this species.

**Podoscypha nitidula** (Berk.) Pat.

Enum. Method. Champ. recue. Guad. & Mart. 21, 1903; *Stereum nitidulum* Berk., Hook. J. Bot. Lond. **2**: 638, 1843.

**Type locality:** Brazil. **(Fig. 57)**

Basidiocarps 12-50 mm high, 7-15 mm wide, usually truely infundibuliform, rarely flabellate, discrete or some fruitbodies may fuse laterally; pileus dirty white, dark brown on drying, with concentric zones of lighter or darker shade, surface glabrous, having waxy or a translucent appearance; hymenial surface smooth, pale cream to greyish brown, blackish zones towards the margin; stipe well developed, 15-20 mm long, 1-2 mm wide, brownish, glabrous, mycelium at the base prominent.

Hyphal system dimitic, generative hyphae 2-4 µm wide, thin-walled, hyaline, branched, clamps present; skeletal hyphae 3-5 µm wide, thick-walled to solid, cuticle absent; pilocystidia and caulocystidia absent; hymenial cystidia absent; gloeocystidia long undulating, thin-walled, of unlimited growth, up to 150 µm long; basidia 4-spored, clavate, 8-15µm wide; spores (3.3-)3.5-

5.5 (-5.6) x 3-4µm, L= 5.2µm, W= 3.8 µm, Q=1.37 (n=20/2) oval to broadly ellipsoid, inamyloid, smooth.

**Specimens examined :** (WB) Howrah, IBG, rotting log of *Polyalthia,* 10 Sept. 1984, JRS CAL 514; (AP) E. Siang, Mebo, rotting log of hardwood, 10 Oct. 1988, CAL 835; (UK), way to Uttarkashi, rotting hardwood branch, 22 Sept. 2012, DM 1024.

**Habitat and distribution:** Usually terrestrial, although seemingly growing from buried wood; very occasionally growing on trunks.

**Geographical distribution:** This species is found only in the Neotropics, Mexico, South America, Africa, Australia, China, Madagascar, Martinique, Samoa, Tasmania.

**India:** West Bengal , Arunachal Pradesh, Uttarakhand, Himachal Pradesh

**Remarks :** The terrestrial and infundibuliform stipitate fruitbodies, zonate and light coloured upper surface and lack of any cystidial element recognise this species.

**Podoscypha petalodes** (Berk.) Pat.

Enum. Method. Champ. recue. Guad. & Mart. 20, 1903; *Stereum petalodes* Berk., Ann. Mag. nat. Hist. Series **9**: 198, 1852.

**Type locality:** Cuba **(Fig. 58)**

Basidiocarps 20-70 mm high, 8-25 mm wide, spathulate or flabellate, edges of pilei frequently curl inward and fuse to form pseudoinfundibuliform fruitbodies, usually gregarious, confluent; pileus light to pinkish brown, becoming purplish to chestnut brown on drying, with concentric zones; hymenial surface ochraceous to greyish brown, covered with an ashy priuna; stipe short to well developed, surface hispid due to the presence of caulocystidia; hymenium thickening, up to 180µm thick.

Hyphal system dimitic, generative hyphae 2.5-4.5 µm wide, thin-walled, septate, with clamp-connections, skeletal hyphae 3-6 µm wide, thick-walled to solid, unbranched; pilocystidia subcylindric to clavate, thick-walled, 6-15 µm wide; caulocystidia deep rooted, thick-walled, protruding up to 130 µm, subcylindrical to clavate; hymenial cystidia absent; gloeocystidia abundant, elongated, thin-walled, subcylindrical to subventricose, traversing the entire width of the hymenium; basidia clavate, 4-spored; spores (3.5-) 3.75-5 (-4.9) x 2.5-3.75 (-4)µm, L= 4.90 µm, W= 3.5 µm, Q= 1.4 (n=20/2) thin-walled, hyaline, uniguttulate, oval to broadly ellipsoid.

**Specimens examined :** (WB) Sunderbans, rotting log of hardwood, 28 Sept. 20, 1984, JRS CAL 428; (AP) E. Siang, Dambuck, rotting stump of hardwood, 20 Sept. 1988, JRS CAL 836; (HP), Kalatope, Chamba, branches of dead hardwood tree, 15 Sept. 2014, DM 2057.

**Habitat & Distribution:** Usually on logs or dead wood, but occasionally on the ground and then probably arising from buried wood. This taxon occurs most frequently in tropical America but it may also prove to be widespread in the Pacific Islands.

**Geographical distribution:** America, Australasia, Bolivia, Brazil, Martinique.

**India:** West Bengal, Aruanchal Pradesh, Himachal Pradesh

**Remarks :** The spathulate, flabellate fruitbodies without a basal mycelial disc, presence of abundant thick-walled caulocystidia and pilocystidia predominantly differentiate this species.

**Podoscypha venustula** (Speg.) Reid s sp. ***cuneata*** Reid

Monogr. Stip. Stereoid Fungi p. **264**, 1965; *Thelephora venustula* Speg. An. Soc. Cient argent **19**: 36, 1885; *Podoscypha venustula* (Speg.) Reid, Monogr. Stip. Stereoid Fungi p. 260, 1965; *Stereum affine* Lev., Ann. Sci. Nat. Series III, **2**: 210, 1844; *Stereum crenatum* Lev., Ann. Sci. Nat. Series III, **2**: 210, 1844.

**Type locality:** Tembeling Estate, Pahang., Malaysia **(Fig. 59)**

Basidiocarps 10-60 mm high, 5-20 mm wide, discrete with an elongated stipe which expands into a small narrow cuneate or ligulate or rarely even a flabellate pileus, sometimes confluent; pileus diaphanous when fresh, pinkish-fawn to ochraceous fawn to orange brown, dark reddish to purplish chestnut on drying, with darker concentric zones, very thin and translucent with a silky sheen in herbarium specimens, minutely wrinkled; hymenial surface pinkish-buff or pinkish fawn, covered with ashy grey pruina; stipe 5-45 mm long, elongated and attached to the substrate by a basal disc of mycelium, yellowish- flesh coloured to orange brown on drying, tomentose to hispid due to the presence of caulocystidia; without distinct cuticle; hymenium thickening, up to 60 µm thick.

Hyphal system dimitic, generative hyphae 2-4.5 µm wide, thin- walled, freely branched, septate with clamp connections, skeletal hyphae thick-walled to solid, 2-5µm wide, unbranched; pilocystidia up to 170 µm long and 6-12µm wide, cylindrical to clavate with rounded apices, thin to thick-walled; caulocystidia numerous, reaching up to 300 µm long, 12-15 µm wide, deep seated, contents brownish, thick-walled, secondary septa present; cystidia absent; gloeocystidia elongated, subcylindrical, apex obtuse, contents retractive; gloeocystidia present as elongated subcylindrical, thin-walled organs with somewhat inflated bases, but narrowing gradually toward the obtuse apex, and having highly refractive contents; gloeocystidia have the potential of unlimited growth and those that are formed first arise in the context just above the hymenium and may traverse the entire width of this zone, some, however, cease to grow and become buried, but they are replaced by others which arise at any level in the thickened hymenium; basidia

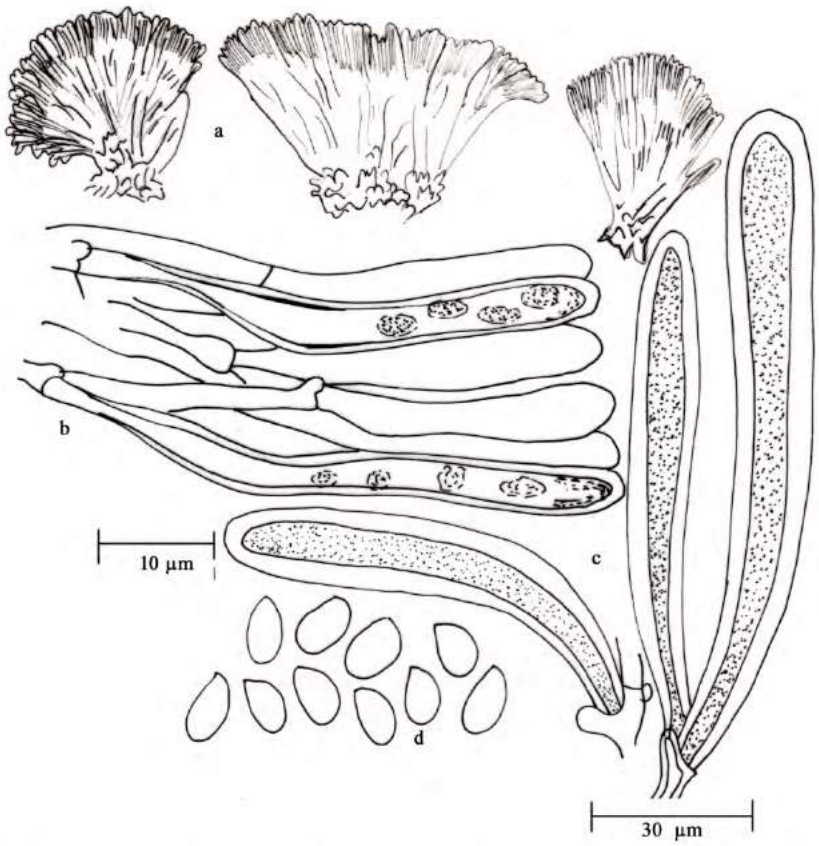


**Fig. 59:** *Podoscypha venustula* s.sp. *cuneata:* a) basidiocarp, b) part of hymenium, c) caulocystidia, d) spores.

clavate, 20-35 x 4-5 µm, 4-spored; spores (3.9-) 4-5.5(-5.7) x 3-3.5 (3.6)µm, L= 5.25 µm, W=3.2 µm, Q=1.64 (n=20/2), thin-walled, hyaline, broadly ellipsoid.

**Specimens examined :** (UK) D. Dun, FRI, on dead branch in humus, DD 7014; *ibid,* D. Dun, Rajaji National Park, rotting hardwood branches, 20 Aug. 2002, JRS 9026; *ibid,* Corbett National Park, rotting log of *Shorea robusta*, 22 Aug. 2012, DM 167; (WB**)** Howrah, Indian Botanic Garden, on living trunk of *Schleichera oleosa,* 14 June 1987, JRS (678, CAL); *ibid,*, base of a living hardwood tree, 09 Aug. 1986, JRS (415, BSD); Jharkhand, Sahibganj, Beindaban, on dead wood, 14 Sept. 2009 Manoj Hembroeum, (1369, BSD).

**Habitat & Distribution:** On fallen twigs, branches and rotten trunks. This taxon occurs in Africa, Asia and Australasia, but seems to be most abundant in the Pacific area.

**Geographical distribution:** Africa: West Africa, Nigeria, Annam, Bolivia, Cameroon, Congo Asia: Boninislands, Ceylon, Cocos Island, Java, Malaya, Thialand, Madagascar, Phillipine, Symatra, Malaysia; Australasia: NewZealand.

**India:** Uttarakhand, West Bengal

**Remarks :** This taxon is remarkable in having an elongated stipe expanding into a narrowly ligulate or cuneate pileus. Microscopically, it resembles the typical variety except the larger spores. The collection no. (7014 DD) described under *Stereum elegans* (Meyer) Fr. by Rehill & Bakshi (1966) belongs to this taxon.

**Podoscypha venustula** s. sp. **cuneata** Reid **f. malabarensis** (Lloyd) Reid

Beih. Nova Hedwigia 18: 272 (1965); *Stereum malabarense* Lloyd, Mycol. Writ. 4: 39 (1913).

**Type locality:** Malabar, Bababoodun Hills, India

Basidiocarps 27-55mm high, 15-40mm wide, consisting of a cuneate or flabelliform pileus narrowed behind into a short but distinct stipe, and with adjacent fruitbodies often becoming laterally confluent; pileus of herbarium material translucent, and mostly uniform orange-brown in colour, although rarely with a few indistinct concentric zones; margin very conspicuously and deeply laciniate giving it a ragged fringed appearance; hymenial surface owing to the extremely thin, translucent nature of this fungus the lower surface is usually concolorous with the remainder of the pileus, have a slightly greyer tint; stipe 5-10 mm high, 1.0-1.5 mm wide, brown, appearing minutely tomentose-hispid under a lens.

Hyphal structure, pilo- and caulocystidia, hymenium, gloeocystidia and basidia as in *P. venustula* s. sp. *cuneata*; spores: (3.2-) 3.5-4.2(-5) x (2.2-) 2.5-3.2(-3.75) µm, L= 3.95 µm, W= 2.95 µm, q=1.33 (20/2) varying in shape from ovate to broadly elliptical, but scanty.

**Habitat & Distribution:** probably on fallen wood, distributed in Western Ghats.

**Geographical distribution:** India

**India:** Maharashtra

**Remarks:** The type collection of this taxon consists of about 30 basidiocarps which are remarkably uniform in appearance. However, despite an examination of numerous fruitbodies, spores would seem to be very scanty. This suggests that the material may have been preserved in spirit at some time and that most of the spores have been washed off the hymenium. This scarcity of spores makes it difficult to classify the taxon but it seems to be most closely allied to *P. venustula* s.sp.*cuneata.* Nevertheless it differs from the latter in its shorter stipe, its thinner translucent pileus and its conspicuously laciniately-fringed margin. It is clear, therefore, that further material is required for study before a satisfactory decision can be taken on the true status of this taxon.

The collection from Sarawak has been referred to this taxon with some doubt since, although it is remarkably similar to the type material in its macroscopic features, it has slightly smaller spores which are more narrowly elliptical and measure 3.2-4.75 (-6)x 2.0-2.75 (-3.2) µm. there are also a number of other minor differences involving (1) the suface of the pileus which appers minutely but densely radiately wrinkled, especially when seen under a lens, and in places these wrinkles may simulate spiculose processes (2) the pileus which narrows behind into a less well defined and rather flattened stipe and (3) the presence of more numerous pilocystidia especially toward the stipe.

*The author was not able to procure or collect the material from herbaria or field. The above description is based on Reid (1965).

**Stereopsis** Reid
Monogr. Stip. Stereoid Fungi p. 290, 1965

Basidiocarps large, coriaceous, pleuropodial, ligulate, spathulate, flabellate, pseudo to truly infundibuliform, discrete or may become confluent and sometimes forming small rosettes; upper surface glabrous, without any distinct cuticle; radiately rugulose in dried specimens; hymenium smooth to faintly radially rugulose, thickening; hyphal system monomitic, generative hyphae septate, with or without clamp connections; cystidia absent; gloeocystidia present or absent; basidia 2-4 spored, clavate; spores smooth, hyaline, nonamyloid, broadly elliptical to subglobose, often with a prominent lateral apiculus; lignicolous or terrestrial.

**Type species:** *Stereum radicans* Berk.

The genus is mainly separated on the basis of monomitic hyphae, defined gloeocystidia and absence of a distinct cuticle on the pilear surface. *Stereopsis* is closely related to *Cotylidia*, but it differs in the absence of cystidia. The phylogenetical relationships remain still unclear (Larsson 2007).

**Key to species**

1. Clamp connections absent; hymenial surface violet grey; spores 3.5-4.5 x 2.5-3µm; gloeocystidia absent ……..…..……***S. sparassoides***

1. Clamp connections present; hymental surface not as above; spores larger; gloeocystidia present or absent ……2

2. Gloeocystidia present; hymenial surface straw-coloured; spores 5.5-6.5 x 3.5-4.5µm ……...…..……***S. mussooriensis***

2. Gloeocystidia absent; hymenial surface greyish brown; spores 6-7.5 x 5-6.5µm ...***S. dimiticum***

**Stereopsis dimiticum** (Rehill & Bakshi) Sharma.

Aphyllophorales of Himalya, BSI New Delhi: 328, 2012; *Stereum dimiticum* Rehill & Bakshi, Ind. For. Bull. n.s. **250**: 8, 1966.

**Type locality:** India, Uttarakhand, FRI Dehra Dun, on bamboo stilt-roots. **(Fig. 60)**

Basidiocarps solitary, sometimes gregarious to subcaespitose, coriaceous; pileus flabellate to spathulate or pseudoinfundibuliform with a slit on one side, 30-90 x 3-40 mm, white at first, then pale cream, brownish white or pale ochraceous with faint darker zones, glabrous, radiately sulcate, sometimes plicate; margin light coloured, acute, entire or wavy, sometimes lacerated; hymenial surface greyish brown, smooth or thrown into undulating radial folds, waxy; stipe 5-25 mm long, 2-3 mm thick, usually discrete, sometimes coalesced, concolorous with the pilear surface hymenium with layers of different ages, each layer up to 40µm deep; context up to 1 mm thick, subhyaline, composed of compact layer of parallel hyphae.

Hyphal system monomitic, generative hyphae branched, 2-3.5 µm wide, with clamp connections at the septa, generative hyphae frequently produce very long, unbranched, aseptate segments which may become thick-walled and these can easily be mistaken for skeletal hyphae unless traced throughout their length when they pass into normal thin-walled clamped hyphae at either end; cystidia and gloeocystidia absent; basidia narrowly clavate, 25-40 x 5.5-9µm, 2-4 spored, sterigmata slender, 7-15µm long; spores hyaline, subglobose to globose, 6-7.5 (-8) x (4.8-) 5-6.5 (-6.6)µm, L= 6.7 µm, W= 5.80 µm, Q=1.12 (n=20/2) thin-walled, inamyloid.

**Specimens examined:** (UK), Dehradun, on bamboo roots, DD 7253 (type); *ibid,* Nainital, Kaladungi Road, rotting culms of *Saccharum,* 25 Sept. 2002, JRS 9066; ibid, Dehradun, Raipur, on rotting hardwood log, 22 Aug. 2009, DM 112; (HP) Near Renuka lake, base of living trunk, 26 Oct.2018, DM 505; (WB) Kolkata, BSI campus, on twigs, 16 March 2011, DM 172.

**Habitat & Distribution:** A common species growing in tropical to sub tropical zones throughtout the country.

**Geographical distribution:** India

**India:** Uttarakhand, Himachal Pradesh, West Bengal.

**Remarks :** This species was reported as *Stereum dimiticum* by Rehill and Bakshi (1966), [type : 7253] on bamboo roots. It was characterized by its flabelliform to spathulate pilei, glabrous and discrete stipe, brownish white pileus surface and greyish brown hymenial surface. On the careful examination of the type [DD. 7253], I found the hyphal system to be monomitic and not dimitic as reported earlier. The generative hyphae frequently produce very long, unbranched, aseptate segments which may become thick-walled and look like skeletal hyphae. These segments if traced throughout their length can be seen to pass into normal thin-walled clamped hyphae at both the ends. These intercalary segments may sometimes be confused for skeletal hyphae. On the basis of monomitic hyphae and stipitate fruitbodies, the species belongs to *Stereopsis.*

**Stereopsis mussooriensis** (P. Henn.) Reid

Monogr. Stip. Stereoid Fungi p. 311, 1965; *Cladoderris mussooriensis* P. Henn., Hedwigia **40**: 324, 1901.

**Type locality:** India **(Fig. 61)**

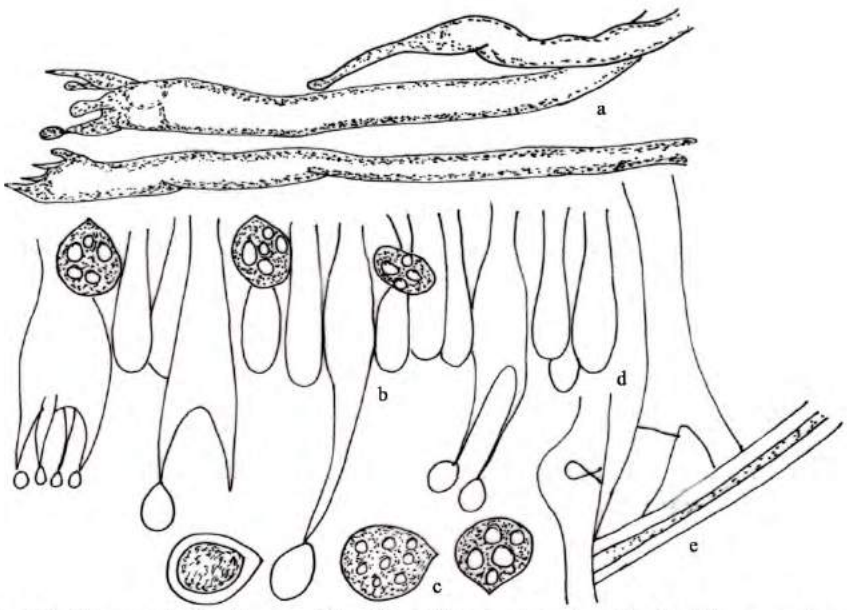


**Fig. 60:** *Stereopsis dimiticum:* a) basidia, b) hymenium showing basidia, paraphyses, c) spores, d) generative hyphae, e) skeletal hyphae.

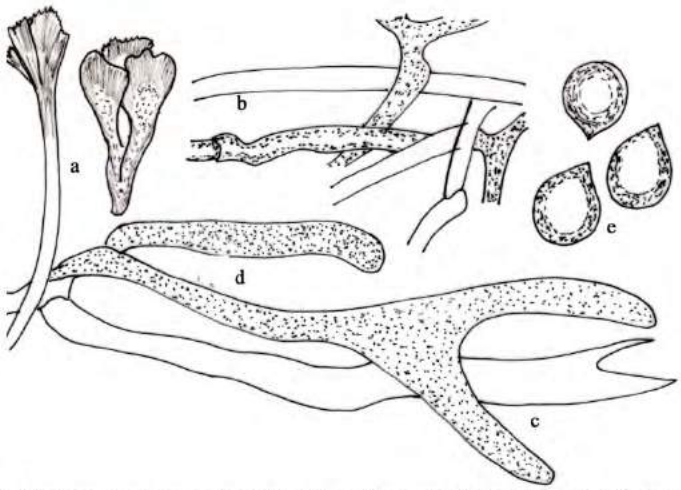


**Fig. 61:** *Stereopsis mussooriensis:* a) basidiocarp, b) hyphae, c) gloeocystidium d) basidium, e) spores.

Basidiocarps annual, lignicolous, substipitate, 30-40 mm long, 50-65 mm broad and 2-4 mm thick, subflabellate, attenuated towards the base and often more or less stipitate, occurring in imbricate, subcaespitose groups; pileus thin, coriaceous, sulcate, velutinate; margin entire; hymenial surface straw-coloured, rugulose, smooth, shiny, even, radiating; context 2-3µm thick, homogeneous, chalky when dry, composed of loosely woven hyphae, cuticle absent.

Hyphal system monomitic, hyphae thin-walled, branched, septate, clamped, 4-6µm wide; hymenium thickening; cystidia none; gloeocystidia present, cylindrical with obtuse tips, 120-130 x 5-7µm, sometimes with light orange granular contents, immersed or projecting slightly out of the hymenium; basidia, 30-40 x 6.5-7.5µm, hyaline, clavate, 2-4 spored; sterigmata 6-7µm long; spores 5.5-6.5 x 3.5-4.5µm, L= 6.3µm, W= 4.2 µm, Q=1.5, (n=20/2) broadly ellipsoid to ovoid, smooth, pale straw-coloured, shortly apiculate, uniguttate, inamyloid.

**Specimens examined:** (UK) Mussoorie, on decaying twigs, 12 Sept. 2006, JRS 874; Udhamsingh Nagar, Corbett NP, rotting hardwood log, 07 July 2011, DM 287**;** (HP) Kangra, Dharamsala, rotting wood, 16 Sept. 2011, JRS 5194;

**Habitat & Distribution:** On soil or on decaying twigs embedded in the soil, growing mostly in caespitose clusters, and forming small rosettes.

**Geographical distribution:** India

**India:** Uttarakhand**,** Himachal Pradesh

**Remarks:** The presence of clamp connections, gloeocystidia, light coloured hymenial surface and larger spores make this species easily distinguishable.

**Stereopsis sparassoides** (P. Henn.) Reid

Monogr. Stip. Stereoid Fungi p. 325, 1935; *Thelephora sparassoides* P. Henn., Hedwigia **40**: 324, 1901; *Stereum sparassoides* (P. Henn.) Reid, Thind & Adlakha, Trans. Brit. Mycol. Soc. **41**: 129, 1958.

**Type locality:** India **(Fig. 62)**

Basidiocarps annual, terrestrial, stipitate, 10-40 mm high, 15-25 mm wide, coriaceous, flabellate, with adjacent basidiocarps frequently becoming confluent; pileus pale brown, profusely lobed especially when mature, marked by radiating ridges and grooves; margin incised, crenulate, light-coloured; hymenial surface decurrent, violet grey, pale buff on drying, almost smooth, uneven to radiately ridged towards the margin; stipe 5-20 mm long, 1-2 mm wide, dark brown, solid, glabrous, cylindrical to flattened; context subhyaline, homogeneous; cuticle absent.

Hyphal system monomitic, generative hyphae thin-walled, branched, septate, hyaline, 2-4 µm wide, clamps absent; cystidia and gloeocystidia absent; basidia 35-45 x 6-6.5µm, clavate,

subhyaline, 2-4 sterigmate, sterigmata 4-5.5 µm long; spores hyaline, (3.4-)3.5-4.5(-4.6) x 2-3 µm, L=4.25 µm, W=2.65 µm,, Q=1.49 (n=20/2) broadly ellipsoid to subglobose, smooth, inamyloid; on soil or on decaying twigs embedded in the soil.

**Specimens examined :** (UK), Mussoorie, on soil under Oak forest, Sept. 1954, PAN 192; *ibid*, Champawat Marnaula, on soil under mixed forest, 25 Sept. 2002, JRS 9012; (HP), Shimla, Hattoo peak, on soil under Oak forest, Oct. 1967, PAN 5333; *ibid* PAN 5343; *ibid,* Shimla, Narkanda, on soil under mixed forest, 03 Oct 2018, DM 523 & 517.

**Habitat & Distribution:** A common species growing on dead hardwoods in the temperate zones

**Geographical distribution:** India

**India:** Uttarakhand**,** Himachal Pradesh

**Remarks :** The lighter coloured fruitbodies, violet greyish hymenial surface, absence of cystidial elements, clampless hyphae ellipsoid to subglobose spores are the main identifying features of this species.

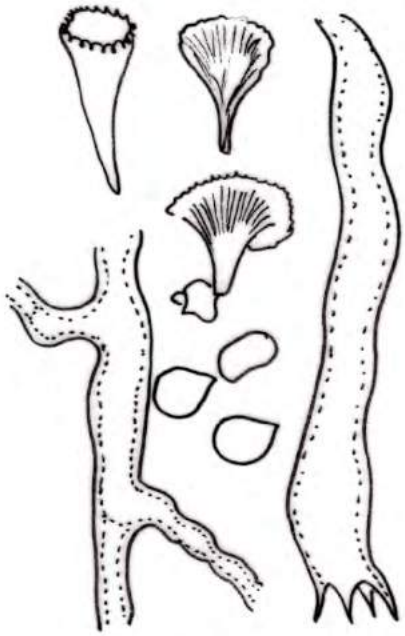

**Fig. 62:** *Stereopsis sparassoides:* a) basidiocarp, b) basidium, c) hyphae, d) spores.

**Stereum** Hill ex Pers.
Neues Mag. Bot. 1: 110, 1794

Basidiocarps annual or perennial, resupinate, orbicular, effused- reflexed to pileate, rather tough to hard, pileus at first tomentose, later in most species becoming glabrous in zones and exposing a dark coloured cuticle, tomentum white to rusty brown, hispid or velutinous; hymenium smooth to slightly tuberculate, yellow, clay- coloured, orange to beige, in some species bleeding when cut or squeezed, fluid first yellow or purplish red, later discoloured, hymenial layer homogeneous or stratose; context thin and dense, in almost all species separated from the tomentum by a thin, brown zone becoming the cuticle on the exposed parts of the pileus.

Hyphal system dimitic, generative hyphae narrow, thin to thick-walled, hyaline, branched, simple septate; skeletal hyphae wide, thick walled to solid in parts, hyaline to pigmented, unbranched, aseptate or exceptionally and irregularly septate forming the dense, often pigmented cutis when present; cystidial elements of two kinds; pseudocystidia, normally originating from horizontal hyphae in the trama and bent into the hymenium, smooth, thick-walled except for in the apical part, often constricted and with one, seldom two, schizopapillae, hyaline to yellow to light brown, filled with an oily to granular substance; cystidioles, appearing as either acutocystidia with pointed apex or as acanthocystidia with protuberances near the apex, both types thin-walled and hyaline; basidioles may have plump, obtuse apices or many metamorphose and have acute tips (acutophyses) or several prong extensions (pseudoacanthophyses); pilocystidia and caulocystidia, rarely present; basidia elongate-clavate, with four sterigmata; spores ellipsoid to narrowly ellipsoid to cylindrical, often slightly bent, thin-walled, smooth, hyaline, amyloid, noncyanophilous; decay white, cosmopolitan genus with several widespread and common species.

*Stereum* is one of the easily recognized genera at macroscopic level due to its characteristic effused-reflexed to pileate basidiocarps with an usually yellowish to orange coloured smooth hymenophore. Some confusion exists regarding to the species because many of them have been described under different names, and too many forms and varieties are found in the litterature based only on slight macroscopic differences such as shape, size and/or colour of the basidiocarps. In *Xylobolus* and *Stereum* there are species which have developed various degrees of substratum specialization.

**Type species:** *Thelephora hirsuta* Willd.

**Key to species**

**1.** Hymenium stratose, compsoed of two or more layers; pseudocystidial hyphae often elongated and growing through hymenial strata ……..……***S. rugosum***

**1**. Hymenium single and not stratose …….2

2. Basidiocarps resupinate, effused-reflexed; spores 10-12.8 µm long……..….***S. peculiare***

2. Basidiocarps effused-reflexed to sessile; spores smaller……...……..3

**3**. Hymenium bleeding on bruising ……..……..…….4

**3**. Hymenium not bleeding on bruising ……..……6

**4**. Basidiocarps radially plicate, bruising in red, margin white to cream when fresh; pseudocystidia with brown contents; on Oaks……..…..…***S. gausapatum***

**4**. Not as above ……..……...……5

5. Pileus dimidiate, fabelliform, tomentum strigose hirsute; spores 5-6.5 µm long…….. ……..***S. hirsutum***

5. Pileus dimidiate, fabelliform to semicircular, usually narrowly attached; spores 5.5-8 µm long……..……***S. subtomentosum***

**6**. Pilear surface scantly tomentose; basidiocarps becoming petaliform, radiately even and rarely imbricate; acanthocystidia present…….…… 7

**6**. Pilear surface hirsute to glabrescent; basidiocarps becoming dimidiate, radiately plicate and usually imbricate; acanthocystidia absent ……..…..8

**7**. Acanthocystidia abundant, digitate processes covering upper 1/3 part of cystidia; pseudocystidial hyphae thin to thick-walled; spores 6-9 x 3.5-4.5 µm…..***S. acanthophysatum***

**7.** Acanthocystidia rare to common, digitate processes very few and only at the apex of the cystidium; pseudocystidial hyphae thick-walled to solid near the apices; spores 5-7.5 x 1.8-2.6 µm ……..…….***S. versicolor***

**8**. Pilear surface glabrescent; pseudocystidial hyphae absent; spores 3.5-5 x 2.5-4 µm ……***S. princeps***

**8**. Pilear surface densely tomentose to strigose; pseudocystidial hyphae present or absent; spores larger…….……..**9**

**9**. Pilear surface densely wooly tomentose; acanthocystidia, pseudocystidia and acutocystidia absent; spores 4.8-5.6 x 2.8 µm…….…..……***S. thindii***

**9.** Pilear surface hirsute to strigose; acanthocystidia, pseudocystidia, acutocystidia present; spores 5-6.5 x 2-2.8 µm…….***10***

**10**. Mostly restricted to conifers; basidiocarps thin, papery, thin-walled pseudocystidia with dark or red contents always present; pseudoacanthophyses present……..…….***S. sanguinolentum***

**10.** Mostly on hardwoods; basidiocarps thicker; pseudocystidia not with red contents; pseudoacanthophyses absent…….……..…….***11***

**11.** Hymenial surface brown to yellowish brown; not rimose; pale yellow to brownish orange; tomentum hirsute-strigose……..***S. hirsutum***

**11.** Hymenial surface pale cream, brusing to orangy-red turning black or cinereous on drying rimose, tomentum thick, fetty, pad-like and some what –spongy, not hirsute……..***S. rimosum***

**Stereum acanthophysatum** Rehill & Bakshi

Ind. For. Bull. **242**: 6. 1966; *Stereum papillatosporum* Rehill & Bakshi, Ind. For. Bull. **242**:11. 1966.

**Type locality:** Chakrata Forest, Uttar Pradesh. **(Fig. 63)**

Basidiocarps effused-reflexed to pileate, membranous to membranous-coriaceous, loosely adnate, effused up to 340 x 60 mm, up to 1 mm thick; hymenial surface pinkish brown to brown when fresh but appears whitish brown in dry specimens, smooth to finely tuberculate, faintly sulcate, irregularly and deeply creviced on drying; margin thick, usually recurved or reflexed forming pileus; upper surface of pileus cream to whitish brown or straw coloured, tomentose, tomentum often disappearing with age; context subhyaline to straw coloured in section, composed of compactly arranged hyphae with a thick brown cuticle on the abhymenial side.

Hyphal system dimitic, generative hyphae 2-4 µm wide, branched, septate, clamps absent, thin to moderately thick-walled, subhyaline; skeletal hyphae 3.5-4.5 µm wide, unbranched to rarely branched, aseptate, thick-walled to almost solid, usually tinted yellow-brown; pseudocystidia hyphae 60-120 x 6-9 µm, arising from the subhymenium or upper part of the context, thin to thick-walled especially in the basal part, subhyaline, contents orange coloured, immersed or scarsely projecting out of the hymenium; acanthocystidia 15-20 x 3-4.5 µm, clavate or subulate, thin-walled, subhyaline, with digitate processes covering the upper 1/3 part; sometimes acutocystidia present like aculeate tipped basidioles; basidia 20-25 x 4-5 µm, clavate, 4-spored, sterigmata up to 4.5 µm long; spores (5.9-) 6-9 (-9.2) x 3.5-4.5µm, L= 8.5 µm, W= 4.2 µm, Q=2.02 (n=20/2) ellipsoid, minutely apiculate, thin-walled, smooth, subhyaline, amyloid.

**Specimens examined:** (UK) Chakrata, D.Dun dead branch of *Cedrus deodara,* DD 7171 (type); *ibid*, bark of *Quercus* spp., 03 Oct. 2018, DM 423; (HP) Pulga, Kullu, dead branch of *Pinus wallichiana,* 20 Sept. 1994, JRS 4023; *ibid,* Sirmaur, Sungri, on a hardwood stump, 03 Nov. 2006, JRS (13101, BSD); (AP), Tirup, Pangsoo pass, on dead hardwood log, 11 Oct. 1986, JRS (3518,CAL)

**Habitat and distribution:** In India found only *Quercus, Cedrus* and *Pinus* spp., usually on standing trunks and still attached branches, more rarely on fallen branches and other debris of Oaks.

**Geographical distribution:** Europe: Estonia, France, Germany, Czech Republic, Belarus, Hungary, Irland, United Kingdom, Belgium, Slovenia, Russia, Romania, Bulgaria, Portugal, Turkey, Sweden, Italy, Denmark, Norway, Finland, Spain, Ukraine, and the Caucasus. Present in almost all Italian Regions.

**India:** Himachal Pradesh, Uttarakhand, Sikkim, Arunchal Pradesh.

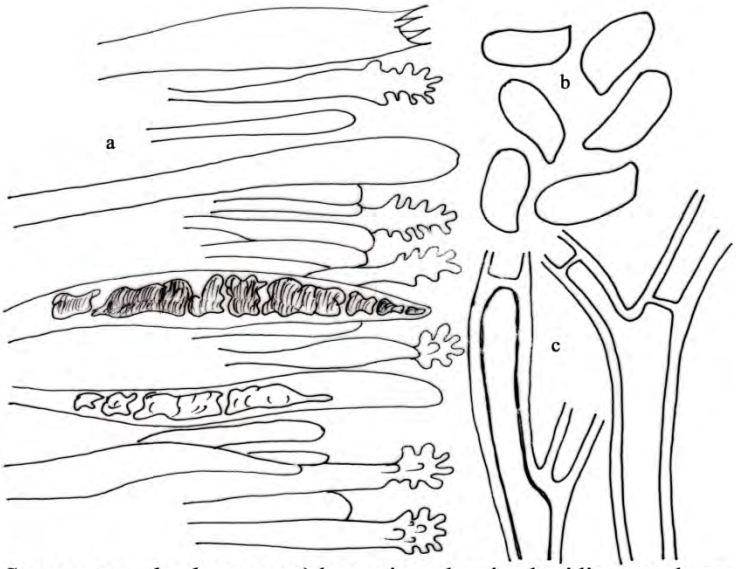


**Fig. 63.** *Stereum acanthophysatum:* a) hymenium showing basidia, paraphyses, acanthophyses and gleocystidia, b) spores, c) generative hyphae.

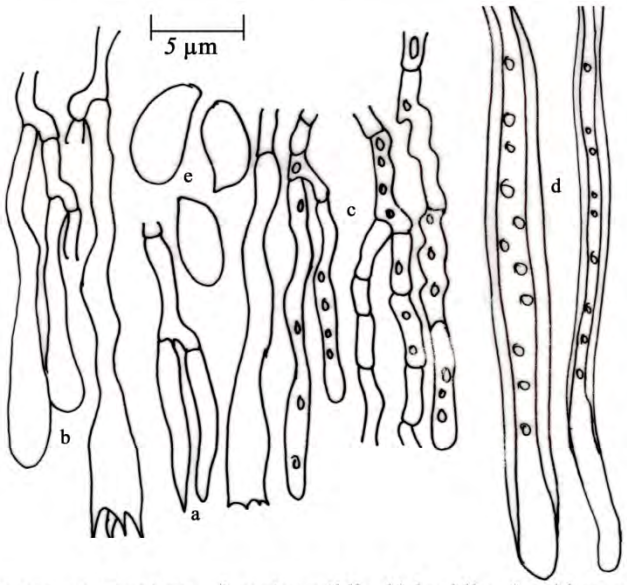


**Fig. 64:** *Stereum gausapatum:* a) acutocystidia, b) basidia, c) subhymenial hyphae, d) cystidia, e) spores.

**Remarks:** This species is marked by the soft texture of fruitbodies presence of acanthocystidia, acutocystidia and pseudocystidia. It comes very close to *Stereurn sanguinolentum* and *S. ostrea* but differs in the shape of acanthocystidia and absence of acutocystidia. The pseudocystidial hyphae in this species are very distinctive and are moderately thick-walled, while in *S. rugosum,* S. *sanguinolentum*, and *S. gausapatum* these are thin-walled, comparatively longer and appear hypha-like.

**Stereum gausapatum** (Fr. ) Fr.

Hym. Europ. p. 638, 1874; *Thelephora gausapata* Fr., Elench. fung. (Greifswald) 1: 171 (1828).

**Type locality:** Europe **(Fig. 64)**

Basidiocarps effused-reflexed to pileate, gregarious, broadly confluent, coriaceous, tough when dry, 0.5-1 mm thick; margin finely tomentose, soon entire; pilei 30-80mm wide, protruding 30-40 mm, dimidiate, laterally attached to imbricate, strongly undulate and radiately complicate; upper surface greyish orange, brownish orange to light brown, yellowish white to pale yellow at the margin, usually zonate by exposing brown to dark brown cuticle in narrow bands, tomentose, somewhat glabrescent; hymenial surface brownish orange, light brown with age, yellowish white to pale yellow at the margin, bleeding when cut or bruised and dark brown on drying, smooth, finely chinked near the base; context pale, separated from the tomentum by a cuticle.

Hyphal system dimitic, generative hyphae 2.4-3.2 µm wide in the subhymenium, hyaline, thin to somewhat thick-walled, septate without clamps, frequently branched and twisted, with transitions to pseudocystidial hyphae; skeletal hyphae 3-7µm wide, thick-walled to solid; pseudocystidial hyphae 4-5.2 µm wide, yellowish brown, thick-walled sparsely branched; cystidia of two kinds, both numerous; pseudocystidia often more than 160 µm long, 5.2-7.2 µm wide, yellowish brown, thick-walled except the apex; acutocystidia 20-28 x 2.8-4µm, hyaline, thin-walled; basidia 32-40 x 4.8-5.6 µm, narrowly clavate, 4-sterigmate; spores (4.9-)5-7.5 (-7.7) x 2.3µm, L= 6.9 µm, W=2.8 µm, Q= 2.47 (n=20/2) narrowly ellipsoid, amyloid.

**Specimens examined:** (HP) Shimla, Hattoo peak, log of Oak, 10 Sept.1994, JRS 839; *ibid*, Narkanda, log of *Q. dilatata* Oct. 03, 2018, DM 513; *ibid,* Kalatope, stumps of Oak, 12 Oct. 2014, DM 2079; (UK) Rudraprayag, Dhar, dead tree trunk of Oak, 03 Sept. 1995, JRS 4155; *ibid,* Uttarkashi, on stump of *Cedrus deodara*, 02 Oct. 2012, DM 1006; (JK) Badarwah stump of Oak, 24 Sept. 1996, JRS 1384; Haryana, Panchkula, Morni Hills, at the base of *Acacia nilotica*, 06 Oct. 2010, DM 97.

**Habitat and distribution:** In India found only on *Quercus*, usually on standing trunks and still attached branches, more rarely on fallen branches and other debris of Oak. It is widely spread species and follow *Quercus* in India.

**Geographical distribution:** Holland, England, Sweden, Italy, Canada, Europe (Austria, Belgium, Denmark, Estonia, France, Germany, Georgia, Greece, Norway, Portugal, Russia, Spain, Sweden, Ukraine); Middle East (Israel, Turkey), Asia (Azerbaijan, Japan, South Korea, India); North America (Mexico, USA); South America (Panama).

**India:** Himachal Pradesh, Jammu and Kashmir, Uttarakhand, Haryana, Punjab

**Remarks:** This is known as a bleeding *Stereum* and is easily recognised by its conspicuous bleeding reaction on bruising in the field. It usually occurs on *Quercus* but also rarely on other hardwoods. *Stereum gausapatum* was considered as "bleeders" along with *S. sanguinolentum* and *S. rugosum* Pers. The bleeding reaction in fresh specimens appears upon hymenial surface injury and is caused by inner-colored exudates of the numerous pseudocystidia present in the hymenium of these species. Due to this particular fact, *S. gausapatum* can be confused with *S. rugosum*, which when bruised also stains red and in addition shares the same habitat, however differs by its stratified perennial hymenium, larger spores, and presence of acanthohyphidia. Other species sharing a common habitat with *S. gausapatum*, are *S. hirsutum* and *S. ostrea* (Blume & T. Nees) Fr. In the field, *S.gausapatum* can be distinguished from *S. ostrea* by densely hirsute and thicker pilei but microscopically, *S. gausapatum* may be confused with specimens belonging to *S. hirsutum*-complex because they share the same habitat, have similar spores size, and in some specimens, turn red when injured.

**Stereum hirsutum** (Willd.: Fr.) Gray

Nat. Arr. Br. Pl. p. 653, 1821; *Thelephora hirsuta* Willd. : Fr., Syst. Mycol. **1**: 439, 1821.

**Type locailty:** Netherlands. **(Fig. 65)**

Basidiocarps effused-reflexed to pileate, orbicular, separate to gregarious, then confluent, coriacoeus, stiff when dry, 0.5-1.5 mm thick; margin finely tomentose, soon entire; pilei 5-25 mm wide, protruding 5-10 mm, dimidiate, often deflexed, broadly attached, often laterally fused to imbricate, undulate; upper surfae greyish yellow (sometimes due to overgrown algae) to greyish orange, zonate with narrow bands of light brown to dark brown, tomentose hirsute, to strigose, glabrescent; hymenial surface pale yellow, greyish yellow, greyish orange, brownish orange, light brown to brown, yellowish white to pale yellow at the margin, smooth to somewhat tuberculate, often finely chinked; context whitish to pale, separated from the tomentum by a cuticle.

Hyphal system dimitic, generative hyphae 2.4-3.2 µm wide, hyaline, thin to somewhat thick-walled, septate, without clamps, frequently branched; skeletal hyphae 5-7.5 µm wide, sparsely branched, aseptate; pseudocystidial hyphae 3.4-5.2 µm wide, yellowish brown, thick-walled often secondarily septate, sparsely branched; cystidia of two kinds, both numerous; pseudocystidia more than 120 µm long, 5.4-7.2 µm wide, yellowish brown, greyish buff when

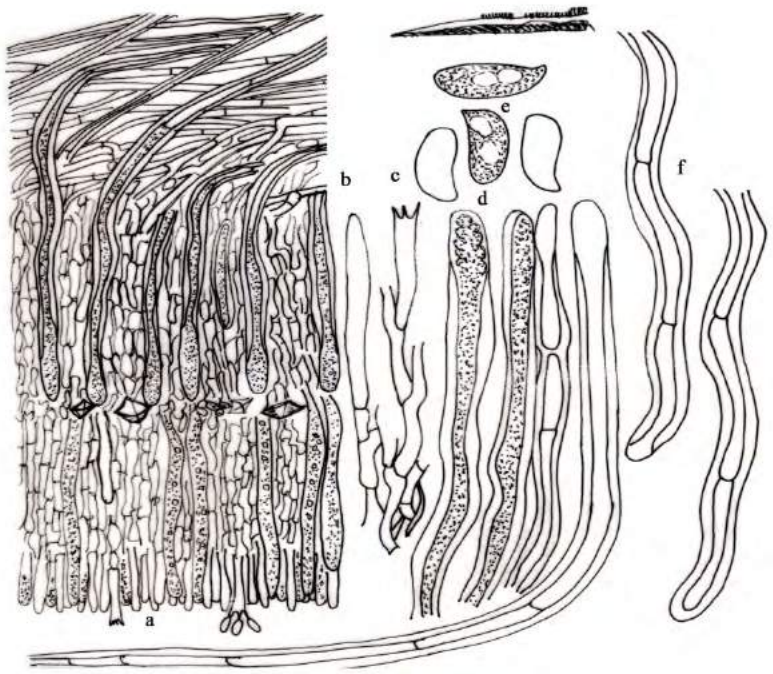


**Fig. 65:** *Stereum hirsutum:* a) section through basidiocarp b) section through two-layered hymenium, b) acutocystidium, c) basidium, d) pseudocystidia, e) spores, f)

old, thick-walled except the apex; caulocystidia 20-28 x 2.4-3.8 µm, hyaline, thin-walled; basidia 22-32 x 3-4.8 µm, narrowly clavate, 4-sterigmate; spores (4.9-) 5-6.5 (-6.7) x 2-2.8µm, L= 6.3, W=2.5 µm, Q=2.52 (n=20/2) cylindrical to narrowly ellipsoid, amyloid.

**Specimens examined:** (UK) Uttarkashi, Dodital, log of *Abies pindrow,* 03 Oct.1996, JRS 1287; *ibid,* Har ki Dun, On *Quercus*, 07 Oct, 2012, DM 1050; (JK) Pehalgam, Shikargah, stump of *Pinus wallichiana,* 30 Aug. 1996, JRS 1386; (HP) Kalatope, fallen tree trunk of *Quercus*, 22 Oct. 2014, DM 2040.

**Habitat and distribution:** One of most common lignicolous fungi on broadleaved trees, very rarely conifers, and widely distributed. It was mentioned in the majority of publication on higher fungi in India. The species within the *Stereum hirsutum*-complex are generally known to grow on bark and wood of trunks, twigs, or stumps of a wide range of dead or living deciduous trees.

According to present-day knowledge, the members of this complex are widespread and common in several countries on deciduous woods but occasionally also on *Picea* and *Pinus*.

**Geographical Distribution:** Europe (Austria, Croatia, Denmark, Finland, France, Germany, Greece, Iceland, Italy, Macedonia, the Netherlands, Norway, Poland, Portugal, Romania, Russia, Spain, Sweden, UK, Ukraine); Middle East (Israel, Turkey); East Asia (Mongolia, Japan, South Korea); North America (Canada, USA); South America (Mexico, Guatemala, Cuba, Jamaica, Colombia, Brazil, Venezuela, Costa Rica, Dominican Republic, Venezuela); Southern Hemisphere (Australia, New Zealand); Africa (Morocco, Tanzania); Greater Antilles (Jamaica).

**India:** Uttarakhand, Himachal Pradesh, Jammu and Kashmir, Haryana

**Remarks:** Microscopically, *Stereum hirsutum* has more distinct and more thick-walled pseudocystidial hyphae and longer spores. *Stereum hirsutum* is one of the decay fungi that first fruit on recently fallen or cut-down trees. Some authors treat *Stereum hirsutum* as a complex that shares a common or similar inner structure but exhibits different morphological forms; other authors split this complex into separate species. However, some specimens, depending on biotic and abiotic factors of their habitat in various geographic biomes, show some stable morphotypes. During its active growth, hymenium in some fruitbodies turns yellow-orange to red when bruised; thus, in the field, they might be confused with *S. rugosum* and *S. gausapatum*. Therefore, careful morphological examination is needed.

None of the freshly collected specimens clearly bled or bruised, but some very moist ones occasionally exuded clear yellow droplets or bruised yellowish to light brownish, drying a brown, grey or purple colour; pseudocystidia never showed brown or red contents, fresh basidiomata placed in water with the hymenium upward, turned the water yellow and often formed a clear yellow exudate on the hymenial surface. *S. hirsutum* is readily distinguishable by the yellow to orange hymenium, the hirsute tomentum and the presence of a brown cutis.

**Stereum peculiare** Parmasto, Boidin & Dinghra

*Persoonia* **10**(3): 311, 1979.

**Type locality:** Primorye, Russia. **(Fig. 66)**

Basidioacrps effused or with narrowly reflexed pilei, annual, adnate or with almost free margins, denselycoriac eaous, pliable, arising as small patches 3-25mm in diam. which soon become confluent and may become effused up to 150mm long and wide and upto 1mm thick in section; the initial points distinct; pileus narrow or rarely almost semicircular, up to 6mm wide, 3mm thick, upper surface covered with thick tomentum, faintly concentrically zonate, grayish apricot with somewhat darker indistinct zones; tomentum disappearing soon and surface subglabrous, radially striate, almost silky smoke grey with narrow whitish edge,


Fig. 66: *Stereum peculiare*: a) section through basidiocarp, b) section through hymenium and context, c) cystidia, d) acanthohyphidia, e) spores.

darkening with age, almost fuscous black; margin of the resupinate part determinate, thinning white or whitish, becoming concolorous with hymenium with age; hymenial surface uneven, tuberculate, with rare or scattered irregular finger-like outgrowths or toothed, rarely almost smooth, golden brown or fulvous ochraceous, old specimens becoming deeply radially cracked on drying, teeth 0.5-2mm long, 0.2-1mm broad at the base, broadly conical or irregularly cylindrical, obtuse, sometime flattened, often confluent at their bases, sometimes forming toothed ridges; context distinctly layered, composed of loose cottony tomentum; concolorous with young upper surface, and almost suberose buff; main layer separated by a narrow dark line.

Hyphal system dimitic; generative hyphae abundant, with thin or thickened walls frequently septate, without clamps, slightly yellowish or almost yellow, 4-5.5 µm in diam; skeletal hyphae usually small in number except in the upper part of the conext or at the bottom of the 'processes', thick-walled or almost solid, with rare septa, dark honey-yellow-brown, 4.5-6 µm in diam; some skeletal hyphae curve into the subhymenium and hymenium as immersed indistinct 'pseudocystidia' having rounded, slightly or sometimes distinctly clavate tips, 6-8 µm in diam; mostly they end obliquely in the subhymenium as acanthophyses with rough diverticules; tomentum thick in young specimens, very thin in old ones, composed of loosely woven, olive brown, thick-walled, sparsely branched hyphae with rare septa, 4-5.5 µm in diam; cuticular layer distinct, 40-100 µm thick, of densely arranged, almost parallel, brown, thick-walled hyphae, agglutinated with resisnous matter; context layer composed of compactly radiately arranged parallel hyphae, covered into the subhymenium; subhymenium thin, composed of almost perpendicularly arranged, thin-walled, branched, dark yellow generative hyphae 4-5.5 µm in diam.; gloeocystidia frequent, immersed in subhymenium and hymenium, obpyriform, moderately thick-walled, sometimes with thin-walled rostrate upper part, 25-50 x 10-17 µm, rarely with 1-2 secondary septa, contents negative with sulfo-aldehyde; hymenium composed of very abundant acanthohyphidia, basidioles and scattered basidia; acanthohyphidia subclavate, subfusiform or subcylindrical, some rather irregular, with a basal septum, sometimes with secondary septa, thin-walled, in old hymenium thick-walled, and brownish, 30-100 x 3.5-7µm, covered with naked spines or digitate processes in the apical third; spines densely arranged, 2.5-7 µm long; basidioles few, thin-walled, with rounded apex, 2-3.5 µm in diam; basidia rarely seen; spores ellipsoid to cylindrical, hyaline, (9-)10-12.8 (-14.2) x (2.5)3-4 µm, L=12.7 µm, W=3.5µm, Q= 3.62 (n=20/2) smooth, thin-walled, amyloid.

**Specimens examined:** Manipur, Ukhrul, Sirohi, in a forest with *Michelia champaka* dominating, Chandigarh herbarium, 02 Sept. 1978, PAN 190093 and LY 9250; (AP) Tirup, Pangsoo pass, on dead hardwood log, 21 Oct. 1989, JRS (4069, CAL); Sikkim, Gangtok, on dead wooden log, Sep.10, 1980, JRS (6068 & 6076, CAL); (HP) Shimla, Khadrala, on thin branches of *Q. semecarpifolia,* 25 Sept. 2018, DM 547; (UK) Chamoli, Anusuya Devi, on a hard wood stump, 22 Sept. 2011, DM 1067.

**Habitat & Distribution:** Usually on dead corticated stumps, trunks and large limbs of *Quercus* widely spread in India

**Geographical distribution:** USSR, India

**India:** Sikkim, Arunachal Pradesh, Manipur, Himachal Pradesh, Uttarakhand.

**Remarks:** It is rather easy to recognize this *Stereum* in *Quercus* forests because of its scattered irregular fine teeth and brown color of resupinate hymenial surface finely to deeply cracked when dry, and acanthohyphidia are microscopically an important character for the identification of this species (Boidin *et al* 1979).

**Stereum princeps** (Jungh.) Lev.

Ann. Sci. nat. series III, **2**: 210, 1844; *Thelephora princeps* Jungh. Verh. Batavi. Genoot. **17**: 38, 1838; *Xylobolus princeps* (Jungh.) Boidin, Rev. Mycol. Paris **23**: 341, 1958; *Stereum annosum* Berk. & Broome, J. Linn. Soc., Bot. 14(no. 74): 67 (1873) [1875]

**Type locality:** Kendang and Patuha, Java. **(Fig. 67)**

Basidiocarps dimidiate, sessile, occasionally effused-reflexed, soon broadly confluent, coriaceous, up to 0.5 mm thick; pileus 5-10 mm wide, radially cracking with age; upper surface zonate with narrow alternating bands of brownish, brown or reddish brown colour initially tomentose, soon glabrescent and shiny; hymenial surface pale yellow to light yellow or brownish orange, rarely light brown; context whitish to pale, separated from the tomentum by a thin cuticle.

Hyphal system dimitic, generative hyphae 2.5-4.5 µm wide, branched, septate, clamps absent, skeletal hyphae thick-walled; pseudocystidial hyphae absent; basidia 20-30 x 4-5 µm, clavate, 4-sterigmate; spores (3.3-) 3.5-5 (5.2) x 2.5-4µm, L=4.8 µm,W=3.6µm, Q=1.35 (n=20/2) globose to subglobose.

**Specimens examined:** (UK) Dehradun, Kalsi, stump of *Shorea robusta,* 25 Sept. 1992, JRS 892; *ibid,* Chamoli, Mandal, on a rotting stump of Oaks, 24 Sept. 2011, DM 1077; *ibid,* Bageshwar, Dhakuri forest, rotting trunk of *Taxus wallichiana*, 13 Oct. 2010, DM 2032; (HP) Narkanda, on decorticated hard wood tree, 01 Oct. 2018, DM 588.

**Habitat & Distribution:** The species within the *Stereum hirsutum*-complex are generally known to grow on bark and wood of trunks, twings, or stumps of a wide range of dead or living deciduous trees and rarely on coniferous woods.

**Geographical distribution:** Europe (Austria, Crotia, Denmark, finland, France, Germany, Greece, Iceland, Italy, Macedonia, the Netherlands, Norway, Poland, Portugal, Romania, Russia, Spain, Sweden, UK, Ukraine); North America (Canada, USA); South America (Colombia, costa Rica, Dominican Republic, Venezuele); Southern Hemisphera (Australia, New Zealand); Africa (Morocco, Tanzania); Greater Antilles (Jamaica).

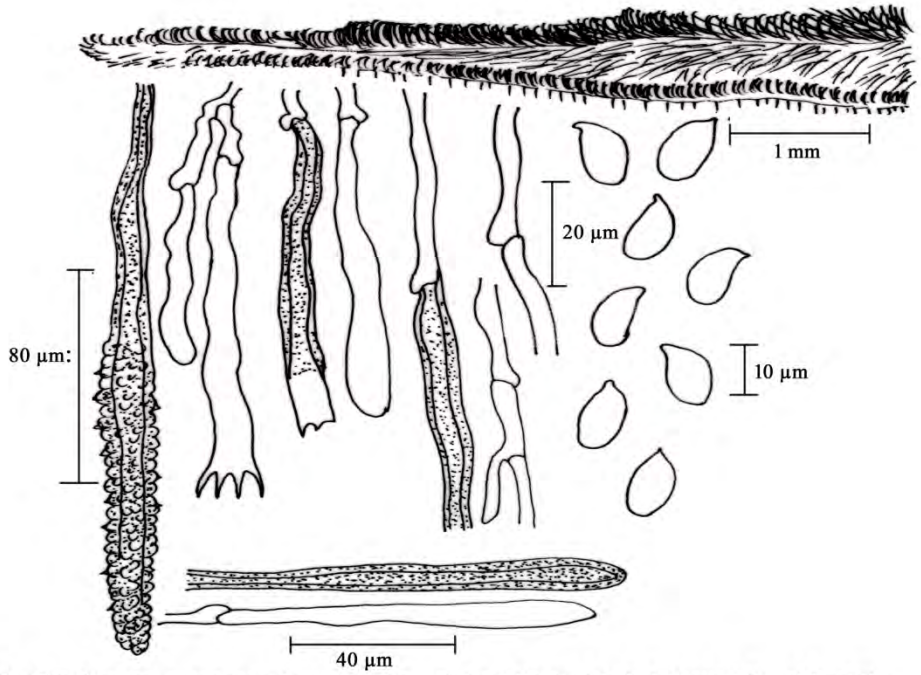


**Fig. 67:** *Stereum princeps:* a) section through basidicarp, b) skeletocystidia, c) basidia, d) spores, e) hyphae.

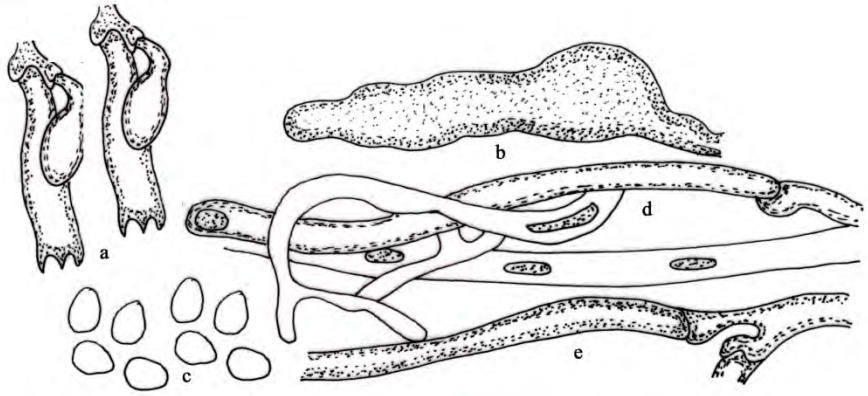


**Fig. 68:** *Stereum rimosum:* a) basidiocarp, b) basidium, c) spores, d) gloeocystidia, e) generative hyphae.

**India:** Uttarakhand, Himachal Pradesh

**Remarks:** The thin, dimidiate basidiocarps, glabrescent and radially cracked pilear surface, absence of pseudocystidial hyphae, subglobose spores mark this species. During its active growth, hymenium in some fruitbodies turns yellow-orange to red when bruised; thus, in the field, they might be confused with *S. rugosum* and *S. gausapatum*. Therefore, careful morphological examination is needed.

**Stereum rimosum** Berk.

Hooker's J. Bot. Kew Gard. Misc. 3: 169, 1851.

**Type Locality:** Darjeeling, West Bengal. **(Fig. 68)**

Basidicarps coriaceous, lignicolous, usually broadly effused, becoming narrowly reflexed in places or resupinate on larger branches and often covering them, but also sessile and attached by a broad umbo, sometimes only narrowly attached and laterally extended, often enveloping smaller twigs effusedly with broad, wing-like reflexions; on drying the reflexed part often turns back covering the effused part; abhymenial surface buff to ochre to fulvous; margin usually light buff, covered with a thick, felty, pad-like, or somewhat spongy tomentum, margin even or lobate; hymenium conspicuously rimose and rugose with phleboid radiating ridges and tubercles, sometimes appearing blistered, thicker specimens often cracking to show a pallid silky context, often coloured, saffron to salmon tinged when fresh, sometimes becoming fawn to orange with age, ridges often ochreous tinged, bleeding orangy-red when bruised, soaked or injured parts drying violaceous black; thickness in section.

Hyphal system dimitic, generative hyphae thin walled, 2.0-3.5µm diam; variable, 490-1525µm, due to thickening, layered, hymenium, cutis: relatively narrow, orange to rust coloured, not always very distinct, skeletal hyphae 5.0-10.0µm, wall thickness 1.0-3.0 µm, lumen often has orange brown contents; tomental hair 4.0-6.0µm diam, narrow lumen; hyphidia: ordinary hyphidia, acute or cylindrical; pseudocystidia subcylindrical to cylindrical, yellow to orange, somewhat oily contents, relatively thin-to slightly thick-walled, 4.0-9.0 µm diam; basidia clavate to subcylindrical 4-sterigmate, basal clamp absent, 30-60 x 4-6 µm; spores (4.8-) 5-7(-7.8) x 2.5-3.5 µm, L=7.2µm, W=3µm, Q= 2.4 (n=20/2) ellipsoid to cylindrical, unilaterally depressed: binucleate, hyaline, smooth, thin-walled, amyloid.

**Specimens examined:** (WB), Sevok, base of a hardwood stump, 14 Sept.1988, JRS (61061, CAL); *ibid*, Darjeeling, on a hard wood log, 13 Nov. 1990, JRS (9040, CAL); (AP), Tirup, Saltlik forest, on dead rotting tree trunk, 14 Sept. 1986, JRS (60071 , BSD); Sikkim, Gangtok, on dead wooden log, 24 Sep. 1988, JRS (6003, CAL); *ibid*, Gangtok, near BSI Campus, on hard wood, 07 Oct. 2010, DM 3013.

**Habitat and distribution:** A common species on rotting hardwoods in the temperate Himalayan forests.

**Geographical distribution:** India

**India:** West Bengal, Sikkim, Arunachal Pradesh.

**Remarks:** *S. rimosum* has thin-walled pseudocystidial elements, very similar to those of *S. sanguinolentum*. The upper suface of the basidicarps is not conspicuously concentrically colour zoned and appears to be of a more uniform colour than most *Stereum* species. Skeletal hyphae seen to be more abundant in the sessile and broadly reflexed parts than in the completely resupinate parts. The spore range was found to be larger than described by Wakefield and Talbot (1948). The basidia are exceptionally long, sometimes up to 60µm. As *S. rimosum* is a "bleeding" species so the colour of the hymenium may vary considerably, becoming cinereous to black when bruised but seeming to dry a very pale cremy buff when unharmed, which tends to darken somewhat with age. The thickness of the tomentum is not a very stable character as this layer rubs off quite easily with age and resupinate parts are compeletety without tomentum.

**Stereum rugosum** Pers.

*Neues Mag. Bot*. **1**: 110, 1794; *Thelephora rugosa* (Pers.: Fr.) Pers., Syn. Meth. Fung., p. 569. 1801; *Haematostereum rugosum* (Pers. : Fr.) Pouzar, Ceská Mykol. 13:13. 1959

**Type locality:** America. **(Fig. 69)**

Basidiocarps effused-reflexed, adnate, membranous to coriaceous, arising in small resupinate colonies which grow later and may become effused-reflexed, up to 1 mm thick; hymenial surface smooth, pinkish brown to yellowish or greyish brown, often bleeding on bruishing in fresh specimens, becoming layered with age margin rather abrupt, adnate, concolorous abhymenial surface light yellowish brown, tomentose when young but tomentum often disappears with age; context subhyaline to pale orange in section, composed of compactly arranged hyphae, with a well developed cuticle on the abhymenial side.

Hyphal system dimitic, generative hyphae 1.5-3 µm wide, branched, septate, clamps absent, thin to moderately thick-walled, subhyaline, skeletal hyphae 3.5-6 µm wide, sparsely branched, aseptate, thick-walled, hymenium thick and stratose; pseudocystidial hypahe 5-8 µm broad, cylindrical to flexuous, arising from the upper layers of context and traversing through different hymenial strata, immersed or projecting slightly out of it, often containing yellow-orange contents, thin-walled, subhyaline; basidia 5-6 µm broad, clavate, 4-sterigmate; spores (5.8-)6-7(-7.2) x 2.8-3.5µm, L= 7.2 µm, W=3µm, Q=2.3, (n=20/2) ellipsoid to suballantoid, minutely apiculate, subhyaline, smooth, nonamyloid.

**Specimens examined:** (UK) Uttarkashi, Puncdodi, dead branch of Oak, Sept. 10, 1998, JRS 6157; *ibid,* Bageshwar, Dwali, twigs of Oak, Oct. 20, 1999, JRS 6209; (HP) Kalatope, fallen tree trunk of Oak, Oct. 24, 2014, DM 2083.

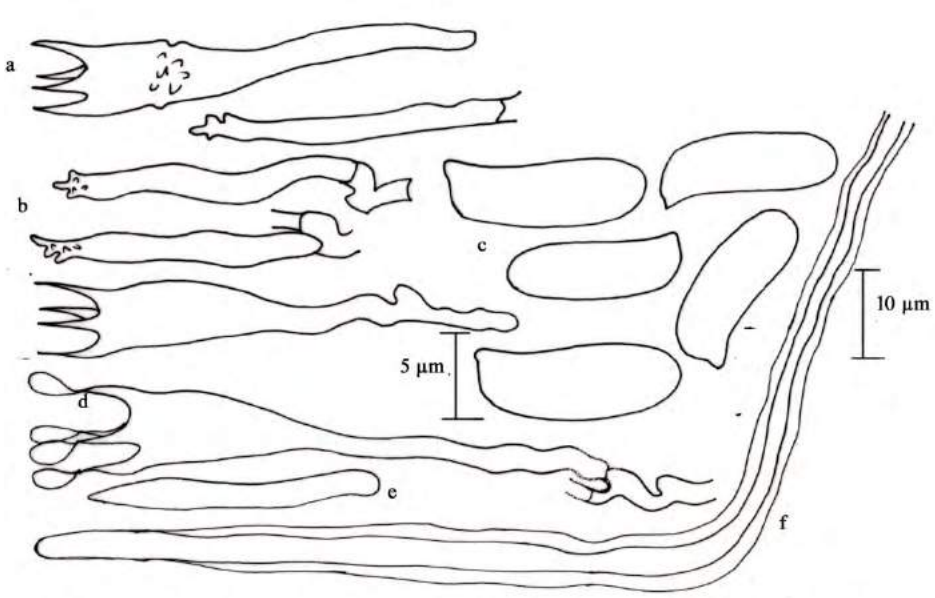


**Fig. 69:** *Stereum rugosum:* a) acanthobasidium, b) pseudoacanthocystidia, c) spores, d) basidium, e) acutocystidium, f) skeletocystidium.

**Habitat & Distribution:** Very common species in all phytogeographical zones of India and grows mostly on dead and old hardwoods stumps.

**Geographical distribution:** Europe: Russia, Turkey, Estonia, France, Belarus, Czech Republic, Germany, Austria, Poland, Hungary, Irland, United Kingdom, Belgium, Slovenia, Russia, Romania, Bulgaria, Portugal, Turkey, Sweden, Italy, Denmark, Norway, Switzerland, Finland, Spain, Ukraine, and the Caucasus Western Europe and Eastern Asia, North America.

**India:** Uttarakhand, Himachal Pradesh

**Remarks:** This species is quite close to *S. sanguinolentum* and *S. gausapatum* but differs in having thicker fruitbodies and stratose hymenium. *S. rugosum* is as a rule easy to determine by its hard resupinate to subresupinate and orbicular fruitbodies often covering large areas of dead and standing trees. Its pileus becomes glabrous rather soon and the basidiocarps is perennial and harder than for other species dealt here.

**Stereum sanguinolentum** (Alb. & Schwein.) Fr.

Epicr. syst. mycol. (Upsaliae): 549 (1838)**;** *Thelephora sanguinolenta* Alb. & Schwein., Consp. fung. (Leipzig): 274, 1805

**Type Locality:?** **(Fig. 70)**

Basidiocarps effused-reflexed to pileate, orbicular, separate to gregarious, confluent, coriaceous, stiff when dry, up to 1 mm thick; margin finely tomentose to entire; pilei 5-25 mm wide, protruding 5-10mm, narrow or dimidiate, often laterally fused to imbricate, undulate, sometimes crenate or incised; upper surface yellowish grey, golden grey, greyish yellow, orange grey, brownish grey to brownish orange, light brown or rarely olive brown due to overgrown algae, zonate by exposing a greyish brown cuticle in narrow bands, tomentose or hirsute, becoming glabrescent; hymenial surface orange grey to greyish orange, brown when old, bleeding when cut and dark brown on drying, smooth or finely tuberculate, sometimes finely chinked; context whitish to pale, separated from the tomentum by a cuticle.

Hyphal system dimitic, generative hyphae 2.4-4 µm wide, hyaline, thin to slightly thick-walled, septate, without clamps, frequently septate and densely branched in the subhymenium, skeletal hyphae 3-8 µm wide, unbranched, aseptate; pseudocystidial hyphae 3-5.6 µm wide, yellowish brown, thick-walled, often secondarily septate, not or rarely branched; cystidia of two kinds, both numerous; pseudocystidia usually 100 µm or sometimes more than 200 µm long, 4.8-10.2 µm wide, yellowish brown, thick-walled except the apex; acanthocystidia 24-36 (-44) x 2.4-4 µm, hyaline, thin-walled, with protuberances up to 2 µm long; same basidioles with many prong-like extensions (psendoacanthophyses) present and distinct; basidia 24-44 x 4.4-7.2 µm,

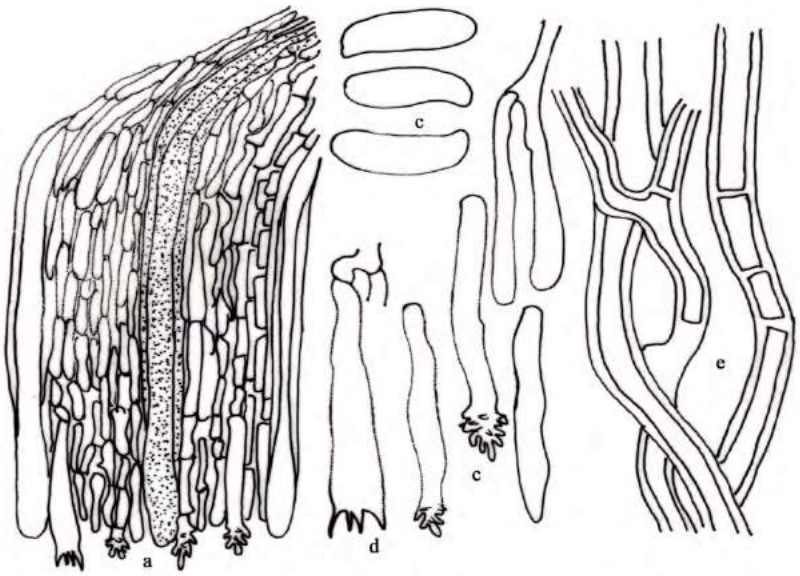


**Fig. 70:** *Stereum sanguinolentum:* a) section through hymenium, b) spores, c) pseudoacanthocystidia, d) basidium, e) hyphae.

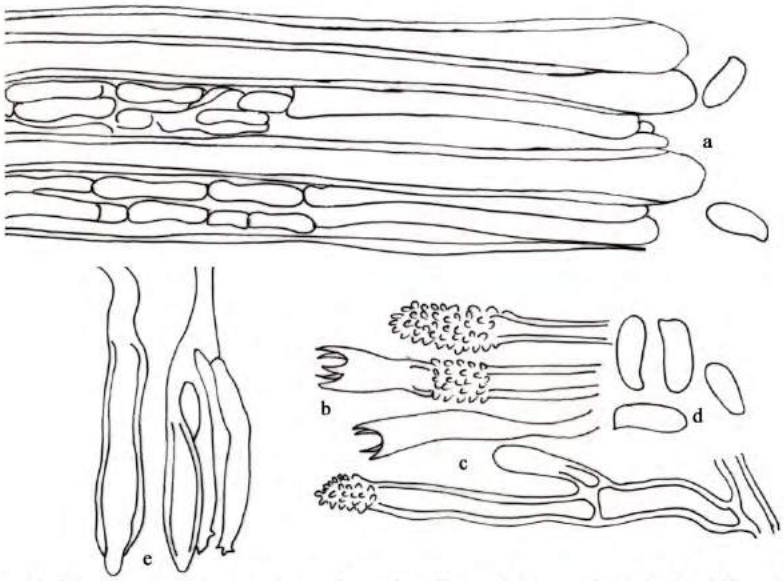


**Fig. 71:** *Stereum subtomentosum:* a) section through hymenium, b) basidia, c) acutocystidia, d). spores, e) pseudocystidia.

narrowly clavate, 4-sterigmate; spores (5.9-) 6- 10 (10.2) x 2.2-4.2µm, L= 8.9 µm, W=3.5 µm, Q=2.54 (n=20/2) narrowly ellipsoid or cylindrical, amyloid.

**Collections examined :** (UK) Bageshwar, Dhakuri, stumps of *Cedrus deodara,* 29 Aug. 1999, JRS 617; *ibid,* Champawat, Mayawati, stump of *Pinus wallichiana,* 20 Sept. 2002, JRS 8818; Ghirgaon, *ibid,* Pithoragarh, rotting trunk of *Taxus wallichiana,* 03 Oct. 2008, JRS 14702; *ibid,* Chamoli, Chopta, stump of *Pinus*, 07 Oct. 2011, DM 1062; (HP) Chamba, on trunk of *Pinus*, 28 Sept. 2014, DM 2066.

**Habitat & Distribution:** It occurs on trunks of coniferous trees particularly belonging to species of *Pinus, Cedrus and Taxus* in the temperate Himalayan forests.

**Geographical distribution:** Europe (Austria, Russia, Turkey, Estonia, France, Germany, Czech Republic, Poland, Irland, United Kingdom, Belgium, Slovenia, Romania, Bulgaria, Portugal, Turkey, Sweden, Italy, Denmark, Norway, Switzerland, Finland, Spain, Ukraine, and the Caucasus) Great Britain, North America, South Africa, Australia, New Zealand, India.

**India:** Uttarakhand, Himachal Pradesh.

**Remarks:** This is another bleeding species of *Stereum* and causes a red heart rot of conifers and a sap rot on their slash. The decayed wood is light in weight and light brown in color. Its occurrence on coniferous woods and absence of acutocystidia distinguish it from the closely related *S. gausapatum.* The species is usually easy to recognize because of its bleeding reaction and occurence on coniferous wood, being the only bleeding species on this type of substrata.

**Stereum subtomentosum** Pouz.

Ceska Mykol. 18 p. 147-148, 1964.

**Type locality:** **(Fig. 71)**

Basidiocarps annual, normally reflexed with a distinct pileus, single or more commonly in dense, imbricate clusters, coriaceous and tough, pileus up to 500m wide and 20-80mm long in fused fruitbodies, fanshaped to spathulate with a distinctly tapering and often short stipe-like base, or more broadly attached margin, lobed and undulate involute, especially when dried, first finely adpressed tomentose to velutinous, yellowish grey to pale brown in narrow zones, with age some old specimens often more hirsute and grey with a greenish tint at the base because of algae in the tomentum, some of the zones may be separated by dark bands reflecting distinct stages in the development, margin thin and light-coloured; hymenium smooth, tuberculate or undulate, light beige to ochraceous, becoming immediately yellowish when cut or wounded in fresh condition; context beige to ochraceous and separated from the tomentum by a distinct dark brown zone of agglutinated hyphae.

Hyphal system dimitic, generative hyphae simple septate, hyphae, in the subhymenium thin-walled and abundantly branched, in the cortex and the tomentum, skeletal hyphae thick-walled and sparsely branched, 3- 10 µm wide, often with adventitious septa of contracted protoplasm; cystidia of two kinds: pseudocystidia thick-walled except in the apical part, often constricted and provided with an apical appendix, projecting slighty above the basidia, filled with yellowish content, 4-12 µm wide, usually longer than 100µm; acutocystidia numerous, about 35-40 x 4-5 µm, projecting slight above the basidia; basidia clavate, 25-40 x 4-6 µm, with four sterigmata; spores cylindrical to narrowly ellipsoid, often slightly bent, thin-walled, smooth, (5.3-) 5.5-8 (8.2) x 2-3 µm, L= 6.8 µm, W=2.5 µm, Q=2.72 (n=20/2), amyloid.

**Specimens examined: (**HP) Kalatope, dead wood of *Cedrus deodar*, 24 Oct. 2014, DM 2084; (UK) Champawat, Mayawati, stump of Oak, 21 Oct. 2010, DM 2096; Sikkim, Singba Rhododendron Sanctuary, dead rotting log of *Rhododendron*, 22 Sept. 1982, JRS (6112, CAL)

**Habitat and distribution**: It is common species in the temperate Himalayan forests mostly growing on all types of dead woods.

**Geographical Distribution:** Europe: Switzerland, Russia, Estonia, France, Czech Republic, Poland, Germany, Austria, Croatia, Hungary, United Kingdom, Belgium, Slovenia, Belarus, Bulgaria, Spain, Turkey, Sweden, Italy, Denmark, Norway, Switzerland, Finland, Ukraine, and the Caucasus. Common species in all European countries. Recorded from Piemonte, Lombardia, Trentino Alto-Adige, Friuli Venezia-Giulia, Emilia-Romagna, Toscana, Abruzzo, Puglia, and Sicilia.

**India:** Himachal Pradesh, Uttarakand, Sikkim.

**Remarks:** *Stereum subtomentosum* is rather easy to recognize in the field because of the large and often distinctly fanshaped to spathulate fruitbodies with a soft and velutinous tomentum and by its yellowish bleeding reaction when fresh. It is similar to *S. versicolor* which, however, has a tropical or subtropical distribution and is separated by its oyster-like fruitbody, and more brownish colour.

**Stereum thindii** A.B. De

Mycotaxon **69**: 167, 1998.

**Type locality:** Burdwan, West Bengal, India. **(Fig. 72)**

Basidiocarps effused-reflexed to distinctly pileate; pileus 20-36x 20-55, up to 3mm, thick, tough when fresh, hard on drying, dimidiate to flabellate, often fused laterally to adjacent fruit bodies or densely imbricate, often lobed and wavy; upper surface densely woolly tomentose, concentrically zonate, pale yellow; margin thin, acute, white, involute when dried; context ochraceous, up to 400 µm thick; separated from the tomentum by a thin brown zone;

hymenial surface smooth to crisped or folded radially, ochraceous, changes to yellow when bruised in fresh material.

Hyphal system dimitic; generative hyphae hyaline, thin-walled, simple-septate, branched, irregularly wide, 2.5-3.5 µm in diameter; skeletal hyphae hyaline, thick-walled to solid, often with secondary septa, unbranched, apex variable, some thin-walled, others thick-walied, 3.5-5.6 µm in diameter; acyanophilous; skeletocystidia abundant, arising from the trama and forming a fairly dense layer, mostly projecting above the basidia, smooth, thick walled, hyaline to subhyaline with oily contents and rounded ends, 5.6-7.0 µm wide; acanthohyphidia, pseudoacanthohyphidia and acutocystidia absent; basidia hyaline, thin-walled, clavate, 24-30 x 4-6 µm, 4-sterigmate with sterigmata up to 2 µm long; spores hyaline, thin-walied, smooth, ellipsoid, small, (4.6-) 4.8 -5.6 (5.8) x 2-2.8µm, Q=2.14 (n=20/2) apiculate, amyloid.

**Specimen Examined:** (UK) Dehradun, Rajaji national Park, stump of *Malotus* spp., 07 Oct. 2012, DM 57; *ibid,* Dehradun, FRI campus, on *Shorea robusta*, 24 Aug. 2017, DM 3027; (WB) Darjeeling, Sevok, base of a hardwood stump, 14 Sept. 2009, JRS (60161, BSD).

**Habitat & Distribution:** Fairly common species growing on hardwoods, from tropical to subtropical areas.

**Geographical distribution:** India

**India:** Uttarakhand, Aruanchal Pradesh, West Bengal.

**Remarks:** *Stereum thindii* is distinct from any known species of *Stereum* due to the following combination of features : (i) basidiocarp large, pileus 20-36 x 20-55mm, dimidiate to flabelliform, concentrically zonate with densely woolly tomentose upper surface; (ii) hymenial surface smooth and ochraceous which becomes yellow in fresh specimens when bruised; (iii) hyphal system dimitic with hyaline, thin-walled, simple septate generative hyphae and hyaline, thick-walled skeletal hyphae; (iv) basidiospores hyaline, thin-walled, smooth, ellipsoid, small, being 4.8-5.6 x 2.0-2.8 µm; (v) skeletocystidia smooth, hyaline to subhyaline, arising from trama and forming a dense layer beyond the hymenium; (vi) absence of acanthohyphidia, pseudoacanthohyphidia and acutocystidia.

*S. thindii* shows close similarity with three species of *Stereum*, namely *Stereum ostrea* (Blume & Nees: Fr.) Fr. *Stereum hirsutum* (Willd.: Fr.) S.F. Gray and *Stereum subtomentosum* Pouz. However, *S. thindii* differs from all of these three species by its smaller spores. Besides, *S. thindii* is characterised by absence of acutocystidia which are abundantly present in *S. hirsutum* and *S. subtomentosum* (Eriksson *et al*. 1984). Upper surface of *S. thindii* also differs from *S. hirsutum* and *S. subtomentosum*. In *S. thindii* the upper surface is densely woolly tomentose whereas in *S. hirsutum* it is tomentose-hirsute-hispid (Eriksson *et al*. 1984, Hjortstam and Ryvarden 1990) and in *S. subtomentosum* finely adpressed tomentose to velutinous or hirsute.

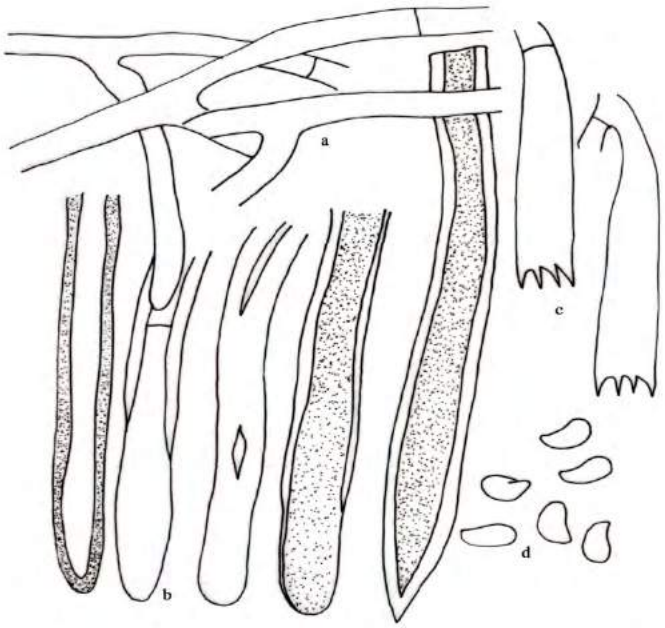


**Fig. 72:** *Stereum thindii:* a) generative hyphae, b) skeletocystidia, c) basidia, d) spores.


**Fig. 73:** *Stereum versicolor:* a) spores, b) section of hymenium

(Eriksson *et al*. 1984) The striking difference between *S. thindii* and *S. versicolor* is the lack of pseudoacanthohyphidia in the former and their presence in the latter.

**Stereum versicolor** (Sw.) Fr.,

Epicr. syst. mycol. (Upsaliae): 547 (1838); *Helvella versicolor* Sw., Prodr.: 149 (1788); *Thelephora ostrea* Blume & Nees, Nova Acta Acad. Caes. Leop.-Carol. 13:13. 1826; Fr., Elench. fung. 1:175. 1828.

**Type locality:** Java **(Fig. 73)**

Basidiocarps pileate, single to gregarious, coriaceous, 0.5-1 mm thick; pilei 30-40 mm wide, protruding 20-25 mm, dimidiate to petaliform, sometimes laterally attached, radiately even, somewhat plicate where coalesced; margin entire; upper surface brownish grey to greyish brown, greyish orange to brownish orange at the margin, tomentose, indistinctly zonate with narrow appressed bands; hymenial surface light brown at the margin, smooth; context whitish to pale, separated from the tomentum by a cuticle.

Hyphal system dimitic, generative hyphae 2.4-4µm wide, hyaline, thin to slightly thick-walled, septate, without clamps, commonly branched, skeletal hyphae 5-8 µm wide, sparsely branched, hyaline; pseudocystidial hyphae 4-6 µm wide, yellowish brown, thick-walled, often secondarily septate; cystidia of two kinds, both numerous; pseudocystidia more than 120 µm long, 7.2-9 µm wide, yellowish brown, thick-walled except the apex; acanthocystidia 24-30 x 3.2-4 µm, hyaline, thin-walled, with few protuberances near the apex; basidia 24-28 x 4-5µm, narrowly clavate, 4-sterigmate; spores (4.9-)5-7.5(-7.6) x 1.8-2.6µm, L=6.85µm, W=2.2 µm, Q=3.11 (n=20/2) narrowly ellipsoid to cylindrical, amyloid.

**Specimens examined**: (UK) Uttarkashi, Seema, on stump of *Cedrus deodara,* 27 Sept. 1996, JRS 13003; *ibid,* Rudraprayag, Nannu, dead trunk of Oak, 05 Sept. 1997, JRS 5207; *ibid,* Chakrata, Deoban, on *Abies,* 13 Sept. 2011, DM 3006; *ibid,* Bageshwar, Dhakuri, on *Quercus*, 26 Aug. 2009, DM 1003; *ibid,* Hanumaan Chatti, Uttarkashi, on dead wood, 22 Sept. 2012, DM 1004; (HP) Kajihaar, on stump of Oak tree, 23 Oct. 2014, DM 2056.

**Habitat & Distribution:** On dead branches and rotting tree trunks; causing a white fibrous rot of wood; a common species in the temperate to subtropical areas.

**Geographical distribution:** Common in both hemispheres, but perhaps more common in warm regions. From Mexico to Brazil, and on the Caribbean islands.In North America, Mexico, Guatemala, Costa Rica, Windward islands, Colombia, Brazil, Central and South America, Africa, Asia, Australasia

**India:** Uttarakhand, Himachal Pradesh.

**Remarks:** Large fruitbodies, radiately even pilei, and the presence of acanthocystidia distinguish this species from *S. hirsutum. Stereum versicolor* can be distinguished from other members of subg. *Aculeatostereum* by its annual basidiomata, habitation of hardwoods, and small basidiospores. In the Northeast *S. versicolor* can be confused with the *S. hirsutum*. *Stereum versicolor* however, possesses pseudoacanthohyphidia which are not found in the *S. hirsutum* complex.

## Excluded species

The following species of *Stereum* have also been reported from India but do not belong to the genus for the reasons given below:

***Stereum adustum*** Lév.
(Banerjee 1953, from Andaman and Nicobar islands)
= ***Hymenochaete adusta*** (Lév.) Har. & Pat.

***Stereum bicolor*** (Pers.) Fr.
(Rehill & Bakshi 1965 from Chakrata, Kullu, West Bengal)
= ***Laxitextum bicolor*** (Pers.) Lentz

***Stereum coalescens*** Lloyd
= an abnormal state of some terrestrial, brown fleshed polypores (Reid 1965) from Almora, Uttarakhand).

***Stereum curreyi*** Sacc.,
This species not a *Stereum* but belongs to ***Nidularia emodensis*** (Berk.) Lloyd (Reid, 1962, 1965)

***Stereum fuscum*** (Schrad. ex J.F. Gmel.) P. Karst.,
= ***Laxitextum bicolor*** (Pers.) Lentz (Banerjee, 1935 from Nilgiris and West Bengal)

***Stereum karstenii*** Bres.
= ***Dacryobolus karstenii*** (Bres.) Oberw. ex Par. (Rehill & Bakshi 1965 from Chakrata)

***Stereum medicum*** Curr.,
= ***Hjortstamia medica*** (Curr.) Hjort. & Ryv. (Massee 1891 from Sikkim)

= ***Porostereum spadiceum*** (Pers.) Hjort. & Ryv. ***Stereum spadiceum*** Fr.,

Following *Stereum* species were also reported from India but no description and/or authentic specimens were found in the field or in the herbaria.

**Stereum alternum** Lloyd
(Banerjee, 1935 reported from West Bengal, Darjeeling)

***Stereum endocrocinum*** Berk.
(Banerjee, 1935 reported for West Bengal-Behala)

**Stereum notatum**, B. & Br.
(Bagchee & Singh 1960, from temperate zone of Himalaya)

***Stereum papyraceum*** Massee,
(Massee in Kew Bulletion (l.c) on the basis of specimens collected by E. J. Butler from Khasi hills, Assam)

**Xylobolus** Karst. Emend Boidin
Revue Mycol. 23: 340-41, 1958.

Basidiocarps resupinate, effused-reflexed or pileate, annual or perenninal, stratose; pilear surface concentrically zonate, hard; hymenial surface smooth to finely tuberculate, rarely cracked; hyphae dimitic, skeletal hyphae light brown, generative hyphae with or without clamps; hymenium generally stratose with acanthocystidia; hymenial cystidia present, incrusted; gloeocystidia present or absent; basidia clavate, 4-spored; spores ellipsoid, thin-walled, smooth, amyloid; lignicolous.

This is a satellite genus to *Stereum* and above all resembling the subgenus *Acanthostereum* introduced by Boidin *et. al*. 1979. The type of *Xylobolus* is however, separated from *Stereum* by its vertically arranged hyphae and by the pseudocystidia (or oleiferous hyphae) turning greyish black in sulphovanillin. It has also an intense white pocket rot of a type unknown in *Stereum*. Other characters match the concept of *Stereum* e.g. simple septate hyphae, occurence of acanthocystidia, and smooth, amyloid spores.

**Type species:** *Thelephora frustulata* Pers.

**Key to species**

1. Gloeocystidia present; basidiocarps effused-reflexed ……***X. ahmadii***

1. Gloeocystidia absent ; basidiocarps resupinate to pileate……..……2

2. Basidiocarps resupinate, often breaking into frustules; hymenial surface pale yellow, becoming yellowish brown with age; incrusted cystidia absent ……***X. frustulatus***

2. Basidiocarps pileate, not breaking into frustules; hymenial surface pale or grey brown; incrusted cystidia present ……..…..……***X. subpileatus***

**Xylobolus ahmadii** (Boidin) Boidin

Revue Mycol., Paris 23: 341 (1958); *Stereum ahmadii* Boidin [as 'ahmadi'], Biologia, Lahore 2: 217 (1956)

**Type locality:** Pakistan. **(Fig. 74)**

Basidiocarps perennial, woody, stratose, effused-reflexed, often attached by a narrow base; pileus up to 100 mm long and up to 70 mm broad, up to 6 mm thick at maturity; upper surface dark brown, azonate to concentrically zonate; hymenial surface greyish white, smooth to

somewhat even, occasionally cracked, never forming frustules; margin pale brown, black with KOH solution; context very thin, composed of compactly arranged hyphae, light brown.

Hyphal system dimitic, generative hyphae 3-4 µm wide, septate, clamped, thin-walled, hyaline, skeletal hyphae 3-6 µm wide, unbranched, thick-walled, pale-brown; gloeocystidia 30-180x5-10 µm, cylindrical, with a clamp at the base, staining deeply with phloxine; acanthocystidia 20-35 x 2-4 µm, clavate to cylindrical, beset with spines-like processes, spines up to 1 µm long, concentrated on the apical part; basidia 20-25 x 3.5-4.5µm, narrowly clavate, 4-sterigmate; spores ellipsoid, minutely apiculate, (4.2-) 4.5-5.5 (-5.6) x 3-3.5µm, L=5.30µm, W= 3.35 µm, Q=1.58 (n=20/2) thin-walled, smooth, amyloid.

**Specimens examined :** (UK) Champawat, Mount Abbot, rotting stump of *Cedrus deodara*, 10 Sept. 2002, JRS 8713; *ibid*, Dehradun, Dhanaulti, rotting trunk of Oak, 25 Sept. 1992, JRS 881; *ibid*, Almora, on the way to Jageshwar temple, rotting log of *Abies pindrow*, 04 Aug. 2012, BSD, DM 328; (HP) Shimla, Narkanda, hardwood stump under mixed forest, 19 Aug. 1971, PAN 5625.

**Habitat & Distribution:** On the underside of small, dead branches of living coniferous trees particularly *Abies, Cedrus*, and also on Oaks in the temperate Himalayan forests.

**Geographical distribution:** Pakistan, New Zeland, Southern Canada and northern parts of USA.

**India:** Uttarakhand, Himachal Pradesh.

**Remarks**: This species is widely present on both types of woods. The woody texture of the distinguishing features of this species. Presently species on the basis of phylogentic and molecular data has been treated as *Acanthofungus ahmadii* (Boidin) Sheng H. Wu, Boidin & C.Y. Chien.

**Xylobolus frustulatus** (Pers.) P. Karst.,

Meddn Soc. Fauna Flora fenn. 6: 11 (1881); *Thelephora frustulata* Pers., Syn. meth. fung. (Göttingen) 2: 577 (1801); *Thelephora frustulosa* Pers., Syn. Fung. 577,1801; *Stereum frustulosum* (Pers.) Fr., Epicr. 552, 1838.

**Type locality:** Europe. **(Fig. 75)**

Basidiocarps woody, perenninal, resupinate, often arising as small circular colonies which become effused-reflexed with age, up to 4mm wide, 4-6mm thick with age; upper surface black, crust-like, concentrically sulcate, glabrous; hymenial surface smooth to somewhat uneven, pinkish to pale yellow when young yellowish-brown with age, smooth, deeply creviced to almost broken forming polygonal to irregular frustules, frustules remain attached to the substratum by

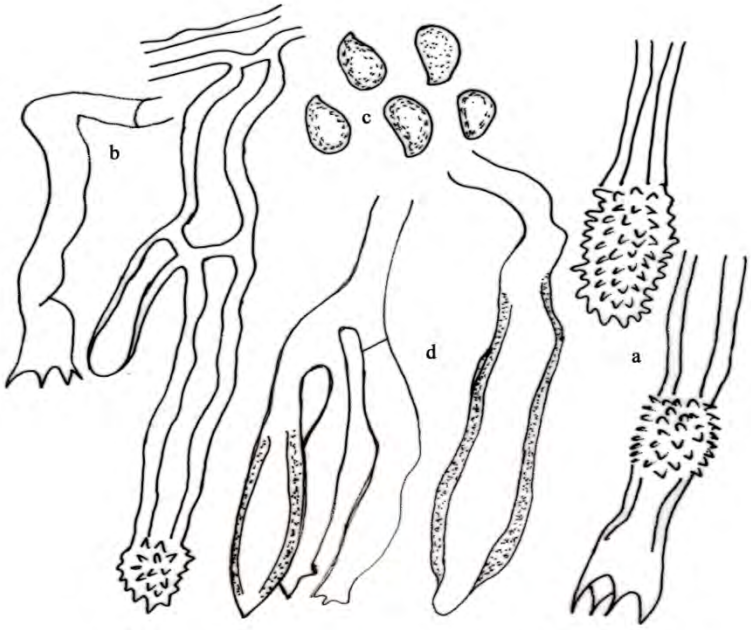


**Fig. 74:** *Xylobolus ahmadii:* a) acanthocystidia, b) basidium, c) spores, d) gloeocystidia.

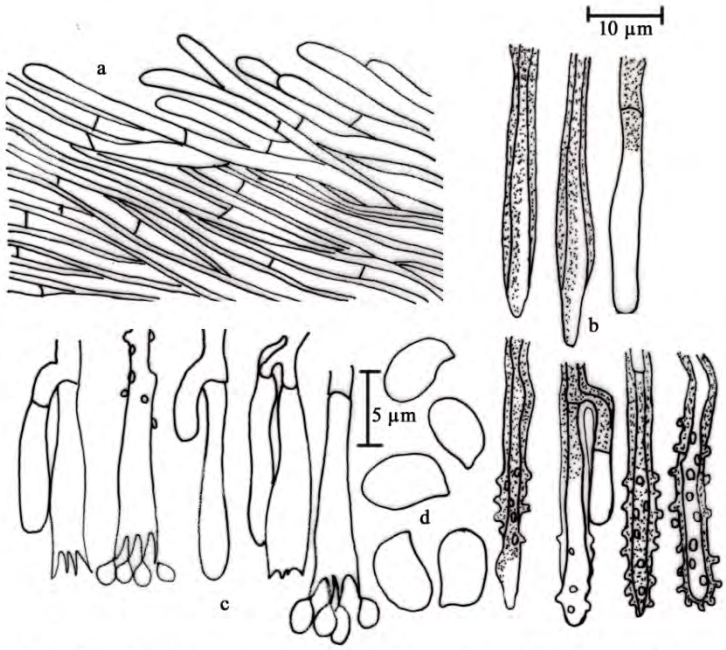


**Fig. 75.** *Xylobolus frustulatus:* a) section of tomentum, b) acanthocystidia with protuberances, c) basidia, d) spores.

the narrow base and continue to grow making the margin slightly raised; margin darker; context yellowish-brown, composed of compactly arranged to more or less agglutinated hyphae.

Hyphal system dimitic, generative hyphae 2-3 µm wide, branched, septate, clamps absent, skeletal hyphae 3-4.5 µm wide, unbranched aseptate; cystidia or gloeocystidia absent; acanthocystidia 25-30 x 3-5 µm broad, clavate to clavate-cylindrical, beset with numerous spines in the upper part, pale brown; basidia 25-30 x 4-5 µm, clavate-cylindrical, 4-spored; spores 4-5.5 (-5.7) x 2.5-3.5 µm, L=5.3 µm, Q=1.66 (n=20/2) ellipsoid, smooth, amyloid, thin-walled, shortly apiculate.

**Specimens examined:** Sikkim, Gangtok, Near BSI campus, on rotting stump of *Quercus* 16 Oct. 2011, BSD DM 30007; (HP) Chamba, Dalhousie, on stump of *Cedrus deodara*, 16 Aug. 1966, PAN 5169; *ibid,* Kullu, Pulga, coniferous trunk, 10 Sept. 1994, JRS 1124; (UK) Uttarkashi, Mangi, rotting coniferous log, 05 Sept. 1996, JRS 2010; *ibid,* Chakrata, Deoban, on *Abies,* July, 09, 2018, DM 433 & DM 411; *ibid,* Bageshwar, on *Abies,* 08 Aug. 2010, DM 2083 & DM 2074.

**Habitat and distribution:** *Xylobolus fruslulatus* grows most frequently on old decorticated stumps, branches and logs of deciduous trees, mainly of the genus *Quercus* finding the most favourble conditions for development on old oak logs that have been laying in the forest for a long time. Furthermore the specimens were recorded also on *Betula*, *Castanea*, Pinus, Cedrus and Abies by other researchers.

**Geographical distribution:** *Xylobolus frustulatus* is a widespread species, known from Europe **(**Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Normay, Spain and Sweden), Asia Iran, Japan and Thailand), North America(Canada, Mexico and the united states) and Australia, Noryway and Finland

**India:** Himachal Pradesh, Uttarakhand, Sikkim.

**Remarks :** This species is easily recognized by its occurrence in small convex fruitbodies of woody consistency usually crowded on the underside of logs of both coniferous and hardwoods.The bottle brush-like acanthocystidia and zoned hymenium also add to its distinguishing features. It is widely spread throughout western Himalaya and causes white pocket rot. *Xylobolus frustulatus* is associated with a white rot of *Quercus* and other angiosperms throughout the Himalaya. In phytopathological literature this characteristic and easily recognised species is cited as a serious destroyer of wood of *Quercus* spp.

**Xylobolus subpileatus** (Berk.& Curt.) Boidin

Revue Mycol. **23:** 341, 1958; *Stereum subpileatum* Berk. & Curt., Hook. J. Bot. **1**: 238, 1849.

**Type locality:** South Carolina, South eastern United States. **(Fig. 76)**

Basidiocarps thick, perenninal, corky, drying rigid, woody, effused-reflexed to pileate, sometimes laterally confluent forming large patches, up to 400mm broad,150mm long and up to 5 mm thick and attached by umbos; pileus small to quite large, irregular, flabelliform to dimidiare; upper surface concentrically sulcate, somewhat zonate, cinnamon to blackish brown, tomentose when young, soon becoming hard with a bark-like rind; margin paler, acute, entire; hymenial surface smooth to tuberculate, yellowish-brown; context light brown, composed of compactly arranged parallel hyphae with a denser and darker crust on the abhymenial side.

Hyphal system dimitic, generative hyphae up to 3 µm wide, septate, branched, skeletal hyphae up to 4 µm wide, aseptate, unbranched, projecting into the hymenium as skeletocystidia; cystidia present, immersed or projecting slightly beyond the hymenium, incrusted, 30-60 x 5-8 µm, slowly becoming coloured with age; acanthocystidia 25-35 x 3-5 µm, clavate-cylindrical, sub-hyaline to brownish, moderately thick-walled, often covered with spines; gloeocystidia absent; basidia 15-22.5 x 3-4.5 µm, clavate-cylindrical, 4-spored; spores (3.8-) 4-5 (-5.2) x 2-3 µm, L= 4.8 µm, W= 2.6 µm, Q=1.84 (n=20/2) hyaline, smooth, shortly apiculate, amyloid.

**Specimens examined:** (HP), Shimla, Bagi, trunk of standing Oak tree, 20 Sept. 1994, JRS 827; (UK) Bageshwar, Dhakuri, dead fallen trunk of Oak, 30 Sept. 1998, JRS 6018; *ibid,* Chakrata, Deoban, on *Abies*, 29 Aug. 2018, DM 409 & 427; *ibid,* Bageshwar, Dhakuri, on *Quercus* stump, 27 Sept 2010 DM 2062 & DM 2054; *ibid,* Dehradun, Mussoorie, standing trunk of Oak, 07 Aug. 1996, JRS 882.

**Habitat & Distribution:** Associated with white pocket rot, It occurs on living hardwood substrata, mainly oaks. It is one of the commonest fungus in the North-western Himalayan forests and is associated with white pocket rot of Oaks. The pocket rot produced by this species is essentially the same as for *X. frustulatus* when the mycelium is active, the colonized wood may show dark violet stains, and often has an unusual, disagreeable odor.

**Geographical distribution:** Europe (Austria, Macedonia, Russia, Spain); Middle East (Israel); East Asia (China, Japan, Nepal); North America (Canada, Cuba, Mexico, USA); South America (Colombia, Costa-Rica, Venezuela), Netherland, West Indies.

**India:** Uttarakhand, Himachal Pradesh, Sikkim, West Bengal.

**Remarks:** The characteristic large woody fruitbodies with sulcate pilear surface and smooth whitish hymenial surface, coupled with encrusted cystidia, skeletocystidia and acanthocystidia easily recognize this species. *Xylobolus subpileatus* differs from *X. frustulatus* in having a normally effuso-reflexed growth form, and in the production of encrusted pseudocystidia and acanthohyphidia. At first glance basidiomata may be mistaken for species of *Stereum* in the field; however the thickness, corky to hard texture, and tuberculate, cracked hymenial surface should distinguish it.

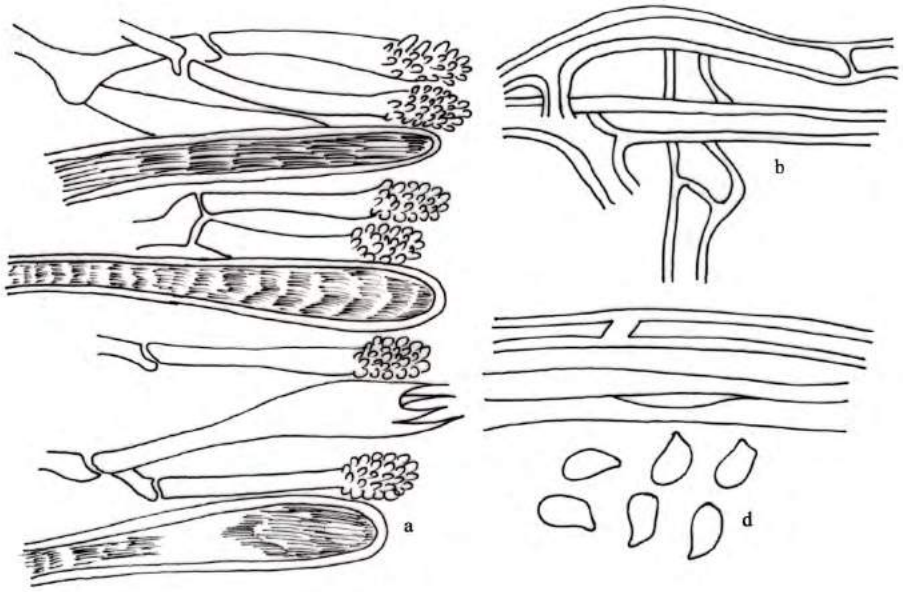


**Fig. 76:** *Xylobolus subpileatus:* a) hymenium showing basidium, acanthophyses and cystidia, b) generative hyphae, c) skeletal hyphae, d) spores.

## Summary

The Stereoid fungi are a group of organisms belonging to order Aphyllophorales and utilize wood as a nutrient source by means of enzymatic digestion of wood cell walls. The present project entitled "**Revision of Indian Stereaceae**" was taken up to investigate fungi belonging to this group from Indian subcontinent. The presentation is mainly based on the thorough study of the specimens collected in the field by the author from all phytogeographical zones of the country for the last three years( 2017-2020). Additionally, the author also utilized extensively, the herbarium material and voucher specimens accumulated in the Indian Herbaria viz. AHMA, AMH, DD, HCIO, PAN BSA, BSIS, CAL, MH, BSD, BSHC, PBL, BSI, ASSAM, TBGT and PUN as well as numerous collections sent by students and researchers working in different regions of the India.

During the tenure of this project the author had an opportunity to survey many inadequately or under explored areas in the different phytogeographical zones of the country. The extensive surveys led to the collection of about 547 field numbers belonging to the Stereoid fungi under consideration of this project. All the specimens were dried under sunlight and kept in brown papers packets with Napthalene balls. The identified specimens were preserved well in the Cryptogamic section of Botanical Survey of India Northern Regional Centre (BSD) Herbarium at Dehradun. The detailed studies of macroscopic and microscopic characters of all the specimens in the laboratory have identified them to 71 species under 14 genera.

A composite key based on the distinguishing characters of the species has also been given for all the 14 genera and 71 species. Each species has been provided with the latest taxonomically correct name with a full citation and basionym if any. Also mentioned are the distinguishing characters of each species under remarks. The worldwide distribution of each species follows its distribution in the Indian subcontinent. The important distinguishing microscopic characters are depicted with the help of line drawings. During this study two new combinations have been proposed.

Nearly 04 species (c. 6 %) grow on ground, while the remaining 67 species (c. 94 %) are lignicolous. Both angiospermic and coniferous woods provide the major hosts for these fungi. Out of the 67 lignicolous species, 44 (*c*.66%) grow on angiosperms, 9(*c*.13%) on conifers while the remaining 14(*c*. 21%) prefer both type of woods. All the lignicolous species grow on the woody substrate lying on the ground. Interestingly the rich stereoid fungal flora can be gauged by the fact that nearly 64% of genera and 57% species are represented in all phytogeographical zones of India. *Gloeocystidiellum* with about 22 species is the largest and widely distributed genus in India followed by *Stereum* (11) *Aleurodiscus* (10), *Podoscypha* (6) and *Hjortstamia* (4) .Only about 5% of these fungi appear to be endemic to India

.

In the forests, species of Stereoid fungi are very prominent in decomposing dead timber. In general, these fungi occupy wood while it is still in a reasonable sound condition and are among the earlier links in the chain of humus-producing organisms.

The Stereoid fungi cause white rots and play an important role in degradation of wood material and thus take part in carbon recycling of the forest ecosystem. Most of them cause white rot on hardwoods but certain species like *S. sanguinolentum* have various degrees of substratum affinities and are specialized for the growth on coniferous trees. A best known caused by *Chondrostereum purpureum* is the silver leaf disease and is especially prevalent among woody Rosaceae, particularly plums and apples. *Xylobolus subpileatus* is among the most important of the organisms that cause heart rots of living oaks and then continue to grow in the infected wood after the trees have fallen.

# Abbreviations

| | |
|---|---|
| alt. | altitude |
| BC | before Christ |
| ca. | circa |
| cm | centimeter |
| e.g. | from Latin exempli gratia |
| et al. | from Latin et alii / et aliorum |
| Fig. | figure |
| ha. | hectare |
| km | kilometer |
| $km^2$ | square kilometer in area |
| KOH | Potassium hydroxide |
| µm | micrometer |
| m | meter |
| mm | millimeter |
| Mt. | mountain |
| s.l. | from latin sensu lato |
| sp. | species (with undetermined epithet) |
| sp. nov. | from Latin species nova |
| spp. | species in plural |
| Tab. | table |
| var. | from Latin varietas (variety) |
| °C | temperature degree in Celsius |
| % | percentage |
| UK | Uttarakhand |
| TN | Tamil Nadu |
| HP | Himachal Pradesh |
| AP | Arunachal Pradesh |
| JK | Jammu & Kashmir |
| WB | West Bengal |

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