HYMENOCHAETACEAE OF INDIA

J.R. SHARMA

BOTANICAL SURVEY OF INDIA

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Cover Photo : *Phellinus pachyphloeus* (Pat.) Pat. A serious parasite on a variety of angiospermous hosts especially *Ficus* and *Mangifera* in the plains of India.

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FOREWORD

In recent years the Botanical Survey of India has made innumerable contributions in the field of systematics of Indian Flora. It has not only intensified its work on survey and documentation of floras at National, Regional and District levels but has also financed projects in a few Research and Educational Institutions, in these disciplines, to expedite the task.

During all these years while the Cryptogams, in general received lesser attention, an effort had always been underway to streamline studies on these groups as well, especially lichens, fungi, bryophytes and pteridophytes. Among the cryptogams, the fungi, with about 13,000 species known to occur in India, constitute a major group of plants in the country almost equalising the number of species in flowering plants. Because of their paradoxical status of being both 'friends' and 'foes' of mankind and the economic significance it assumes thereby, the need for bridging any gap in the knowledge of floristics and taxonomy of fungi can not be over emphasized.

I am happy that Dr. J. R. Sharma, a scientist of our department, has been engaged in studies on 'Woody Fungi' (Aphyllophorales) for more than a decade now. His present work on Hymenochaetaceae a large and diverse group of wood rotting fungi, is a first major contribution from the Botanical Survey of India on fungi. Every aspect of this treatise proclaims the sound knowledge of Dr. Sharma and reflects his long experience of working on this interesting group of plants. I congratulate him for acomplishing this arduous yet masterly task exceedingly well.

I hope that this book would serve as a useful reference guide as well as identification manual, and will be welcomed by the students, mycologists, agriculturists and foresters all over the world.

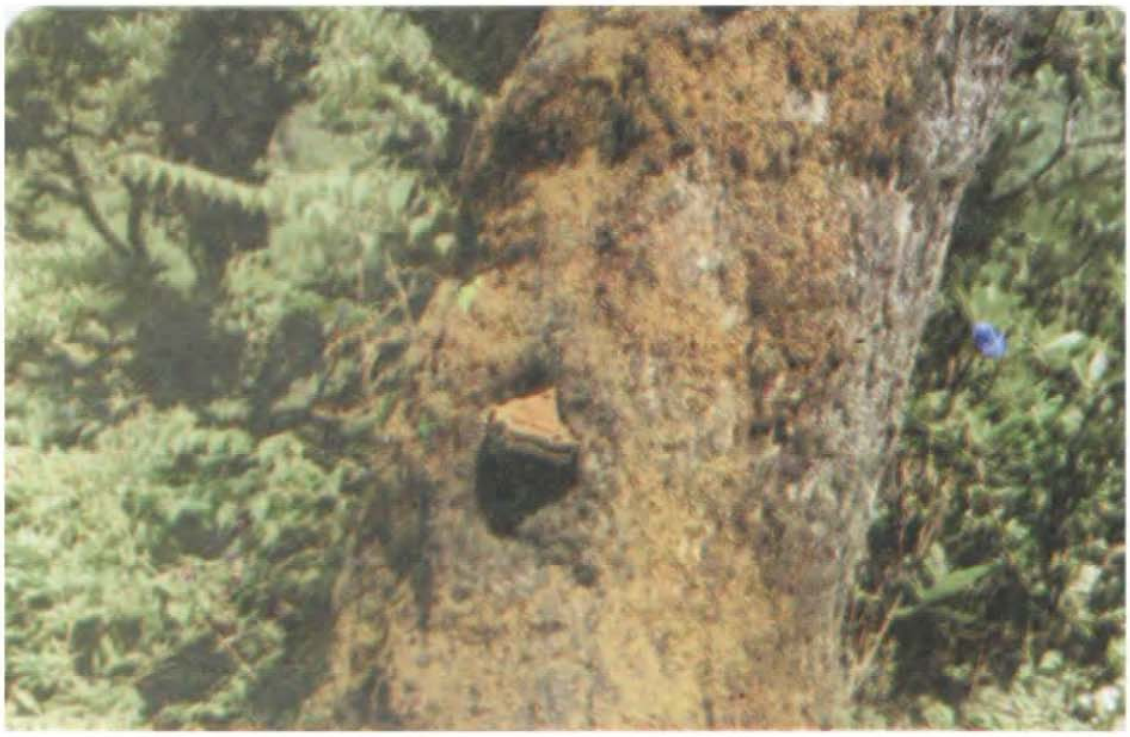
Botanical Survey of India
P-8 Brabourne Road
Calcutta 700 001.

P. K. Hajra
Director

1. *Inonotus tenuicarnis* Pegler & Reid. A widely distributed polypore from warmer temperate to subalpine forests.

2. *Inonotus patouillardii* (Rick.) Imaz. A rare species causing butt rot of Oaks.

3. *Inonotus cuticularis* (Bull. : Fr.) Karst. A common species on *Quercus semicarpifolia*



4. *Inonotus flavidus* (Berk.) Ryv. A cosmopolitan polypore in Western Himalayas.

5. *Inonotus dryadeus* (Pers. : Fr.) Murr. A common temperate polypore on Oaks.

6. *Phellinus allardii* (Bres.) Ahmad One of the commonest species of polypore in Himalayas on Oaks only.

7. *Phellinus badius* (Berk. : Cke.) Cunn. A serious parasite on *Acacia catechu* in tropical forests.

8. *Phellinus extensus* (Lev.) Pat. A rare subtropical to temperate species.

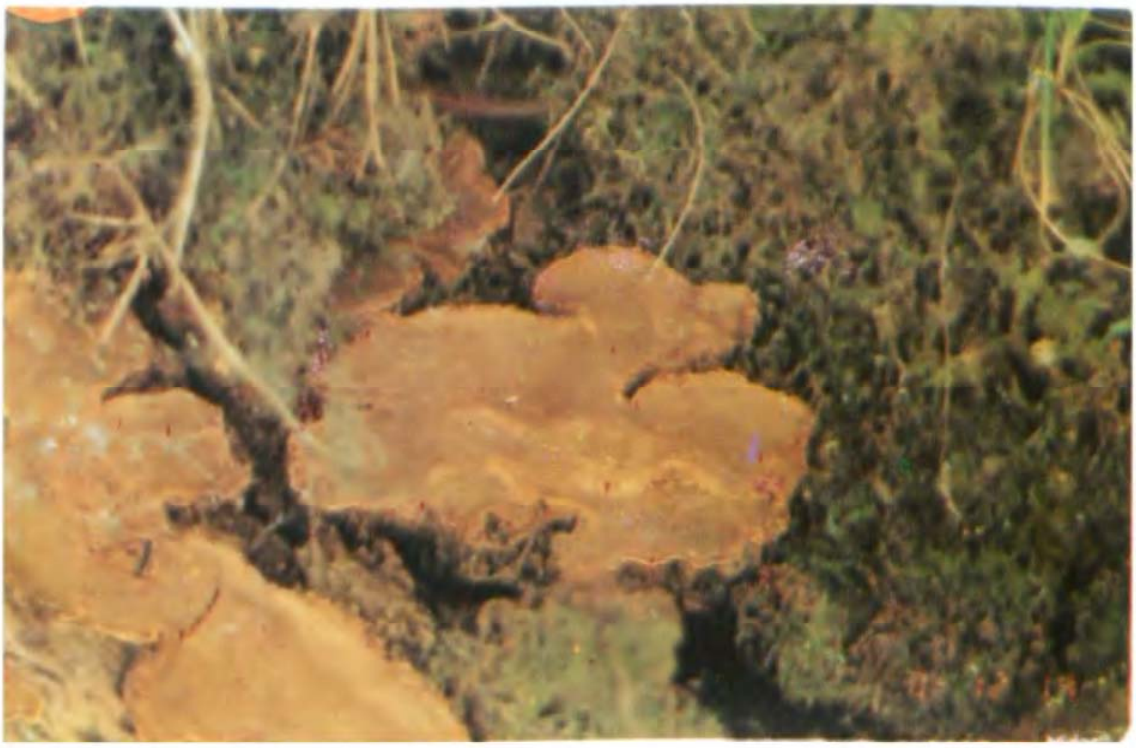
9. *Phellinus ferreus* (Pers.) Bourd. & Galzin : A common resupinate polypore on dead thin branches of hardwoods in temperate forests.

10. *Phellinus gilvus* (Schw. : Fr.) Pat. A widely spread species both on living and dead angiospermous hosts.

11. *Phellinus igniarius* (L. : Fr.) Quel. A serious parasite on hardwoods in temperate boreal zones.

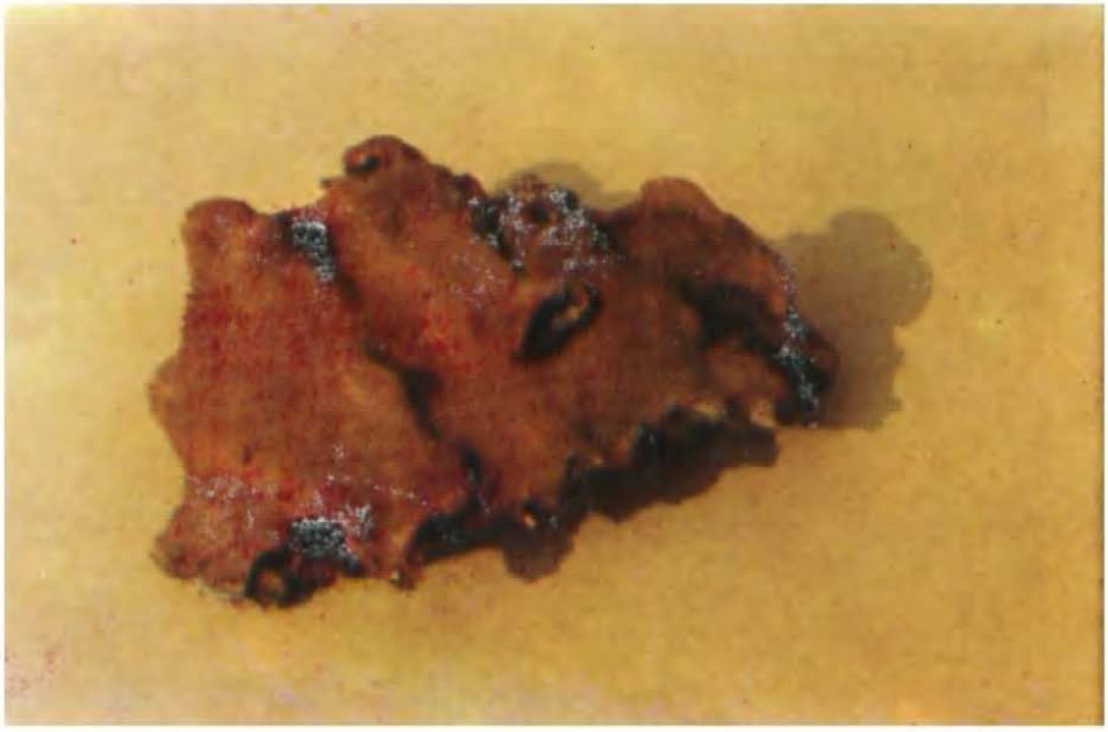
12. *Phellinus laevigatus* (Fr.) Bourd. & Galzin : Grows exclusively on living or dead *Betula utilis*.

13. *Phellinus pachyphloeus* (Pat.) Pat. A serious parasite on a variety of angiospermous hosts especially *Ficus* and *Mangifera* in the plains of India.

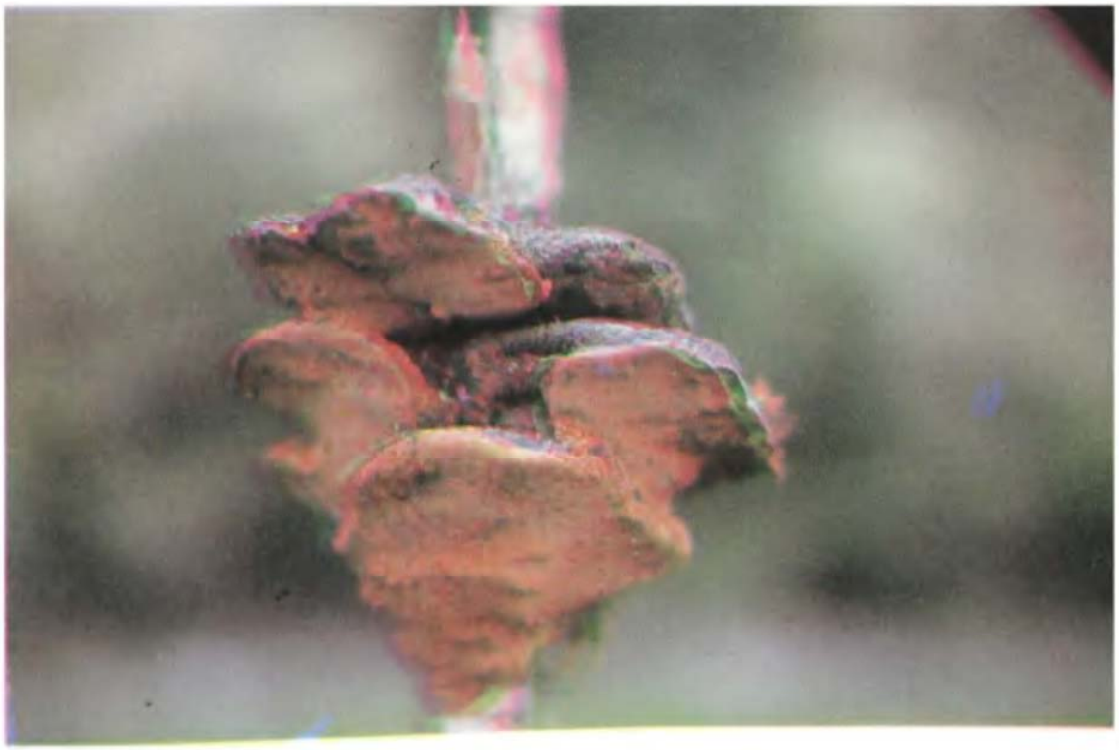


14. *Phellinus pectinatus* (Kl.) Quel. A widely spread polypore growing on hardwoods only.

15. *Phellinus pini* (Thore : Fr.) Ames : A serious parasite on Himalayan conifers especially *Pinus wallichiana*.



16. *Phellinus purpureogilvus* (Petch) Ryv. A common resupinate polypore on dead or living angiospermous woods.



17. & 18. *Phellinus sandfordii* (Llyod) Ryv. A characteristic species of tree line in Himalayas occurring only on angiospermous trees.

19. *Phellinus robustus* (Karst.) Bourd. & Galzin : A common and a serious parasite on Abies pindrow.

20. *Phellinus linteus* (Berk. & Curt.) Teng : Widely spread on living or dead angiospermous trees.

21. *Phellinus xeranticus* (Berk.) Pegler : One of the commonest polypore in the temperate Himalayan zones.

22. *Phylloporia weberiana* (Bres. & Henn. : Sacc.) Ryv. A common species on living or dead branches of Oaks.

Introduction

This manual is intended to cover fungi having different kind of hymenophore but with distinct brown basidiocarps turning permanently black in KOH. The earlier reports of hymenochaetaceous fungi from India dates back to Montagne (1842, 1846); Berkeley (1954); Llyod (1898-1925) and Theissen (1911). However, Bose (1924, 1925, 1934, 1937, 1946); Bagchee *et al* 1954, Bakshi 1971 and Rattan 1977 were among the pioneer Indian workers giving accounts of many species belonging to Hymenochaetaceae. In addition, there are some other scattered reports on these fungi from India by : Bagchee (1957, 1961); Bagchee and Bakshi (1950); Bagchee & Singh (1960); Bakshi (1957); Bakshi *et al* (1963); Banerjee (1935, 1947); Ganesh and Leelavathy (1986); Lowe (1963); Pegler (1964a, 1967); Reid *et al.* (1958, 1959); Roy (1979); Ryvarden and Dhanda (1975); Sharma (1989, 1993, 1994a & b); Sharma and Wright (1989); Sharma & Ghosh (1989); Thind & Adlakha (1956), Thind & Chatrath (1960); Thind & Dhanda (1979, 1980a & b); Thind & Rattan (1971a & b, 1973) and Thind *et al* (1970). These reports, however do not cover the entire specific composition of Hymenochaetaceous fungi and in majority of cases, owing to the extremely inadequate or incomplete descriptions, the species of Hymenochactaceae cannot be determined. The author's main objective in the given work is to present the specific composition of Hymenochaetaceae in India and also possibly to give full information about their morphology, biology, distribution and systematization.

The information compiled in this manual from the fields of taxonomy, morphology, and ecology of these fungi is based on the material collected extensively during the period 1980-1994 by the author from different regions of the country. The material collected by the author aggregated to about 2500 specimens belonging to 98 species. Apart from this, the author also utilized extensively, the herbarium material accumulated in other Indian Herbaria viz. PAN, CAL, DD, BSD, HCIO and AMH.

Though, the author has strived to make his work sufficiently complete and assimilable by wide circles or researchers of corresponding institutes but inspite of such a significant amount of accumulated material, the results of my investigations cannot all the same reflect either the completeness or the diversity of species composition of these fungi, as the huge territory of India has not so far been sufficiently explored in this respect.

The genera have been placed alphabetically. The description of each genus comprises 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 basionyms. Only those synonyms, are given which have been recorded from India by earlier workers. For each taxon, the accepted name has been recorded with authority, its date and place of publication. The abbreviations of the names of author follows Hawksworth (1980). The description of each species contains the characteristics of macroscopic and microscopic structures of the basidiocarps. 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. The final notes of each description present the most typical features of fruitbody by which the latter may be readily distinguished from those of similar species. With a few exceptions, the illustrations of microscopic morphology of basidiocarps are derived from the author's material collected from India. Drawings were made with a camera lucida. Colours are quoted from Kelly & Judd (1955).

COLLECTING

Fruitbodies of Hymenochaetaceae are most frequently observed on old living trees in forests, parks, roadsides, on fallen and broken trees and dead branches, on old stumps and timbers. For less frequently, the fruitbodies grow on ground (genus *Coltricia*). The best appropriate time for making fresh collections is during July to September or up to middle of October. This is the period of their highest development and viability. At this period mostly young fruitbodies grow, whereas, on perennial fruitbodies, a new hymenophore layer develops. Though, the fruitbodies of these fungi are woody and coriaceous and can also be found during winter of summer season but they are generally devoid of both spores and hymenophore layer. The collections should be made with as little a damage to the basidiocarps ensuring that each specimen is cut from the substrate with a piece of wood to help in recording the associated rot. In order to remove the perennial fruitbodies growing on wood, it is advisable to use a small axe. It is desirable that several specimens of young and mature basidiocarps of each species should be collected. While collecting widely varying species, efforts should be made to collect them in all their variety of forms. Each collected specimen must be provided with correct field information regarding name of place, type of forest, date of collection, habitat, name of host and its parts on which the fungus is growing, colour in fresh, colour change on bruising and wood rot. This is usually supplemented by a probable name of the species or atleast the genus. The degree

of occurrence is also recorded. It is quite convenient to place each specimen equipped with labels in a paper bag which in turn is folded at the top and transported to camp site in a rucksack.

After return from field collections, the work of sorting out should be taken up quickly. First of all, the collected specimens should be spread out freely on the floor or on the table. Though, it is not easy to obtain spore prints from all the specimens but in certain cases, they can be obtained by placing a strip of black paper under the hymenophore surface for 10-12 hours. The dried basidiocarps may be moistened by wrapping a wet newspaper around them overnight before placing them on the spore print paper. The spore prints are then stored alongwith the specimen in paper bags.

DRYING

Basidiocarps of Hymenochaetaceae have a leathery or woody, perennial consistency and usually do not require special drying, but due to humid monsoon conditions, it is essential to dry them quickly in order to kill the insect larvae and avoid the growth of the molds, etc. In dry conditions, the fruitbodies are spread in the sun and wind or even kept at room temperature conditions alongwith the labels. As it is not convenient to carry electric drier or hot air ovens in the collecting areas, so the larger specimens are better dried by keeping them near the moderate hot air produced by kerosene wick-type stove or by burning fire-woods in the camp. The dried specimens should be placed in fresh paper bags and their tops tightened with a rubber band. It is advisable to put one or two naphthelene balls in each packet to avoid any damage by insects especially to the annual fruitbodies.

DETERMINATION

While investigating a fungus in the laboratory, first of all with naked eyes or with the help of a ten fold pocket magnifying glass, the dimensions of the fruitbody, the form of pileus, the characters of its surface (smooth, zonate, scaly, wrinkled, etc.) shape and size of pores, consistency and thickness of context and tubes, are required to be determined. In view of the wide variability of macroscopic features of fruitbodies, their microscopic morphology which being rather stable, is decisive and necessary to reach a reliable determination.

For microscopic examination of the basidiocarps, the specimens are sectioned along the tubes with razor blades for noting down the shape, size, and dimensions of hyphae, spores, basidia and various setal elements. Samples from various parts of basidiocarps should be taken for cutting thin sections as recommended by

Teixeira (1962). Thin sections are mounted in 5% KOH plus a drop of 1% aquous solution of Phloxine. The sections mounted in 5% KOH, can easily be squashed with a gentle tap on the cover slip and it facilitates the recording of hyphal morphology and dimensions. The spore measurements are taken from thin sections or hymenial squashes and should mostly be based on the of observation on spores not yet detached from their basidia. All measurements of microscopic structures have been made in 5% KOH. Thin sections are also mounted in lactophenol for increasing clarity and transparency of sections as it is more convenient to observe the occurrence, size and shape of setal elements in the hymenium, dissepiments, context and on the pilear surface. For recording Iodine reaction, the sections are mounted in Melzer's reagent. Spores and hyphae are said to be amyloid if they turn grey or blue and dextrinoid if reddish brown. A negative reaction with Melzer's is noted as IKI-.

The formulae of the chemicals used are as follows :

KOH	:	5 gm KOH in water.
Lactophenol	:	5 gm lactic acid, 5 gm phenol in 10 ml glycerine and 5 ml water.
Phloxine	:	1 gm phloxine in 100 ml water
Melzer's Reagent	:	0.5 gm Iodine, 1.5 gm potassium iodide,
	:	22 gm chloral hydrate in 20 ml water.

STORAGE

After the fungi are determined, they are placed in the herbarium. Each collection is laid down in a thick brown paper packet or envelope with corresponding field notes pasted on it. These envelopes can be prepared by taking a leaf of brown paper and bend it so that a strip of paper, approximately 5-6 cm remains uncovered at the top. Then this strip is folded on the narrower half and 5-6 cm of the lateral edge is turned back on the reverse side. These envelope-like packets are then arranged genus-wise in card board boxes (20" x 10" x 8") like index cards. The card board boxes in turn are placed permanently in steel cupboard. To protect; the collections from insect damage, it should be ensured that the disinfection is done annually just before the rainy season by putting 2-3 naphthelene balls in each packet. All the collections made by the author during the past 14 years have been deposited in the Cryptogamic herbarium, Botanical Survey of India, Howrah (CAL); and Botanical Survey of India, Dehra Dun (BSD). A sizeable part of many collections has also been sent to Department of Biology University of Oslo, Norway (O) and Departmento de Ciencies, Biologicas, Boenos Aires, Argentina (BAFC).

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. To the three genera of Polyporaceae listed by Persoon, he added the genus *Polyporus* (First proposed by Micheli in the eighteenth century) and made an attempt to separate Boletaceae from Polyporaceae. Two-third of the known species of Polyporaceae were placed under the genus *Polyporus*. This genus was divided into sections and sections into sub-genera. The same arrangement was continued in his "Epicrisis Systema Mycologicum" (1836-38). In the meantime many genera like *Cyclomyces, Trametes,* etc. were carved from the old genus *Polyporus*. In the last of his major works i.e. "Hymenomycetes Europaei" (1874), adopting Persoon's system, the Hymenomycetes were divided into five families :

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

B. Hymenio laevigato
   - IV. Horizontali infero = Thelephorei (5 genera)
   - V. Verticali amphigeneo = Clavariei (6 genera)

Fries families from II to V included 32 genera and later on constructed the order Aphyllophorales (Donk 1964, 1971). The Friesian system was based on the configuration of the hymenophore. It soon became traditional and proved to be so practical at the generic level, that the research on Aphyllophorales was retarted for many years and no efforts were made to improve it.

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 (1886), Karsten (1889), Murrill (1907), Schroeter (1889), etc. introduced changes in the Friesian system mainly in the genus *Polyporus*. Many generic characters were refined and the generic subdivisions raised to generic ranks. This resulted in the erection of major Hymenochaetaceous genera like *Phellinus* Quel. and *Inonotus* Karst.

Around the turn of 20th 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 laid great emphasis on the consistency of fruitbody 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 Aphyllophoraces 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)

B. Tribu des 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 Laptopores (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 genera)
b. Serie des Hydnes (4 genera)
c. Serie des Echinodonties (1 genus)
d. Serie des Phylacteries (5 genera)
e. Serie des Astrostromes (2 genera)

Patouillard's, classification was extended and followed mainly with minor rearrangements by Bourdot & Galzin (1928), Konrad and Moublanc (1924-1925), Pilat (1936-42).

Donk (1933, 1948) initiated a revision of this troublesome group through a series of taxonomic and nomenclatural studies and proposed a number of new or amended genera. He mainly followed the principles introduced by Karsten and Patouillard and thoroughly revised and supplemented it with microscopic details. The groups "Serie des igniaires" and "Serie des Astrostromes" of Patouillard were accepted under a subfamily Hymenochaetoidae (Donk 1933) and a family Hymenochaetaceae (Donk 1948). Thus the genera having brown basidiocarps, clampless hyphae and setae irrespective of their hymenial configuration e.g. *Asterostroma* Massee *Hymenochaete* Lev. with smooth hymenophore; *Asterodon* Pat., *Hydnochaets* Bres. with more or less aculeate hymenophore and the genera *Phellinus* Quel., *Inonotus* Karst., *Coltricia* S.F. Gray, *Cyclomyces* Fr. with tubular hymenophore were grouped together. Domanskii (1965) and Domanskii *et al.* (1967) however, preferred family Mucronosporaceae for members having tubular hymenophore and Hymenochaetaceae for those, having smooth or aculear hymenophore following Imazeki & Toki (1954) but this disposition has not been widely accepted.

The naturalness of the family Hymenochaetaceae Donk (not supported by Bondartsev 1953) was further emphasized by Corner (1948, 1950); Nobles (1958) Kotlaba & Pouzar (1957); Oberwinkler (1977); Reid (1965) and Parmasto (1968). In the meantime some workers (Lowe 1957, 1963 & 1966; Overholts 1953; Bondartsev 1953) though basically followed Friesian or their own systems but contributed significantly to the study of Aphyllophorales particularly the species of Hymenochaetaceae.

Donk (1964) In his "Conspectus of the families of Aphyllophorales", included genera like *Vararia* and *Lachnocladium*, having dichohyphidia in their context in the family Hymenochaetaceae. Since the species of these genera conform poorly to the family characters (basidiocarps may be pure white) context may not or hardly changes to black in KOH), so the limits of this family as conceived in this manual are confined to the Asterostromatoideae Donk and Hymenochaetoideae Donk as is followed by many modern workers (Pegler 1973a & b; Ryvarden & Johansen 1980; Gilbertson & Ryvarden 1986, 1987, Ryvarden 1991, Ryvarden & Gilbertson 1993).

The position of the monotypic genus *Phaeolus* which is a serious parasite on conifers in the temperate Himalayan coniferous zones is very controvercial. In the field, it resembles the genus *Inonotus* and the family Hymenochaetaceae in having brown context and simple septate monomitic hyphae. On the basis of these characters many authors prefer to keep it in this family (Kotlaba & Pouzar 1957; Fiasson & Niemela 1984; Jung 1987). But the presence of gloeocystidia not known in Hymenochaetaceae and the brown cubical rot which it causes, the author prefers not to include it in Hymenochaetaceae following Parmasto & Parmasto (1971); Ryvarden & Johansen (1980); Gilbertson & Ryvarden (1986, 1987) and Ryvarden (1991).

Ecology and Distribution

Our information is very fragmentary and inadequate on the ecology of hymenochaetaceous fungi. We are still far from revealing the boundaries of each species. Clarification of distributional areas will ultimately help to unravel many puzzling and quite intricate occurrence in the process of fungal colonisation. The little ecological and distributional pattern information available is only about the most common and widely distributed species. Environmental factors such as temperature, humidity, light and kind of trees are very important for developing basidiocarps. Based on climatological and ecological factors, the genera of Hymenochaetaceae fall into three categories.

1. The genera like *Phellinus, Coltricia, Phylloporia, Hymenochaete* and *Cyclomyces* are known to occur in all major climatic and forest zones.

2. The genera like *Hydnochaete* and *Aurificaria* are generally confined to tropical zones.

3. The genera like *Inonotus, Pyrrhoderma* and *Asterostroma* are confined to temperate boreal zones.

Similarly based on the experience of the author in the field and the informations available in the Indian herbaria, the species of Hymenochaetaceae fall into three groups.

In the first group are the species which are mostly confined to the plains/tropical forests. The dominant and most frequently seen species are : *Phellinus senex, P. badius, P. rimosus, P. fastuosus, P. adamantinus, P. caryophyllii* and *P. durissimus. Phellinus pachyphloeus* and its allies are also very characteristic in this zone with *P. pachyphloeus* and *P. lamaensis* showing high frequency of occurrence while *P. melonodermus, P. hoehnelii* and *P. portoricensis* being very rare even in their areas of distribution. *P. noxius* which is quite common in Eastern Himalayas and South India has not been collected from the other parts of the country. Other species like *Phylloporia ribis, Hymenochaete tabacina, Aurificaria shoreae* and *A. indica* are also quite dominant in this zone. The major hosts of this zone are the species of *Toona, Melia, Mangifera, Shorea, Schleichera, Acacia, Sweitenia, Terminalia* and *Ficus.*

In the second group are the species like *Phellinus gilvus, P. conchatus, P. pectinatus, Hymenochaete rubiginosa; Inonotus diverticuloseta* and *I. tenuicarnis* which are common and widely distributed from tropical to temperate or even found up to subalpine forests. Based on the geographic position of their habitats, these species tend to be smaller in size and acquire an effused shape as they approach the alpine zones. *I. tenuicarnis* though widely distributed but become quite dominant in the temperate and subalpine forests. *Coltricia perennis* and *C. cinnamomea* grow on ground in woods especially along the clay banks.

In the third group are the species that are mostly confined to the temperate and subalpine forests. *Inonotus* is the most interesting and complex genus of this zone with about 90% of its species confined to the Himalayas. The common and frequently encountered species of this zone are ; *Inonotus dryadeus, I. cuticularis, I. glomeratus; Phellinus robustus, P. xeranticus, P. allardii; Phylloporia weberiana* and *Hymenochaete cruenta. Phellinus igniarius* and *Inonotus flavidus,* so common in Western Himalayas have quite an insignificant frequency in Eastern Himalayas. *I. tomentosus, I. circinatus, Phellinus pini, P. robustus* are more adapted to temperate coniferous forests of Himalayas. *Pyrrhoderma sendaiense,* and *Inonotus hamusetulus* are very rare and confined to Sikkim Himalayas only. *P. laevigatus, P. nigricans* grow exclusively on *Betula utilis* while *P. acontextus* grows only on *Rhododendrons* in the subalpine forests. The most preferred hosts of this region are the species of *Pinus* and *Abies* among conifers, and *Quercus, Betula, Salix, Pyrus, Viburnum* and *Aesculus* among angiosperms.

Based on the survey and study of these fungi, following general conclusions can be drawn :

1. Out of 10 genera of Indian Hymenochaetaceaè, 5 are cosmopolitean, 2 tropical and 3 are temperate-boreal in distribution.

2. Though the number of cosmopolitan genera is higher yet the number of cosmopolitan species is not more than 10%. The tropical species are slightly more (*ca* 50%) in number than the temperate (*ca* 40%).

3. *Phellinus* is the largest and widely distributed genus of all the Hymenochaetaceae. It is followed by *Inonotus, Hymenochaete* and *Coltricia.*
4. Eastern Himalayas are richer in Hymenochaetaceous flora than the Western Himalayas.

5. About 3% of these fungi grow on ground, 15% are serious parasites on living hardwoods/conifers and the ramaining ones grow as sparophytes on dead woods.

6. Species of *Quercus, Melia, Toona, Shorea, Schleichera, Betula, Mangifera, Sweitenia, Abies* and *Pinus* serve as the most-liked hosts for these fungi. More than 10% of their standing trees support one or the other species of these fungi.

Wood Decay

The members of the family Hymenochaetaceae form a cosmopolitan group of wood-inhabiting fungi capable of utilizing components of wood cell walls for their growth and reproduction. Although, all wood basically is composed of the structural polymers cellulose, lignin and hemicelluloses but there is considerable variation which is particularly evident in the heartwood of living trees in which a wide array of non structural extraneous materials (extractives) are deposited as the maturing cells die (Hillis 1962; Rowe & Conner 1978; Scheffer & Cowling 1966). Cellulose is the most consistent of the structural components varying minimally between wood species. Lignin and hemicelluloses however vary both in composition and amounts not only between hardwoods and conifers but also among hardwoods (Timell, 1967). The conifer wood is far more homogeneous. Cellulose is a long chain polymer of glucose anhydride units joined by ß 1-4 linkages. In general, cellulose components of wood are light in colour, have strong affinity for water and are soft and tough. Hemicelluloses consists of similar polymers of glucose joined by other linkages or polymers of monosaccharides other than glucose. Lignin is quite different from celluloses and hemicelluloses and is also the most resistant to biodegradation. It is a three dimensional, amorphous, branched polymer of phenylpropane units joined by a variety of interunits linkages (Adler 1977). It is formed by a random free radical oxidative copolymerization of three different oxy-cinnamyl alcohols which occur in various ratios depending upon the tree species. The greatest differences are between coniferous and hardwoods. It differs from all polymers in being largely nonhydrolizable, forming a protective layer around the wood polysaccharides and limiting the cellulase accessibility within the cell walls. Conifer wood in general has a higher lignin content (27-35%) than wood of angiosperms or hardwoods (19-24%). Unlike cellulose, lignin components are darker, have no affinity for water and are harder and brittle.

Since these substances differ markedly in their physical characters, so the effect of wood decaying fungi is different depending upon which substance is removed. The wood that has been acted upon by a lignin dissolving fungus contains a relatively high remainder of cellulose and is whitened in contrast to normal wood. In addition, it becomes soft and spongy in texture and retains its fibrous structure into the advanced stages and will absorb and retain a considerable amount of water. A decay of this type is called white rot. All the

species of Hymenochaetaceae are associated with *white rots*. A wood from which, the cellulose components have been removed, is darker than the normal wood, will be dry, brittle and of charcoal consistency. The decay of this sort is called *brown rot*. White rot fungi degrade cellulose and hemicelluloses at approximately the same rates relative to the original amounts present (Kirk & Highley 1973) where as the lignin is decomposed at a similar rate or usually somewhat at faster rate on a relative basis (Blanchette 1980; Setliff & Eudy 1980). A rather specialized type of white rot is caused by some species of *Phellinus* where the end result is a series of oval holes (about 1.5 cm x 0.5 cm) distributed evenly throughout the infected zone. This distinctive type of decay is called a white pocket rot.

In wood products and slash, there is a strong tendency for soft woods to be degraded primarily by brown rot and hardwoods by white rot fungi (Scheffer 1964). This is probably related to the fact that the lignin in hardwoods is easier to biodegrade than that in coniferous wood (Yang *et al* 1979) and not due to the difference in the hemicellulose components (Highley 1976). The white rot fungi in apparent contrast to brown rot fungi must degrade lignin in order to decay wood.

Hyphae of the white rot fungi are concentrated in the ray cells and vessels although, other cells are invaded very early in decay. The hyphae initially invade other cells from ray cells and vessels via pits or directly by penetration of cells walls (Wilcox 1970, Liese 1970);. White rot fungi have cellulase and lignase enzyme systems secreted at hyphal tips and on lateral surfaces. These enzymes assist cell wall penetration and enlarge bore holes to perforations. Along the young hyphae, lysis furrows are produced. The degradation products of various cell wall layers are completely absorbed by the hyphae. White rot fungi successively deploymerise cell wall substances only to the extent that the products can be utilized consecutively for metabolism (Cowling 1961). The action of the enzyme system of white rot fungi is restricted to the cell wall layers in the immediate vicinity of the hyphae in contrast to the brown rot fungal enzymes which apparently have a deep diffusion into the inner layers of cell walls. White rot fungi also produce extra cellular phenol oxidases and generally give positive oxidase tests on tannic and gallic acid media and with gumguaiac and syringaldazine reagents. Unlike the brown rot fungi, white rot fungi decay wood completely and the residues are not stable components of forests soils.

Many white rot fungi like *Phellinus igniarius* begin their development in the living trees and continue it on the dead wood while other species develop only on dead wood and still other kind (*Phellinus pini*) attack only growing trees. The saprophytic Hymenochaetaceae like most Aphyllophorales utilize dead wood as a food base and are extremely important in their role as decomposers in recycling of carbon in the world's ecosystem.

Those Hymenochaetaceae that grow and produce basidiocarps on living trees are either restricted to interior, primarily nonliving portions of a living tree (heartwood) or are capable of invading and killing outer living sapwood. In living trees, the sapwood is quite immune to decay fungi unless it is exposed by a wound of some sort. Though, the decay is not likely to progress much beyond the limits of wounded area but these fungi (e.g. *Aurificaria shoreae, P. gilvus,* etc.) are true pathogens and are known as biotrophs. They are capable of invading and killing living sapwood and may result in outright killing of the tree. These fungi generally do not attack the heartwood except a limited attack in certain cases.

Of the several thousand wood decaying fungi, only a small number can cause degradation in the wood of the hearts of living trees (Wagner & Davidson 1954) and are known as necrotrophs or heart-rot fungi. These usually invade trees through dead branch stubs (Boyce 1961) and can tolerate the chemical and physical constraints within the tree trunk. The constraints which are obviously suspect in this regard are levels of O_2, Co_2, variation of moisture content and pH of heart tissue, concentration and nature of volatile organic compounds, interaction with other microbes and above all the host response (Shigo & Hillis 1973; Shortle & Cowling 1978; Shain 1971; Fries 1973). These factors are probably involved in determining the host specificity of heart-rot fungi. The heart rot fungi do not normally attack the sapwood. As such the infected tree is not killed but continues to grow and present all outward signs of a healthy tree with vigorous growth. However, the decay is progressive and with increasing years more and more sound heartwood becomes decayed resulting in a considerable volume loss in standing timber particularly in old growth stands. Besides basidiocarps, other symptoms like stem canker (*Phellinus laevigatus, P. nigricans*) and punk knots (*P. caryophyllii* and *P. pini*) indicate heart-rot decay. In a few cases symptoms like wounds, trunk or butt swell; dead or broken tops, crooked or forked trees, fire stars are also indicative of heart-rots.

Taxonomical Characters

A few important terms regarding morphology and anatomy of these fungi are discussed in the following paragraphs :

Basidiocarp

It is the part of fungus that is visible to the collector and has been given names like sporophore, fruiting body, carpophore, fructification, basidiocarp, basidiome, etc. In this manual generally the term basidiocarp is used. The term plant or plant body refers to the vegetative part of the plant lying in the substratum and is known by the accepted term mycelium. The basidiocarps of Hymenochaetaceae vary from resupinate to effused-reflexed or pileate. The shape of the basidiocarp in many cases is distinct and is an important character. Some common forms of basidiocarps are shown in Fig. 1. The attachment of the basidiocarps to the substrate is rather distinctive in many cases. The pileate basidiocarps are either broadly attached or may taper towards the base almost to a stipe-like structure to distinctly stipitate in *Coltricia, Pyrrhoderma* and a few species of *Inonotus*. The stipe may be central to eccentric or lateral. Fig. 1 shows different types of attachments. Basidiocarp size seems to be rather consistent to the species but many resupinate forms are capable of indeminite growth over their substratum under favourable conditions.

The measurements of basidiocarps given in this manual are length or breadth, width and thickness. Length or breadth is measured more or less parallel to the substrate to the margin of the basidiocarp. The thickness is measured vertically from the pileus surface to the hymenophore surface in pileate forms and from the hymenophore surface to the substrate in case of resupinate forms. A range of variation in the measurements is given to include both smaller and larger basidiocarps.

The structure and density of tissue i.e. its consistency also varies. All the transitions from tough-fleshy and cartilaginous, corky to woody are encountered in the family. Similarly the basidiocarps display a great variety in colour from yellowish brown, orange brown, reddish brown, fuscous brown to almost black. The colour and consistency of basidiocarps are important diagnostic features, although they change with both age and dehydration. In resupinate forms, the

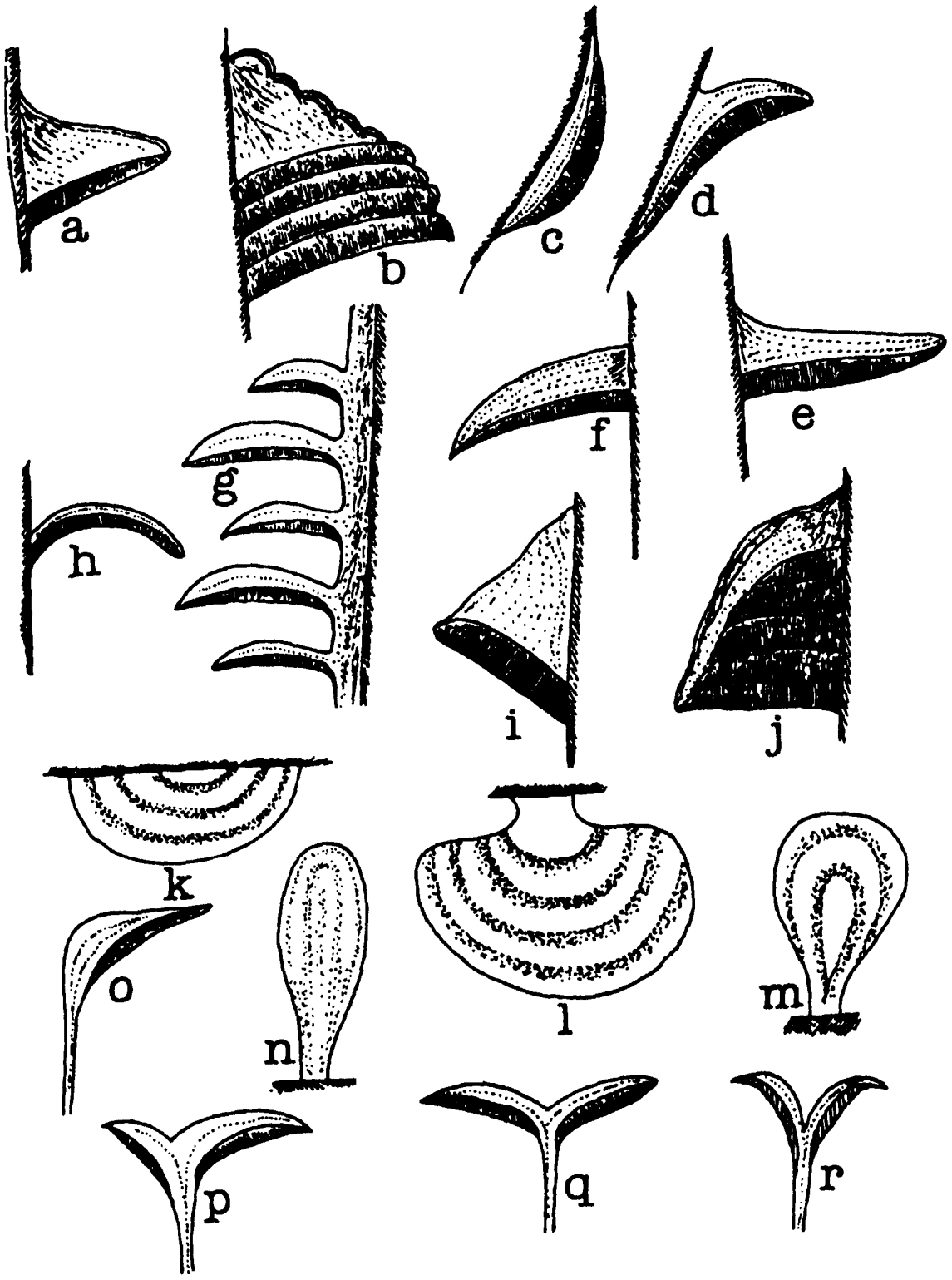


Fig. 1. Different forms of basidiocarps and their types of attachments. a. annual, b. perennial, c. resupinate, d. effused-reflexed, e. applanate, f. convex, g. imbricate, h. conchate, i. triquetrous, j. ungulate, k. broadly attached, l. dimidiate, m. flabelliform, n. spathulate, o. laterally stipitate, p. eccentrically stipitate, q. centrally stipitate, r. infundibuliform.

margins are characteristic and may be smooth, pruinose to fimbriate or even rhizomorphic. Annual, biennial and perennial basidiocarps distinguished according to the life span are found. Perennial basidiocarps are more common in the genus *Phellinus*. They are often recognised by their pulvinate to ungulate shape, woody consistency, deep concentric striations on the surface of the cap and also by their property of adding a new layer each year. However, the occasional alterations of favourable and unfavourable growth conditions in summer result in the formation of more than one layer of tubes in each growth season. perennial basidiocarps are more woody because of the dominance of skeletal hyphae while the annual ones are more soft-fleshy because of monomitic hyphae and usually shrink considerably on drying.

The pileus cover serves to protect the inner, usually soft tissue from external influences. The characters of importance in connection with the pileus surface include the type and degree of hairiness which varies from glabrous to velvety, hirsute, tomentose to villosa. When the surface is glabrous, it may be dull or shiny and covered with a very thin and fragile cuticle often not seen in fresh basidiocarps. In many species of *Phellinus*, *Aurificaria* and *Pyrrhoderma*, the surface is covered with a more or less distinct crust which is very hard, horny and may be up to 4 mm thick. A glabrous surface may be smooth without concentric zonations or radial ridges but it is often common to see a distinct, sulcate zonation, reflecting different stages of growth, sometimes combined with radial ridges, the latter becoming more prominent because of shrinkage of basidiocarps on drying. In many species of *Phellinus* like *P. rimosus* the crusty surface of perennial basidiocarps cracks up with age either in radial lines or both concentrically and radially into irregular patches of angular pieces. Such a deeply cracked surface is called rimose and is of some taxonomical value. Basidiocarps of some perennial species are covered with algae and mosses, giving the pileus surface a greenish shade. In certain species the hairs on the surface may become agglutinated to the surface as warts or scrupose tufts of hyphae. The *Phylloporia* and a few *Phellinus* species, have a dark cuticle below the tomentum.

The colour of the pilear surface is diagnostic. The basidiocarps colour in Hymenochaetaceae remains reasonably unchanged because of the presence of polyphenols which are very resistant to degradation by natural causes. Old specimens are commonly more intensely coloured than when young perhaps because of increased pigmentation. The density of coloured spore deposits (*Inonotus tenuicarnis*) or brown setae (*Hymenochaete*) on hymenial surface or setigerous elements (*I. cuticularis*) on the pilear surface may change the colouration of basidiocarps.

Hymenophore

The basidiocarp essentially consists of two portions, the context which supports the hymenophore and the hymenophore which bears the hymenium. It was the hymenophore that Fries used as his principal character to subdivide the Hymenomycetes and this character still has a influential role in the modern classification of Aphyllophorales, though its significance is subordinate (Donk, 1964). In Hymenochaetaceae, smooth, tubulate toothed to lamellate types are recognised. The smooth type is potentially fertile all over the exposed surface except its extreme margin. In *Hydnochaete* the hymenophore is toothed while in *Cyclomyces montagnei*, it may be concentrically lamellate. Tubulate hymenophore is the commonest and is usually fertile inside the pore tubes. In the poroid members of the family, tube layer is easily recognised as a layer of vertically placed tubes attached to the lower surface of the context and usually inseparably united to that region. The tube layer vary in length from 1 mm to several centimetres. In the perennial species of the family, a new layer of tubes is added over the surfaces of the old layer each year. Sometimes these annual layers are quite distinct from each other and can be readily counted but more frequently, the tubes are gradually extended downward, year after year and the layers are indistinct. The tubes open, at a surface called pore surface.

The number of pores per mm or cm is a rather consistent and important character though the pores often have a tendency to become larger with age and in larger specimens. In the basidiocarps with larger pores, the walls of the pores are irregularly torn and lacerated. The colour is diagnostic for many species, and with age it has a tendency to become darker.

Context

The context is the tissue of the pileus, that lies between the upper surface and the tube layer. it may be thin to practically nonexistent or it may be several centimeters thick. The context in Hymenochaetaceae is pale to reddish brown and blackens rapidly and permanently on the application of potassium hydroxide. In most cases, the context is homogeneous with regard to both colour and consistency and will normally have a radial structure as the hyphae grow from the base towards the margin. However, in certain species, it is divided into two different regions, an upper soft layer and a lower firm or hard layer, in which case it is said to be duplex. A duplex context is more easily recognised in dried specimens than in fresh ones. A mycelial core is present in the context of a few

species (*I. rheades*). The core is like a spherical body close to the substrate. It has a loose and cheesy or granular structure, normally mottled with light coloured spots or streaks.

Hyphae

Hyphal characters are an integral part of the keys to the primary divisions of Aphyllophorales. It was corner's (1932) fundamental work on the hyphal system which recognised different types of hyphal constructions. His study has since become a useful tool to describe basidiocarp structure and is now essential to an understanding of the taxonomy of Aphyllophorales. Types of hyphal systems are fairly consistent to the species and are applied on a wide scale to characterize genera of Hymenochaetaceae. In this family, there are only two types of hyphal systems i.e. Monomitic and Dimitic. In the family Hymenochaetaceae, except the genus *Phellinus* only one type of hyphae i.e. generative hyphae are present in the basidiocarp and so the hyphal system is called monomitic. Generative hyphae of the family are always septate and without clamp connections. They are mostly hyaline to pale yellow or pale golden brown, thin to thick walled and may be branched to a variable degree. Generative hyphae ultimately give rise to the basidia, and directly or indirectly to all other structures. These hyphae are of unlimited growth, possessing protoplasmic contents which stain readily. The thin walled generative hyphae in dimitic basidiocarps collapse easily during drying and may be difficult to observe because of the dominance of skeletal hyphae. The edges of dissepiments and along the basidiocarp margins are the good places for their search. In some species of the genera *Hydnochaete, Hymenochaete* and *Phylloporia,* generative hyphae often become thick walled and look rather skeletal but normally exhibit occasional to frequent primary septation. Quite rarely, in the thick walled hyphae, the protoplasm dries up and appears as a dark line across the hyphae forming an adventitious septum, which is normally much thinner than the hyphal wall, while the true septum has the same thickness as the hyphal wall.

The occurrence of gloeopleurous hyphae is not known except a few scattered reports in one or two species belonging to the genera *Coltricia* and *Inonotus.* When found, these hyphae are thin walled, aseptate, often long and tortuous without branching, with homogeneous or grainy refractive contents staining brightly in phloxine.

In the genus *Phellinus,* the generative hyphae seem to be rapidly replaced by thick walled skeletal hyphae of tough texture with only traces of generative

hyphae. These hyphae may be easily recognised by their thickened wall and correspondingly narrow lumen, a complete absence of primary septation and lack of branching. They are of even diameter in most of their length as compared to binding hyphae which normally have tapering side-branches. Skeletel hyphae often dominate in the context.

Spores

Spores are important in the diagnosis of wood-rotting fungi at the specific level. Characters like shape, size, colour, wall thickness and the chemistry are employed in the descriptions. Spore shape varies to a great extent. Globose, subglobose and ellipsoid forms are most common, while the cylindrical to allantoid spores are not found frequently. Spores are always smooth. Fig. 2 shows some of the common shapes found in Hymenochaetaceae.

Spore size is quite variable. Minute spores of 4 μm length and above 10 μm length are quite rare, but spores of 5-7 μm length are most common. Genera like *Phylloporia* and *Aurificaria* Comprise of species with fairly constant spore size while in other genera especially *Phellinus* it varies considerably. Spores are hyaline, subhyaline to tinted. Spore walls are usually thin except a few *Phellinus* and *inonotus* species where they are quite thick.

Spore prints are not always as readily obtained as in gilled fungi. Some species of *Phellinus* and *inonotus* are good spore printers, while other deposits almost nothing or invisible films of spores. In some collections, spores are very rare or none, probably because of periodicity in spore productions. In collections of *Aurificaria, Inonotus, Cyclomyces, Coltricia* and a few species of *Phellinus* with tinted spores, they are easily found.

In the basidiocarps of *Inonotus rickii,* thick walled intercalary or terminal chlamydospores occur. Probably these asexual spores, function as resistent resting stage in the life cycle.

Basidia

Basidia develop on the terminal cells of hyphae spreading from the subhymenial layer. Upon reaching full maturity, the basidia slightly protrudes above the general surface of the hymenium bearing at its free end 4-processes called sterigmata, with one spore on each. Upon maturation, the spores are ready

to separate from the sterigmata and are successively and forcibly discharged. More commonly, the basidia are clavate to cylindrical and hyaline and are found in all stages of development in actively sporulating basidiocarps. Their size and shape have little taxonomic importance in Hymenochaetaceae. Each basidium has a septum at the abse.

Cystidia and Cystidioles

Cystidia are not found in Hymenochaetaceae. However, in certain species of *Phellinus* and *Pyrrhoderma sendaiense* basidia-like structures are seen in the hymenium. These structure called cystidioles differ from basidia in having a pointed and tapering apex. They are smooth, narrowly clavate to bottle-shaped with pointed or whip-like apices and are diagnostic at the specific level.

Setae and setal hyphae

These sterile and conspicuous organs are found in the hymenium and context of some species of Hymenochaetaceae and are important for determination of species within the different genera of the family. Because of their shape and dark brown colour, they are always easily recognised, though their number and distribution is somewhat erratic in certain species. It is advisable to mount thin sections of basidiocarps along the tubes in lactophenol for confirming their presence and position as these organs become much darker in KOH Phloxine solution.

There are two types of setae : hymenial setae and tramal setae. Hymenial setae arise terminally from generative hyphae at the level of basidia and will largly project beyond them. They are stiff, simple, subulate, ventricose or fusiform. The top may be straight or distinctly hooked or bent. The form and size of setae are fairly constant for each species and are important character at the specific level.

The tramal setae are embedded in the trama and usually run parallel to the tube walls. These setae are distinctly conical and are widest in the middle part and taper slightly towards the apex. In the genus *Asterostroma*, the setae are like star shaped bodies with a central boss having 3-7 radiating rays and are present throughout the context and hymenium of the basidiocarp.

Sometimes hyphae with setae-like terminations are imbedded in the walls of the tubes and context and are called setal hyphae. They are quite conspicuous and

may reach a length of 400 μm and breadth up to 15 μm. They either run straight and parallel to the tube walls or in some species, the apex is bent into the hymenium. The setal hyphae are not swollen at the middle portion unlike tramal setae and are much longer than the latter. They are quite characteristic in species belonging to *Phellinus pachyphloeus* group and a few species of *Inonotus*. They may be present alone or with hymenial setae and this forms an important distinguishing feature. Different forms of setal organs are shown on Fig. 2.

Chemical features

One of the chemical tests that attained the reputation of being high taxonomic standing in the systematics of Aphyllophorales was the amyloidity or inamyloidity of the spore and hyphal walls. This reaction is most commonly recorded with melzer's reagent, Spores and hyphae are said to be amyloid if they colour grey or blue and dextrinoid if they turn reddish brown. Except for a very few species of *Phellinus* and *Coltricia* where the spore and hyphae show a dextrinoid reaction, the species of Hymenochaetaceae are generally negative in Melzer's.

Because of the presence of styrylpyrone pigments in the basidiocarps of Hymenochaetaceae (Fiasson & Bernillon 1977, Fiasson 1982), the positive reaction of Potassium Hydroxide permanently darkens the brown hyphae. This reaction is known as "xanthochroic reaction" and so the name "xanthochroic series" is given to the family.

The KOH-phloxine is frequently used for staining thin sections and preparation of squashes. Hyaline spores of *Pyrrhoderma*, and some species of *Phellinus* and *Inonotus* can sometimes be better observed in cotton blue-lactophenol.

For the clear observation of setae, tramal setae and setal hyphae, it is better to mount thin sections of basidiocarps in lactophenol.

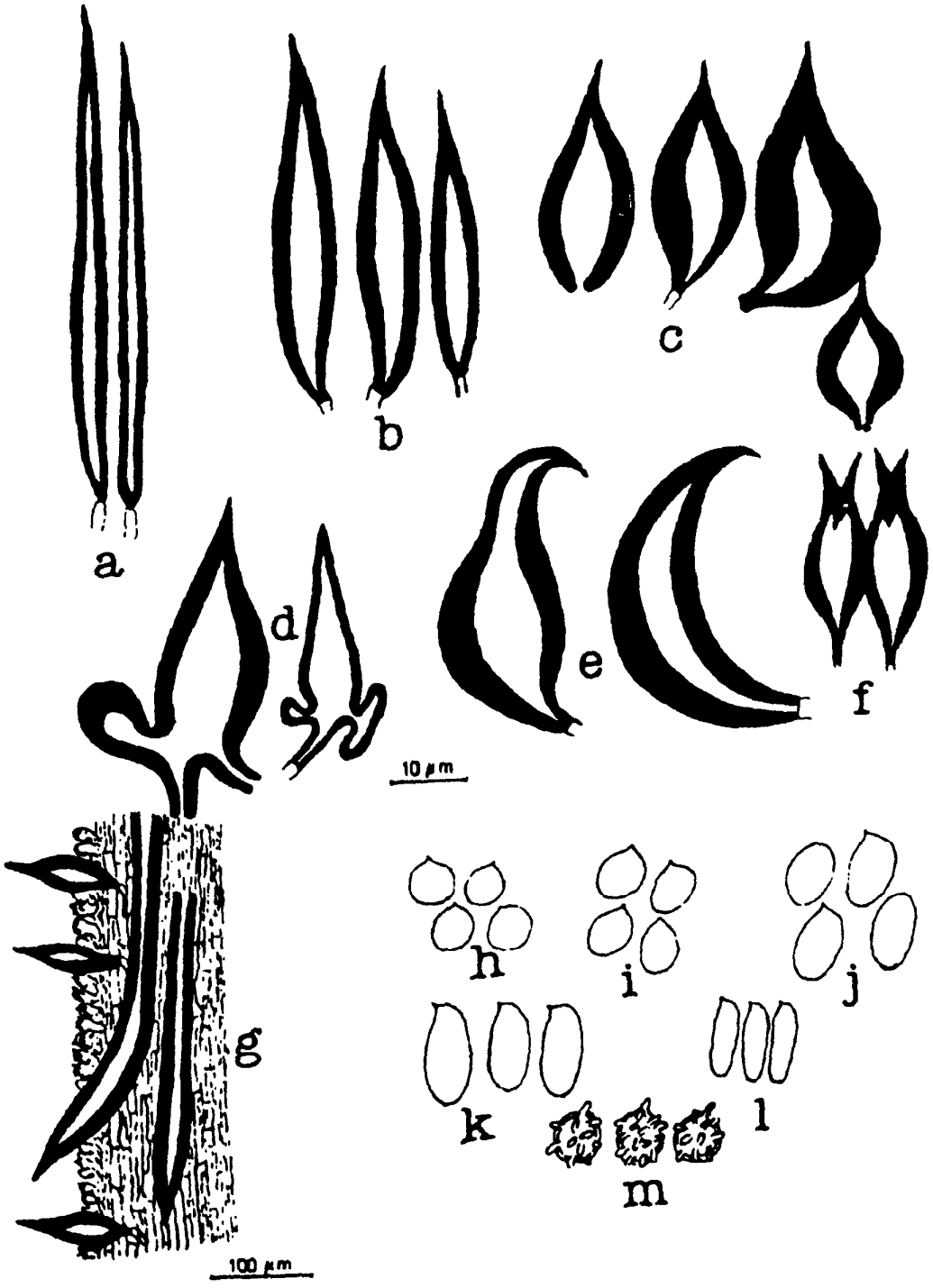


Fig. 2. Types of setal organs and spores. a. acuminate, b. subulate, c. ventricose, d. setae with lateral appendage, e. hooked, f. dichotomously split, g. section through tube showing setal hyphae, h. globose, i. subglobose, j. broadly ellipsoid, k. oblong ellipsoid, l. cylindrical, m. warted.

HYMENOCHAETACEAE Donk

Basidiocarps annual to perennial, resupinate or effused-reflexed to pileate, sessile to stipitate, brown to dark coloured, darkening permanently in KOH; pileus if present dimidiate, flabelliform, applanate to ungulate; surface tomentose to glabrous, with or without a distinct crust, smooth or sulcate, sometimes rimose or deeply cracked; context soft, loose to fibrous and succulent to often more or less toughish leathery or corky to woody, dark coloured; hymenophore dark coloured, smooth, granuliferous, tubulate to rarely toothed or concentrically lamellate; hyphal system mono/dimitic; generative hyphae coloured, somewhat thick-walled, all of about same width in monomitic and hyaline to pale yellow, thin-walled in dimitic, simple septate; skeletal hyphae thick-walled, dark coloured; hymenial/tramal setae and setal hyphae present or absent; asterosetae present in one genus ; basidia 4-sterigmate, club-shaped; basidiospores hyaline to coloured, darker in KOH, thin to thick-walled, smooth, rarely ornamented, mostly IKI negative; rarely amyloid or dextrinoid, lignicolous or rarely terrestrial; mostly saprophytic, some species parasitic on trees; widely distributed, represented by 10 genera and 98 species in India.

Type genus : **Hymenochaete** Lev.

KEY TO THE GENERA

1. Asterosetae present in the context; hymenial setae absent; gloeocystidia present; spores ornamented, predominently, amyloid **Asterostroma**
1. Asterosetae absent; hymenial setae present or absent; gloeocystidia absent; spores smooth, non-amyloid 2

2. Hymenophore smooth or granuliferous to hydnoid; hymenial setae always present 3
2. Hymenophore poroid to rarely concentrically lamellate; hymenial setae present or absent 4

3. Hymenophore hydnoid **Hydnochaete**
3. Hymenophore smooth to granuliferous **Hymenochaete**

4. Basidiocarps pileate laterally or centrally stipitate 5
4. Basidiocarps resupinate to pileate, sessile to rarely with a lateral tapering base. 7

5. Basidiocarps more or less with central stipe; pilear surface velutinate to adpressed tomentose; normally on ground, rarely on grasses **Coltricia**
5. Basidiocarps with a lateral tapering stipe; pilear surface glabrous with a distinct brown to black crust; on dead/living hardwoods 6

6. Spores rare, hyaline, subglobose to drop shaped, up to 8.5 μm in diameter, unchanging in KOH; a rare temperate genus growing on living Oaks **Pyrrhoderma**
6. Spores abundant, golden brown, subglobose to ellipsoid, up to 7 μm in longest dimensions, olivaceous brown in KOH; a common tropical genus growing on dead/living hardwoods **Aurificaria**

7. Hyphal system dimitic with skeletal hyphae; generative hyphae delicate, thin-walled, narrow, septate, hyaline; basidiocarps mostly woody hard, perennial **Phellinus**
7. Hyphal system monomiti, generative hyphae thin to thick-walled with conspicuous septa, narrow to wide, pale brown; basidiocarps thin, flexible, more brittle and fragile when dry, annual 8

8. Context duplex, a black zone separating the upper loose part from the denser lower part 9
8. Context homogeneous, black zone absent 10

9. Basidiocarps applanate, up to 3 mm thick; hymenophore poroid to concentrically lamellate; hymenial setae present; on dead woods **Cyclomyces**
9. Basidiocarps ungulate to convex, up to 20 mm thick; hymenophore poroid; hymenial setae absent; usually on thin branches of living trees **Phylloporia**

10. Pilear surface glabrous with a distinct crust; hymenial setae/setal hyphae absent; spores olivaceous brown in KOH; tropical genus. **Aurificaria**
10. Pilear surface hirsute, tomentose to glabrous, normally without a crust; hymenial setae/setal hyphae present or absent; spores rusty brown in KOH; temperate genus **Inonotus**

ASTEROSTROMA Massee
J. Linn. Soc. Bot. 25: 154, 1889.

Basidiocarps annual, resupinate, pelliculose to spongy and soft; hymenophore smooth, brown; context soft, full of asterosetae; hyphal system monomitic; hyphae septate, branched, hyaline to subhyaline, non-dextrinoid; hymenial setae absent; asterosetae pale golden brown, dark brown in KOH; gloeocystidia cylindrical to subfusiform; spores globose to subglobose, subhyaline, ornamented, amyloid; on dead woods; causing a white rot; temperate genus with two species in India.

Type species : *Corticium apalum* Berk. & Br.

KEY TO THE INDIAN SPECIES

1. Asterosetae abundant, mostly with 4-7 branched rays, each ray up to 60 μm long; tubercles on spore wall up to 2 μm long
A. muscicolum

1. Asterosetae not abundant, mostly with 3-5 unbranched rays, each ray up to 80 μm long; tubercles on spore wall up to 1.2 μm long
A. cervicolor

Asterostroma cervicolor (Berk. & Curt.) Massee Fig. 3
J. Linn. Soc. Bot. 25: 154, 1889 - *Corticium cervicolor* Berk. & Curt., Grevillea 1: 179, 1873.

Basidiocarps annual, effused up to 4 cm long and 1 mm thick, spongy, dry, loosely adnate; margin fibrillose-floccose, loosely adnate, white or concolorous with hymenial surface; hymenial surface pinkish yellow to golden brown to ochraceous, smooth, pulverulent, becoming pallid where well fruited; context light brown, composed of loosely arranged hyphae and conspicuously coloured, thick walled stellate organs.

Hyphal system monomitic; generative hyphae hyaline, frequently branched, simple septate, 2-3.5 μm thick, thin walled; asterosetae with 3-5 unbranched rays, rays subulate, 30-80 μm long, 3-4.5 μm wide, distributed throughout the fructification, rigid, golden brown; gloeocystidia 30-60 x 7-14 μm, fusoid, often sharp-pointed, not incrusted, protruding up to 20 μm beyond the basidia, with subhyaline granular contents; basidia 30-40 x 5-6 μm, utriform, 4-sterigmate, hyaline, sterigmata up to 6 μm long; spores globose to subglobose, 4.5-6 μm,

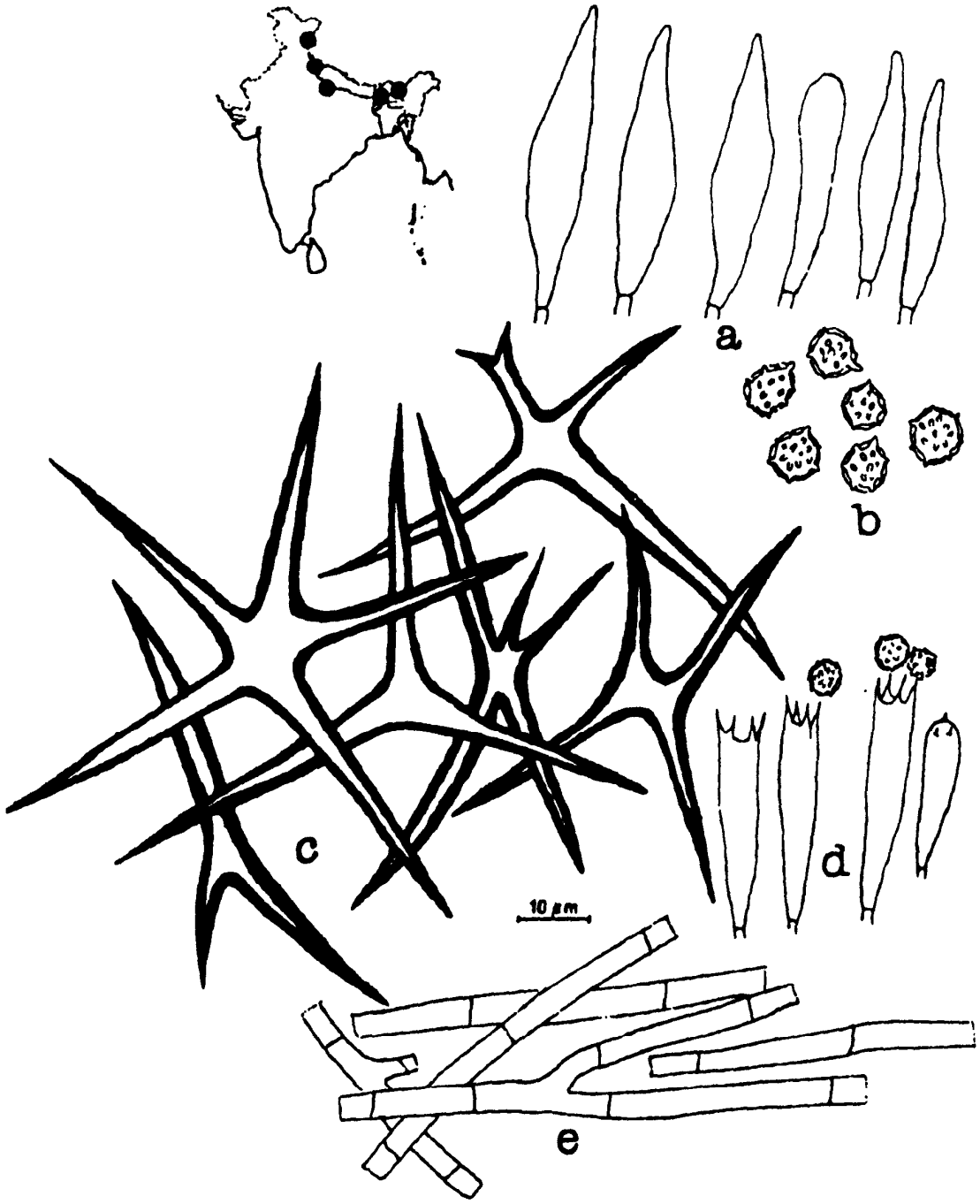


Fig. 3. *Asterostroma cervicolor* (JRS 741) a. gloeocystidia, b. spores, c. asterosetae, d. basidia, e. generative hyphae.

strongly ornamented with tubercles up to 1.2 µm long, amyloid, prominently apiculate, subhyaline, white in spore prints.

Habitat and Distribution

On dead stumps and logs of angiosperms and conifers : causing a white rot; a common and widely distributed species in the temperate forests.

Remarks

The diagnostic features of this species are usually unbranched asterosetae in the basidiocarps and ornamented, amyloid spores.

Asterostroma muscicolum (Berk. & Curt.) Massee. Fig. 4

J. Linn. Soc. Bot. 25: 155, 1889 - *Hymenochaete muscicola* Berk. & Curtis, J. Linn. Soc. Bot. 10: 334, 1868.

Basidiocarps annual, resupinate, broadly effused up to 15 cm long, 1 mm thick, soft, spongy or felt-like; margin narrow, fimbriate with coarse whitish hyphal strands and rhizomorphs, hyphal strands and rhizomorphs also conspicuous in the lower context, and in the bark below the basidiocarps; hymenial surface smooth, light pinkish brown to ochraceous, with a thin whitish pruina; context soft and spongy, composed of loosely arranged thin walled, hyaline hyphae and of numerous, coloured stellate organs, pinkish buff, up to .5 mm thick.

Hyphal system monomitic; generative hyphae hyaline, thin walled, simple septate, with occasional branching, 2-3.5 μm wide; asterosetae of lower context with 4-7 main rays, each ray up to 5 μm wide at base, and tapering to a pointed apex, up to 60 μm long, frequently dichotomously branched, rarely with three or more branches, asterosetae of the surface regions smaller with short main rays up to 20 μm long, these mostly with 1-2 dichotomous branching; gloeocystidia frequent, thin walled, clavate to bluntly fusiform, not frequent, 40-65 x 8-12 μm, not incrusted, with subhyaline granular contents, immersed or projecting only up to 10 μm beyond the hymenium; basidia clavate or with a swollen base, mostly 2-sterigmate, rarely 4-sterigmate, sterigmata up to 7 μm long, simple septate at the base, 25-30 x 6-9 μm; spores globose, strongly ornamented with rounded tubercles up to 2 μm long, hyaline, amyloid, 5-6 μm in diam, with a prominent blunt hilar appendix.

Habitat and Distribution

On dead moss-covered branches/twigs of angiosperms and conifers; not found on living trees; causing a white rot, a common species confined to temperate conferous forests.

Remarks

The presence of so many stellate organs make the basidiocarps very tough and difficult to cut thin sections of hymenium. In this respect it differs from A.

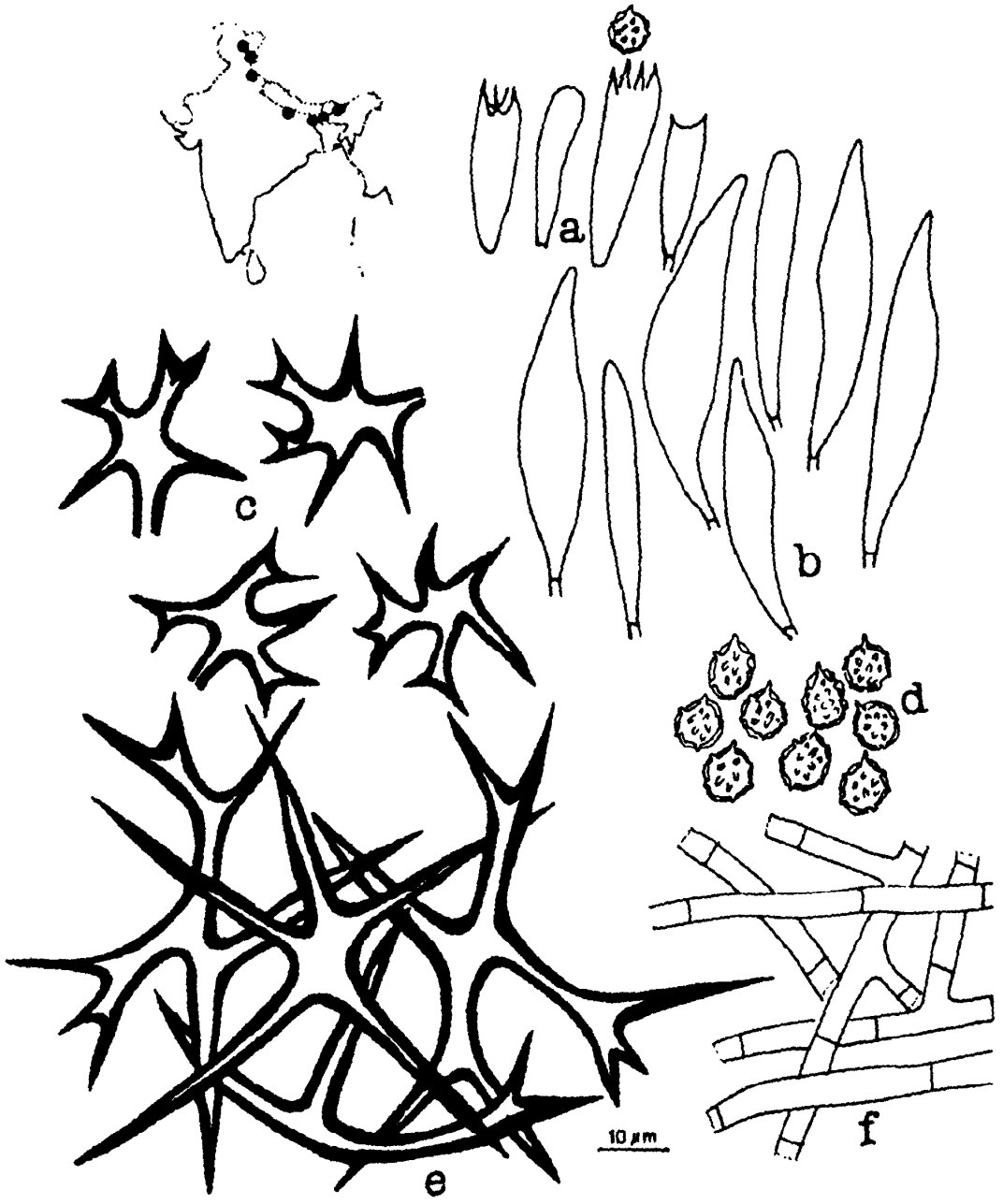


Fig. 4. *Asterostroma muscicolum* (JRS 640) a. basidia, b. gloeocystidia, c. asterosetae from hymenial surface, d. spores, e. asterosetae from lower context, f. generative hyphae.

cervicolor. Further, the rays in the present species are branched and the spores are thicker walled and covered with stouter and numerous warts as compared to *A. cervicolor.*

AURIFICARIA Reid
Kew Bull. *17:* 278, 1963.

Basidiocarps annual to rarely perennial, sessile to substipitate, dimidiate, flabelliform to funnel-shaped, single or imbricate; pilear surface yellowish to dark greyish brown or black with a cuticle or crust, often covered with a rusty pruina; context golden brown, hard and brittle when dry; pore surface golden brown to pale rusty brown; hyphal system monomitic; generative hyphae pale golden brown, septate; setae and setal elements absent; cystidia absent; basidiospores globose or sub-globose to rarely ellipsoid, pale to dark golden brown, olivaceous brown in KOH; parasitic on deciduous trees (especially *Shorea, Schleichera, Heritiera,* etc.), rarely on dead hardwoods; common tropical genus with 5 species in India.

Type species : *Aurificaria indica* (Massee) Reid

KEY TO THE INDIAN SPECIES

1. Basidiocarps large, up to 20 cm x 15 cm x 2 cm, dimidiate to funnel-shaped; parasitic on the roots of *Shorea robusta* **A. shoreae**
1. Basidiocarps small, up to 10 cm x 6 cm x 1 cm, dimidiate to flabelliform; on living/dead hardwoods 2

2. Basidiocarps sessile; greyish black overall; margin thick, obtuse **A. luteoumbrina**
2. Basidiocarps sessile to substipitate, reddish brown to black near the base and bright or golden brown near the margin; margin thin, acute 3

3. Spores broadly to oblong ellipsoid **A. flammans**
3. Spores globose to subglobose 4

4. Spores 4-5.5 x 3.5-4.5 μm **A. poncei**
4. Spores 5-7 x 4.5-6 μm **A. indica**

Aurificaria flammans (Berk.) Ryv. Fig. 5
Norw. J. Bot. *24:* 220, 1977. *Polyporus flammans* Berk., Hook. J. Bot. 6: 139, 1854.

Basidiocarps annual, soitary or imbricate, sessile or substipitate, coriaceous, woody hard and light when dry; pileus flabelliform to applanate, up to 6 cm long

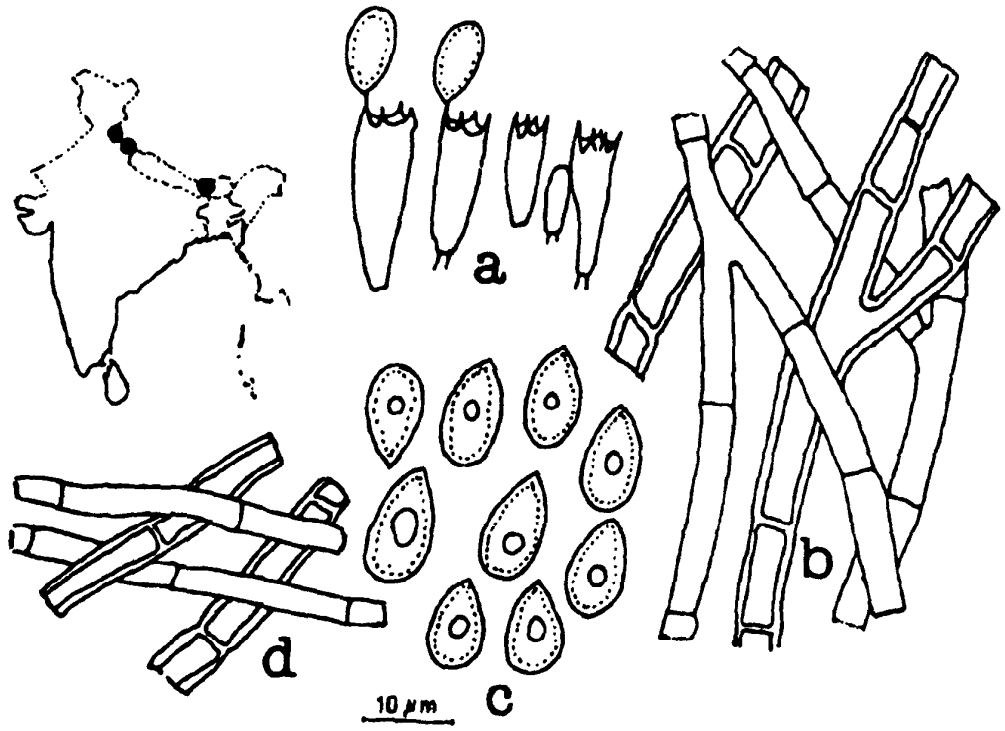


Fig. 5. *Auricularia flammans* (JRS 63041) a. basidia, b. contexual hyphae, c. spores, d. tramal hyphae

4 cm broad and 8 mm thick; upper surface dark brown to black, lighter towards margin, a distinct black cuticle present, with a dark brown pruina, zonate; margin thin, incurved; context yellowish brown, soft with a lustre, up to 4 mm thick; pore surface grey yellowish brown; pores round, thick walled, 4-5 per mm;

Hyphal system monomitic, generative hyphae pale to golden brown, simple septate, thin to thick-walled, 4-6 µm wide; basidia clavate, 12-18 x 5.5-5 µm, 4-sterigmate; spores oblong ellipsoid, pale to dull brown, slightly thick walled, 6-7 (7.5) x 3-4 µm, IkI-.

Habitat and Distribution

A rare species, growing on dead hardwoods in the sub-tropical forests; causes white rot.

Remarks

Macroscopically, the basidiocarps resemble *A. indica* except that they are thinner and also the crust is slightly thicker and less wrinkled in *A. flammans*. The oblong ellipsoid spores make this species distinct and separate it from other species of the genus.

Aurificaria indica (Massee) Reid Fig. 6

Kew. Bull. *17:* 279, 1963. - *Polyporus indicus* Massee, Bull. Misc. Inf. Kew, 250, 1910; *Polypoeus indicus* Massee var. *depauperatus* Reid, Thind & Chatrath, Trans. Brit. Mycol. Soc. *42:* 40, 1959.

Basidiocarps annual, solitary or in clusters to imbricate, sessile to substipitate, coriaceous when fresh, woody hard, brittle when dry, light in weight; pileus dimidiate to flabelliform, up to 8 cm long, 5 cm broad and 1 cm thick; upper surface velvety to pruinose, greyish or dark reddish brown to black near the base, lighter or golden brown towards the margin, usually radially sulcate, azonate, cuticle present; margin thin, acute, incurved when dry; stipe lateral, concolorous with the pileus, 1-2 cm long, sometimes branched, with a strong decurrent pore layer; context golden brown, homogeneous, soft with a lustre, up to 6 mm thick; pore surface yellowish brown to dark brown, dull; pores round, thick-walled, 4-5 per mm; tubes single-layered, concolorous with pore surface or somewhat lighter, up to 6 mm deep.

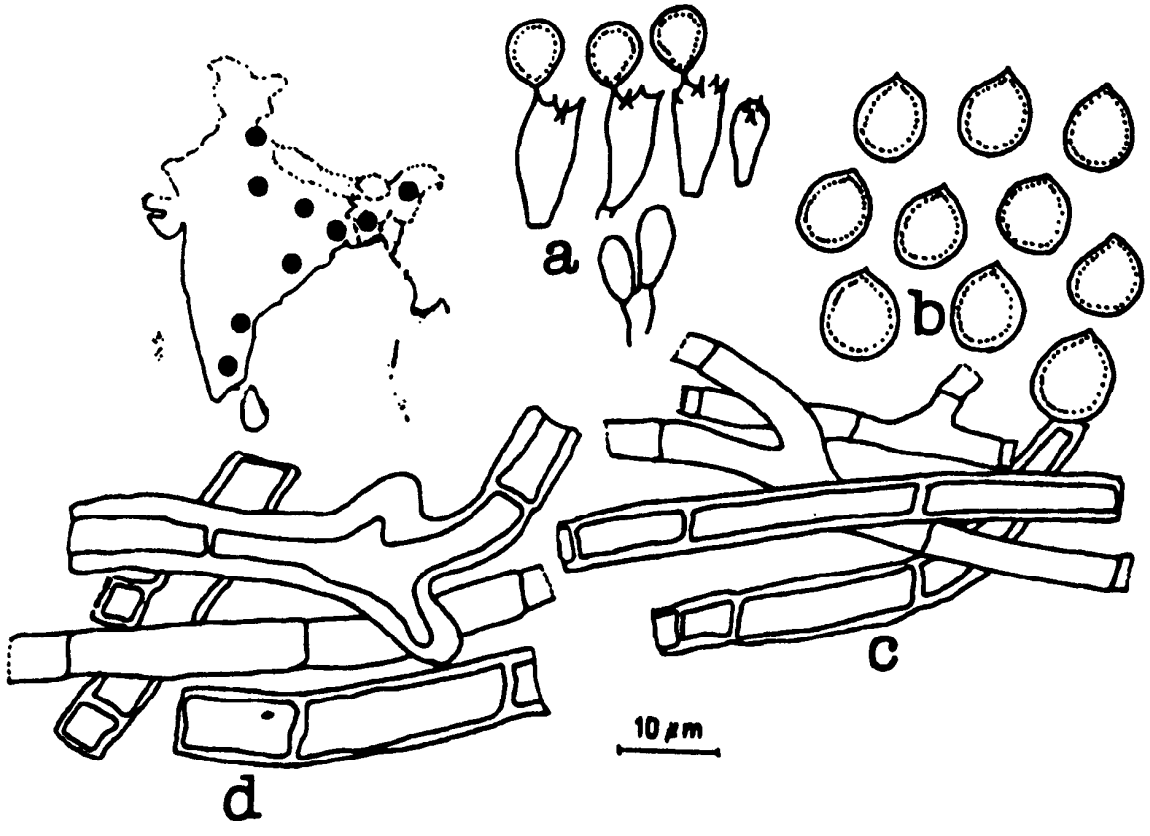


Fig. 6. *Aurificaria indica* (JRS 60006) a. basidia, b. spores, c. contexual hyphae, d. tramal hyphae.

Hyphal system monomitic, generative hyphae thin to thick-walled, hyaline to golden brown, simple septate, 3-5 μm wide; basidia 11-16 x 4-6 μm, clavate, 4-sterigmate; spores globose to subglobose, pale to dull brown, thin-walled, smooth, 5-7 x 4.5-6 μm, IKI-.

Habitat and Distribution

Common on living deciduous trees, rarely on dead hard woods; tropical to subtropical forests; causes white pocket rot.

Remarks

The flabelliform basidiocarps with a black cuticle, often radially wrinkled surface make this species easy or recognise in the field. the size and shape of spores separate it from the closely related species like *A. poncei* and *A. flammans*. Ried *et al.* (1959) described var. *depauperatus* Reid, Thind & Chatrath differing from var. *indicus* in small dimidiate, substipitate basidiocarps with smaller pores.

Aurificaria luteoumbrina (Rom.) Reid Fig. 7

Kew Bull. *17:* 279, 1963. *Phaeoporus luteoumbrinus* Rom. Kung. Svenska vetensk. Akad. Hand. 26: 27, 1901.

Basidiocarps annual, solitary to imbricate, sessile, dimidiate to subungulate or applanate, coriaceous when fresh, woody hard, brittle when dry, light in

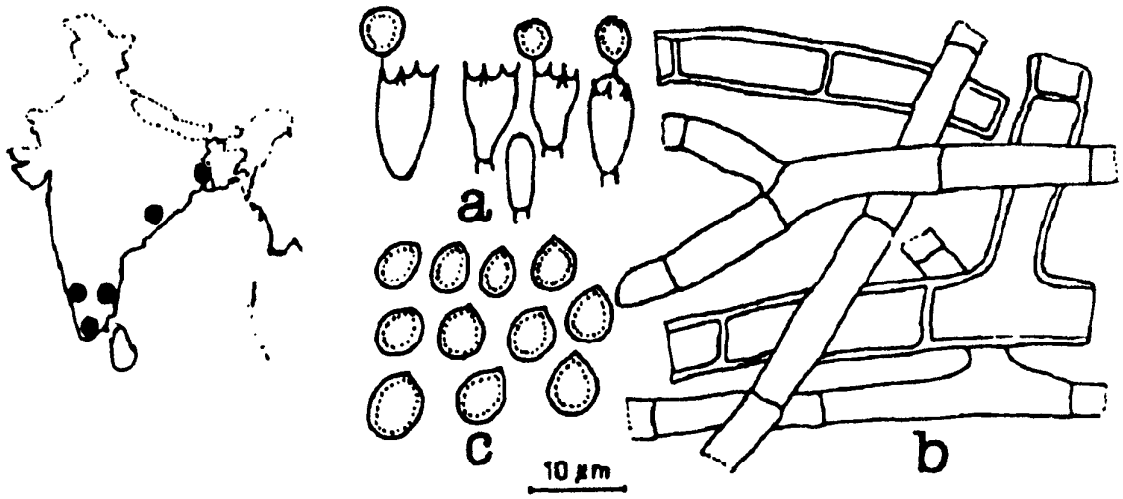


Fig. 7. *Aurificaria luteoumbrina* (JRS 60079) a. basidia, b. generative hyphae, c. spores.

weight; pileus 6-8 cm long and broad and up to 1.3 cm thick; upper surfacegreyish black, zonate, smooth or radially wrinkled, glabrous with a thin cuticle, often with a rusty pruina; margin thick, obtuse, somewhat fleshy and watery; context yellowish to bright golden brown, homogenous, slightly zonate, up to 1 cm thick; pore surface light to dark brown, darkening on bruishing; pores minute, uniform, round, 6-8 per mm, thick-walled, not extending up to margin; tubes chocolate brown, up to 5 mm deep.

Hyphal system monomitic; generative hyphae simple septate, branched, 3-7 μm wide; basidia 8-11 x 4-6 μm, 4-sterigmate; spores pale to dark brown, globose to subglobose, slightly thick-walled, one guttulate, 4-4.5 (5) x 3.5-4.2 μm, IKI-.

Habitat and Distribution

Parasitic on species of *Schleichera* and *Heritiera;* a common species in the tropical forests; causes white pocket rot.

Remarks

The greyish black basidiocarps with a glabrous, wrinkled and crusty surface and the watery, thick, obtuse margin are features sufficient for its determination in the field.

Aurificaria poncei (Llyod) Reid Fig. 8

Kew Bull. *17:* 279, 1963. *Polyporus poncei* Llyod Mycol. Writ. *7:* 1191, 1923.

Basidiocarps annual, usually solitary, rarely imbricate or in clusters of two or three; coriaceous when fresh, woody hard and brittle on drying; pileus dimidiate to flabelliform, up to 5 cm long, 3 cm broad and 8 mm thick; surface dark brown, with a black cuticle from base, yellowish or greyish brown towards the margin; margin narrow and incurved; context golden brown, zonate towards the base, up to 4 mm thick; pore surface grey yellowish brown, darker on bruising, spongy when fresh; pores round, 4-6 per mm; tubes single layered, concolorous with pore surface or lighter, up to 4 mm deep.

Hyphal system monomitic; generative hyphae, pale to golden brown, thick-walled, up to 5 μm wide, simple septate, contexual hyphae thin-walled, up to 7 mm wide; basidia clavate, 8-13 x 5-6 μm, 4-sterigmate; spores globose to subglobose, golden brown, slightly thick-walled, 4-5.5 x 3.5-4.5 μm, IKI-.

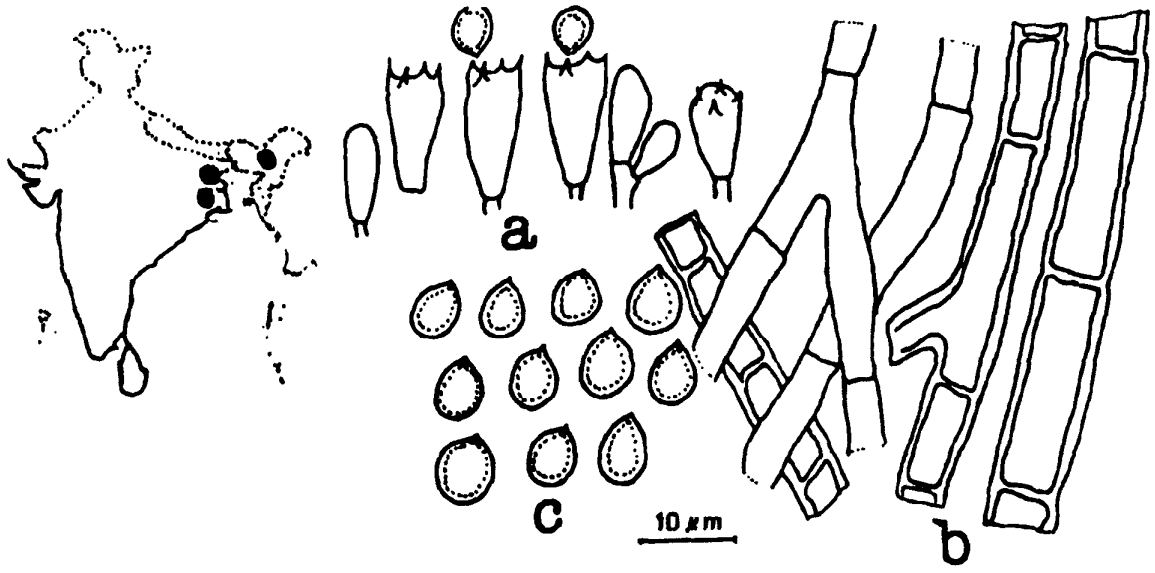


Fig. 8. *Aurificaria poncei* (JRS 63069) a. basidia, b. generative hyphae, c. spores.

Habitat and Distribution

A rare species; on dead hardwoods in tropical forests; causes white rot.

Remarks

This species resembles *A. indica* in almost all respects except the size of spores.

Aurificaria shoreae (Wakf.) Ryv. Fig. 9

Mycotaxon *5:* 335, 1977 - *Polyporus shoreae* Wakf., Kew Bull. Misc. Inf. p..72, 1916.

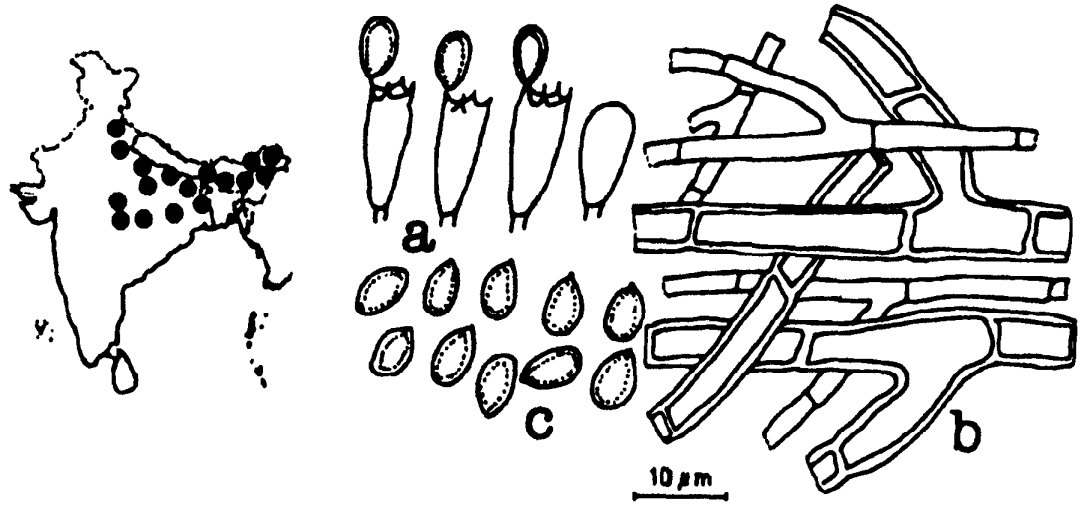


Fig. 9. *Aurificaria shoreae* (JRS 58905) a. basidia, b. generative hyphae, c. spores.

Basidiocarps annual, sessile to substipitate, solitary or imbricate, soft when fresh, brittle on drying, light in weight; pileus dimidiate, flabelliform or sometimes funnel-shaped, usually 15-20 cm long, 10-15 cm wide and 1-2 cm thick; upper surface brown to black, glabrous with prominent raised nodules, cuticular; context yellowish brown, with small dark spots, crowded at places, transversely zonate near the base, up to 1 cm thick; pore surface brown to greyish black; pors subcircular to angular, not extending up to the margin, 2-4 per mm; tubes light greyish brown, 2-8 mm deep.

Hyphal system monomitic; generative hyphae septate, branched, pale to golden brown, 2-4 μm wide; hyphae in trama are thicker, basidia clavate, 9-14 x 4-6 μm, 4-sterigmate spores light brown to hyaline, subglobose to oblong ellipsoid, 3.5-5 x 2.5-3 μm, IKI-.

Habitat and Distribution

Parasitic on sal; and widely distributed in the sal forests of India especially in the areas of high moisture; causes white pocket rot.

Remarks

A. shoreae is a serious parasite on roots and butts of sal. The infected trees die from top to downwards. This species is easily recognised in the field because of host specificity and larger basidiocarps.

COLTRICIA S.F. Gray

Nat. Arrang. Br. Pl. 1: 644, 1821.

Basidiocarps annual, pileate, centrally to laterally stipitate; pilear surface velutinate-tomentose to hirsute with adpressed hairs, pale yellowish, golden brown to dark rusty brown, mostly concentrically zonate; stipe yellowish to rusty brown, velutinate to tomentose; pore surface yellowish to dark rusty brown; pores circular to elongated, rarely concentrically lamellate; context yellowish brown to rusty brown, often duplex; hyphal system monomitic; generative hyphae hyaline to golden brown to rusty brown, simple septate; setae present only in one species, setal hyphae always absent; spores subglobose to broadly ellipsoid; mostly on ground, rarely on buried roots or stumps or culms of grasses; cosmopolitan genus with 8 species in India; *ca* 15 species in the world.

Type species : *Coltricia perennis* (Fr.) Murr.

The genus as defined here includes terrestrial stipitate species with central or lateral stipe, mostly without hymenial setae and seems to be natural. Species of *Inonotus* are true wood inhabiting fungi, have resupinate to sessile basidiocarps with the frequent presence of setae. However the border line between *Coltricia vallata* and *Inonotus* species like *I. tomentosus* and *I. circinatus* is very narrow and troublesome because of the presence of hymenial setae and stipitate basidiocarps. But *C. vallata* unlike the latter two species lacks the duplex consistency and is not known to cause a white pocket rot on the roots and butts of conifers.

KEY TO THE INDIAN SPECIES

1. Hymenial setae present — **C. vallata**
1. Hymenial setae absent — 2

2. Spores 2.5-3.5(4) µm long; pores 7-9 per mm; dark line between the upper tomentum and context — **C. spathulata**
2. Spores longer than 4.5 µm; pores 1-6 per mm; dark line absent — 3

3. On dead culms and roots of *Bambusa* or *Saccharum;* Spores strongly dextrinoid — **C. bambusicola**
3. On ground; spores negative in Melzers or weakly dextrinoid — 4

4. Basidiocarps pale yellow to yellowish white, dark reddish brown on drying; pore surface dark brown on bruising; spores 4.5-5.5 μm long. **C. pyrophila**

4. Basidiocarps reddish to cinnamon brown; unchanged on drying, no change on bruising; spores usully longer than 6 μm 5

5. Spores 9-14 μm long; pores 1-3 per mm **C. montagnei**

5. Spores 5-9.5 μm long; pores 2-4 per mm 6

6. Pilear surface velutinate-tomentose, dull, not shining **C. perennis**

6. Pilear surface adpressed-tomentose and usually shining with silky striations 7

7. Spores 5.5-9.5 x 4.5-7 μm; in deciduous forests **C. cinnamomea**

7. Spores 5-6.5 x 3-4.2 μm in coniferous forests **C. pusilla**

Coltricia bambusicola (Henn.) Reid Fig. 10

Microscopy 32: 449, 1975 *Polyporus bambusicola* Henn., Hedwigia 40: 326. 1901.

Basidiocarps annual, laterally or centrally stipitate, solitary to gregarious, tough coriaceous when fresh, rigid when dry; pileus flabelliform to spathulate, up to 3 cm wide and broad and 2-3 mm thick, adjacent pilei confluent; upper surface bright yellow or golden brown to cinnamon brown, azonate or faintly zoned in broad concentric zones, first finely velutinate, becoming glabrous with age, radially wrinkled on drying; margin thin, wavy, lighter than the pore surface, flat or deflexed on drying; stipe irregular to somewhat circular, golden brown, up to 2 cm long and 2-4 mm thick, glabrous, expanded towards the pileus; pore surface golden yellow to brown, darkening when dry; tubes 1-3 mm deep, dark yellowish brown; pores entire, angular, 4-6 per mm, dissepiments entire, thin; context slightly duplex, upper layer soft, lower layer darker and compact without a dark line, golden brown, azonate.

Hyphal system monomitic; generative hyphae simple septate, hyaline to golden brown, thin to moderately thick walled, 2.5-6 μm wide; setae and cystidia none; basidia clavate, hyaline, 8-12 x 4.5-6 μm, 4-sterigmate; spores hyaline, thin walled, ovoid to subglobose, 4.5-5.5 x 3-4.5 μm, dextrinoid.

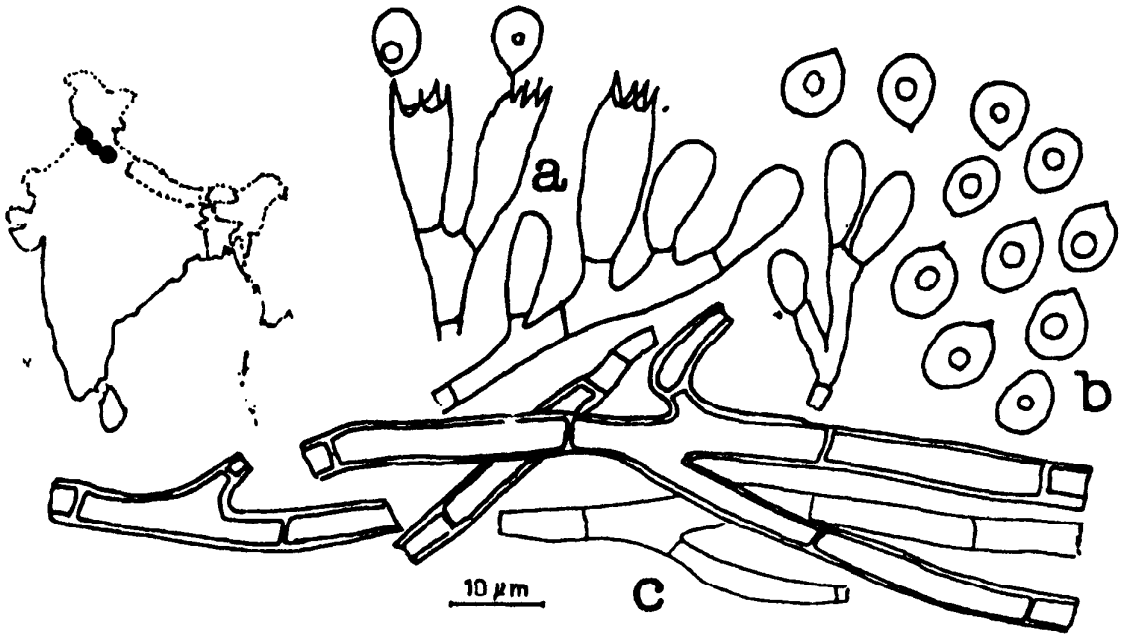


Fig. 10. *Coltricia bambusicola* (JRS 749) a. basidia, b. spores, c. generative hyphae.

Habitat and Distribution

On dead roots and culms of *Saccharum* and *Bambusa;* a very rare species growing in the tropical zones only.

Remarks

This species is quite conspicuous in having bright yellow to golden brown, spathulate and fairly small basidiocarps. Further, the specialized habitat and strongly dextrinoid spores distinguish it from other species of this genus.

Coltricia cinnamomea (Pers.) Murr. Fig. 11

Bull. Torr. Bot. Cl. 31: 343, 1904 - *Polyporus cinnamomeus* Pers., Mycol. Europ. 2: 41, 1825; *Polystictus cinnamomeus* Sacc. Syll. VI : 210, 1888; *Polystictus cinnamomeus* var. *Lahorensis* Llyod, Mycol. Lett. 65: 7, 1917; *Polyporus oblectans* Berk., Lond. J. Bot. 4: 51, 1845.

Basidiocarps centrally stipitate, coriaceous when fresh, rigid when dry; pileus circular, flat to infundibuliform, 1-4 cm in diameter, 1-2 mm thick; upper surface finely velutinate to silky fibrillose, fibres erect at centre, shiny to glossy with numerous distinct to indistinct concentric zones, bright reddish cinnamon to amber brown or tobacco brown; margin thin, often fimbriate, lobed, incised or entire, often fused with adjacent fruitbodies, deflexed in dried specimens; stipe central, cylindrical to flattened, mostly expanded towards the base, finely velutinate,

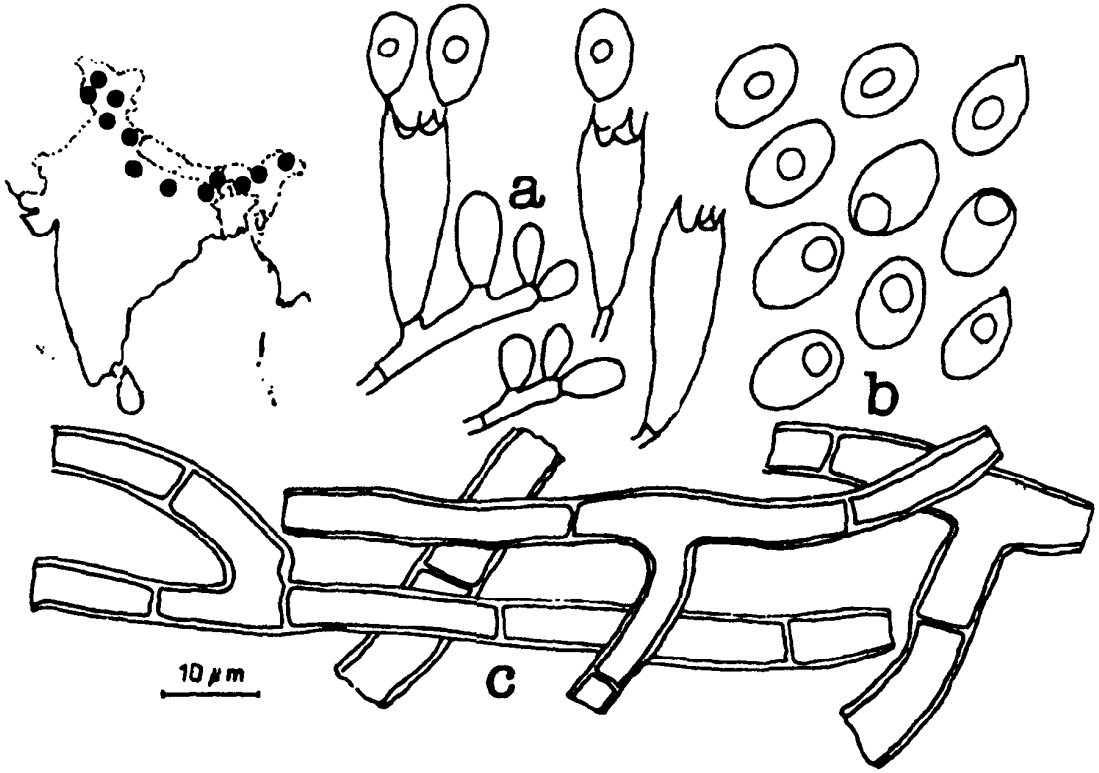


Fig. 11. Coltricia cinnamomea (JRS 340) a. basidia, b. spores, c. generative hyphae.

reddish brown, up to 3 cm long, and 1-3 mm in diameter; pore surface reddish brown; tubes up to 2 mm deep, more or less concolorous with pore surface pores thin walled, angular, 2-3 per mm; context up to 1 mm thin, fibrous, rusty brown to reddish brown reddish black when dry.

Hyphal system monomitic; generative hyphae simple septate, thin to thick walled hyaline to pale yellow or golden or rusty brown, 3-5.5 µm wide; hyphae on pilear surface more thick walled and up to 10 µm wide; setae none; basidia clavate, hyaline, 15-25 x 5.8 µm, 4-sterigmate; spores oblong to broadly ellipsoid, thin to distinctly thick walled, 5.5-9.5 x 4.5-7 µm, golden to light reddish brown, weakly dextrinoid.

Habitat and Distribution

On ground, mostly in deciduous forests; cosmopolitan species occurring from tropical to temperate zones.

Remarks

C. cinnamomea is close to *C. perennis* but differs from it in having smaller basidiocarps and silky, shining, fibrillose upper surface. Its larger spores separate it from *C. pusilla* (5.6.5 x 3-4.2 µm).

Coltricia montagnei (Fr.) Murr. Fig. 12
Mycologia 12: 13, 1920 - *Polyporus montagnei* Fr., in Mont. Ann. Sci. Nat. Ser. 2, Vol. 1: 341, 1836; *Cyclomyces turbinatus* Berk., Hook.J. Bot. 6: 445, 1854; *Cycloporus greenei* (Berk.) Murr., Bull. Torry Bot. Cl. 31: 423, 1904.

Basidiocarps annual, stipitate, single or rarely in clusters, sometimes laterally confluent, soft-spongy when fresh, brittle on drying; pileus circular to flabelliform, sometimes lobed, flat or with a depression at the centre, up to 6 cm in diameter and up to 6 mm thick at centre; upper surface finely adpressed velutinate to velvety tomentose, with age more hirsute to even hispid with tufts of erect hyphae at centre, light golden brown to reddish brown, usually darker towards the centre, faintly concentrically zonate; margin sharp to more or less blunt, concolorous with upper surface, entire or lobed, mostly deflexed when dry; stipe central or less often eccentric, short, tapering towards the base, solid, rusty to reddish brown, covered with a fine tomentum; pore surface reddish to dark brown; tubes concolorous or lighter than the pore surface, up to 5 mm deep; hymenophore poroid, sinuate to concentrically lamellate, pores or lamellae 1-3 per mm, dissepiments thin; context reddish brown, more or less duplex, upper layer soft and spongy, lower layer firm, azonate.

Hyphal system monomitic; generative hyphae with simple septa, thin to slightly thick walled, pale yellow to golden or light reddish brown, 4-7 μm wide, scarcely branched, up to 1 μm wide on the surface of pileus and stipe; setae none; badidia hyaline, clavate, 4-sterigmate, 18-28 x 5-9 μm; spores oblong ellipsoid, distinctly thick-walled, pale golden brown, 9-13.5 (14) x 5.5-7.5 μm, IkI-.

Habitat and Distribution

On ground; a very rare species in the temperate coniferous forests of Himalayas.

Remarks

This species is very confusing in the field because of a great variation in its hymenophore which varies from poroid, sinuous to lamellate even in a single fruiting body. Due to such variations, it has also been reported as *Cyclomyces turbinatus* Berk. (Berk 1854; Sharma 1985) and *Cycloporus greenei* Berk. (Thind & Dhanda 1980) from India. During the field expolorations, the author has collected fruitbodies with hymenophore varying from purely poroid, sinuate to typically concentrically lamellate. Further, the larger spores, stipitate, terrestrial basidiocarps and absence of hymenial setae points towards the inclusion of these

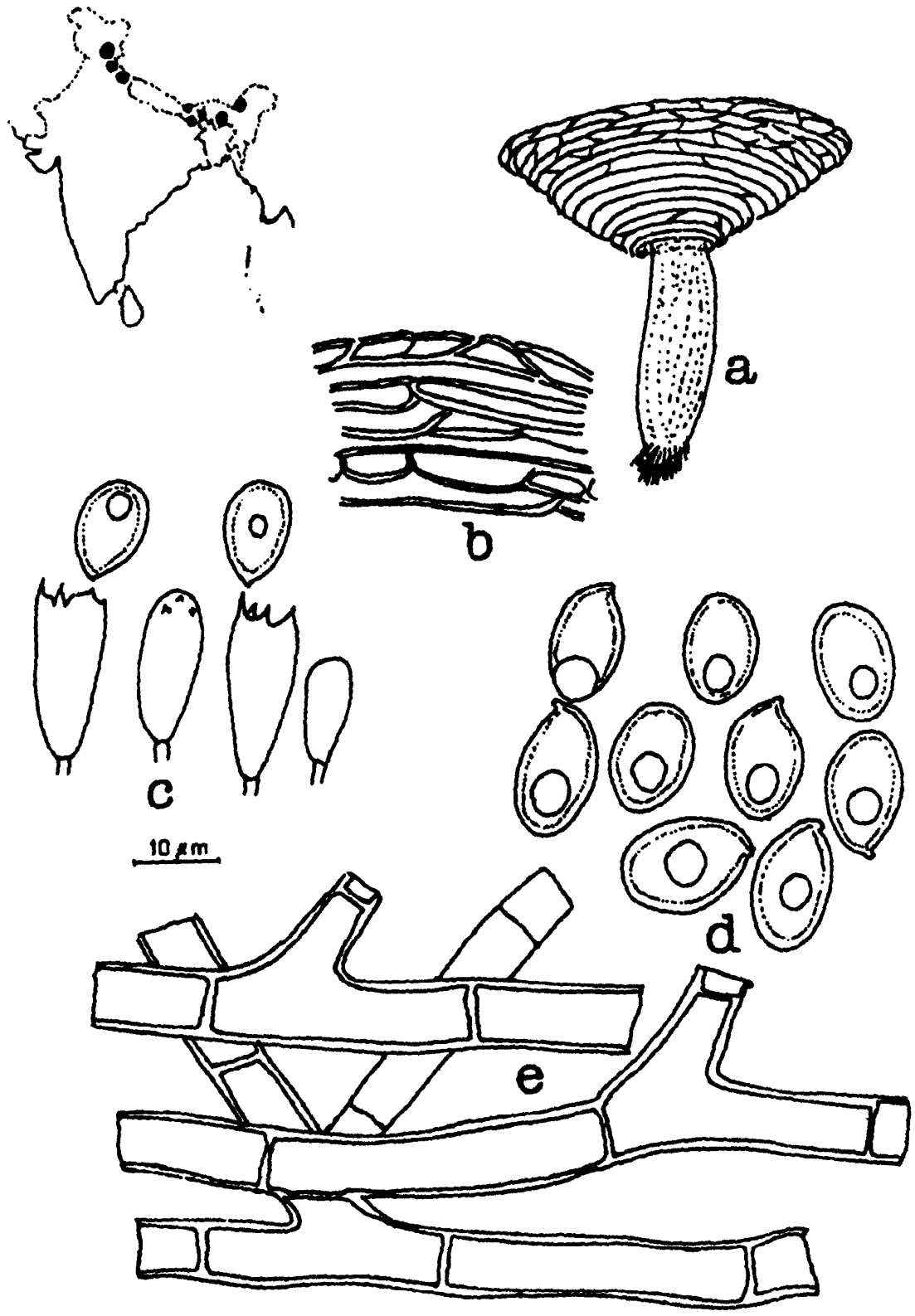


Fig. 12. *Coltricia montagnei* (JRS 60001) a. basidiocarp, b. pore surface, c. basidia, d. spores, e. generative hyphae.

two species in the genus *Coltricia* under *C. montagnei* (Gilbertson 1954, Ryvarden 1977). The absence of any hymenial setae and presence of larger spores separate it from the closely related *Inonotus tomentosus* and *I. circinatus*.

Coltricia perennis (L. : Fr.) Murr. Fig. 13

J. Mycol. 9: 91, 1903 - *Boletus perennis* L., Sp. Plant., p. 1177, 1753; *Polyporus perennis* L. Fr., Syst. Mycol. 1: 350, 1821; *Polystictus perennis* Karst. in Medd. Soc. faunna et Fl. Fenn. V: 210, 1888.

Basidiocarps annual, stipiate, thin, coriaceous when fresh, drying rather rigid; pileus more or less circular, convex to depressed or umbilicate, up to 8 cm in diameter, 2-4 mm thick at center; upper surface finely adpressed velutinate, light golden brown to cinnamon or rusty to dark reddish brown, dull, usually

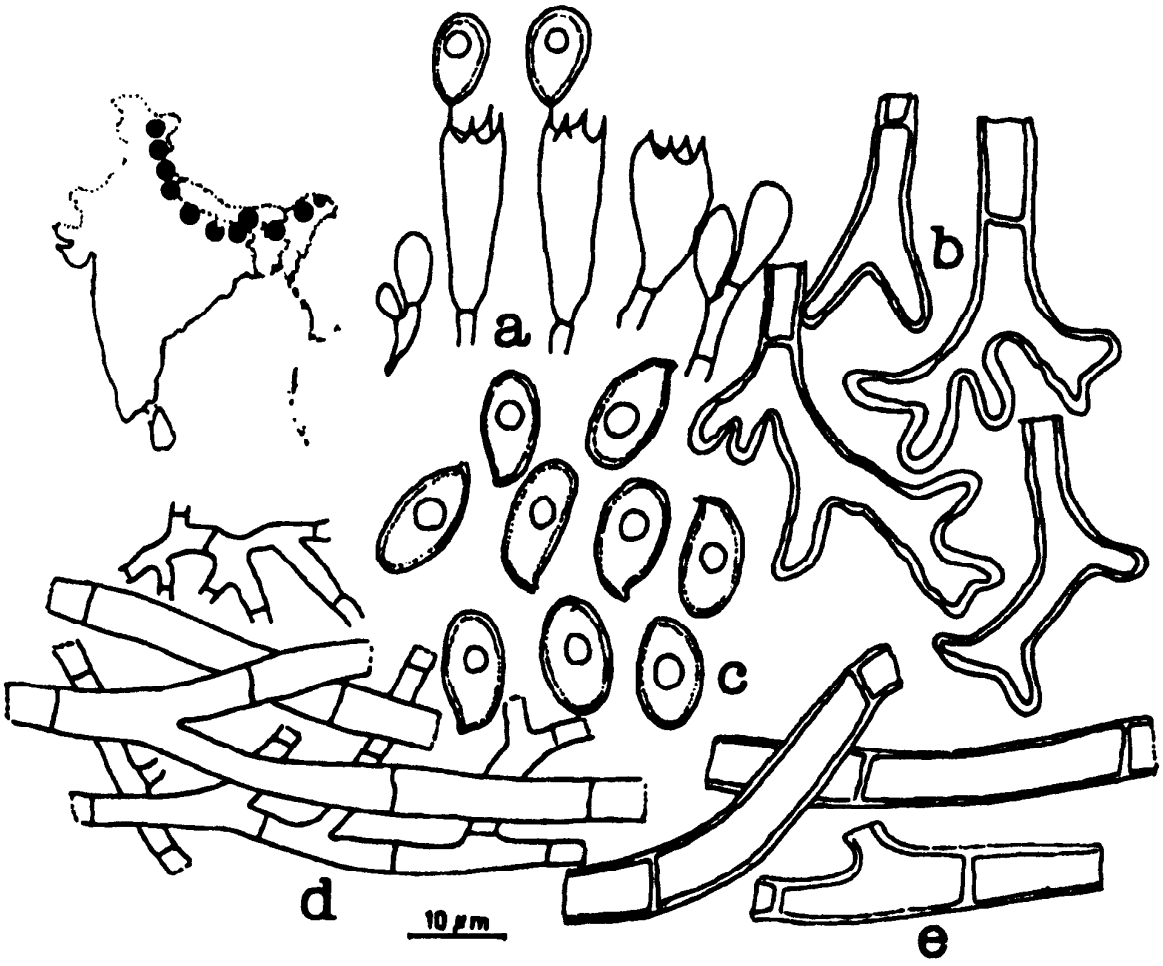


Fig. 13. *Coltricia perennis* (JRS 60113) a. basidia, b. hyphae from pilear surface, c. spores, d. thin walled hyphae, e. thick walled hyphae.

concentrically zonate; margin sharp, thin and fimbriate, deflexing in dried specimens; stipe cylindrical to flattened, 1-3 cm long and 2-3 mm in diameter, adpressed velutinate-tomentose, light rusty or golden brown to dark reddish brown, widened at upper part; pore surface golden brown, cinnamon to dark brown with age; pores thin walled, angular, decurrent on the upper expanded part of the stipe, 2-4 per mm, becoming slightly incised and more uneven with age; tubes 2-3 mm deep, cinnamon brown to rusty brown, lighter than the pore surface; context up to 1 mm thick, dark to deep rusty brown, darker than the upper tomentum and tube layer.

Hyphal system monomitic; generative hyphae with simple septa, pale brown to rusty brown, 3-6.5 μm wide, straight to twisted, sparingly branched, hyphae on pilear surface thicker walled, usually dichotomously branched, dark brown, 4-8 μm wide; setate and setal hyphae none; basidia clavate, 12-22 x 5-7.5 μm, 4-sterigmate; spores ellipsoid to oblong ellipsoid, slightly thick walled, pale golden brown, 6-9.5 x 3.5-5 μm, weakly dextrinoid.

Habitat and Distribution

On ground in coniferous forests, often on exposed soil like paths, clay banks, roadsides, vicinity of fireplaces, etc; never on rotting woods; a very common polypore in the temperate coniferous forests.

Remarks

The larger basidiocarps and lack of silky lustre on the pilear surface distinguish it from *C. cinnamomea* and *C. pusilla.*

Coltricia pusilla Sharma et Wright Fig. 14
Bull. Bot. Surv. Ind. 31: 182, 1989.

Basidiocarps annual, stipitate, soft, coriaceous when fresh, hard and rigid on drying; pileus infundibuliform or depressed at centre, circular, up to 1 cm in diameter, 1-2 mm thick; upper surface adpressed velutinate-tomentose, deep golden brown to cinnamon brown, shining with silky striations, narrowly concentrically zonate; margin sharp, deflexed when dry, fimbriate, concolorous with pilear surface; stipe equal or tapering upwards, usually swollen at base, up to 2 cm long and 1-2 mm thick, finely tomentose, somewhat hispid towards the base, light rusty brown to dark brown; pore surface rusty brown to dark brown, with a narrow sterile margin tubes up to 1 mm deep, light golden to ochraceous brown; pores angular, 2-4 per mm, dissepiments entire, becoming lacerate near the stipe base with age; context 0.5-1 mm thick, dark to rusty brown, fibrous.

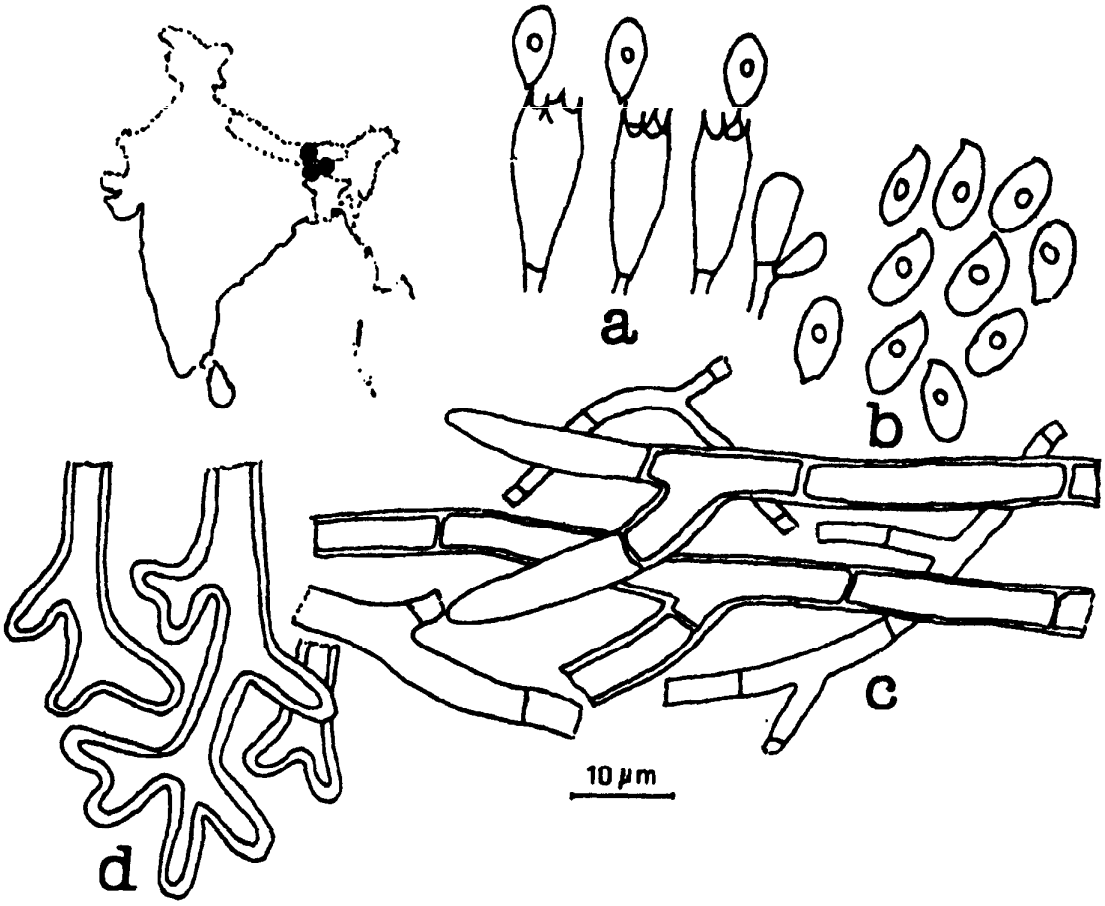


Fig. 14. *Coltricia pusilla* (JRS 60108) a. basidia, b. spores, c. generative hyphae, d. hyphae from pilear surface.

Hyphal system monomitic, generative hyphae septate, pale golden brown to rusty brown, branched frequently, 4-6.5 µm wide, thin to thick walled, more thick walled and up to 8 µm wide on pilear surface; setae and cystidia none; basidia subclavate, 8-12.5 x 5-6 µm, 4-sterigmate; spores oblong ellipsoid, smooth, slightly thick walled, golden brown, 5-6.5 x 3-4.2 µm, IkI-.

Habitat and Distribution

On ground especially along clay banks, in beaten forests trails in the coniferous forests; a rare species in the temperate zones.

Remarks

This species is distinct by small reddish brown basidiocarps, shiny pilear surface with ciliate margin and smaller spores *C. perennis* is morphologically somewhat similar in colour, pore size, habitat and faintly zoned pilear surface but

has larger dull brown, basidiocarps and spores (6-9.5 x 3.5-5 μm). In the shining nature of pilear surface it resembles closely with *C. cinnamomea*, but the latter has larger basidiocarps and spores (5.5-9.5 x 4.5-7 μm). In addition, *C. cinnamomea* usually prefers deciduous forests. *C. montagnei* is, of course differentiated by azonate, larger pilei (up to 6 cm wide and 6 mm thick), pores (1-3 per mm) and spores (9-13.5 (14) x 5.5-7.5 μm).

Coltricia pyrophila (Wakf.) Ryv. Fig. 15
Norw. J. Bot. 19: 231, 1972 - *Polyporus pyrophilus* Wakf. Kew Bull. Misc. Inf.: 71, 1916.

Basidiocarps annual, centrally stipitate, single or many pilei from a common stipe, coriaceous tough when fresh, resinous hard and brittle on drying; pileus circular, infundibuliform with a depression at center, 2-4 cm in diameter, up to 10 mm thick near center, yellowish white to light yellowish brown when fresh,

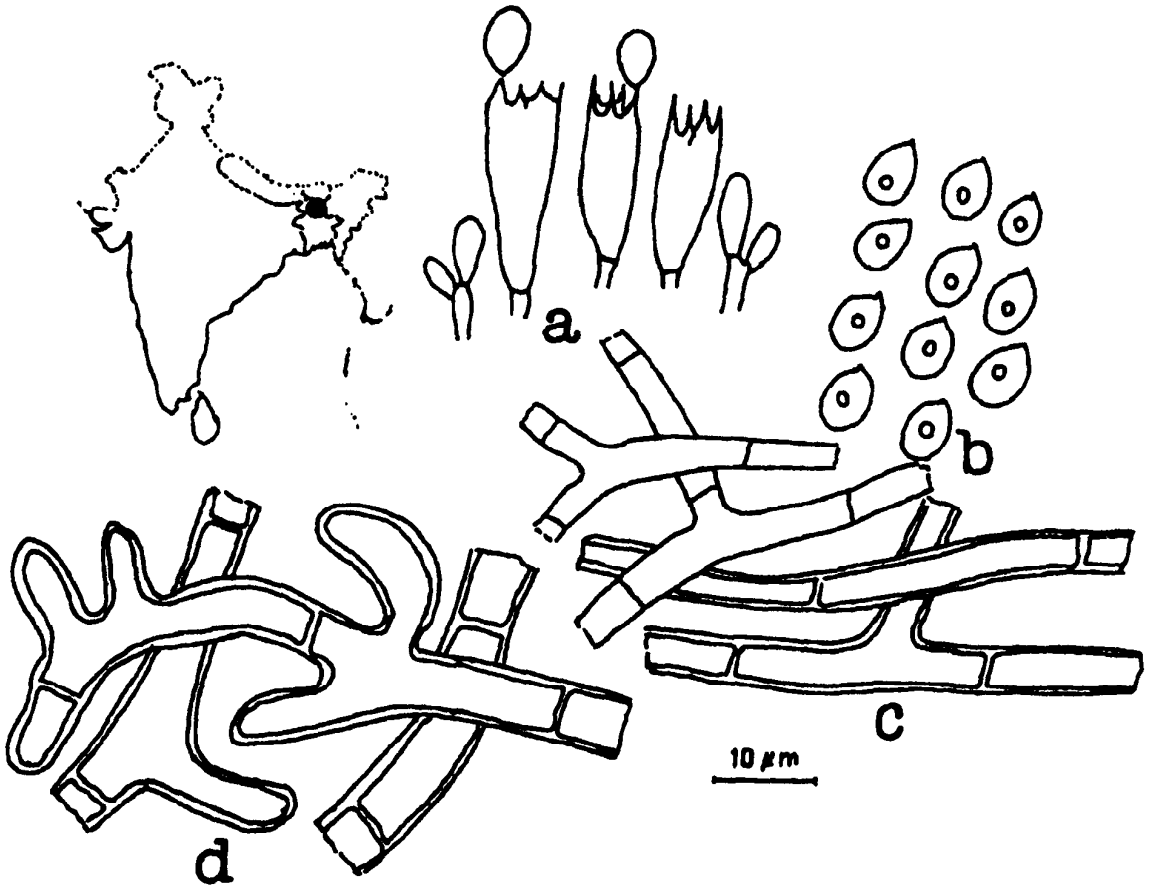


Fig. 15. *Cohricia pyrophila* (JRS 60501) a. basidia, b. spores, c. generative hyphae, d. hyphae from pilear surface.

dark brown on drying, velutinate-tomentose in centric zones when young, glabrous decurved on drying; stipe circular,.equal or expanded towards the base and pileus, finely velutinate, concolorous with pileus colour, dark brown on drying, solid, brittle on drying, 2-4 cm long, 5-10 mm in diameter; pore surface yellowish white to yellowish brown when fresh, dark brown on bruising and drying; tubes decurrent, 2-3 mm deep, brittle on drying; pores angular, 2-4 per mm, becoming sinuate towards the center with age; context thin, light yellowish brown, 2-6 mm thick.

Hyphal system monomitic; generative hyphae simple septate, pale to golden yellow, branched, 3-6 μm wide in the trama and thicker walled, darker and up to 8 μm wide in the context and pilear surface; setae none; basidia clavate, 12-20 x 4.5-7 μm, 4-sterigmate; spores subglobose to broadly ellipsoid, 4.5-5.5 x 3-4 μm, hyaline to pale yellow, thin to moderately thick walled, IkI.

Habitat and Distribution

On ground, under *Shorea robusta* trees. The fruitbodies appear on soil and are connected with the roots underneath; never collected on dead/burnt wood; a very rare species in the tropical to subtropical forests of Eastern Himalayas.

Remarks

The zonate, light yellowish basidiocarps changing to dark brown on drying and bruising make this species distinct in the field. Microscopically, the smaller spores are characteristic. Wakefield (1916) described this species from tropical Africa as growing on burnt ground. But in India, all its collections have been made on the roots covered with soil in *Shorea robusta* (Sharma, 1989), forests. Also the colour change of basidiocarps on drying or bruising about which there is no mention in the literature (Wakefield *Loc. Cit.* Ryvarden & Johansen 1980) is an important field character of this species. Further, the fairly stout stipe and the resinous hard and brittle basidiocarps on drying appear quite unusual characters in the genus *Coltricia.*

Coltricia spathulata (Hook.) Murr. Fig. 16
North Am. Fl. 9: 93, 1908 - *Boletus spathulatus* Hook. in Kunth, Synop. Pl. 1: 9, 1822; *Polystictus spathulatus* (Hook.) Cooke, Grevillea 14 : 78, 1886.

Basidiocarps annual, thin, usually laterally to centrally stipitate, coriaceous-fibrous when fresh, rigid and light in weight on drying; pileus small, flabelliform, spathulate to reniform, often separated into several lobes, conchate, slightly

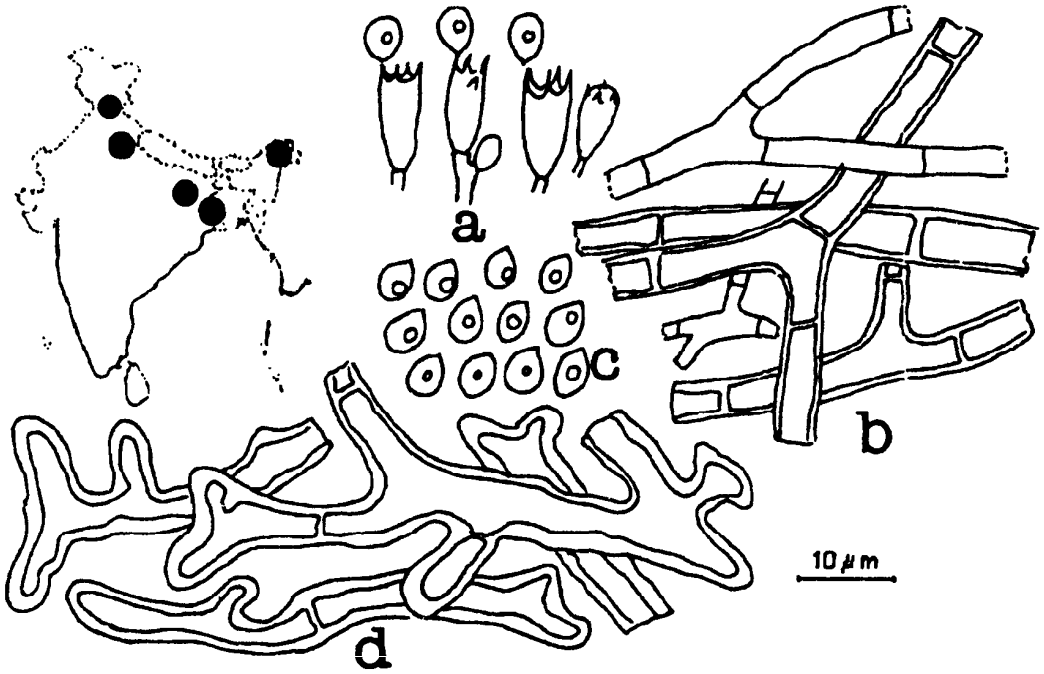


Fig. 16. *Coltricia spathulata* (JRS 60105) a. basidia, b. generative hyphae, c. spores, d. hyphae from pilear surface.

depressed at center, up to 3 cm wide, 2 cm broad and 2-3 mm thick; upper surface persistently tomentose, golden brown to cinnamon brown, silky, azonate to weakly zonate in variable concentric zones, radially striate to wrinkled on drying; margin thin and acute, undulate to lobate, sterile below, concolorous or lighter than the pilear surface; stipe very short to long, often rooted, 1-4 cm long, up to 10 mm thick, much irregular, often branched and flattened, swollen towards the base, cinnamon brown, velutinate spongy, longitudinally wrinkled on drying, core solid, darker, hard and brittle when dry; pore surface golden brown to fulvous; tubes usually less than 1 mm deep, decurrent, yellow or concolorous with the pore surface; pores small, angular to slightly elongated, 7-9 per mm, dissepiments thin, entire; context duplex, two layers separated by a thin black line, coriaceous, very thin, up to 2 mm thick, golden to yellowish brown or nearly concolorous with pore surface.

Hyphal system monomitic, generative hyphae yellowish to golden brown, thick walled, sparsely branched, simple septate, 3-5 µm wide, hyphae in the pilear surface nearly rusty brown, with a narrow lumen, up to 8 µm wide; setae absent; basidia subclavate, hyaline, 4-sterigmate, 5-10 x 3-4 µm; spores yellowish brown, subglobose to minutely oblong ellipsoid, walls slightly thick, 2.5-3.5(4) x 2-2.5 µm, IkI-.

Habitat and Distribution

On dead or burnt wood or stumps of angiosperms; never found on living trees; rot unknown; a rare but a wide spread species in the tropical zones.

Remarks

The shape of the pileus and length and shape of stipe are very confusing and variable characters of this species. The presence of a dark black thin line in between the adpressed tomentum and context is a striking feature. Further, the smaller pores and minute subglobose spores which are quite uncommon in the genus *Coltricia*, are good features for separating this species.

Coltricia vallata (Berk.) Teng. Fig. 17

Fungi of China, p. 759, 1964 - *Polyporus vallatus* Berk., Hook. J. Bot. 6: 138, 1954.

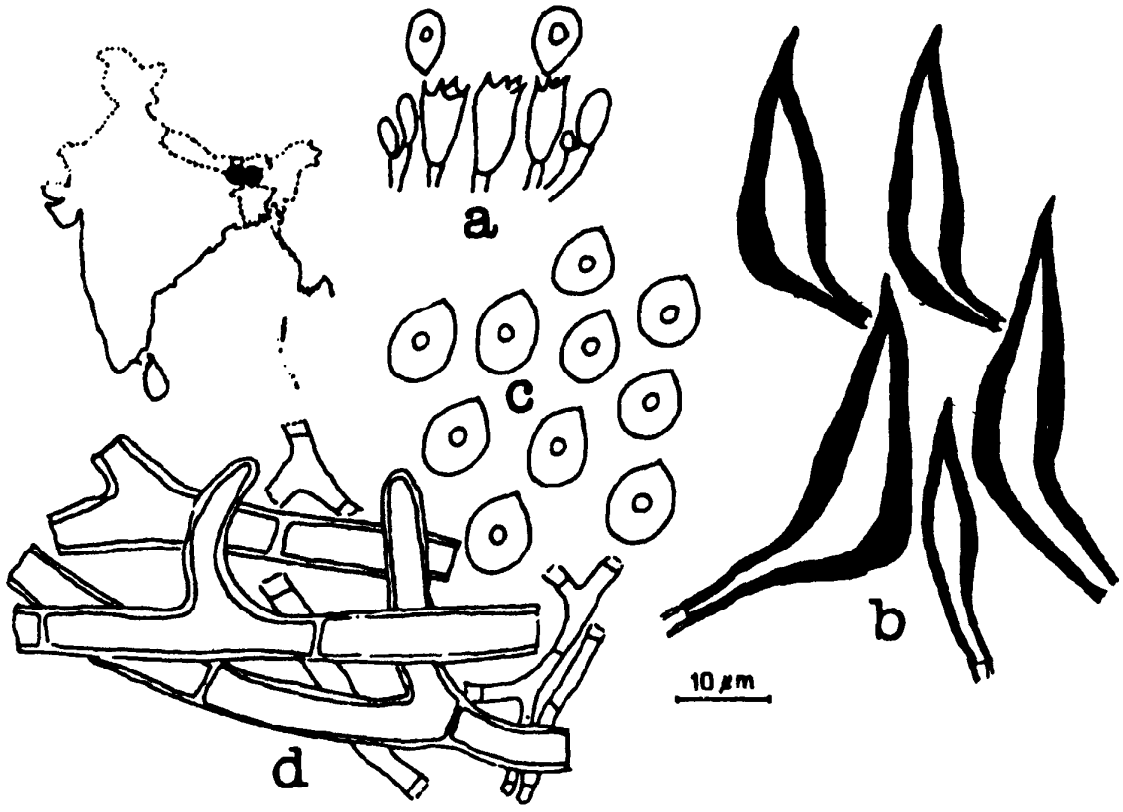


Fig. 17. *Coltricia vallata* (JRS 60123) a. basidia, b. setae, c. spores, d. generative hyphae.

Basidiocarps annual, single or in clusters, centrally stipitate; pileus circular, 3-6 cm wide, up to 8 mm thick, coriaceous tough when fresh, hard and brittle on drying, cinnamon to fulvous, finely velutinate-tomentose, soon glabrous and wrinkled on drying with a very thin reddish brown to dark brown cuticle, azonate to weakly zonate near the margin; margin entire or deeply lobed, narrow, sterile; pore surface rusty brown; tubes 1-2 mm deep, pale rusty to medium brown, decurrent on stipe; pores angular to entire, 4-6 per mm; context 1-3 mm thick, homogeneous, reddish to rusty brown; stipe 1-2 cm long, 6-8 mm thick, tapering towards base, cinnamon to pale reddish brown, hard on drying.

Hyphal system monomitic; generative hyphae pale rusty or golden brown, moderately thick walled, septate, 4-8 μm wide, wider and thicker-walled on pilear surface, sparingly branched; hymenial setae present, scanty to abundant, dark brown, thick walled, lumen narrow, tips straight, single or dichotomously split, ventricose, base swollen and elongated, 22-40 x 7.5-14 μm; basidia clavate, hyaline, 7-12 x 4-6 μm, 4-sterigmate; spores broadly ellipsoid, smooth, slightly thickwalled, light rusty brown, 6.5-7 (8) x 5-6 μm, IkI-.

Habitat and Distribution

On ground; in temperate Himalayan forests, an extremely rare species.

Remarks

This species was first reported by Berkeley (1854) out of the collections of Hooker from Khasi hills (Type at Kew). Later on it was collected by J. Poelt and reported by Ryvarden (1977) from Nepal. The species appears to be so rare that the author has made only one collection from tempterate coniferous forests of Sikkim. It is desirable to have its more collections before deciding about its position *I. tomentosus* appears to be its closest relative the lack of duplex consistency of context, smaller hymenial setae, narrower and darker spores differentiate the present species from *I. tomentosus* Above all, the setae with straight and split tips is a unique feature of this species.

CYCLOMYCES Fr.

Linnaea 5: 512, 1830.

Basidiocarps annual, pileate, sessile to centrally or laterally stipitate; pileus circular or flabelliform to dimidiate; upper surface tomentose to finely pubescent, light rusty brown to reddish brown; hymenophore poroid; context duplex, upper part as a black zone below the pilear tomentum, lower part dense and rusty brown; hyphal system monomitic; hyphae golden brown, septate; hymenial setae present; spores ovoid to broadly ellipsoid, hyaline to pale yellow; on dead hardwoods; causing white rot; cosmopolitan genus with two species in india; *ca* 5 species in the world.

Type species : *Cyclomyces fuscus* Fr.

The genus as defined here is quite natural and includes lignicolous species having thin and flexible fruitbodies with duplex context and hymenial setae. The presence of hymenial setae, lignicolous habitat and smaller-spores differentiate it from *Coltricia.* From *Inonotus* it is separated by its thin and flexible fruitbodies with duplex consistency.

KEY TO THE INDIAN SPECIES

1. Pores 1-3 per mm — **C. setiporus**
1. Pores 7-9 per mm — **C. tabacinus**

Cyclomyces setiporus (Berk.) Pat. Fig. 18

Essai Tax. Hymen. p. 98, 1900 - *Polyporus setiporus* Berk., Lond. J. Bot. 6: 505, 1847; *Polystictus setiporus* (Berk.) Cke., Grevillea 14: 86, 1886; *Polyporus cichoraceus* Berk. : Fr., Nova Acta, Upsal. Sci. III, 1: 92, 1851.

Basidiocarps annual or biennial, solitary or imbricate, coriaceous, effused-reflexed to sessile, dimidiate or fan shaped; pileus up to 6 cm wide, 5 cm broad and 1-3 mm thick, dark brown to chestnut or cinnamon brown or reddish brown especially in actively growing specimens, tomentose, narrowly concentrically zonate, silky and shinning when fresh, soon becoming glabrous; margin thin, entire, concolorous; pore surface cinnamon brown, slightly concave, sterile border up to 2 mm wide; tubes brownish up to 1 mm deep; pores angular to somewhat round, 1-3 per mm, dissepiments thin, entire, lacerate or toothed with age; context

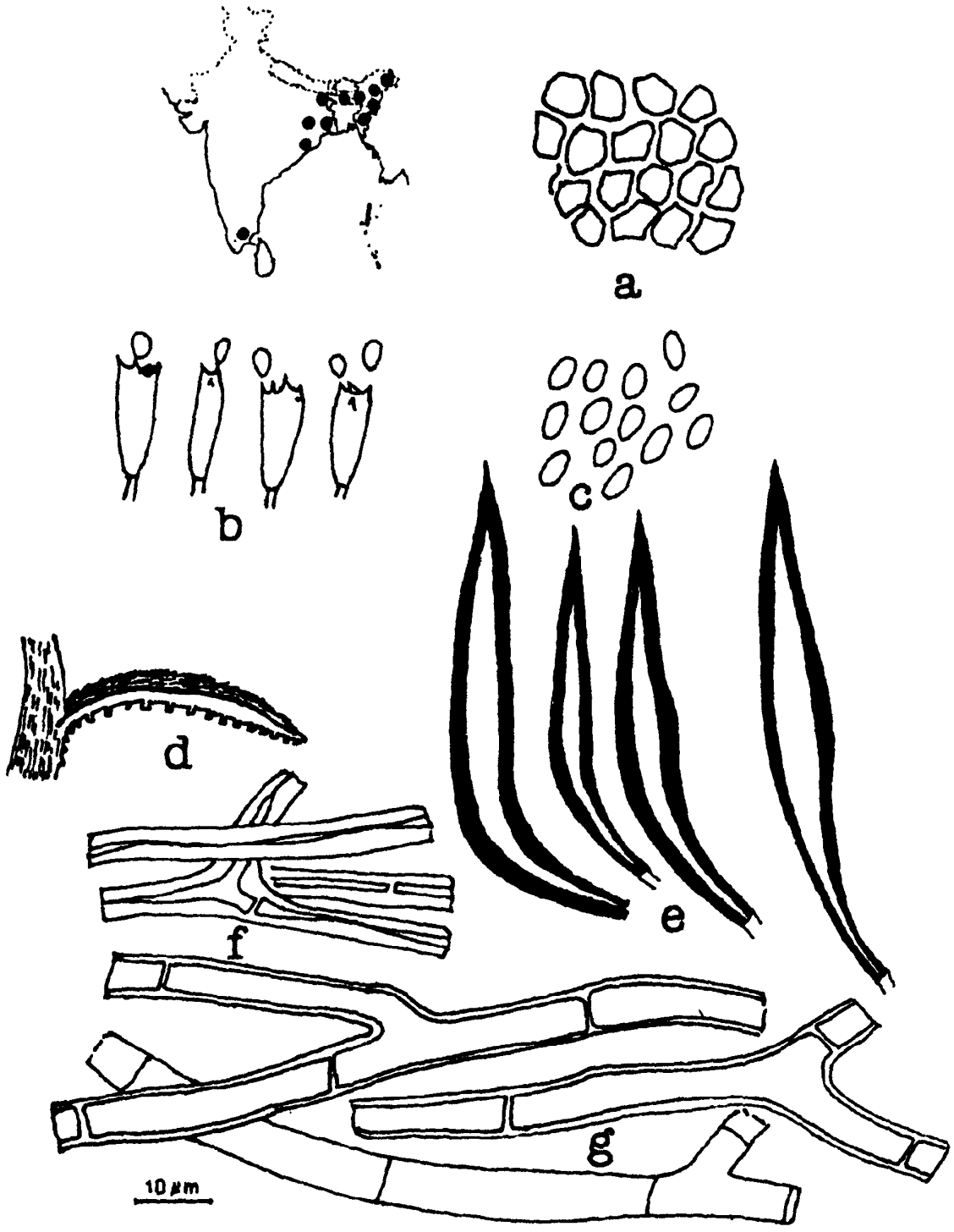


Fig. 18. *Cyclomyces setiporus* (JRS 61120) a. pore surface, b. basidia, c. spores, d. section through basidiocarp, e. setae, f. hyphae from pilear tomentum, g. generative hyphae.

up to 1 mm thick, cinnamon to fulvous, duplex, limited on the upper surface by a dark zone of agglutinated hyphae.

Hyphal system monomitic, generative hyphae pale yellow to pale brown, thin to thick walled, simple septate, 3-5 mm wide, hyphae of tomentum thick walled, more or less solid, 3-6 μm wide, unbranched; hymenial setae abundant, dark brown, thick walled, subulate with straight and tapering apex, slightly curved at base, 40-55 x 5-7 μm; basidia hyaline, clavate, 4-spored, 9-13.5 x 3.5-6 μm; spores broadly ellipsoid, hyaline, 3-4.5 x 1.5-2 μm, guttulate, IkI-.

Habitat and Distribution

On dead stumps and logs of hardwoods; causing a white pocket rot; a common tropical species.

Remarks

In the thin nature, size and colour of the basidiocarps, this species resembles closely with *C. tabacinus*. However, the larger pore size of *C. setiporus* separates the two species.

Cyclomyces tabacinus (Mont.) Pat. Fig. 19
Essai tax. p. 98, 1900 *Polyporus tabacinus* Mont., Ann. Sci. Nat. Ser. 3 vol. 3: 349, 1835; *Polystictus tabacinus* (Mont.) Fr., Nov. Symb. p. 93, 1851.

Basidiocarps annual, imbricate, rarely single, laterally confluent, coriaceous when fresh, hard and brittle on drying, sessile to subsessile, pilei fan-shaped to flabelliform, conchate to applanate, with a lateral stipe-like base, up to 8 cm wide, 6 cm broad and 1-3 mm thick; upper surface dark brown to reddish brown, concentrically zonate, velvety tomentose to finely radially striate, becoming glabrous and reddish black on concentric zones; margin acute, entire, often sterile below, concolorous or lighter than the pilear surface, incurved on drying; pore surface dark brown to reddish brown; tubes up to 1 mm deep, reddish brown; pores round and entire, 7-9 per mm; context duplex, up to 1 mm thick, dark reddish brown, separated from the tomentum by a dark zone of aggulutinated hyphae.

Hyphal system monomitic, generative hyphae yellowish to dark brown, thin to thick walled, sparsely branched, simple septate, 3-5 μm wide, hyphae in pileur tomentum darker, up to 7 μm wide, and more thick walled; hymenial setae dark brown, present abundantly, subulate, pointed, 28-45 x 7-8 μm; basidia clavate,

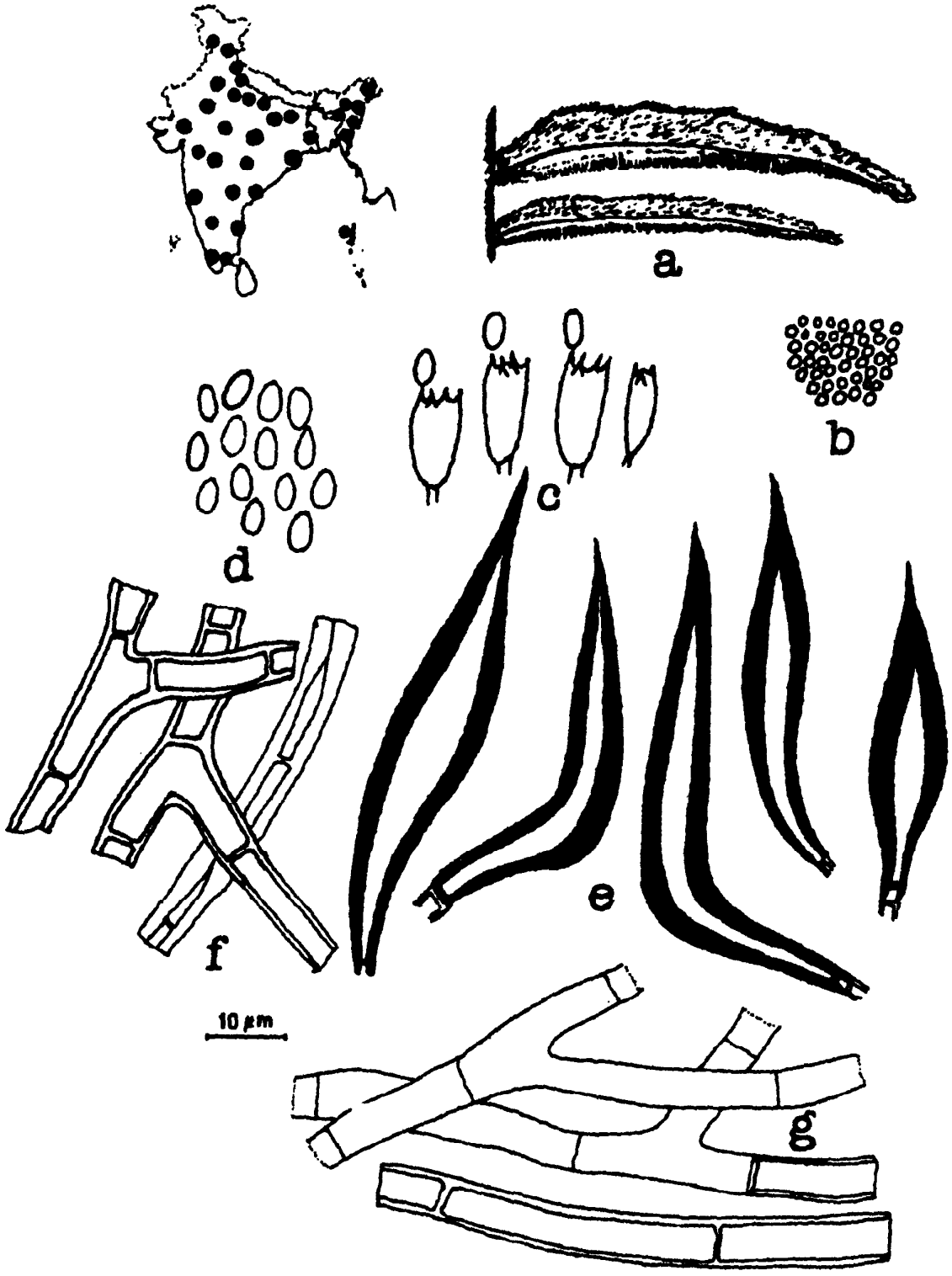


Fig. 19. *Cyclomyces tabacinus* (JRS 302) a. section through basidiocarps, b. pore surface, c. basidia, d. spores, e. setae, f. hyphae from tomentum, g. hyphae from trama.

8-14.5 x 3.5-5 μm, 4-sterigmate; spores hyaline, ovoid to ellipsoid, 1-2 guttulate, 2.5-3.5 (4) x 1.5-2 μm; IkI-.

Habitat and Distribution

On dead stumps and logs of hardwoods, not found on conifers; causing a white pocket rot in both sapwood and heartwood; very common tropical species.

Remarks

Thin, flabellate annual fruitbodies with duplex context and smaller spores characterize this species.

HYDNOCHAETE Bres.
Hedwigia 35: 287, 1986.

Basidiocarps effused-reflexed to sessile; upper surface matted, strigose; hymenial surface hydnoid or tuberculated, rusty to dark reddish brown; context brown, loose; hyphal system monomitic; generative hyphae thin to thick walled, simple septate; hymenial setae and setal hyphae present abundantly; dichohyphae present; spores hyaline, short cylindrical, smooth, nonamyloid; on dead woods; causing a white pocket rot; tropical genus with one species in India; *ca* 8 species in the world (Ryvarden 1982).

Type species : *Hydnochaete peroxydata* (Berk. & Curt.) Dennis

Hydnochaete resupinata (Swartz.) Ryv. Fig. 20
Mycotaxon XV: 437, 1982 *Hydnum resupinatum* Swartz., Nova. gen. Spec. Prodromus descr. Veget. p. 149, 1788; *Hymenochaete aspera* Berk. & Curt., J. Linn. Soc. Bot. 10: 334, 1868.

Basidiocarps annual, effused-reflexed to pileate, with a narrow resupinate base or dimidiate, imbricate, laterally confluent, thin, soft to coriaceous; pileus 2-4 cm wide, 6-10 cm broad and up to 2 mm thick; upper surface rough, matted with strigose forked hairs pointing towards the margin, cinnamon to rusty brown; hymenial surface rusty brown, darkening with age, tuberculate to irregularly hydnoid, aculei pointed to rounded, scattered or in groups, up to 1 mm deep, densely covered with projecting setae; context consisting of longitudinally arranged hyphae which curve outwardly and become interwoven to form the upper loose hairy covering, no dense dark zone present, cinnamon to rusty brown, up to 1 mm thick.

Hyphal system monomitic, some hyphae thin walled, hyaline to yellowish, frequently septate, closely to sparingly branched, somewhat granular, 2-3 μm thick; dichoyhyphae abundantly present in the tubercles, less common in the context, strongly branched; hymenial setae abundant, dark brown, projecting on the teeth, scattered or in groups, subulate, with sharp pointed hyaline tips, 35-60 (70) x 4-10 μm, emerging up to 30 μm beyond the hymenium, arising mostly from the hymenium; setal hyphae present in the trama, context and pilear surface, up to 200 μm long, tips pointed; basidia hyaline, clavate, 14-17 x 4-6 μm, 4-sterigmate; spores hyaline, broadly ellipsoid to subcylindrical, 3-4 x 2 μm, nonamyloid, smooth.

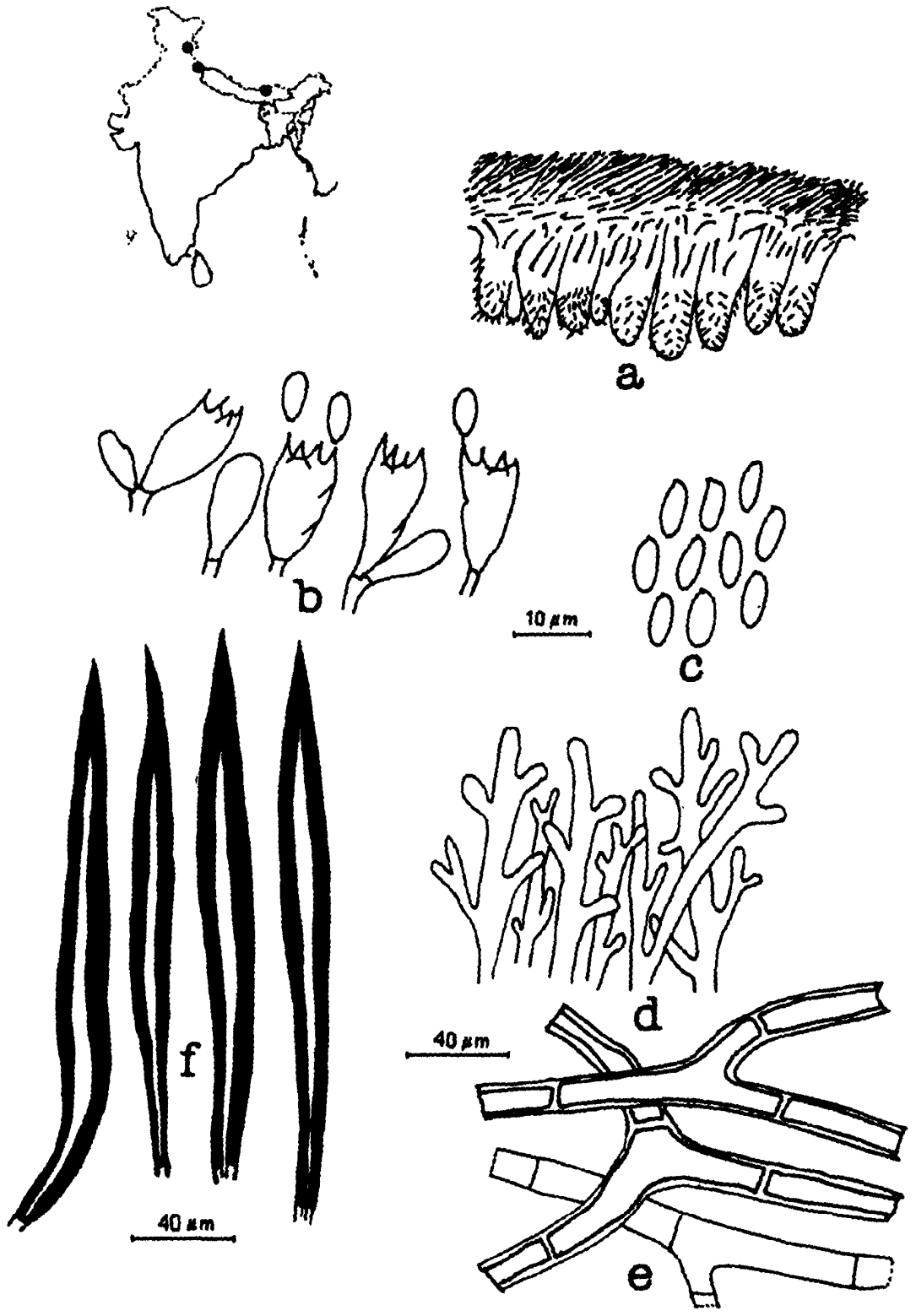


Fig. 20. *Hydnochaete resupinata* (JRS 781) a. section through basidiocarp, b. basidia, c. spores, d. dichohyphae from tubercles, e. generative hyphae, f. setae.

Habitat and Distribution

On dead hardwoods, causing a white pocket rot; a rare tropical species.

Remarks

H. resupinata can be recognised by its thin, pliant basidiocarps having strigose matted rough upper surface, irregular aculei and loose context. Microscopically, the narrow setal hyphae in the context and trama and dichohyphidia are characteristic.

HYMENOCHAETE Lev.

Ann. Sci. Nat. Bot. III, 5: 150, 1846.

Basidiocarps annual or perennial, resupinate, effused-reflexed to pileate, usually thin, membranous-coriaceous to firm, confluent; hymenial surface smooth; context with or without a abhymenial cuticle, brown, darkening in KOH; hyphal system monomitic; hyphae thin to thick walled, hyaline to golden brown in KOH, septate; hymenium composed of setae, sometimes cystidia or paraphysoid hyphae and basidia; setae reddish brown, subulate, thick walled; paraphysoid hyphae simple or branched; basidia clavate or subclavate, 4-sterigmate; spores hyaline, thin walled, smooth ellipsoid to cylindrical, non-amyloid; on dead woods; causing white rots; tropical to temperate genus; with *ca* nine species in India.

Type species : *Hymenochaete tabacina* (Sow.: Fr.) Lev.

Hymenochaete, like other genera of the Hymenochaetaceae is characterized by the presence of simple septate, thick walled hyphae whose thicknened walls become permanently dark in KOH. The hyphal system is monomitic, though it appears to be dimitic because of the presence of thick walled hyphae which look like skeletals. These hyphae do replace thin walled generative hyphae but are not truely skeletals because they branch regularly and become frequently septate (Jung 1987). Macroscopically the growth from, colour and tissues are diagnostic (Reeves & Wlelden 1967). In section there layers (abhymenial cuticle, context and hymenium) are recognized. The presence of cuticle, stratification of context, thickness of setigerous layer, size setae and spores are helpful in diagnosis.

KEY TO THE INDIAN SPECIES

1. Abhymenial cuticle present 2
1. Abhymenial cuticle absent 4

2. Hymenial surface red or deep red, paraphysoid hyphae present in the hymenium; spores cylindrical to suballantoid . **H. cruenta**
2. Hymenial surface not red; paraphysoid hyphae absent; spores broadly elipsoid . . 3

3. Basidiocarps coriaceous-tough, hard and woody on drying; spores 5-7 x 3-4.5 μm **H. rubiginosa**
3. Basidiocarps membranous-coriaceous, pliable on drying; spores 4.5-5.5 x 2-2.5 μm **H. luteobadia**

4. Hymenial surface deeply cracked into irregular isolated squares, atleast in the resupinate portion 5
4. Not as above 6

5. Basidiocarps resupinate to effused-reflexed; brown to dark reddish brown; margin orange yellow; context with only one setigerous layer **H. tabacina**
5. Basidiocarps resupinate, ferruginous brown; margin yellowish brown; context stratified with usually two setigerous layers **H. semistupposa**

6. Basidiocarps pileate, thin, papery, remaining so on drying; abhymenial surface thickly to coarsely pubescent **H. rheicolor**
6. Basidiocarps resupinate to pileate, somewhat hard and brittle on drying; abhymenial surface velvety to smooth 7
7. Setae densely crowded all over the setigerous layer **H. cacao**
7. Setae arising from a distinct setal zone 8

8. Basidiocarps membranous-coriaceous; setae scanty and often covered by growing hyphae from the hymenium, giving them the pyramidal appearance; spores ellipsoid to subcylindrical, 6-7.5 x 3-4.5 μm **H. fuscobadia**
8. Basidiocarps subpelliculose to membranous, setae abundant and without any hyphal covering; spores ellipsoid, 5-7 x 3-3.5 μm **H. leonina**

Hymenochaete cacao Berk. Fig. 21
Linn. Soc. Bot. J. 10; 333, 1868.

Basidiocarps annual, sessile to rarely resupinate, flabelliform, closely imbricate and connate, thin, somewhat rigid and brittle on drying; pileus up to 3 cm broad, 1-2 cm wide and 2-4 mm thick; upper surface velvety, smooth with age, concentrically sulcate, dark reddish brown to blackish brown near the base and in older specimens; margin lobed, paler than the pilear surface; hymenial surface reddish brown to dark olive brown, uneven with a few concentric ridges; context 400-600 μm thick, composed of a setigerous layer up to 100 μm thick and a hyphal layer up to 500 μm thick consisting of closely and longitudinally arranged hyphae, curving on one side into the hymenium and on the other into the surface of the pileus.

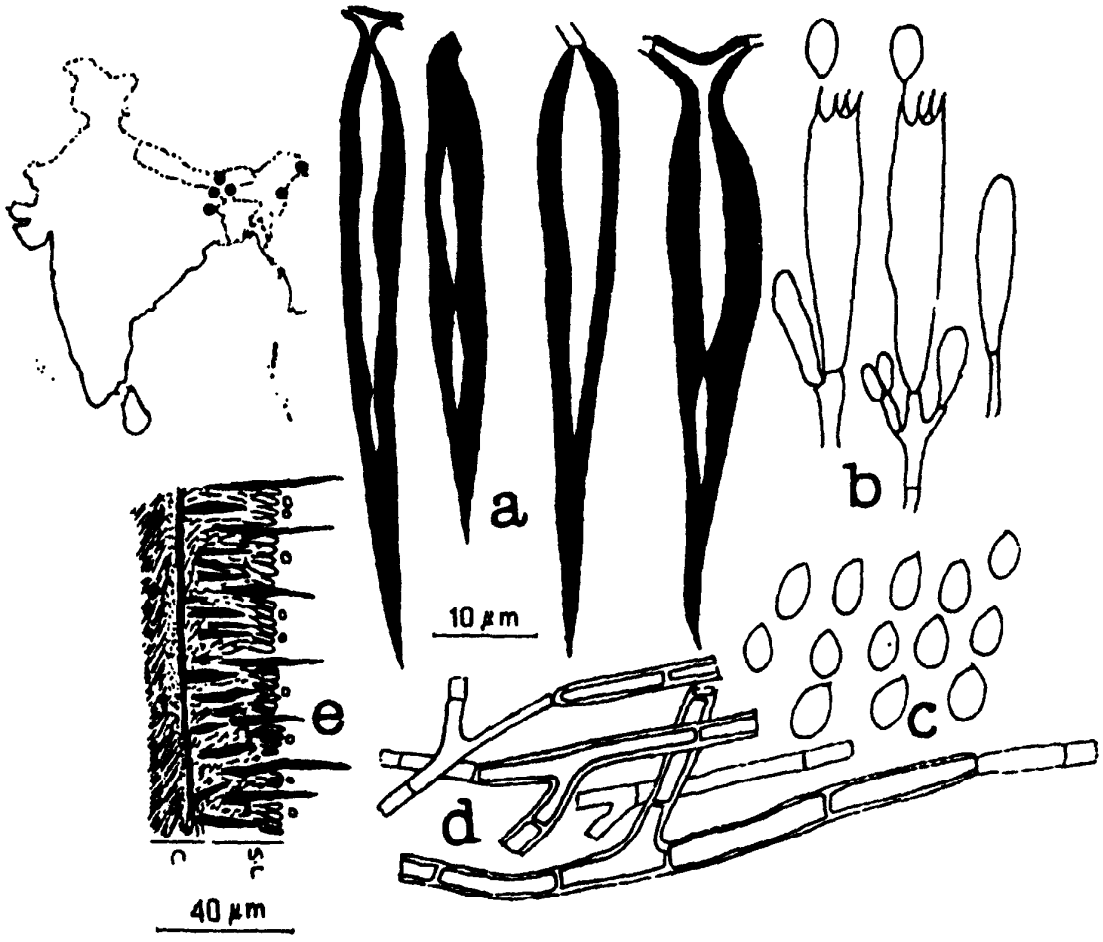


Fig. 21. *Hymenochaete cacao* (JRS 765) a. setae, b. basidia, c. spores, d. generative hyphae, e. section through basidiocarp.

Hyphal system monomitic; hyphae thin to thick walled, pale yellowish to brownish, 2-3.5 µm wide, unbranched to sparingly branched; setae subventricose to subulate, 25-50 x 5-6 µm, densely crowded in all parts of the setigerous layer, dark brown, lumen narrow, emerging up to 15 µm beyond the hymenial layer; basidia subclavate, 20-25 x 4-5 µm, 4-sterigmate; spores hyaline, broadly ellipsoid, 3-4.5 x 2-3 µm, IkI-.

Habitat and Distribution

On dead angiospermous woods, rot unknown; a rare species in tropical to temperate forests.

Remarks

The chief distinguishing feature of this species is the presence of smaller setae densely crowded all over the setigerous layer.

Hymenochaete cruenta (Pers. : Fr.) Donk Fig. 22

Persoonia 1 (1): 51, 1959 - *Thelephora cruenta* Pers. : Fr., Syst. Mycol. 1: 444, 1821; *Hymenochaete mougeotii* (Fr.) Cke, Grevillea 8(48): 147, 1880.

Basidiocarps annual to perennial, resupinate to effused-reflexed, membranous coriaceous, adnate, often arising as small circular colonies which usually coalesce and grow up to 5 cm in diam, 300-500 μm thick in section; pileus when present very small, narrow up to 1 cm wide and 2 cm broad; upper surface brown, faintly concentrically zonate, velutinate-tomentose; hymenial surface smooth to finely pulverulent, deep red, brownish red in matured specimens; margin adnate, lighter than the hymenial surface; context light brown, composed of compactly arranged hyphae, cuticle up to 25 μm thick; setigerous layer 150-175 μm thick; composed of setae and loosely arranged ascending hyphae.

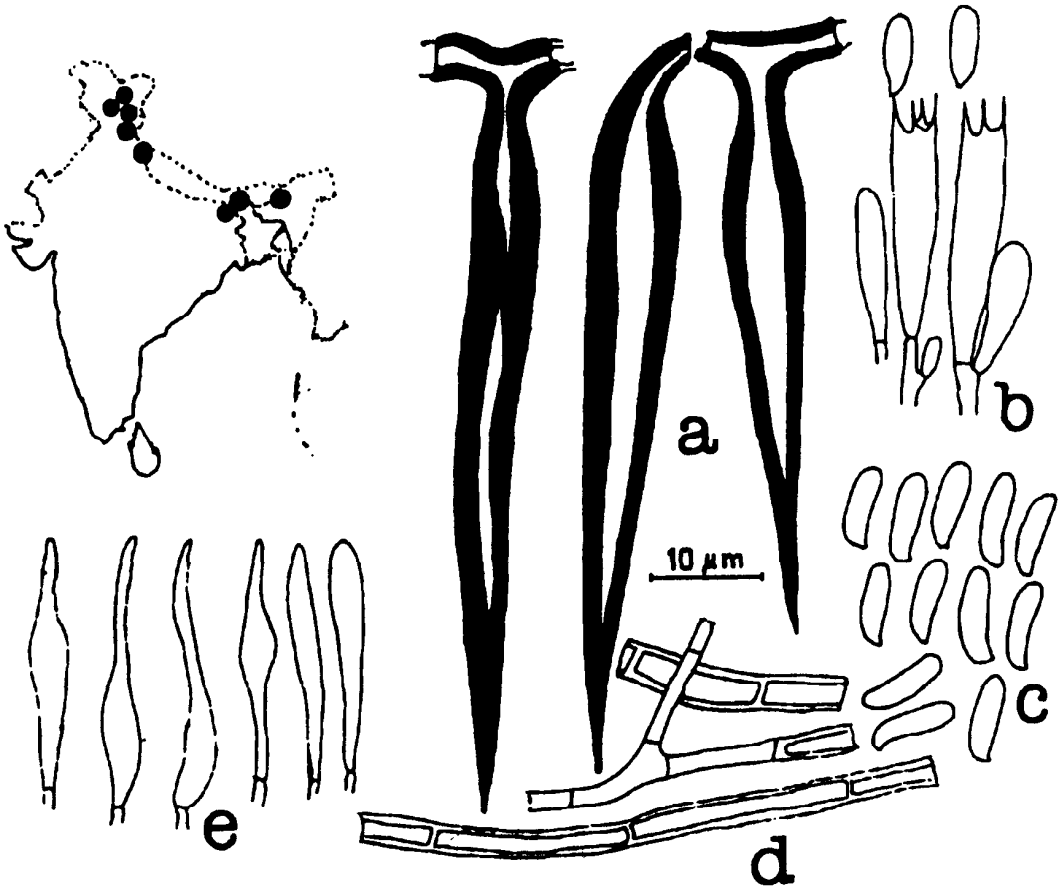


Fig. 22. *Hymenochaete cruenta* (JRS 60160) a. setae, b. basidia, c. spores, d. generative hyphae, e. paraphysoid hyphae.

Hyphal system monomitic; generative hyphae thin to thick walled, subhyaline to light brown, septate, 2-3.5 μm wide, branched; setae 60-90 x 7-10 μm, subulate, light brown, darkening in KOH, projecting up to 40 μm beyond the hymenium, arising at different levels in setigerous layer; basidia 15-25 x 3-5 μm, hyaline, clavate to subcylindrical, 4-spored, sterigma 4-6 μm long. paraphysoid hyphae common to abundant, hyaline to yellowish, branched, projecting up to 10 μm beyond hymenium; spores cylindrical to suballantoid, 5-6.5(7) x 2.8-3 μm, hyaline, thin walled, smooth, apiculate, IkI-.

Habitat and Distribution

On fallen twigs and bark of standing angiospermic trees particularly belonging to the species of *Quercus, Pyrus, Prunus, Juglans, Rhododendron* and *Betula;* causing a white rot; a common species in the temperate zone, sometimes occurring up to tree line in the Himalayas.

Remarks

The basidiocarps vary from resupinate to effused-reflexed. However, the dark to deep red hymenial surface and branched paraphysoid hyphae in the hymenium make this species distinct.

Hymenochaete fuscobadia Thind & Adlakha Fig. 23
In Reid et al., Trans. Brit. Mycol. Soc. 41: 133, 1958.

Basidiocarps annual, resupinate, membranous-coriaceous to somewhat brittle on drying, adnate, widely effused, up to 1 mm thick; margin thinning, adnate, concolorous or paler than the hymenial surface; hymenial surface greyish to olive brown, smooth, cracking on drying; context yellowish brown, composed of a basal zone of somewhat parallel and compactly arranged hyphae and an upper setigerous zone of loosely woven, ascending hyphae supporting a pellicle-like hymenium.

Hyphal system monomitic; generative hyphae 2.5-4.5 μm wide, septate, thin to slightly thick walled, subhyaline to pale yellow; setae 75-110 x 7-11 μm, arising from a distinct subhymenial zone, subulate, thick walled, brown, projecting up to 60 μm beyond basidia; some hyphae from hymenium grow along the setae giving them a pyramidal appearance; hymenium and subhymenium are compact and somewhat agglutinated forming a distinct pellicle-like layer, up to 120 μm thick; basidia 20-25 x 5-6 μm, 4-sterigmate, sterigma up to 6 μm long; spores 6-7.5 x 3-4.5, broadly ellipsoid to subcylindrical, thin walled, IkI-.

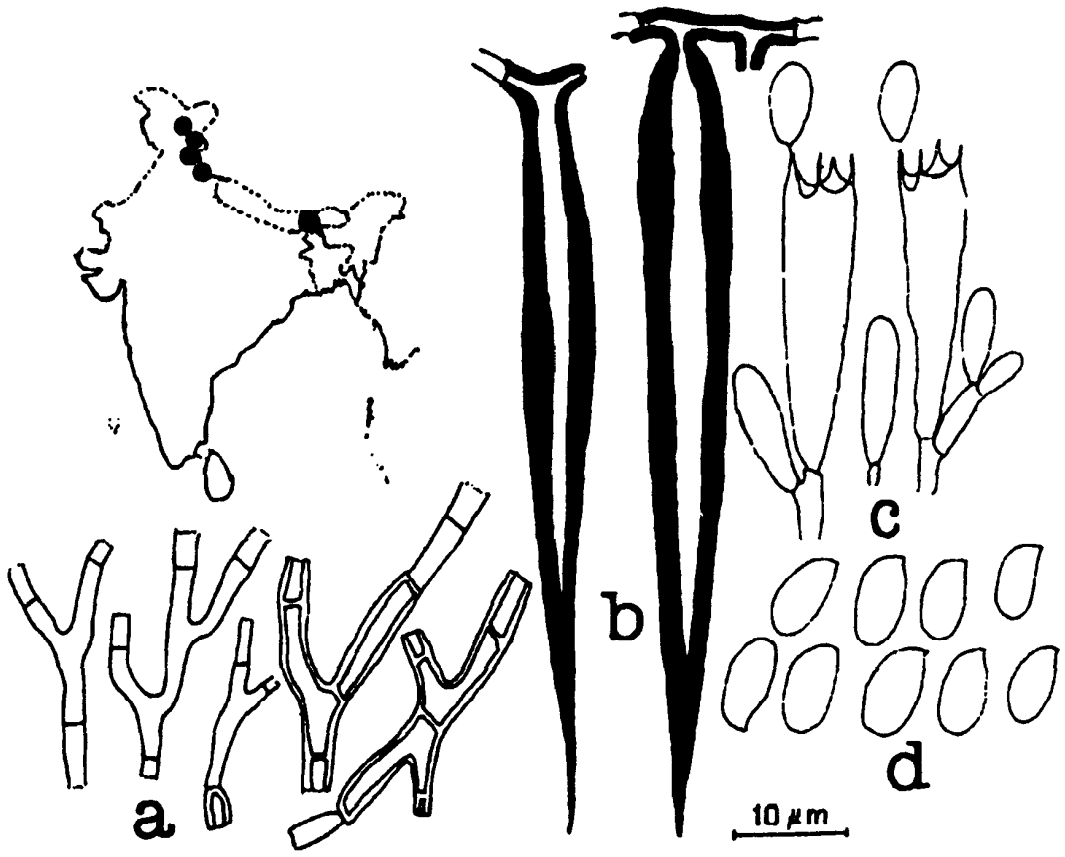


Fig. 23. *Hymenochaete fuscobadia* (JRS 435) a. generative hyphae, b. setae, c. basidia, d. spores.

Habitat and Distribution

On underside of dead angiospermous logs, a very rare species in the temperate zones of Western Himalayas.

Remarks

The above description is based on the type and one more collection from Western Himalayas. Except for the slightly larger spores and more rubust and adnate basidiocarps, this species is very close to *H. leonina*. Moreover, the setae are less common and usually covered by hyphae from the hymenium.

Hymenochaete leonina Berk. & Curt. Fig. 24
Linn. Soc. Bot. J. 10 : 334, 1868.

Basidiocarps annual, resupinate, subpelliculose to membranous, separable from substratum when moist, not cracked, often arising as small circular patches which coalesce and grow later up to 4 cm in diameter and 400 µm in thickness;

hymenial surface woody brown to tawny olive, smooth; margin tomentose, loosely adnate, bright orange brown; context 400-700 μm thick, composed of a compactly arranged setigerous layer, up to 50-60 μm thick, with setae arising at different levels within it, and a broad supporting hyphal layer 200-600 μm thick, composed of loosely interwoven, rather longitudinally arranged hyphae, in fully developed and thick basidiocarps, the loose hyphal layer is divided parallel with the substratum by a narrow dark zone.

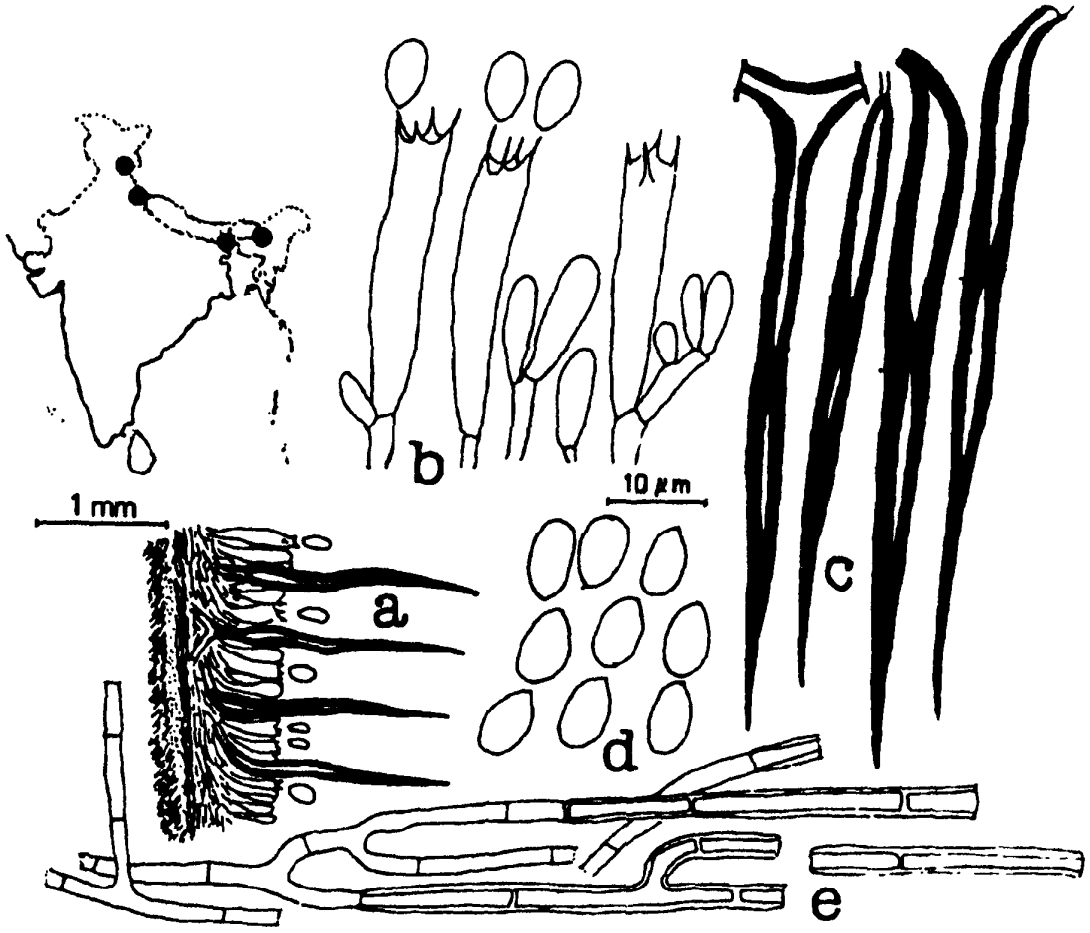


Fig. 24. *Hymenochaele leonina* (JRS 825) a. section through basidiocarp, b. basidia, c. setae, d. spores, e. generative hyphae.

Hyphal system monomitic; generative hyphae 1.5-3 μm wide, thin walled, septate, branched, subhyaline to pale brownish; setae 60-90(-120) x 6-9 μm, thick walled, subulate, dark brown, projecting up to 50 μm beyond the hymenium, often arising from the subhymenial zone; basidia subcylindrical to clavate-cylindrical, 18-26 x 5-6 μm, 4-sterigmate, sterigma up to 6 μm long; spores hyaline, smooth, minutely apiculate, thin walled, ellipsoid, 5-6(7) x 3-3.5 μm, IkI-.

Habitat and Distribution

On dead angiospermous woods; causing a white rot, a very rare species occurring from the subtropical to temperate forests.

Remarks

This specis is well marked by its resupinate habit, usually tawny olive and coriaceous-membranous basidiocarps which are easily detachable from the substratum. Moreover, the bright coloured hyphal layer is finally divided in the middle by a narrow dark zone.

Hymenochaete luteobadia (Fr.) Hoehn. & Litsch. Fig. 25
Wein. Sitz. 116: 754, 1907 *Thelephora luleobadia* Fr., Linnea 5: 526, 1830.

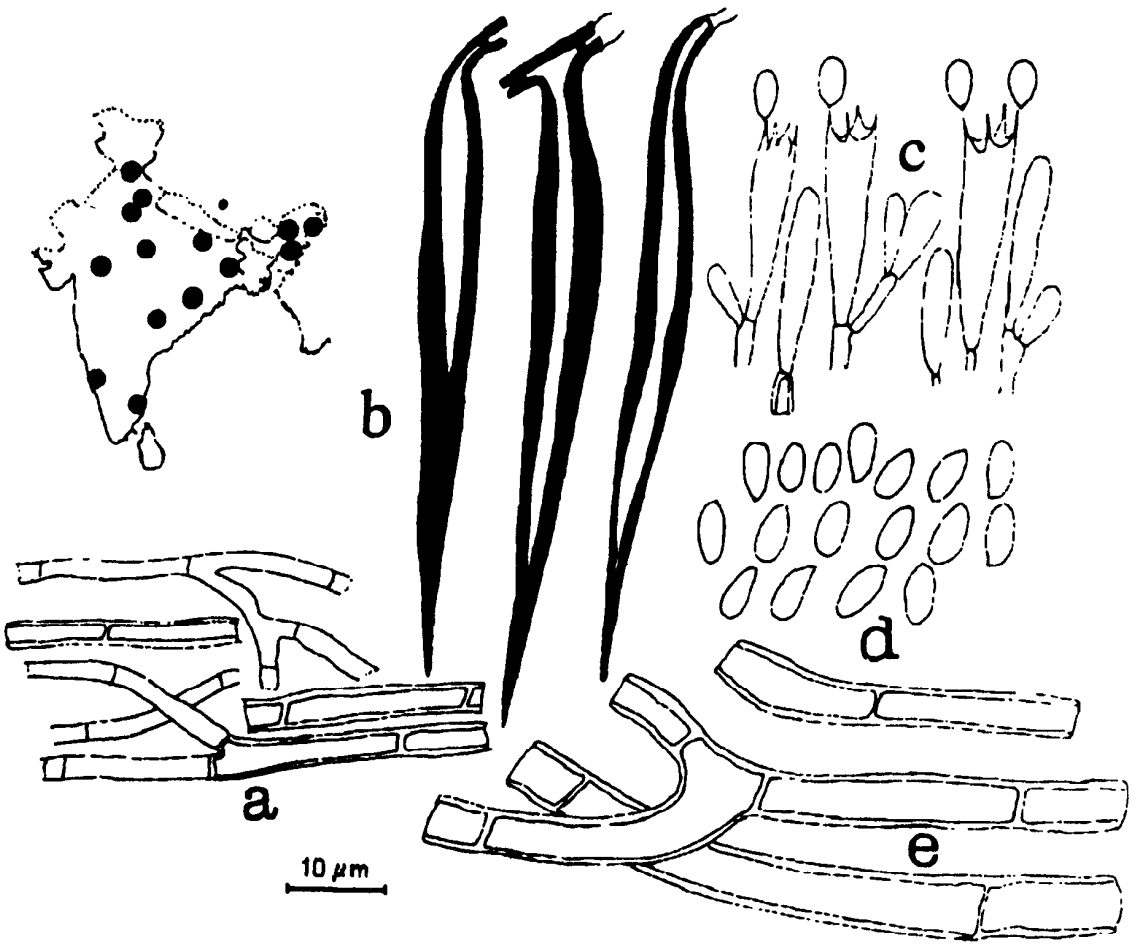


Fig. 25. *Hymenochaete luteobadia* (JRS 746) a. generative hyphae, b. setae, c. basidia, d. spores, e hyphae from tomentum.

Basidiocarps annual, effused-reflexed to pileate, imbricate, very thin, pliant when dry, membranous-coriaceous; pilei up to 3 cm wide, 2-4 cm broad and up to 1 mm thick; upper surface velvety tomentose, when young, becoming somewhat glabrous and minutely fibrillose when older, concentrically sulcate, weakly zoned, radially rugulose on drying, yellowish brown to chestnut brown; margin acute or subobtuse, entire or weakly cleft, yellowish brown; hymenial surface smooth to sparsely tuberculate, radially sulcate and faintly concentrically zonate, brown to olive brown; context 200-300 μm thick, yelowish brown composed of a setigerous layer up to 100 μm thick, and a broad, compact intermediate hyphal layer of longitudinally arranged, coloured hyphae, cuticle on abhymenial side dark brown, up to 20 μm thick, bearing the loose tomentum.

Hyphal system monomitic; hyphae frequently to sparsely branched, hyaline to pale brownish, septate, thin to thick walled, 2.5-3 μm wide, hyphae of tomentum up to 4 μm wide, septa very few, thick walled; setae arising from subhymenial or upper part of the context, immersed or projecting up to 30 μm beyond the hymenium, 35-50 x 6-7 μm, subulate, dark brown in KoH; paraphysoid hyphae absent; basidia 15-20 x 4-5 μm, clavate to cylindrical, 4-spored; spores hyaline, 4.5-5.5 x 2-2.5, broadly ellipsoid, minutely apiculate, thin walled, IkI-.

Habitat and Distribution

On fallen dead twigs and stumps of angiosperms; causing a white rot; a common species in the tropical forests.

Remarks

H. luteobadia is characterized by persistently and densely tomentose, membranous-coriaceous basidiocarps which remain pliable on drying. Further, there is a contrast in colour between the pilear surface (Chestnut brown) and hymenial surface (olive brown). Sometwhat rare and smaller setae are the additional features which separate *H. luteobadia* from the other species of *Hymenochaete*.

Hymenochaete rheicolor (Mont.) Lev. Fig. 26

Lev., Ann. Sci. Nat. Bot. III. 5: 151, 1846 - *Stereum rheicolor* Mont., Ann. Sci. Nat. 17: 23, 1843; *Hymenochaete tenuissima* Berk., Linn. Soc. Bot. J. 10: 333, 1868.

Basidiocarps annual, very thin, papery, effused-reflexed flexible when dry, may be folded without breaking, widely confluent or effused-reflexed along the

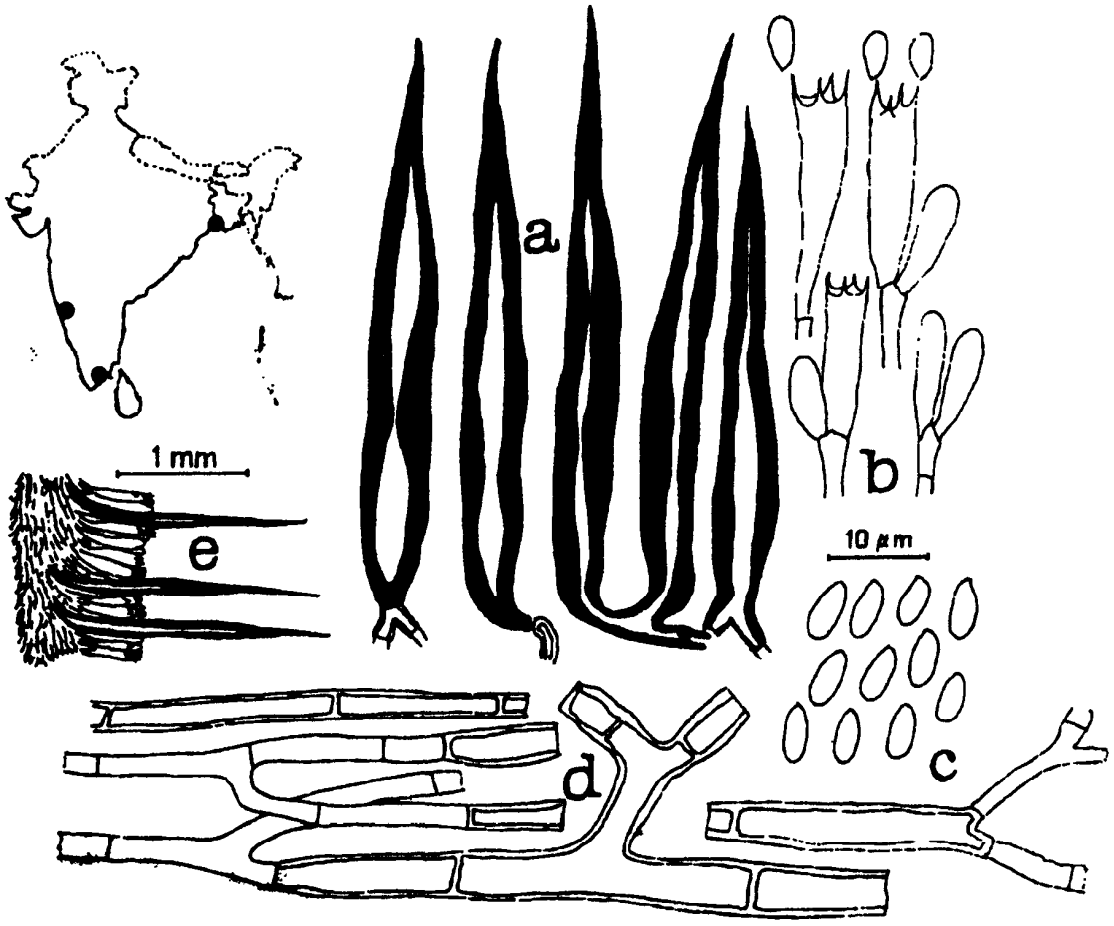


Fig. 26. *Hymenochaete rheicolor* (JRS 60155) a. setae, b. basidia, c. spores, d. generative hyphae, e. section through basidiocarp.

branch and producing flabelliform pilei, up to 2 cm wide and broad, the resupinate part easily separable from the substratum; upper surface silky fibrous, fibres radially arranged, concentrically zonate, dark greyish to yellowish brown, shining; margin lobed; hymenial surface uneven, radially rugose, dark olive brown; context 200-400 µm thick, consisting of a setigerous layer up to 80 µm wide and a hyphal layer of loosely interwoven, longitudinally arranged, thick walled and coloured hyphae, not bordered by a darker subhymenium or cuticle on abhymenial layer.

Hyphal system monomitic; hyphae thin to thick walled, branched, simple septate, subhyaline to pale brownish, 2.5-3.5 µm wide; setae 40-75 x 8-12 µm, emerging up to 60 µm beyond the hymenium, usually arising from subhymenium, dark brown, subulate, with narrow central lumen; paraphysoid elements absent; basidia hyaline, 12-16 x 4-5 µm, cylindrical to narrowly clavate, 4-sterigmate; spores hyaline, smooth, broadly ellipsoid, 3-4 x 2-2.5 µm, nonamyloid.

Habitat and Distribution

On dead thin branches and twigs of hardwoods; causing a white rot; a rare tropical species.

Remarks

H. rheicolor may be recognised by its thin papery, flexible basidiocarps which can be folded without breaking. Further, concentrically, sulcate, somewhat zonate upper surface becoming silky and radially fibrillose with age, make this species more distinct.

Hymenochaete rubiginosa (Dicks.) Lev. Fig. 27
Ann. Sci. Nat. Bot. III 5: 151, 1846 *Helvella rubiginosa* Dicks., Fasc. Pl. Crypt. Brit. 1: 20, 1785.

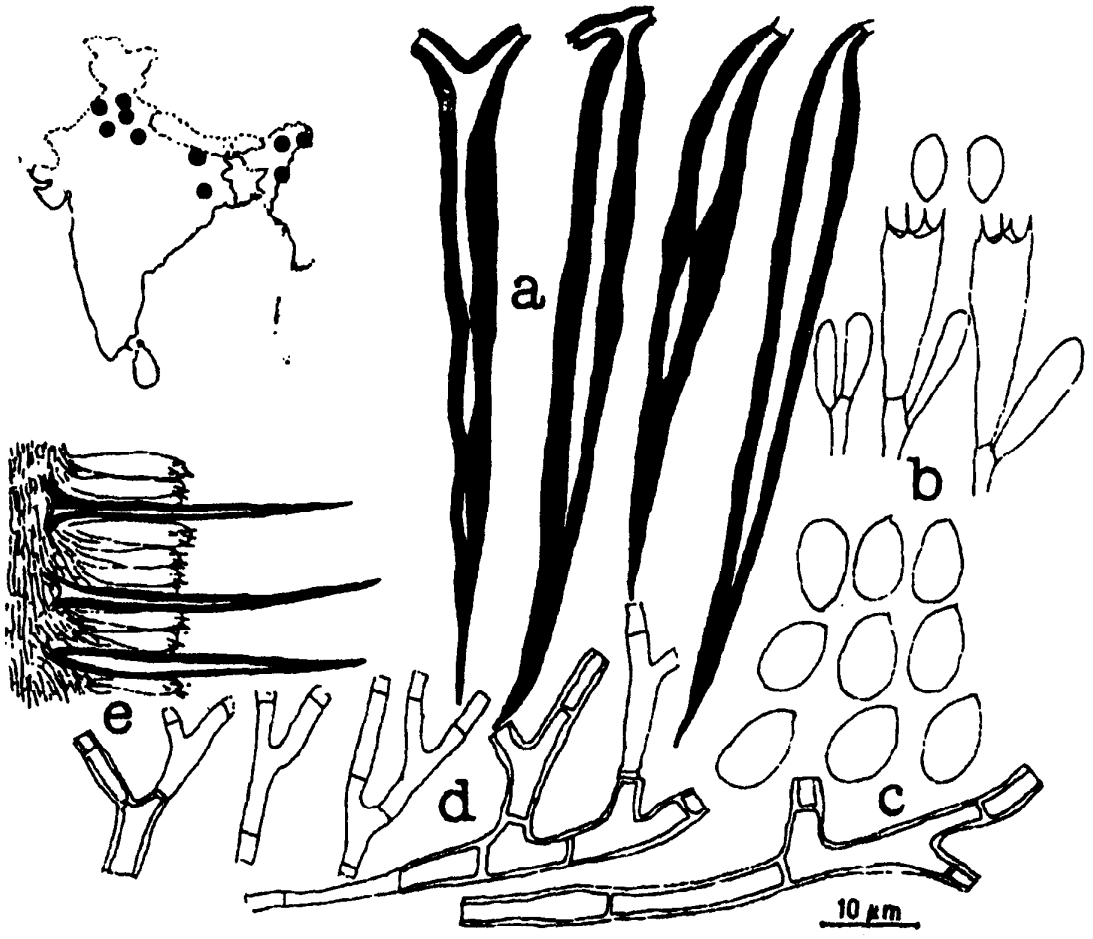


Fig. 27. *Hymenochaete rubiginosa* (JRS 842) a. setae, b. basidia, c. spores, d. generative hyphae, e. section through basidiocarp.

Basidiocarps annual to perennial, widely effused to effused-reflexed, coriaceous-tough when fresh, woody hard on drying, separable, reflexed portion 1-2 cm wide, 1-5 cm broad, laterally confluent, resupinate portion 6-9 cm long, 1-3 cm wide; upper surface dark brown to dark reddish brown, finely tomentose, concentrically zonate, becoming glabrous and reddish black with age; hymenial surface olive brown to snuff brown, smooth, conspicuously setulose under a lens; margin sterile, reddish brown with yellowish brown outer edge, entire or lobed; context 500-700 μm thick, light brown in section, composed of a broad, dense, dark setigerous layer, up to 150 μm thick and a hyphal layer of longitudinally arranged coloured hyphae, bordered above by a cuticle, up to 25 μm thick on the abhymenial surface.

Hyphal system monomitic; hyphae thin to thick walled, 2-2.5 μm wide, branched, simple septate hyaline to pale brown, darkening in KoH; setae abundant, subulate, 60-80 x 5-7 μm, arising in subhymenium, thick walled, reddish brown, darkening in KoH, projecting up to 20 μm beyond the hymenium; paraphysoid hyphae not seen; basidia broadly clavate, 15-28 x 5-6 μm, 4-sterigmate, hyaline to yellowish brown; spores broadly ellipsoid, 5-7 x 3-4.5 μm, hyaline, thin walled, smooth nonamyloid.

Habitat and Distribution

On decaying logs and stumps of hardwoods; causing a white pocket rot; a common species in the tropical and subtropical zones.

Remarks

H. rubiginosa may be recognised by its rigid basidiocarps, separable easily from the substratum and having a bright contrasting margin.

Hymenochaete semistupposa Petch. Fig. 28
Ann. Roy. Bot. Gdns. Perad. 9: 278, 1925.

Basidiocarps annual or perennial, resupinate, widely effused, firm, adnate, membranous, stratose, up to 300 μm thick; margin thinning out, velvety when young, loosely adnate, yellowish brown; hymenial surface smooth to sparsely tuberculate, ferruginous to brown, cracked irregularly and sometimes isolated in the form of squares, finely setulose; context brown, stratified, 300-500 μm thick, composed of 1-2 or rarely 3-strata of setigerous and hyphal layers, with setigerous layers very dense, 50-125 μm thick, broader than the alternating hyphal layers which are composed of loosely arranged, interwoven, thick walled, coloured hyphae.

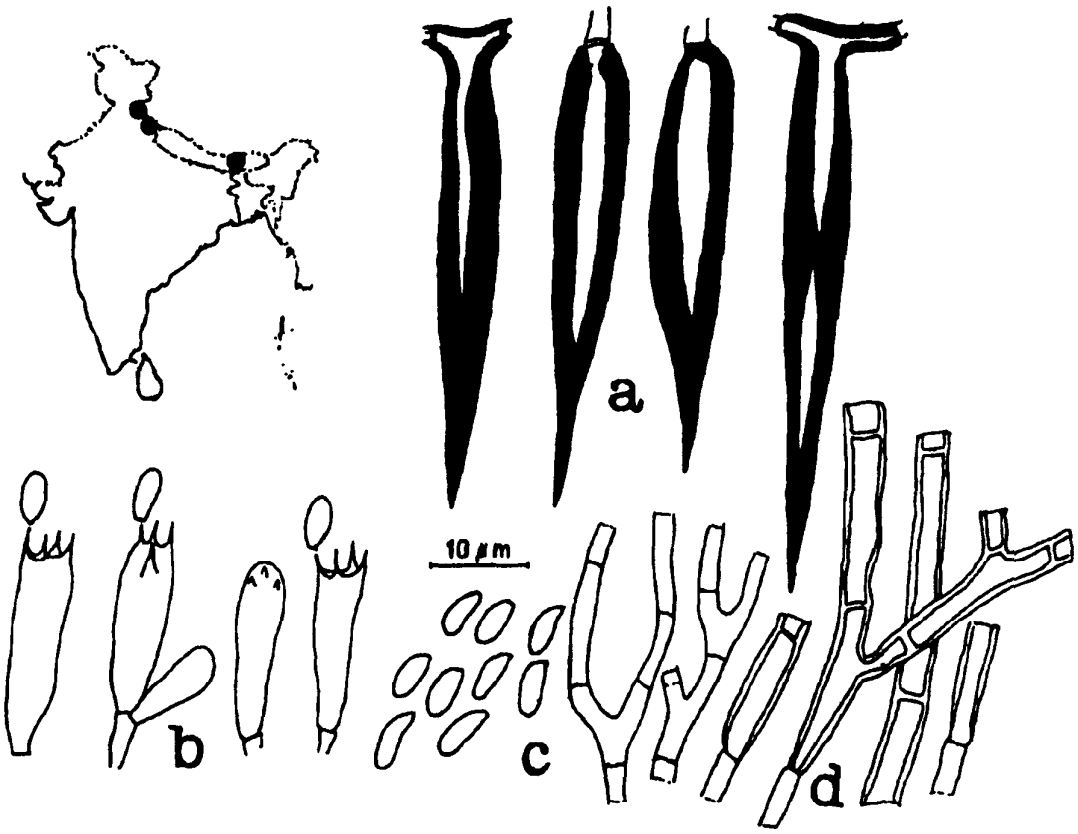


Fig. 28. *Hymenochaete semistupposa* (JRS 314) a. setae, b. basidia, c. spores, d. generative hyphae.

Hyphal system monomitic; hyphae branched, septate, thin to slightly thick walled, pale golden brown, 2.5-3 µm wide; setae abundant, slender, subulate, 60-75 x 6-7 µm, originating at all levels from setigerous layers, protruding up to 45 µm beyond the hymenium; basidia cylindrical to narrowly clavate, 15-20 x 4-5 µm, 4-sterigmate, sterigma up to 4 µm long; spores hyaline, apiculate, thin walled, narrowly ellipsoid to suballantoid, 4.5-5 x 2 µm, smooth, nonamyloid.

Habitat and Distribution

On dead twigs of hardwoods, causing a white rot; a rare species in the temperate forests.

Remarks

The adnate basidiocarps, cracked hymenial surface and the stratose context with usually two setigerous layers separated by thin hyphal layers and the suballantoid spores are the main distinguishing features of this species.

Hymenochaete tabacina (Sow. : Fr.) Lev. Fig. 29

Ann. Sci. Nat. Bot. III, 5: 152, 1846- *Thelephora tabacina* Sow. : Fr., Syst. Mycol. 1: 437, 1821.

Basidiocarps annual, resupinate, effused-reflexed to pileate, thin, coriaceous, often imbricate, pilei 3-7 cm wide, 10-15 cm broad, often laterally confluent, resupinate portion up to 3 cm wide and 15 cm long, 0.3 mm thick, or sometimes more, dimidiate, often constricted at the base, deflexed; upper surface pale brown, finally dark brown to reddish brown, usually orange to bright yellow at the margin, glabrescent, weakly or distinctly zonate; hymenial surface smooth to

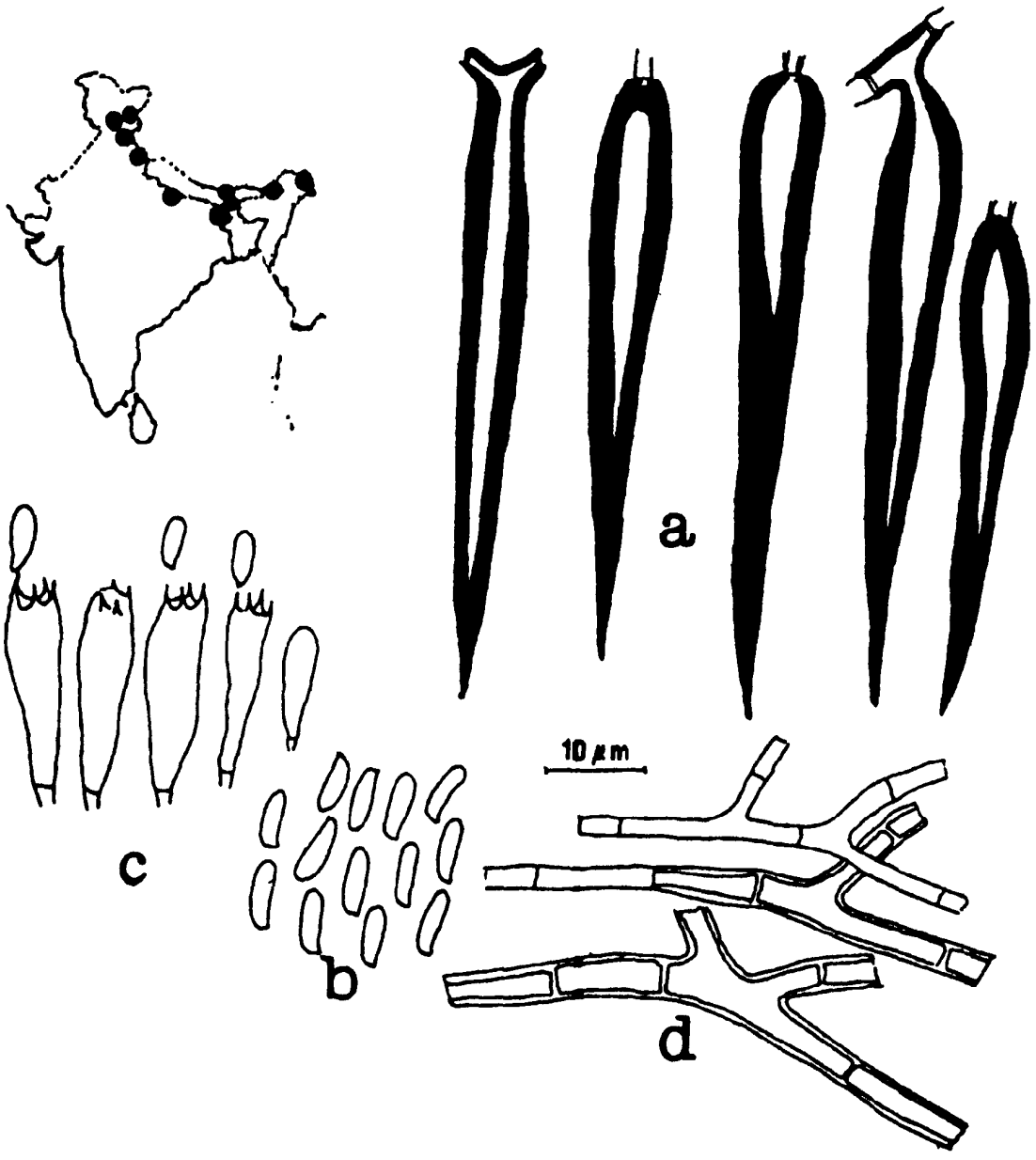


Fig. 29. *Hymenochaete tabacina* (JRS 794) a. setae, b. spores, c. basidia, d. generative hyphae.

colliculose, light to snuff brown, often deeply rimose with radiating cracks in the resupinate portion, finely setulose to almost glabrous; context yellowish brown to orange brown, composed of a setigerous layer, up to 120 μm thick and a hyphal layer of longitudinally arranged orange yellow hyphae.

Hyphal system monomitic; hyphae 2.5-4.5 μm wide, hyaline to yellowish brown, thin to thick walled, septate, commonly branched; setae abundant, 55-85 (90) x 7-13 μm, subulate, thick walled, originating mostly from the subhymenial layer, projecting up to 45 μm or more; basidia 13-18 x 3-5 μm, narrowly clavate to cylindrical, 4-sterigmate; paraphysoid elements not seen; spores cylindrical, allantoid, 4.5-6.5 x 1.5 μm, hyaline, nonamyloid.

Habitat and Distribution

On dead hardwoods; causing a white rot; a common and widely spread species in warmer temperate forests and occurring up to tree-line.

Remarks

H. tabacina is the commonest one of its genus and is easily recognised by its pileate basidiocarps with a bright-yellowish-orange margin and the hymenium cracked into radiating system in resupinate portions.

Species imperfectly known

Hymenochaete damaecornis Link : Lev.
Hymenochaete depallens Berk. & Curt.
Hymenochaete lemiforma Berk.
Hymenochaete nigricans (Lev.) Pat.
Hymenochaete strigosa Berk. & Br.
Hymenochaete villosa Lev. : Bres.

Excluded species (Probably do not belong to *Hymenochate*)

Hymenochaete carteri Berk.
Hymenochaete subpurpureus Berk. & Br.
Hymenochaete trestelia Massee.

INONOTUS Karst.
Medd. Soc. Fauna Fl. Fenn. 5: 39, 1879.

Basidiocarps annual, effused-reflexed to pileate, sessile to rarely stipitate, solitary to imbricate, corky-fleshy to woody hard and brittle on drying; permanently black in KOH; pileus small to medium sized, dimidiate, applanate to conchate, glabrous, tomentose to hispid, yellowish to dark reddish brown, usually without a crust; hymenophore poroid; pore surface dark reddish brown to yellowish brown; pores 2-10 per mm; context rusty to cinnamon brown, with or without a mycelial core; hyphal system monomitic; generative hyphae light yellowish to pale brown, simple septate, thin to thick walled; setal hyphae present or absent; hymenial/tramal setae present or absent; cystidia none; spores mostly globose to ellipsoid, rarely cylindrical, smooth, hyaline to brown; on dead/living hard or coniferous woods; causing white rots; cosmopolitan genus with 16 species in India; *ca* 50 species in the world.

Type species : *Inonotus hispidus* (Bull. : Fr.) Karst.

The genus is easy to recognize by its annual basidiocarps with a fibrous to soft or fragile consistency. The hyphae are monomitic and generally are wider than those of *Phellinus* which usually has woody, perennial basidiocarps with dimitic hyphal system. The stipitate or substipitate and generally terrestrial nature of basidiocarps of *I. circinatus* and *I. tomentosus* have led many authors to exclude these taxa from the genus *Inonotus* (Pegler 1964b; Domanskii *et al.* 1967; Bondartsev 1953). However, basidiocarps of both the taxa vary from centrally to laterally stipitate or even completely resupinate in *I. circinatus* at the base of infected trees. Both are lignicolous, cause white pocket rot of roots and butts of conifers and have hymenial setae. Due to these strong relations, the author prefers to include them in *inonotus* as also reflected in Gilbertson (1974, 1976); Gilbertson & Ryvarden (1986); Ryvarden (1991) and Ryvarden & Gilbertson 1993.

KEY TO THE INDIAN SPECIES

1. Setal hyphae present 2
1. Setal hyphae absent 4

2. Ptychogastric anamorph with abundant chlamydospores commonly produced; tropical to temperate forests **I. rickii**
2. Ptychogastric anamorph absent; temperate forests 3

3. Setal hyphae present in the context and dissepiments; spores 5-7 x 4-5.5 μm; mostly on dead fallen trunks **I. glomeratus**
3. Setal hyphae confined to dissepiments only; spores 6-7.5(8) x 5-6 μm; mostly on living trunks of *Quercus* **I. patouillardii**

4. Spores hyaline to faintly pigmented 5
4. Spores distinctly golden brown to dark reddish brown 11

5. Spores cylindrical, 5-7 x 2-2.5 μm **I. flavidus**
5. Spores ovoid to ellipsoid 6

6. Hymenial setae projecting up to 50 μm beyond the hymenium; mostly on conifers 7
6. Hymenial setae projecting up to 25 μm beyond the hymenium; mostly on angiosperms 8

7. Basidiocarps usually growing singly; hymenial setae hooked **I. circinatus**
7. Basidiocarps usually growing in groups; hymenial setae straight **I. tomentosus**

8. Basidiocarps large up to 25 cm wide; pore surface particularly near the margin exuding brownish guttules; mostly on *Quercus* 9
8. Basidiocarps small, up to 8 cm wide; pore surface without brownish droplets; on *Betula* and *Quercus* 10

9. Spores 5.5-8 x 5-7 U; margin obtuse **I. dryadeus**
9. Spores 4.5-5.6 x 3.5-5 μm; margin acute **I. brevisporus**

10. Pores 4-6 per mm; spores 5-7.5 x 4-5.5 μm; margin bright yellow **I. radiatus**
10. Pores 6-8 per mm; spores 4-4.5 x 3-3.5 μm; margin not bright yellow **I. hamusetulus**

11. Hymenial setae present 12
11. Hymenial setae absent 14

12. Branched setal hyphae present on the pilear surface **I. cuticularis**
12. Branched setal hyphae absent 13

13. Upper surface of basidiocarps strongly hispid at maturity; spores 8-11 x 6-8 μm **I. hispidus**

13. Upper surface of basidiocarps glabrous at maturity; spores 5.5-7.5 x 4.5-5.5 μm **I. diverticuloseta**

14. Context with a granular core at the base of pileus 15
14. Context without a granular core 16

15. Spores 6.5-8 (8.5) x 5-6 (7) μm; granular core up to 6 cm diam.; on *Quercus* **I. dryophilus**
15. Spores 4.5-6 x 3.5-4 μm; granular core up to 1 cm diameter; on chestnut **I. rheades**

16. Upper surface of basidiocarps strongly hispid at maturity; spores 8-11 x 6-8 μm **I. hispidus**
16. Upper surface of basidiocarps tomentose to radially striate and glabrous at maturity; spores 5-6.5(7) x 3.5-4.5 μm **I. tenuicarnis**

Inonotus brevisporus (Thind & Chatrath) Sharma Comb. Nov. Fig. 30
Polyporus dryadeus Pers. : Fr. var. *brevisporus* Thind & Chatrath, Indian Phytopath. 13: 82, 1960.

Basidiocarps annual, pileate, sessile, solitary or imbricate, coriaceous tough when fresh, hard and brittle on drying, pileus flabelliform to fan shaped, sometimes narrowing down to a stipe like base, 8-24 cm wide, 7-18 cm broad and 1-2 cm thick near base; upper surface dark brown to deep greyish brown, faintly concentrically zonate, velutinate-tomentose when young, soon glabrous with a thin cuticle, radially rimose on drying; margin acute, entire to rarely lobed, concolorous with pileus; pore surface plane to convex, light yellowish to greyish brown, lighter and sterile towards the margin, often with droplets of amber liquid in growing specimens; tubes pale rusty to yellowish brown, lighter than pore surface; pores circular, 5-7 per mm, dissepiments thick; context dark to deep brown, up to 1.5 cm thick, azonate, corky on drying, with a silky sheen.

Hyphal system monomitic; generative hyphae thin to thick walled, pale yellow to yellowish brown, simple septate, 3-6.5 μm wide; hymenial setae abundant, dark to reddish brown, ventricose, 10-25 x 5-13 μm, projecting up to 15 μm beyond the hymenium, tips usually curved; basidia clavate, 5-11 x 4-7 μm, 4-sterigmate; spores hyaline, subglobose to ovoid, 4.5-5.6 x 3.5-5 μm, thin walled, IKI-.

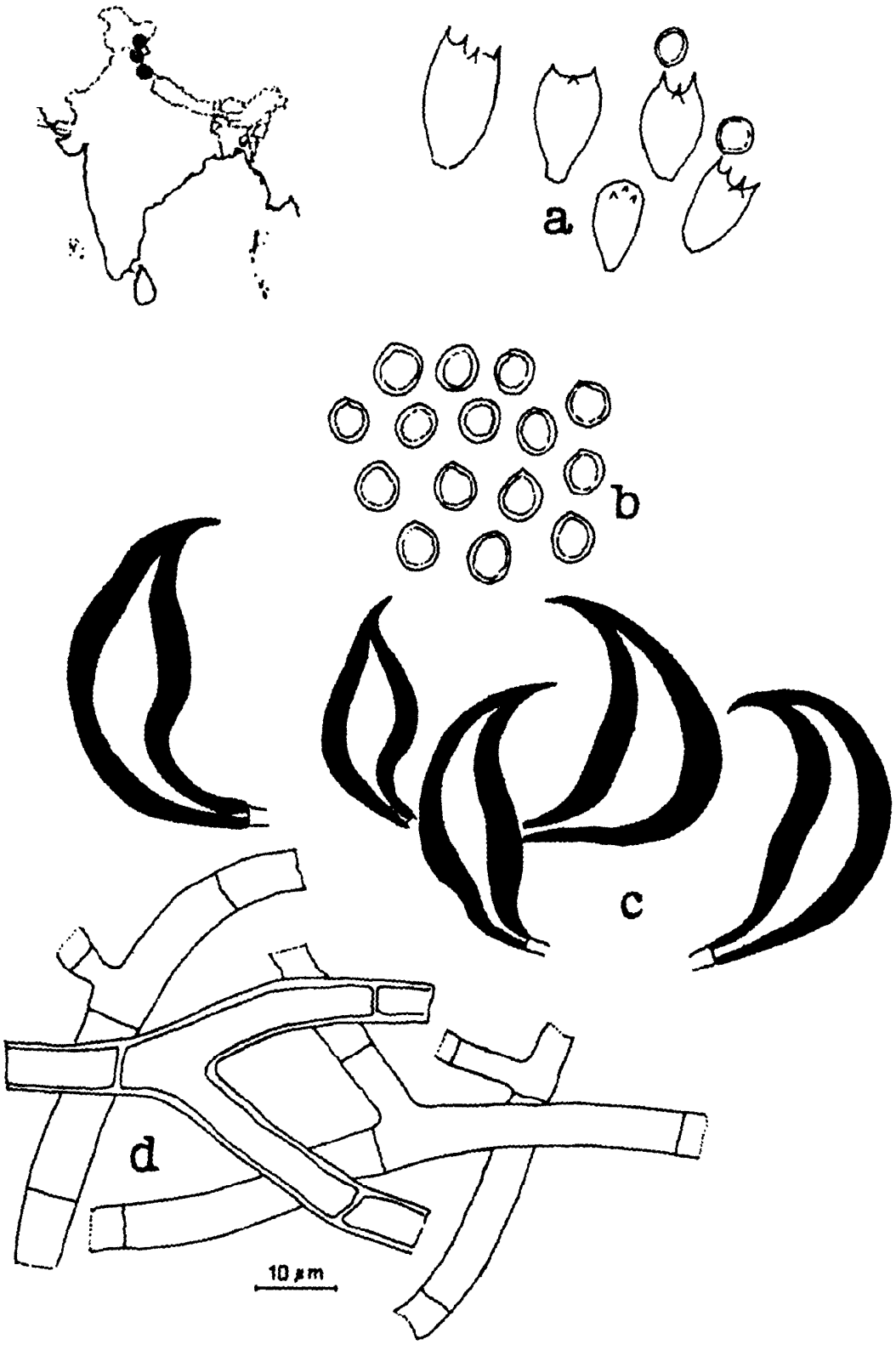


Fig. 30. *Inonotus brevisporus* (JRS 63339) **a.** basidia, b. spores, c. setae, d. generative hyphae

Habitat and Distribution

On stumps and at base of living *Quercus* species; causing a white laminated rot; a rare species in the temperate forests.

Remarks

This species is recognised by a smaller subglobose, hyaline spores, and pores and the thin acute margin of basidiocarps. it closely resembles *I. Dryadeus* but that species has larger spores (5.5-8 x 5-7 μm), pores (3-5 per mm) and obtuse margin of the basidiocarps.

Inonotus circinatus (Fr.) Gilbn. Fig. 31

Fungi that decay ponderosa pine, p. 107, 1974 - *Trametes circinatus* Fr., Svenska Vetensk. akad. Handl. for 1848, p. 128, 1849; *Polyporus circinatus* Fr., Monogr. Hymen. Suec. 2: 268, 1863; *Polyporus tomentosus* Fr. var. *circinatus* (Fr.) Sartory and Maire, Ass. France Sci. Congress de Montpellier, p. 779, 1922.

Basidiocarps annual, stipitate or substipitate when growing on ground on exposed roots, sessile or even resupinate when growing on stumps or tree trunks; sometimes centrally stipitate when growing on the ground near the base of standing trees; pilei up to 8 cm in diam., 1-3 cm thick, circular or irregularly tortuous, flat or somewhat concave soft, coriaceous when fresh, hard and brittle on drying; upper surface tomentose to glabrous, whitish-yellowish to yellowish rusty when young, reddish brown to rusty brown with age, azonate or faintly zoned; margin usually lighter, darkening on bruising, rather thin; stipe usually eccentric to rarely central, up to 3 cm long, 1-2 cm thick, shorter and thicker than *I. tomentosus*, tomentose concolorous with pileus; pore surface yellowish to pale rusty brown, darkening on bruising; tubes decurrent, up to 6 mm deep, concolorous with the context, greyish white from within; pores angular to irregular, small or enlarging due to coalesing; 2-4 per mm; context duplex, upper part soft, spongy, golden brown and lower part firm, corky, more or less black, merging into stipe.

Hyphal system monomitic;, generative hyphae in the upper spongy layer hyaline to pale yellow, septate, rarely branched, 2-5.5 μm wide, sometimes gloeoplerous hyphae with rounded to slightly clavate tips also present, generative hyphae in the lower solid layer pale yellowish to pale golden brown, 3-6 μm wide, with granular or gummy incrustations in some areas, tramal generative hyphae thin walled hyaline to pale yellowish, 2-7 μm wide, frequently branched; hymenial setae scattered to frequent, subulate, mostly hooked, 30-70 x 10-18 μm,

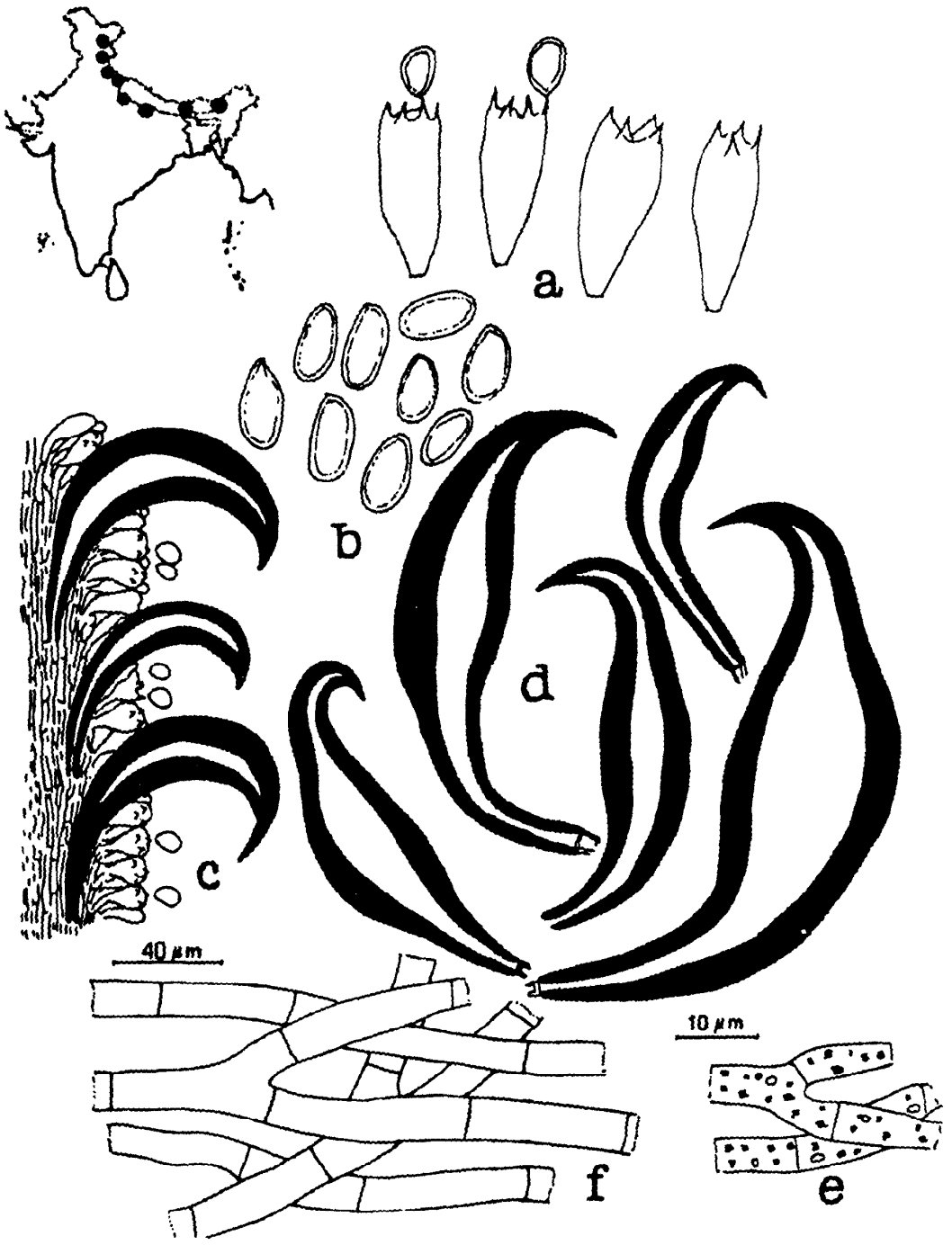


Fig. 31. *Inonotus circinatus* (JRS 14218) a. basidia, b. spores, c. section through hymenium, d. setae, e. contexual hyphae with gummy incrustations, f. generative hyphae.

projecting 25-45 µm above the hymenium, thick walled reddish brown; basidia narrowly clavate to cylindrical, 4-sterigmate, 15-24 x 6-7 µm; spores hyaline, smooth, acyanophilous, ellipsoid to ovoid, 5-6 (6.5) x 3-4 µm, IKI-.

Habitat and Distribution

On roots and tree trunks of living or less frequently on dead stumps of conifers especially on *Pinus wallichiana* A.B. Jackson, *Cedrus deodara* (Roxb.) D. Don in Western Himalayas and *Pinus kesiya* Royle ex Gord. and *Larix griffithiana* (Lindl. et Gord.) Hort. ex Corr. in Eastern and Sikkim Himalayas; causing a white pocket rot of the heartwood in the roots and butts of living conifers; a common species in the subtropical to temperate coniferous forests of Himalayas.

Remarks

The habit of *I. circinatus* varies from centrally stipitate, and terrestrial to sessile or even resupinate on stumps and base of infected trees. The abundant hyaline spores and fairly large hooked setae are the only constant characters. It is closely related to *I. tomentosus*. However, the hooked hymenial setae in *I. circinatus* separates the two species. Moreover, the basidiocarps of *I. circinatus* are mostly found growing single while they grow in groups of many in *I. tomentosus*.

Inonotus cuticularis (Bull. : Fr.) Karst. Fig. 32
Medd. Soc. Fauna Flora Fenn. 5: 39, 1879 *Boletus cuticularis* Bull., Herb. France pl. 462, 1790; *Polyporus cuticularis* Bull. Fr., Syst. Mycol. 1: 363, 1821.

Basidiocarps annual, sessile, single to usually in large clusters, fleshy-spongy when fresh, hard and brittle and very light in weight on drying, more or less dimidiate, applanate to conchate, up to 15 cm broad, 8 cm wide and 1-2 cm thick near base; upper surface reddish, rusty to dark fuscous, soft, velvety, later tomentose to stiff villose, becoming glabrous to rough fibrillose and finally rimose and blackish with age; margin usually sharp, somewhat lighter than the pileus, straight when fresh, later decurved, sterile underneath; pore surface dark yellowish brown to rusty brown; tubes vertical or slightly oblique, distinct from context, yellowish to rusty brown, up to 1 cm deep; pores angular, 2-4 per mm, dissepiments lacerated; context bright yellowish to pale reddish or rusty brown, faintly zoned, with a silky sheen, up to 1 cm thick, duplex at first with a soft upper layer which rapidly deteriorates and disappears, leaving the hard lower context exposed.

Hyphal system monomitic; generative hyphae in the trama thin to thick walled, simple septate, pale yellowish to golden brown, infrequently branched,

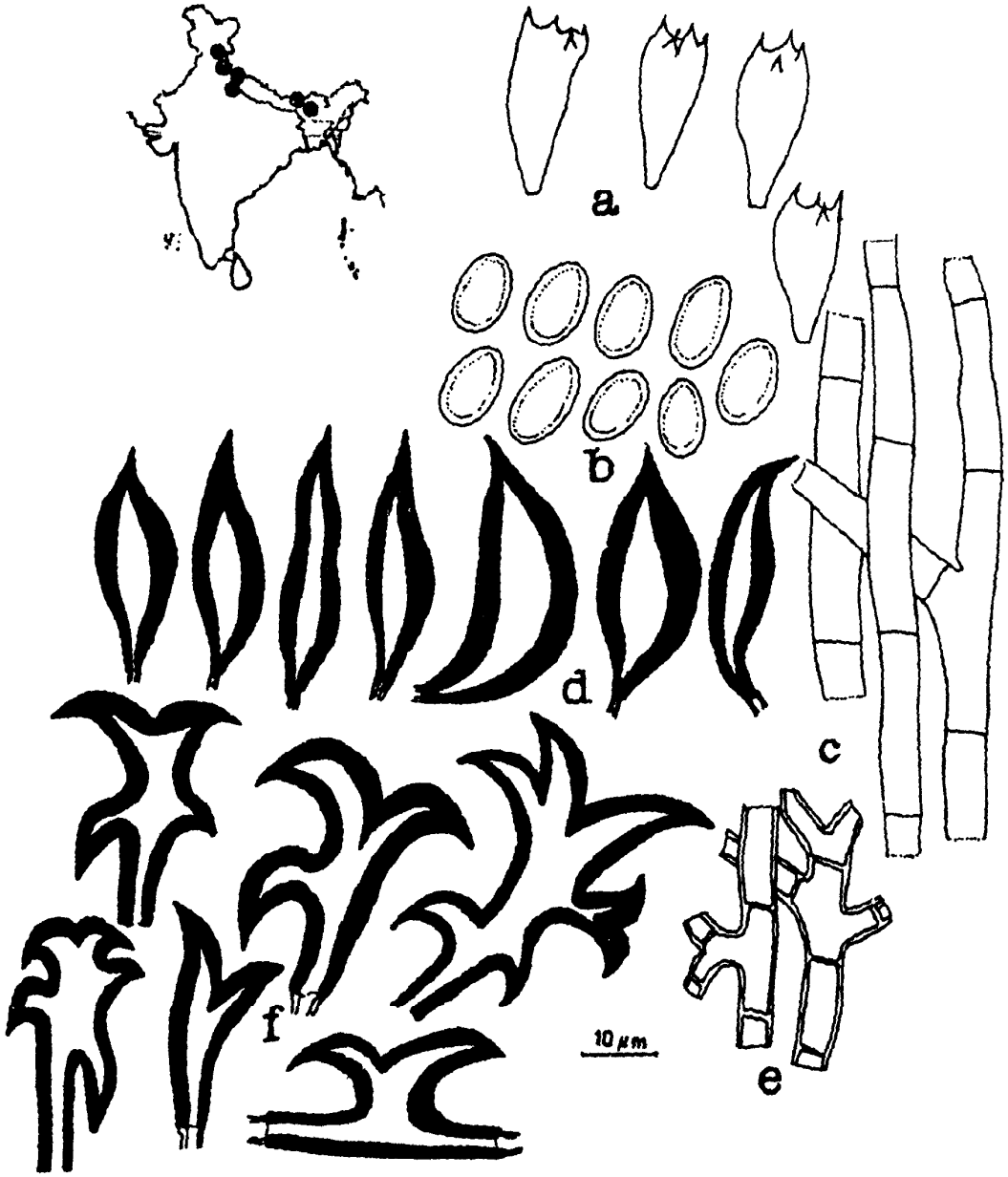


Fig. 32. *Inonotus cuticularis* (JRS 290) a. basidia, b. spores, c. tramal hyphae, d. setae, e. contexual hyphae, f. setal hyphae from pilear surface.

4-10 µm wide, contexual hyphae mostly pale yellowish, 3-7 µm wide, occasionally branched, with patches of granular or gummy incrustations; setal hyphae abundant on upper surface, with monopodial to dichotomous branching, branches with curved tips, main axis up to 12 µm wide, simple unbranched setal elements, similar to hymenial setae also present among the branched setal hyphae;

hymenial setae abundant to rare or even absent in certain specimens, subulate to ventricose, tips straight or curved, thick walled, deeply embedded, 15-32 x 6.5-8 μm, dark brown; basidia broadly clavate, 4-sterigmate, 15-20 x 6-9 μm; spores golden brown, acyanophilous, broadly ellipsoid to ovoid, 6.5-8 x 5.5-6 μm, IKI-

Habitat and Distribution

On living or less oftenly on dead tree trunks of *Q. semicarpifolia* J.E. Sm. and *Q. dilatata* Royle causing a white stringy rot of heartwood with chocolate to black lines in the wood; a common species in the temperate forests of Himalayas, continues to grow and fruit on dead trees and stumps; more common in Western Himalayas.

Remarks

This is the only species having branched setal hyphae in the upper surface and this character makes it quite distinct among the Indian species of *Inonotus*. The hymenial setae are mostly present in the Himalayan collections and they hardly project beyond hymenial layer. Their colour is also lighter than the usual colour of the setae or setal elements. Older glabrous fruitbodies can be confused with *I. flavidus* in the field but the cylindrical spores (5.5-7.5 x 2-2.5 μm), absence of branched setal hyphae in the pilear surface spearate *I. flavidus* from the present species.

Inonotus diverticuloseta Pegler Fig. 33
Kew Bull. 21: 42, 1967.

Basidiocarps annual, sessile, single to mostly imbricate, effused-reflexed or sessile, applanate, attached by a narrow base, sometimes laterally confluent, pileus up to 6 cm wide, 10 cm broad and 1-1.5 cm thick, coriaceous tough when fresh, hard, woody, brittle on drying; upper surface reddish brown to dark reddish orange, loosely tomentose, soon radially strigose and reddish black, concentrically zonate, in older specimens the surface becomes more or less glabrous with a thin black crust-like layer, with a sheen especially towards the margin; margin thin, entire or lobed, strongly inturned on drying; pore surface dark reddish to rusty brown, becoming concave and deeply cracked on drying, extending up to the margin; tubes dark yellowish, rusty brown to reddish black with age, brittle and hard on drying, up to 8 mm deep. concolorous with the context; pores regular, 4-6 per mm, dissepiments thin, dentate and lacerate; context up to 12 mm thick near the base, dark yellowish to pale rusty brown, firm, radially fibrous with a silky sheen, delimited on the upper side by a black crusty line.

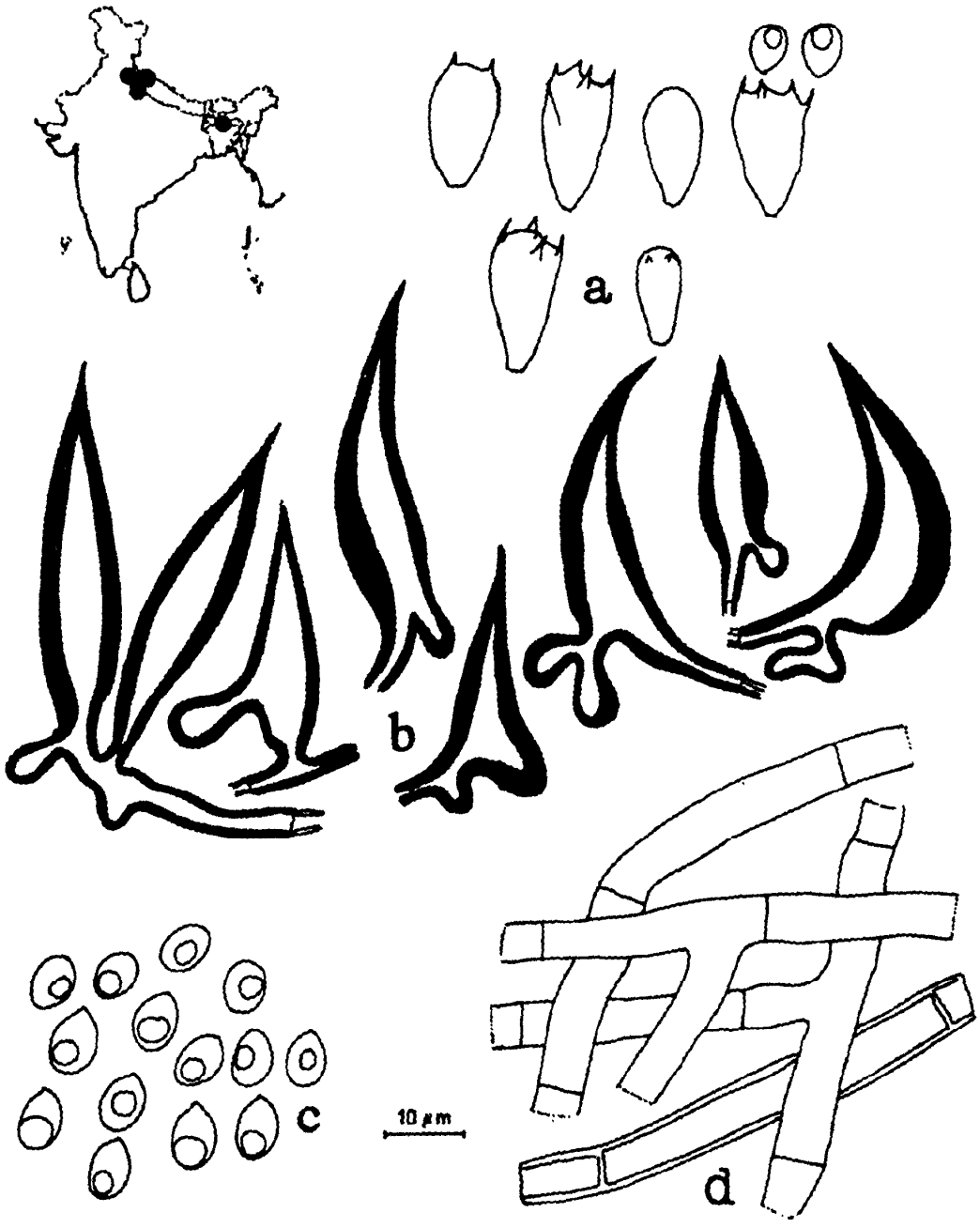


Fig. 33. *Innotus diverticuloseta* (JRS 503) a. basidia, b. setae, c. spores, d. generative hyphae.

Hyphal system monomitic; generative hyphae pale yellow to golden brown, simple septate, occasionally branched, up to 8 µm in the context, up to 5 µm in the trama; hymenial setae usually abundant, unequally distributed, 15-40 (-45) x

5-10 μm, ventricose to lanceolate, often producing one to several lateral projections which may develop into distinct secondary setae, not deeply embedded, thick walled, dark brown, lumen continuous and distinct; basidia observed in fresh specimens only, broadly clavate, 8-16 x 4-6 μm, 4-sterigmate; spores abundant, 5.5-7.5 x 4.5-5.5 μm, ellipsoid to ovoid, slightly flattened on one side, uniguttulate, dark brown, IKI-.

Habitat and Distribution

Base of living tree trunks of *Quercus semicarpifolia* and *Q. dilatala,* never on conifers and other hosts; causing a white rot of heartwood of living trees; fairly uncommon species found from temperate to subalpine forests of Western Himalayas.

Remarks

Based on its close agreement in pilear surface, context, setae and host specificity, Bagchee *et al* (1954) followed by Bakshi (1971) and Sharma (1985) reported it as *Inonotus nothofagi,* the occurrence of which is doubtful in India (Pegler 1967). The sinuous-lanceolate setae with sac-like projections near the base and not being deeply embedded, differentiate the present species from *I. nothofagi.* Further, the spores (4.5-6.3 x 3-4.7 μm) in the latter are considerably smaller. The lanceolate setae with side projections, glabrous to radially striate pileus with a sheen and fairly larger spores are the distinguishing features of this species.

Inonotus dryadeus (Pers. : Fr.) Murr. Fig. 34

North Amer. Flora 9: 86, 1908 - *Boletus dryadeus* Pers., Obs. Myc. 2: 3, 1799. *Polyporus dryadeus* Pers. : Fr., Syst. Mycol. 1: 374, 1821.

Basidiocarps annual, solitary to rarely imbricate, fleshy-spongy when fresh, corky, brittle and light in weight on drying, up to 25 cm wide, 30 cm broad and 2-3 cm thick, applanate, dimidiate; upper surface greyish brown to pale reddish brown or reddish black, very finely tomentose to glabrous, with a thin easily indented crust, azonate, cracking deeply on drying or with age; margin obtuse, concolorous or lighter than pileus; pore surface dark or deep brown, prominently cracking with age, often with exuding droplets of amber liquid in growing specimens; tubes light yellowish to golden brown, up to 1.5 cm deep, whitish from within; pores circular to angular, 4-6 per mm, dissepiments entire and thin; context bright, yellowish brown to dark or rusty brown, soft with a silky sheen, faintly zonate, up to 2 cm thick.

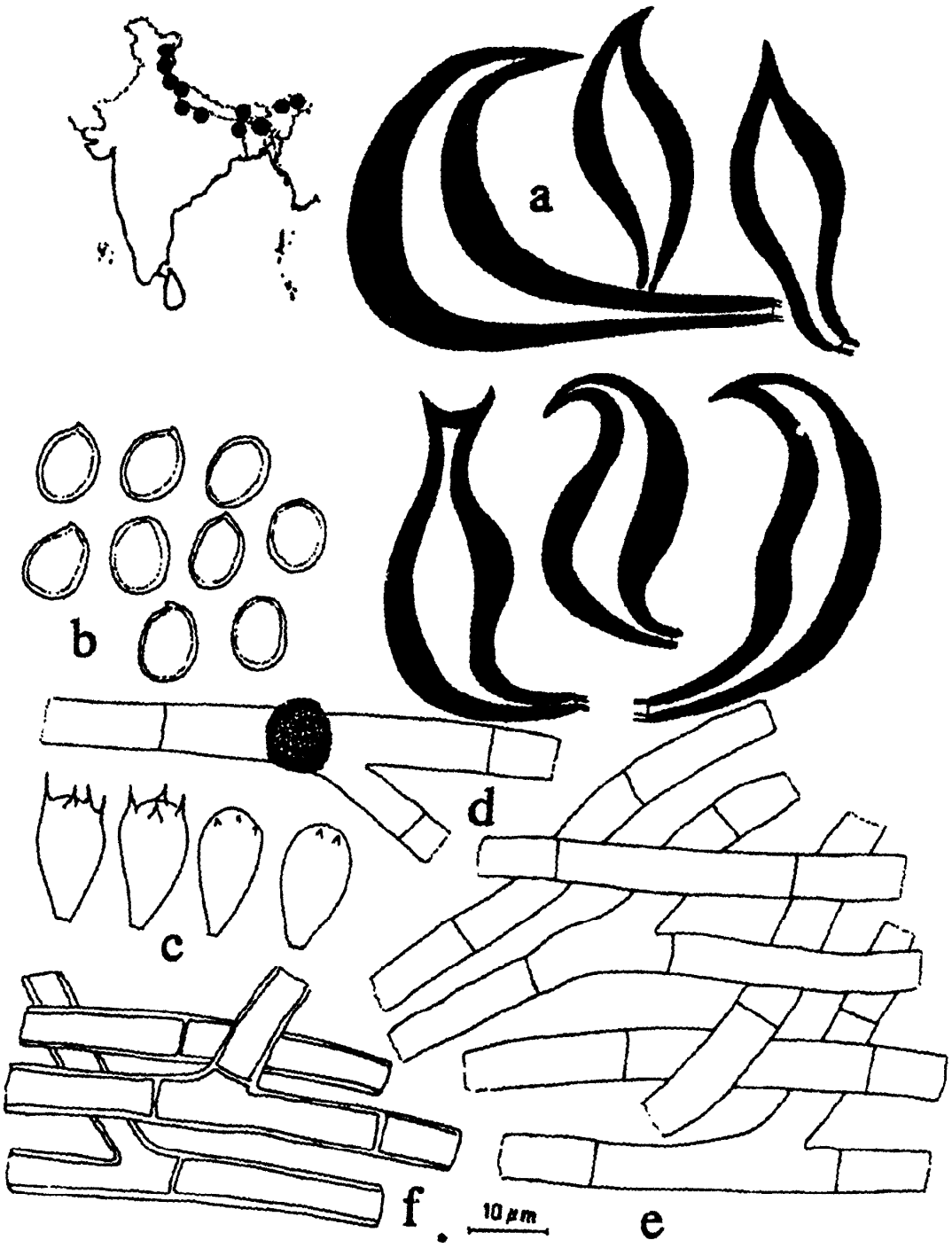


Fig. 34. *Innotus dryadeus* (JRS 438) a. setae, b. spores, c. basidia, d. contexual hyphae with gummy incrustations, e. tramal hyphae, f. contexual hyphae.

Hyphal system monomitic; generative hyphae in the context hyaline to pale brown, thin to thick walled, branched occasionally, simple septate, 5-10 μm wide, with gummy incrustations in some areas; generative hyphae in trama pale golden brown, 4-7 μm wide, rarely branched, more or less thin walled; hymenial setae rare to frequent or abudant in certain specimens, ventricose, tips straight or hooked, 25-35 x 8-15 μm, dark brown; basidia broadly clavate or ovoid, 4-sterigmate, 12-15 x 7-9 μm; sproes abundant, hyaline to pale yellow, thin to moderately thick walled, cyanophillous, subglobose or ovoid, 5.5-8 x 5-7 μm, dextrinoid in Malzers.

Habitat and Distribution

Usually at the base of living trees of *Abies* and *Quercus;* continuing to fruit for several seasons after the host is dead. causing a white rot in both sapwood and heartwood of roots and butts of living trees; a common and a widely distributed species in temperate forests of Himalayas, more common in Western Himalayas.

Remarks

The large massive basidiocarps, generally developing on the roots or base of the infected trees near the ground level and exuding droplets from the pore surface are features enough to identify this species in the field itself. Hyaline, subglobose spores and strongly ventricose setae with curved tips are other distinguishing features. It is closely related to *I. brevisporus* but the latter has smaller spores (4.5-5.6 x 3.5-5 μm) and pores (5-7 per mm).

Inonotus dryophilus (Berk.) Murr. Fig. 35
Bull. Torrey Bot. Club 31: 597, 1904 - *Polyporus dryophilus* Berk., Lond. Jour. Bot. 6: 321, 1847.

Basidiocarps annual, sessile, single or imbricate, corky-fleshy when young, later hardening, nodular or almost ungulate, up to 12 cm wide, 10 cm broad and 3-6 cm thick; pilear surface somewhat tomentose or hirsute, later glabrous, often zonate, yellowish white, slowly changing to brownish, later greyish brown to reddish brown and finally blackish; margin generally lighter, thick, even or somewhat undulate; pore surface yellowish brown to reddish brown; tubes rusty brown, up to 2 cm deep; pores circular to angular, dissepiments rather thick, soon becoming lacerate, 2-3 per mm; context pale coloured, but more brownish next to the tubes and finally dark brown, with a basal globose, up to 6 cm thick granular core at base of pileus permeated with white mycelial strands

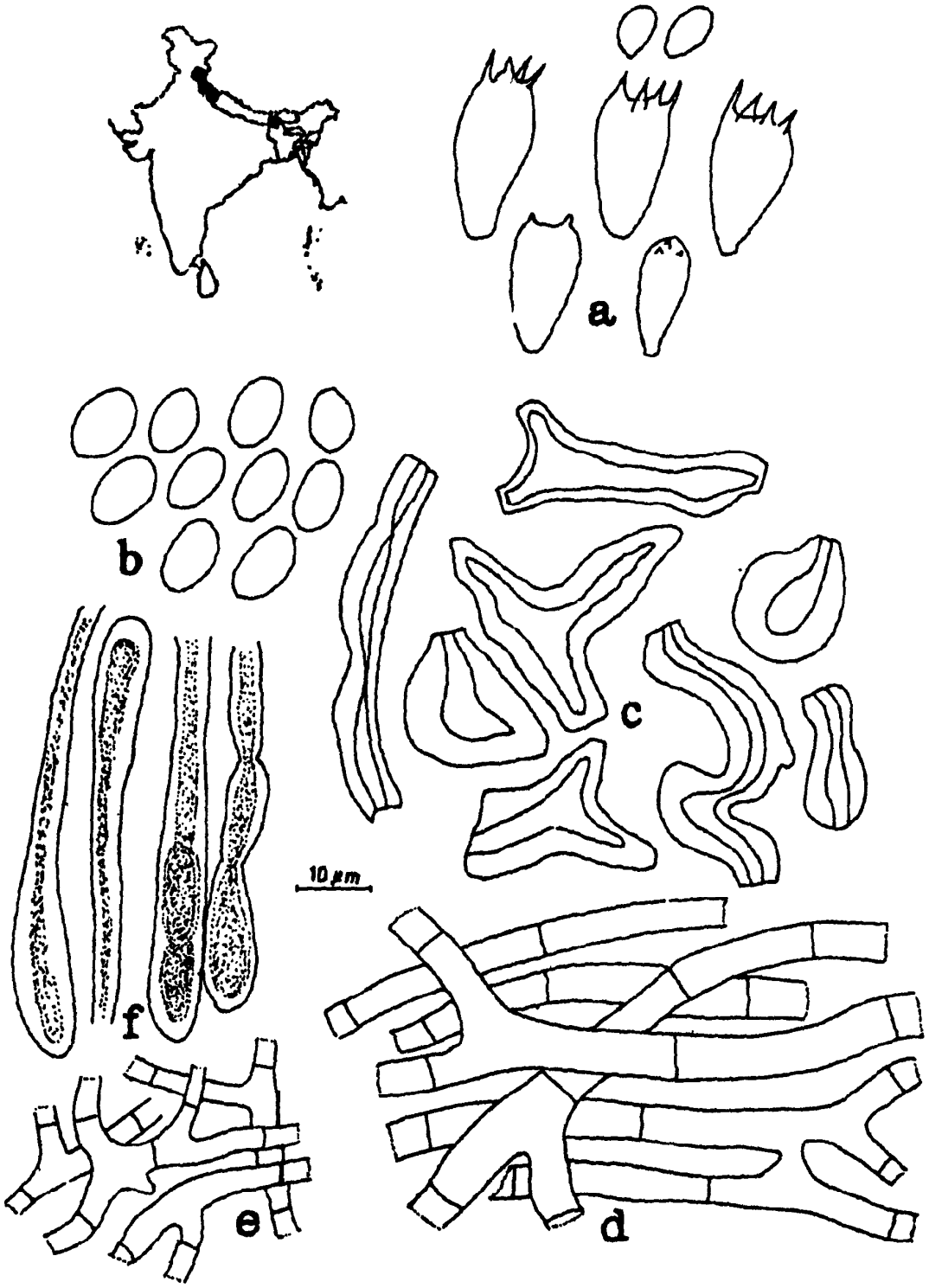


Fig. 35. *Inonotus dryophilus* (JRS 61141) a. basidia, b. spores, c. distorted hyphae from granular core, d. generative hyphae from trama, e. hyaline hyphae from granular core, f. gloeoplerous hyphae from trama.

Hyphal system monomitic; generative hyphae in the firbous portion of context are mostly thin walled, pale yellowish, simple septate, with infrequent branching, 4-8 μm wide, hyphae of the granular core are of two types, some thick walled, branched, contorted and breaking into small fragments, 4-12 μm wide, others hyaline, simple septate, thin walled, mostly 3-4 μm wide with occasional swellings, up to 15 μm; tramal hyphae pale yellowish, thin walled, simple septate, 4-5.5 μm wide, interspersed with gloeoplerous hyphae with clavate tips; basidia clavate 12-16 x 6-7.5 μm; setae none; spores dark brown, ellipsoid to ovate, uneven, generally flattened at one end, 6.5-8 (8.5) x 5-6(7) μm, walls thick, acyanophilous, IKI-.

Habitat and Distribution

On tree trunks or thick branches of living *Quercus dilatata* and *Q. semicarpifolia,* not found on other hosts; causing a white heart rot with brown mycelium developing in the later stages of decay; a very rare species occurring from subtropical to temperate forests.

Remarks

The presence of a central granular core at the base of the pileus distinguishes this species from all other Indian species of this genus. The lack of any setal elements and presence of the central granular core separate it from *I. cuticularis. I. dryadeus* differs decidedly from this species in having a weeping hymenophore, curved setae and smaller spores.

Inonotus flavidus (Berk.) Ryv. Fig. 36

Mycotaxon 20, 145, 1984 *Polyporus flavidus* Berk., Hook. J. Bot. 6: 161, 1854; *Inonotus sciurinus* Imaz., Bull. Tok. Sci. Mus. 6: 106, 1943.

Basidiocarps annual, pileate, sessile, single or closely imbricate, spongy when fresh, corky hard and light in weight on drying, applanate to convex, 8-10 cm broad, 3-6 cm wide and up to 1 cm thick near base; upper surface reddish brown to fulvo-ferruginous, soft velutinate to tomentose, remaining so at maturity or becoming glabrous in narrow concentric zones, a thin crust like layer present, under the tomentoum, radially wrinkled on drying; margin thin, slightly undulating and inturned on drying; pore surface coffee brown, with a sheen; tubes concolorous with pore surface; pores circular, almost regular, 4-6 per mm; context 2-4 mm thick, golden brown, brittle on drying, limited on the upper surface by a thin black line below the tomentum.

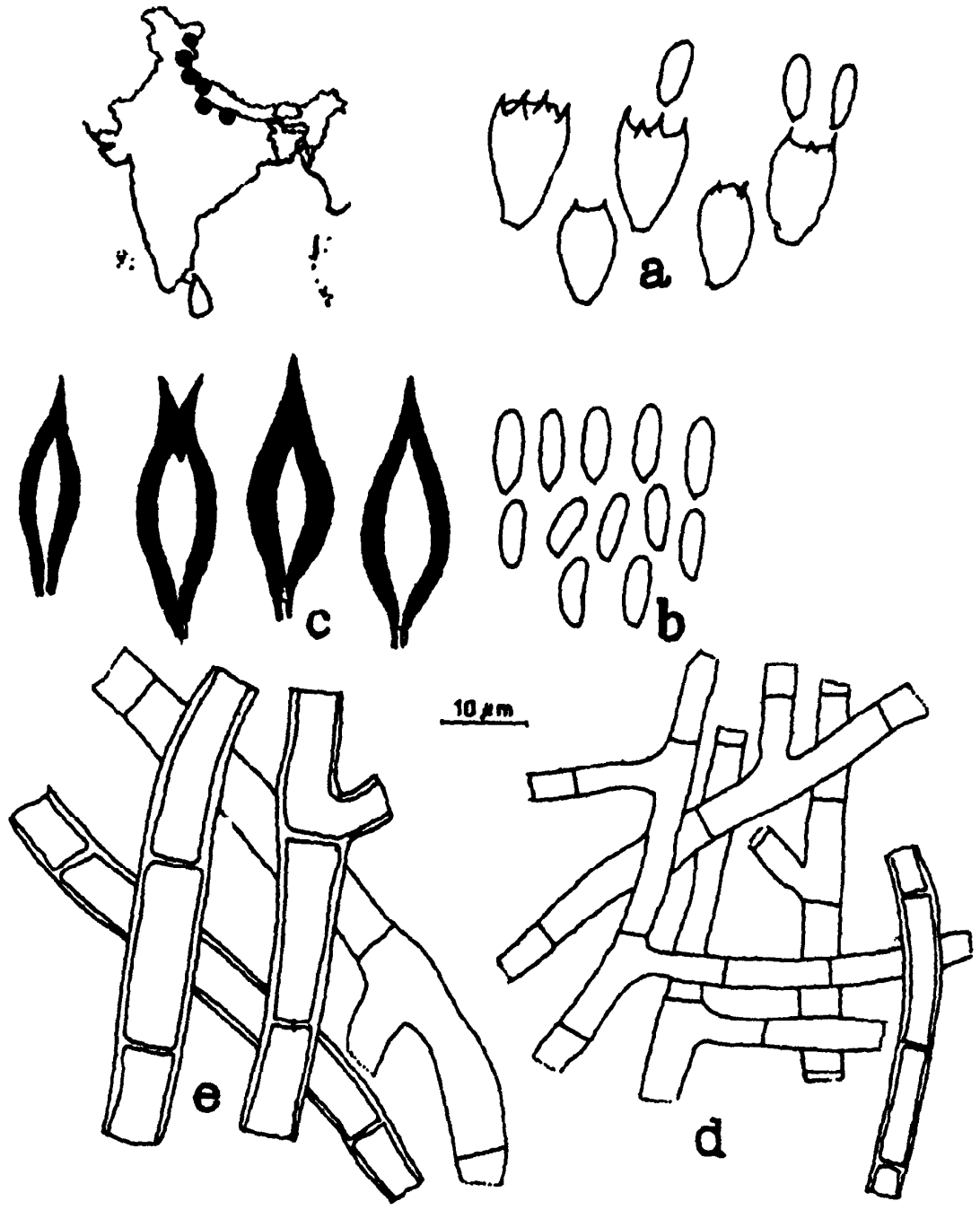


Fig. 36. *Inonotus flavidus* (JRS 515) a. basidia, b. spores, c. setae, d. contexual generative hyphae, e. tramal generative hyphae.

Hyphal system monomitic; generative hyphae thin to thick walled, 2.5-5 µm wide, pale yellow, frequently septate, and branched, tramal hyphae thick walled, pale yellow to golden yellow, rarely branched and not frequently septate, 3-7.5

μm wide; hymenial setae abundant, dark brown, subulate to ventricose, tips straight or sometimes forked, 15-25 (30) x 4.5-8 μm; basidia clavate, 8-12 x 5-6 μm, 4-sterigmate; spores cylindrical, apiculate, 5-7 x 2-2.5 μm, hyaline to pale yellow, IKI-.

Habitat and Distribution

On dead, rarely living hardwoods, especially on *Quercus* and *Betula;* causing a white pocket rot; a very common species in the temperate Himalayan mixed forests.

Remarks

Though this species has been reported as growing on living/dead *Acer* and *Rhododendron* (Imazeki 1943; Ryvarden 1977; Hjorstam and Ryvarden 1984) but has never been found on these hosts in India. It frequently grows on dead/living trees of *Quercus* and *Betula*. The unusual feature is the presence of cylindrical spores which makes it unique in the genus.

Inonotus glomeratus (Pk.) Murr. Fig. 37

Mycologia 12: 18, 1920 - *Polyporus glomeratus* Pk., N.Y. State Mus. Ann. Rept. 24: 78, 1872.

Basidiocarps annual, sessile to rarely effused-reflexed, usually imbricate, coriaceous and watery when fresh, rigid and brittle on drying; 5-8 cm wide and broad, up to 1.5 cm thick; upper surface reddish brown to almost reddish black at maturity, often covered with bright yellow mass of spores, minutely velutinate-tomentose with a silky sheen when young, becoming glabrous at length with a thin but distinct crust, faintly zonate towards the margin; margin golden yellow to brownish when growing, later almost concolorous with pileus, thin, undulating, incurved on drying; pore surface olive brown to greenish yellow when fresh becoming deep to rusty brown at maturity; tubes up to 6 mm deep, concolorous or darker than the context; pores angular, irregular, 3-5 per mm, dissepiments thin, becoming lacerate with age; context golden brown to dark yellowish brown, up to 1 cm thick, shiny on cut surfaces, fibrous-corky, faintly zonate, delimited on upper surface by a thin black layer.

Hyphal system monomitic; generative hyphae thin to thick walled, pale yellow to golden brown, rarely branched, 3.5-6.5 μm wide; setal hyphae present in context and trama, contextual setal hyphae 4-10 μm wide, thick walled dark brown, projecting into the base of the tubes, tramal setal hyphae more numerous

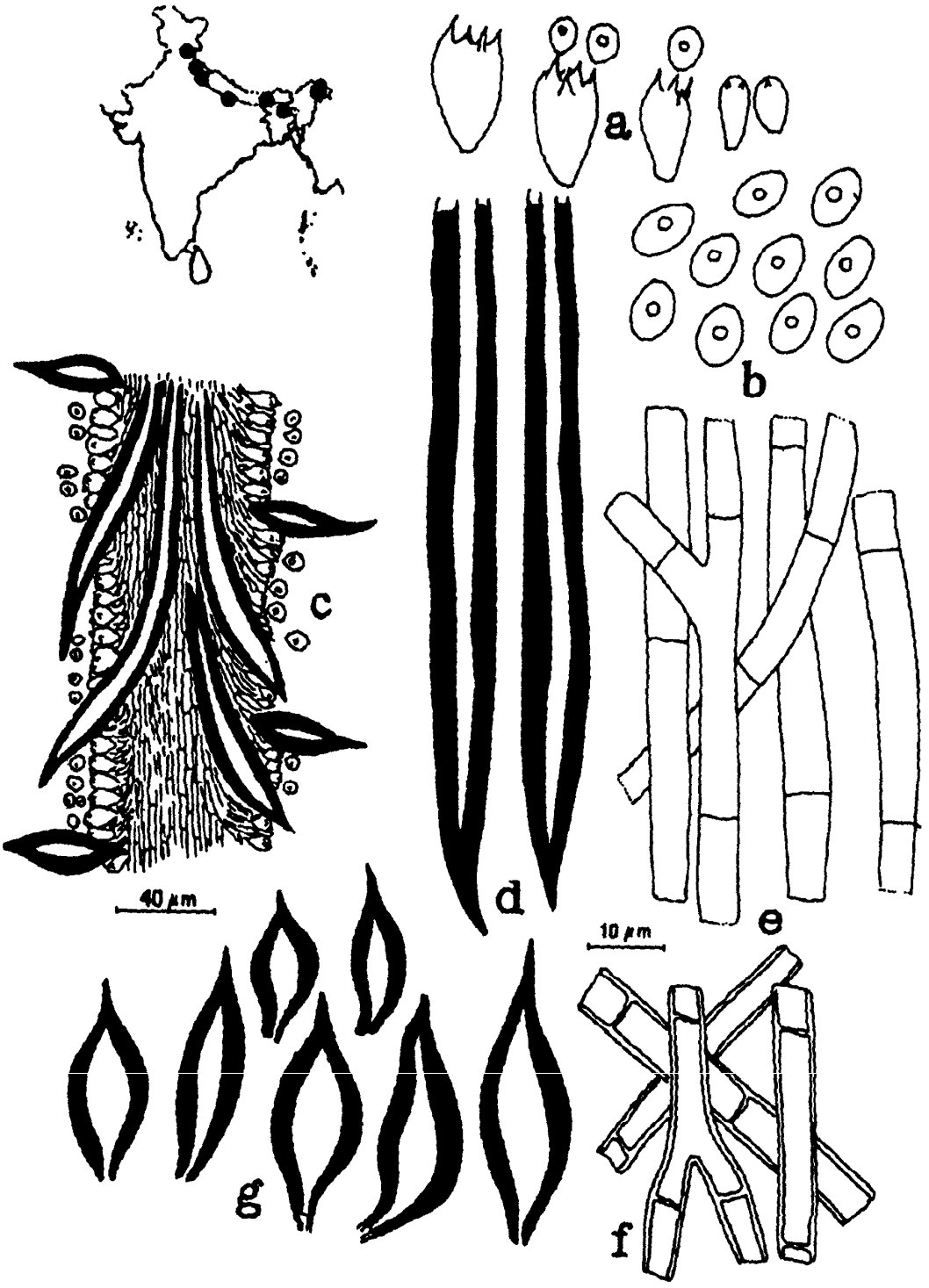


Fig. 37. *Inonotus glomeratus* (JRS 203) a. basidia, b. spores, c. section through tube, d. setal hyphae, e. tramal hyphae, f. contexual hyphae, g. setae.

and conspicuous, running parallel to the long axis of the tubes or diverging towardes the hymenium, projecting at the edges of the dissepiments or obliquely into the tubes, up to 400 μm long and 6-12 μm thick; hymenial setae abundant to rare, sharp pointed, slightly thick walled, subulate to ventricose, 15-26 x 5-8 μm; basidia clavate to broadly clavate, 8-14 x 5-6.5 μm, 4-sterigmate; spores broadly ellipsoid to ovoid, pale yellowish to golden yellow, slightly thick walled, 5-7 x 4-5.5 μm, IKI-.

Habitat and Distribution

Fruiting profusely on dead fallen tree trunks or stumps and rarely on living hardwoods; causing a white rot of heartwoods of living hardwood trees and continuing to decay the dead standing and fallen trees and stumps; a very common and widely spread species in the warmer temperate forests.

Remarks

The main distinguishing characters of this species are the presence of abundant setal hyphae in the context and dissepiments and the golden yellow spores. It is easy to distinguish it in the field by its glabrous, reddish black pileus with a thin crust and a thick deposit of golden yellow spores on the pilear surface. Though, it is reported to occur on living hosts from many countries but in India it flourishes more on dead lying trunks and stumps of deciduous woods belonging to many hardwood genera.

Inonotus hamusetulus Ryv. Fig. 38
In Hjort. et Ryv., Mycotaxon 20: 145, 1984.

Basidiocarps annual, rarely beinnial, sessile, dimidiate to flabelliform with a narrow stipe like base, up to 10 cm broad, 8 cm wide and 1-1.5 cm thick at base, woody hard on drying; upper surface dark greyish brown to dark brown, finely velutinate-tomentose when young, soon glabrous with wide concentric zones, radially wrinkled on drying; margin thick to thin, sterile underneath, slightly bending on drying; pore surface golden or dark to rusty brown, darkening on bruising; tubes golden brown, up to 8 mm deep, concolorous or lighter than the context; pores invisible to the naked eyes, 6-8 per mm, regular, circular, dissepiments rather thick; context duplex when young with a black line in between the tomentum and the lower rusty brown, firm, zone, with age tomentum wards off and the context is limited on upper surface by a black zone, appearing crusty hard.

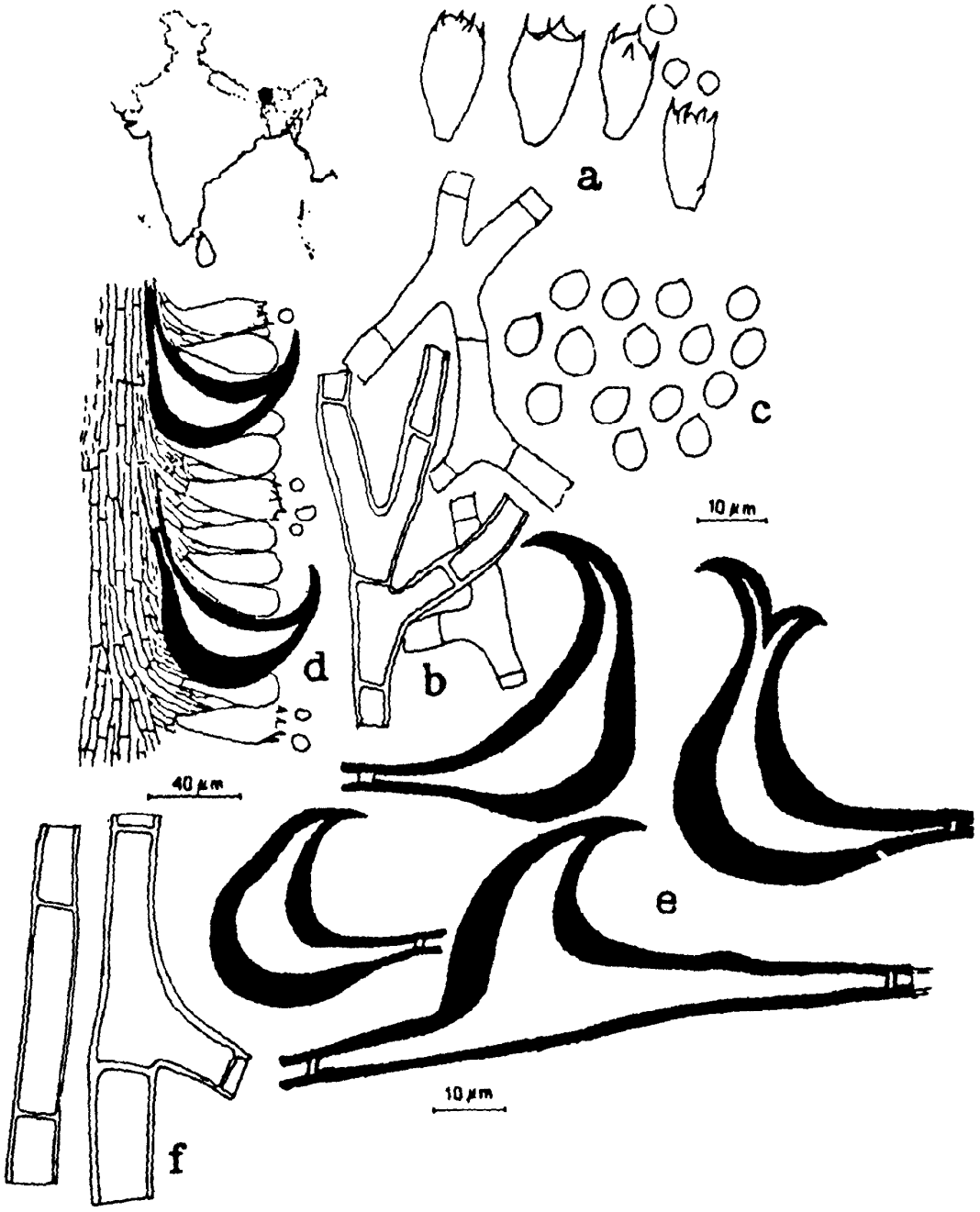


Fig. 38. *Inonotus hamusetulus* (JRS 60994) a. basidia, b. contexual hyphae, c. spores, d. section through tube, e. setae, f. tramal hyphae.

Hyphal system monomitic; generative hyphae simple septate, pale golden brown, more thick walled in the trama, 2.5-8 µm; hymenial setae rare to scattered, tips hooked, 20-30(35) x 8-12 µm, ventricose with base flattened, dark

brown, thick walled, deeply embedded, projecting 8-10 μm above the hymenium; basidia clavate, 12-20 x 5-8 μm, 4-sterigmate; spores hyaline to pale yellowish, subglobose, 4-4.5 x 3-3.5 μm, acyanophilous, IKI-.

Habitat and Distribution

The basidiocarps grow at the base of living Oak trees near the ground level; causing a white rot of heartwood of living trees; a very rare species found in temperate zones of Sikkim Himalayas.

Remarks

This species is characterised by its flabellate to substipitate basidiocarps, hooked setae and small, hyaline to pale yellowish subglobose spores. The closest relative of *I. hamusetulus* is *I. radiatus* as both the species have hooked setae and hyaline to pale yellowish spores. *I. radiatus* however, has smaller applanate to ungulate basidiocarps, cracking excessively on drying and with age, bright yellow margin, larger spores (5-7.5 x 4-5.5 μm) and pores (4-6 per mm).

Inonotus hispidus (Bull. : Fr.) Karst. Fig. 39

Bidrag. Kaenn. Finl. Nat. Folk 48: 330, 1889 *Boletus hispidus* Bull., Herb. France, Pl. 210, 1785; *Polyporus hispidus* Bull.: Fr., Syst. Mycol. 1: 362, 1821; *Polyporus subhispidus* Llyod, Mycol. Writ. 7: 1330, 1924; *Inonotus subhispidus* Pegler & Reid, Trans, Brit. Mycol. Soc. 47(2) : 170, 1964.

Basidiocarps annual, single or imbricate, sessile, applanate, dimidiate, up to 10 cm broad, 15 cm wide and 2-5 cm thick, spongiose-watery when fresh, rigid, hard and woody on drying; upper surface yellowish brown, pale reddish brown to blackish with age, covered with dense hispid hairs, becoming glabrous and rough in parts when old, concentrically sulcate; margin obtuse, somewhat undulating, concolorous with upper surface or lighter in young specimens; pore surface yellowish brown becoming darker with age; tubes yellowish brown or concolorous with the context, brittle on drying, up to 10 mm deep; pores angular 1-3 per mm, dissepiments lacerate; context dark reddish brown, spongiose, radially fibrillose, hard, rather friable with age, up to 3 cm thick.

Hyphal system monomitic; generative hyphae pale yellowish to dark brownish, 3-6 μm wide, simple septate, frequently to occasionally branched, wider and more thick-walled in the trama; hymenial setae scattered to hardly observed or even absent, fusiform to subulate, 18-32(35) x 6-11 μm, dark brown, tips straight; basidia broadly clavate, 4-sterigmate, 10-16 x 6-7 μm; spores

subglobose to ovoid, 8-11 x 6-8 μm, slightly thick walled, dark brown, acyanophilous, IKI-.

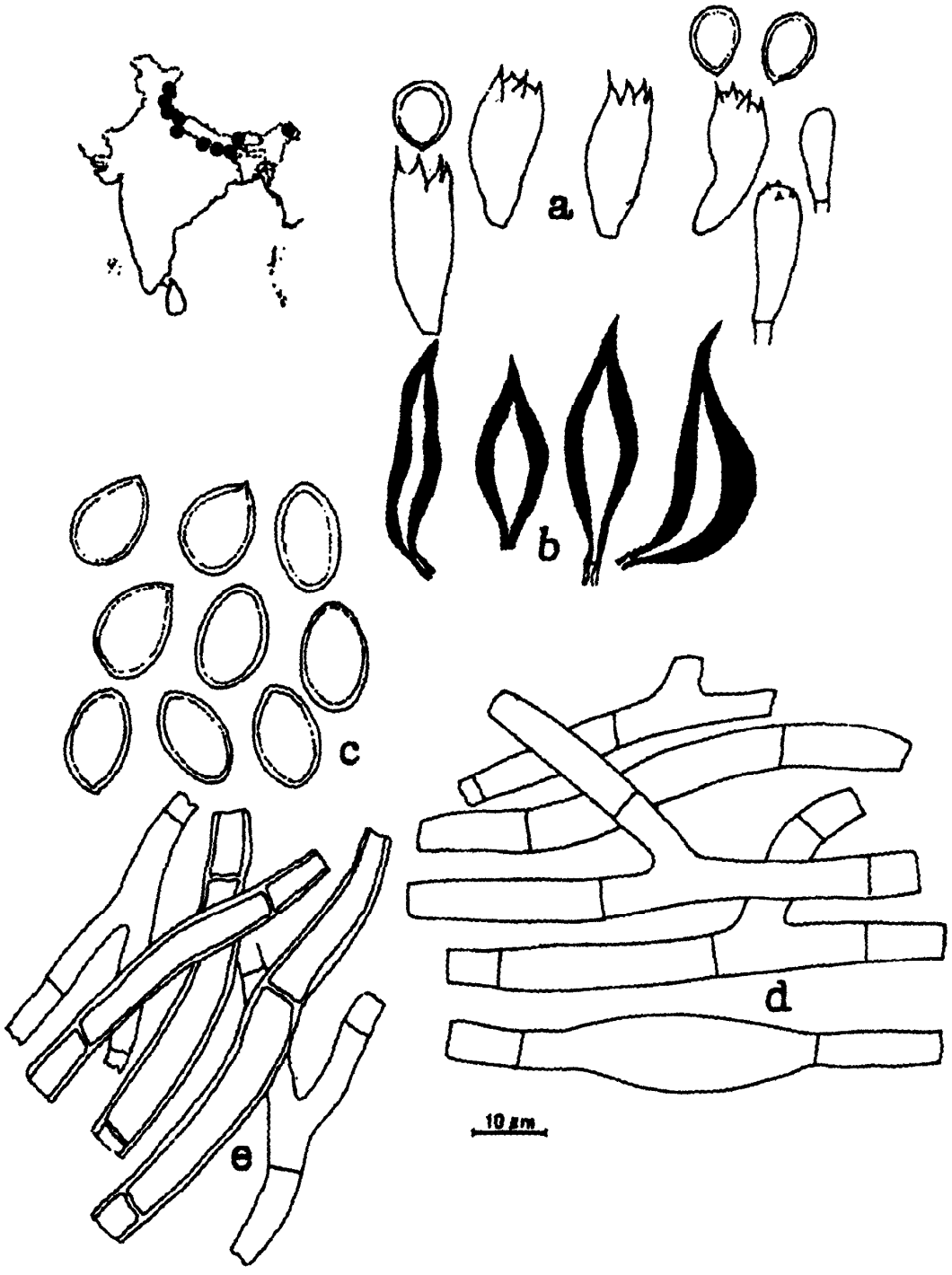


Fig. 39. *Inonotus hispidus* (JRS 61129) a. basidia, b, setae, c. spores, d. contexual hyphae, e. tramal hyphae.

Habitat and Distribution

On living tree trunks or rotting stumps of *Quercus* and *Aesculus*, less frequently on conifers; causing a white rot of living hardwoods; a common temperate species, more frequently seen in Western Himalayas.

Remarks

The presence of hymenial setae is a variable character of this species. It is somewhat related to *I. dryophilus* and *I. cuticularis*. The larger subglobose spores and particularly the absence of branched setal hyphae on the pilear surface and a thicker layer of hispid-tomentose hairs separate this species from *I. cuticularis*. It differs from *I. dryophilus* in lacking a central granular core at the base of the context, having strongly hispid pileus and larger spores (6.5-8.5 x 5-7 μm) in the latter). The larger spores and thick layer of hispid hairs on pilear surface readily distinguishes this species.

Inonotus patouillardii (Rick) Imaz. Fig. 40
Bull. Tokyo Sci. Mus. 6: 105, 1943 - *Polystictus patouillardii* Rick, Broteria 6: 89, 1907.

Basidiocarps annual, sessile, solitary to more frequently imbricate, broadly attached, consistency hard, woody and brittle on drying, up to 10 cm broad, 5 cm wide and .8 to 1 cm thick, dimidiate to semicircular, applanate to conchate, first adpressed tomentose, reddish brown to dark brown, slowly glabrous with radial striations and more or less blackish when old, weakly rimose especially near the base; margin narrow, rounded, concolorous with pilear surface; inturned on drying; pore surface yellowish brown to rusty brown; tubes concolorous with context, up to 10 mm deep, stuffed in older specimens; pores 3-5 per mm, circular to angular, dissepiments thin, becoming lacerate from the base; context dark brown, concentrically zonate, lustrous when broken, up to 10 mm thick.

Hyphal system monomitic; generative hyphae thin to moderately thick walled, pale to golden brown, simple septate, dark reddish brown in KOH, 3.5-8 μm wide; setal hyphae abundant in the dissepiments only, slightly inflated distally, running parallel and downwards in the trama, occasionally projecting into the lumen of the tubes, up to 150 μm long and 8-12 μm wide; hymenial setae rare to scattered, always present in Indian collections, dark brown, thick walled, subulate to ventricose, 15-35 x 6-10 μm, deeply embedded, projecting 6-10 μm beyond the hymenium; basidia broadly clavate, 12-20 x 7-8.5 μm, 4-sterigmate; spores ovoid to ellipsoid, slightly thick walled, golden brown to pale rusty brown, 6-7.5 (8) x 5-6 μm, cyanophilous, IKI.

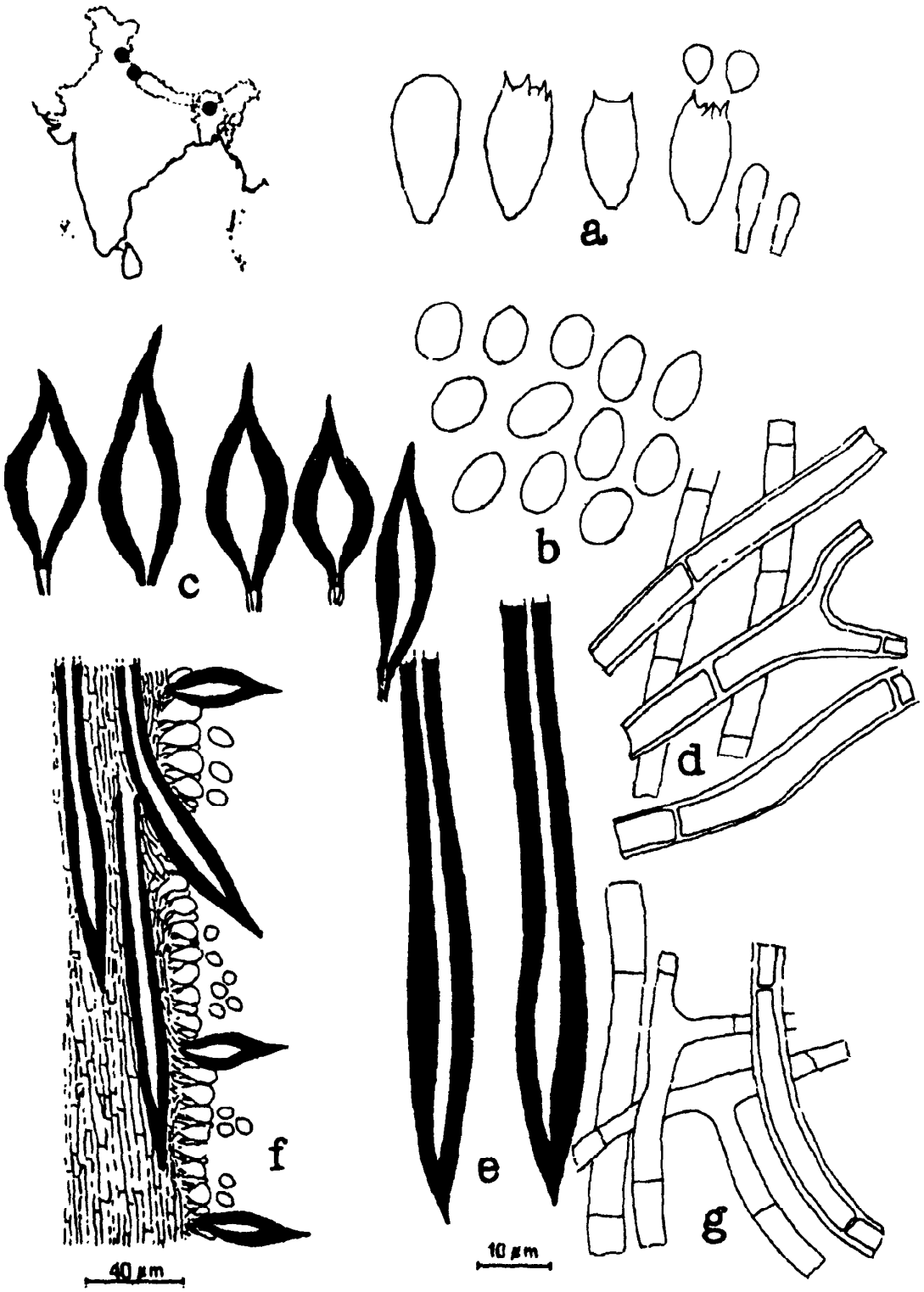


Fig. 40. *Inonotus patouillardii* (JRS 324) a. basidia, b. spores, c. setae, d. tramal hyphae, e. setal hyphae, f. section through tube, g. contexual hyphae.

Habitat and Distribution

On living tree trunks of *Quercus;* causing a white heart rot of the butts of living trees, a very rare species in the temperate zone of Western Himalayas only.

Remarks

This species is very variable in the presence of hymenial setae (Pegler 1964b, Gilbertson 1976). However, rare to scattered hymenial setae have always been found in the Indian collections. The diagnostic features of this species are the presence of setal hyphae in the dissepiments only and the large ovoid, rusty brown spores.

Inonotus radiatus (Sow. : Fr.) Karst. Fig. 41
Krit. Finl. Basidsv. p. 331, 1889 *Boletus radiatus* Sow., Col. Fig. English Fungi, Pl. 196, 1799 : *Polyporus radiatus* Sow. : Fr., Syst. Mycol. 1: 369, 1821.

Basidiocarps annual, sessile, usually imbricate, in large numbers, somewhat decurrent, corky and watery when fresh, corky-woody and brittle on drying; pileus small, 3-6(8) cm broad, 2-4 cm wide and 1-2 cm thick at base, broadly attached, applanate, shrinking on drying; upper surface finely tomentose when young, rusty to maroon brown, later becoming glabrous, dark reddish brown to almost black, uneven azonate, radially rugulose; margin thin, to obtuse, light to bright golden yellow, undulate to slightly lobate; pore surface uneven greyish brown to dark rusty brown, darkening on touching, cracking on drying; tubes 3-5 μm deep, rusty to dark reddish brown; concolorous with pore surface; pores circular to angular, regular, extending up to the margin, 4-6 per mm; context up to 1 cm thick, corky and watery when fresh, hard and almost woody on drying, delimited on upper side by a thin black line, yellowish brown to rusty brown, radially fibrillose.

Hyphal system monomitic; generative hyphae yellowish to golden brown, moderately branched 3-6 μm wide, walls thick, simple septate; hymenial setae not numerous, subulate to subventricose, dark brown, thick walled, tips straight or curved, 16-35 (40) x 6-12 μm, projecting up to 25 μm beyond the hymenium; basidia clavate, 12-18 x 4-6 μm; spores ellipsoid, somewhat flattened at one side, hyaline, 5-7.5 x 4-5.5 μm, acyanophilous, IKI-.

Habitat and Distribution

At the bases of living or very rarely dead *Betula utilis* D. Don and *B. alnoides* Buch.-Ham. Ex D. Don and less frequently also grows on species of

Alnus, *Populus*, *Aesculus* and *Juglans;* never on conifers; causing intensive white pocket rot; a common species in the temperate forests of Himalayas.

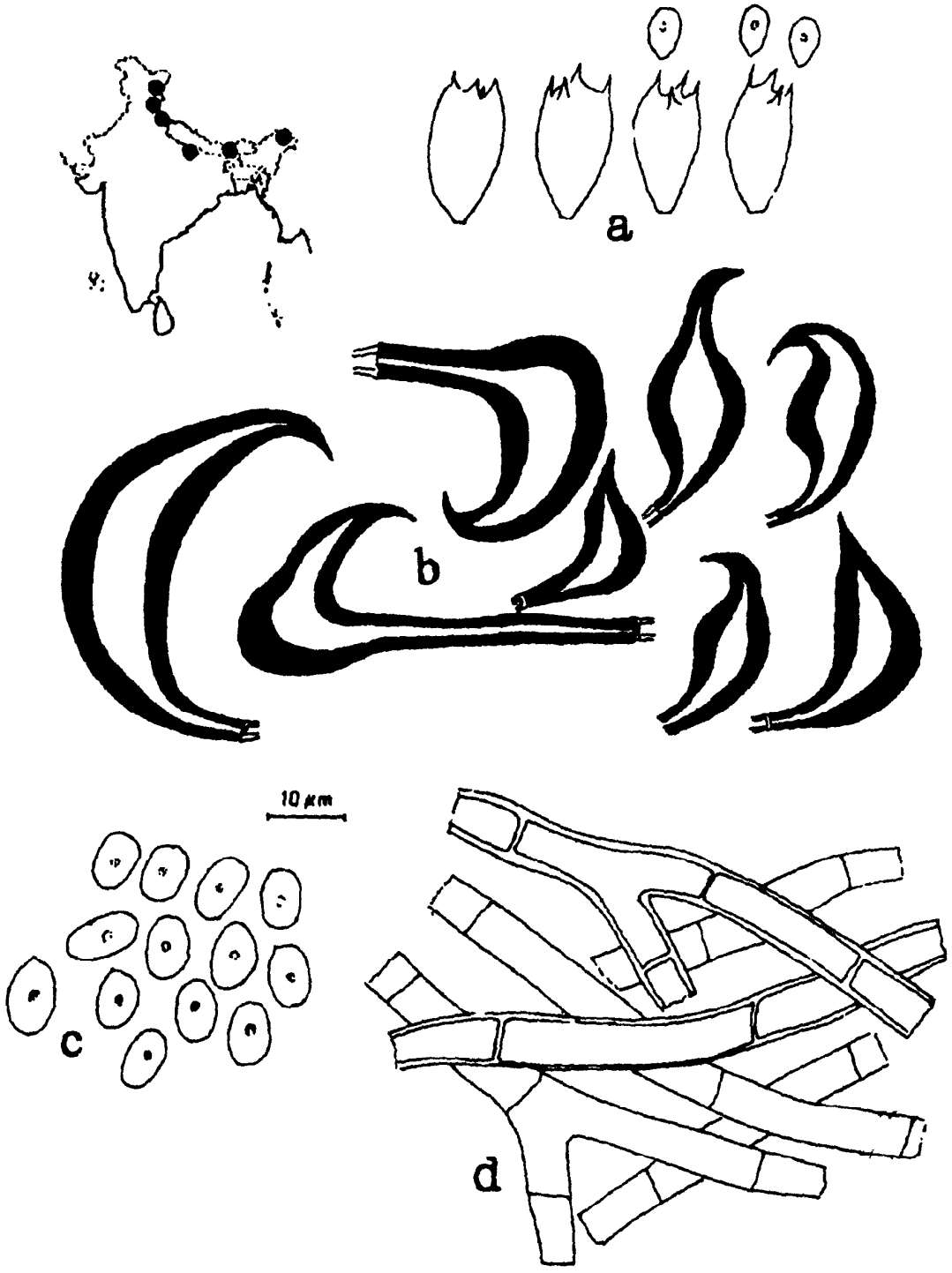


Fig. 41. *Inonotus radiatus* (JRS 61234) a. basidia, b. setae, c. spores, d. generative hyphae.

Remarks

The basidiocarps usually appear quite early in the season and disappear quickly as compared to other polypores. It prefers opener and sunny places. The smaller basidiocarps with bright yellow margin and their excessive cracking on drying are quite characteristic. These features together with curved hymenial setae and hyaline subglobose spores make this species quite interesting. For differences with the closely related *I. hamusetulus*, please see under that species. The bright yellow margin and curved setae separate it from *P. gilvus*. The absence of setal hyphae in the context and dissepimentas distinguishes it from *I. glomeratus* and the absence of branched setal hyphae from the *I. cuticularis*.

Inonotus rheades (pers.) Bond. et Sing. Fig. 42

Ann. Mycol. 39: 56, 1941 *Polyporus rheades* Pers., Mycol. Eur. 2: 69, 1825; *Polyporus vulpinus* Fr., Svenska Vetensk akad. Handl. 1852, p. 130, 1852.

Basidiocarps annual, pileate, sessile, often imbricate, spongy and watery when fresh, firm and crumbling when old, up to 6 cm broad, 4 cm wide and 1-2 cm thick; upper surface yellowish brown or reddish brown with heavy deposits of rusty brown spores, somewhat tomentose or hirsute to strigose-tomentose, finally almost glabrous and reddish black to nearly black; pore surface pale yellowish brown to reddish brown; tubes up to 1 cm thick, concolorous with context, brittle on drying; pores angular, 2-3 per mm, dissepiments rather thick walled, entire or slightly lacerate; context yellowish brown to dark brown with age, faintly zonate, fibrous, with a basal globose, granular core, up to 1 cm in diam., permeated with white flecks of mycelial strands.

Hyphal system monomitic; generative hyphae in the fibrous context pale yellowish to reddish brown, thin to thick walled, simple septate, rarely to much branched, 2.5-5 μm wide; tramal hyphae mostly thin walled, pale brownish, 3-6 μm wide; hyphae of granular core of two types, some pale brownish, much branched, simple septate, 2-3.5 μm wide, others dark reddish brown, contorted or lobed, up to 10 μm wide, mostly unbranched; hymenial setae absent; basidia clavate, 10-14.5 x 6-7 μm, 4-sterigmate; spores broadly ellipsoid to oblong ellipsoid, often flattened at one end, golden brown to pale rusty brown, 4.5-6 x 3.5-4 μm, IKI-.

Habitat and Distribution

On dead tree trunks or branches of *Populus* and *Castanea*; causing aintensive white rot of heartwood; a rare species in the temperate forests.

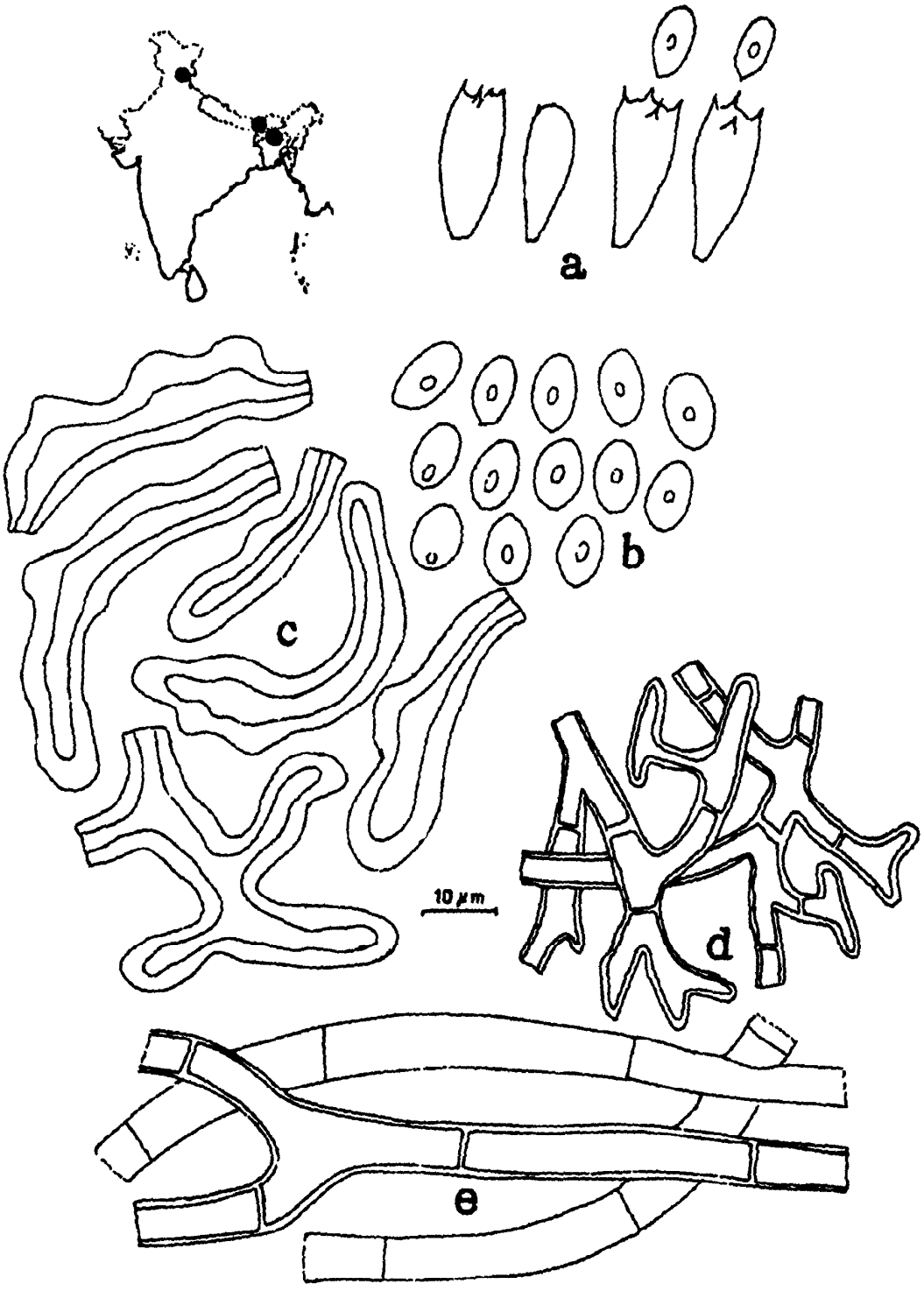


Fig. 42. *Inonotus rheades* (JRS 63379) a. basidia, b. spores, c. contorted hyphae from granular core, d. much branched tramal hyphae, e. contexual hyphae.

Remarks

This species is characterised by the presence of a granular core at the base of pileus, smaller spores and absence of any setal structures. From *I. dryophilus* which also has a well developed and a thicker granular core, it differs in having the smaller granular core and spores (6.5-8 (8.5) x 5-6(7) μm in *I. dryophilus*). Another closely related *I. cuticularis* differs from the present species in the absence of a granular core and the presence of hymenial setae and branched setal hyphae.

Inonotus rickii (Pat.) Reid Fig. 43

Kew. Bull. 12: 141, 1957 - *Xanthochrous rickii* Pat., Bull. Soc. Mycol. Fr. 24: 6, 1908; *Polyporus calcuttensis* Bose, Ann. Mycol. 23: 179, 1925.

Basidiocarps annual, sessile, single or imbricate, easily separable, applanate to ungulate, up to 12 cm wide and broad and 2-5 cm thick, at first soft and fleshy and then finally firm to crumbly and dusty as the formation of chlamydospores progresses; upper surface yellowish brown becoming rough and rusty brown with golden brown margin; pore surface pale brown; tubes pale golden brown, up to 1 cm deep, firm but easily sectioned; pores angular, 2-3 per mm; context pale brown when fresh becoming dark rusty brown with age, concentrically zonate, firm or eventually crumbling into a mass of chlamydospores, up to 5 cm thick; ptychogastric basidiocarps developing as a cushion shaped mass of deep brown tissue, soft and fleshy, exuding clear droplets of exudate from the entire surface, moist and velvety, up to 15 cm in diameter, without any tube layer, soon becoming drier and finally becoming dusty from chlamydospore formation.

Hyphal system monomitic; generative hyphae thin to moderately thick walled, pale yellowish to brownish, rarely branched, 3.5-5 μm wide; setal hyphae present in the tramal tissue, up to 300 μm long, 3-5 μm wide but up to 12 μm below the tips, abundant, running parallel to the long axis and occasionally diverging out into the lumen, thick walled, ends, tapering, rarely setal hyphae also occur on the surface of the pileus, always absent in the context proper beneath the pilear surface; hymenial setae frequent, subulate to ventricose, thick walled, dark brown, rarely forked at tips, tips straight, 15-25 x 5-8 μm; spores abundant, thick walled, brownish, reddish brown in KOH, 6-8.5 x 4-5.5 μm, ellipsoid to ovoid, IKI-; chlamydospores abundant in the context tissue, irregular in shape, globose to ellipsoid or with an elongated appendage, 10-25 μm in longest dimensions.

Habitat and Distribution

On living tree trunks of *Quercus*, *Casuarina*, *Caesalpinia* and *Melia;* causing a white rot of living tree trunks; a rare species occurring from tropical to temperate forests.

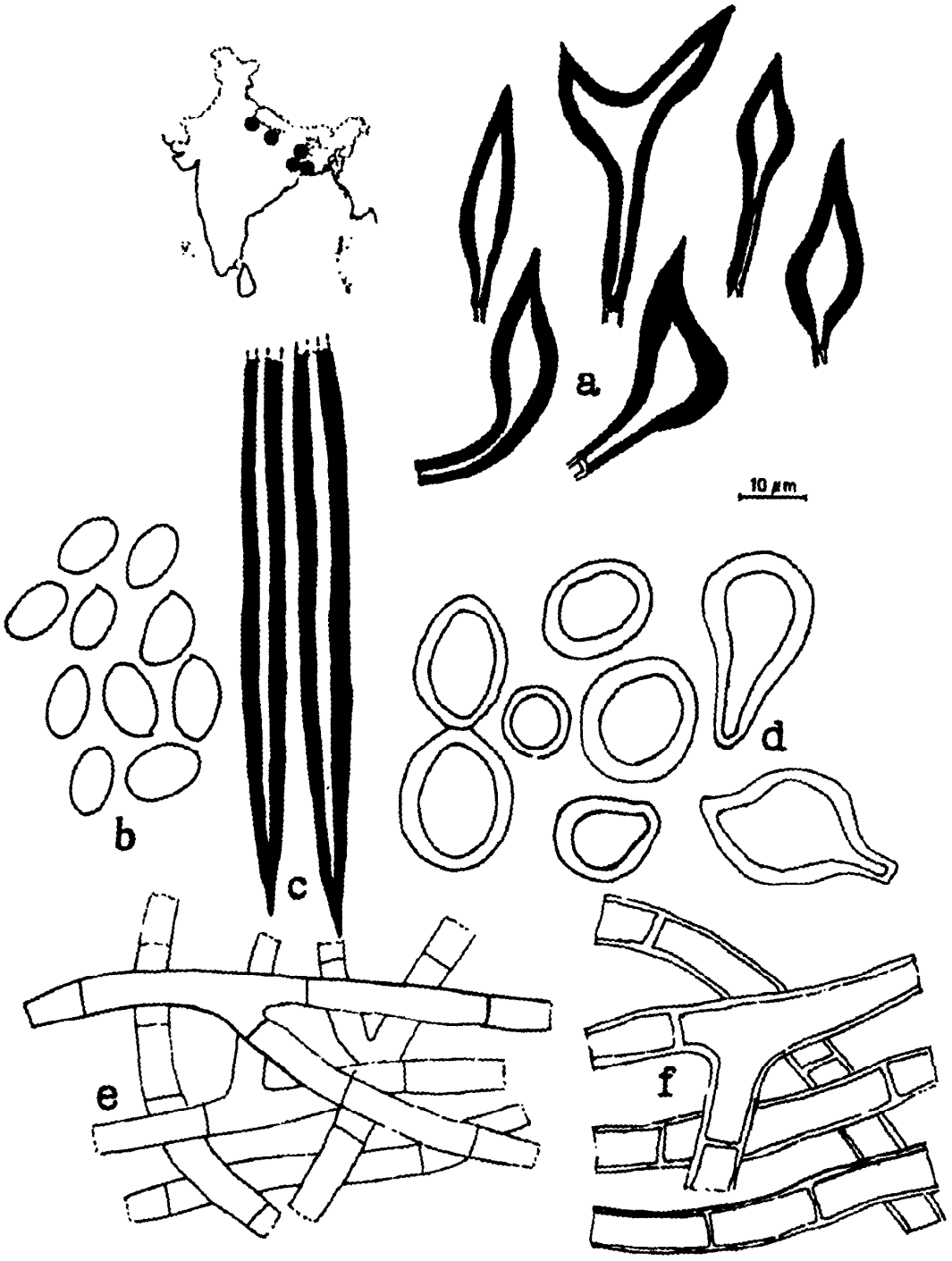


Fig. 43. *Inonotus rickii* (JRS 61004) a. setae, b. spores, c. setal hyphae, d. chlamydospores, e. tramal hyphae, f. contexual hyphae.

Remarks

I. rickii is the only species in the genus known to produce a ptychogastroid stage and abundant thick walled chlamydospores. This feature together with the presence of setal hyphae in the trama only make this species quite unique. However, the rare presence of setal hyphae on the pilear surface of certian collections is quite confusing and a varying character. Normally it has been observed that the setal hyphae are present on the pilear surface of the collections made from tropical forests and absent on collections from higher altitudes. These hyphae are much different than the setigerous elements of *I. cuticularis*. Unlike *I. glomeratus*, the setal hyphae are confined to the trama only.

Inonotus tenuicarnis Pegler & Reid Fig. 44
Trans. Brit. Mycol. Soc. 47: 172, 1964.

Basidiocarps annual, sessile, applanate, flabelliform to dimidiate, convex, single to mostly imbricate to many pilei arising from the common base, up to 25 cm wide, 18 cm broad and 1-2 cm thick at base, spongy when fresh, hard, brittle and light in weight on drying; upper surface reddish brown to darker with age, concentrically zonate, tomentose to radially striate, becoming glabrous with a distinct thin crust of strongly agglutinated hyphae at maturity; margin acute, undulate, incurved on drying, yellowish brown soon; dark red to reddish brown with a sheen; pore surface uneven, plane to concave on drying, glancing, yellowish when young, becoming darker on touching, yellowish to umber brown when dry or old; tubes deep to dark brown, up to 1.5 cm deep, always longer than the context, brittle on drying; pores angular to irregular 4-5 per mm, dissepiments thin becoming lacerate; context homogeneous, pale reddish brown to rusty brown, spongy, up to 4 mm thick near base, with a silky sheen, concentrically zonate, fibrous and hard on drying.

Hyphal system monomitic; generative hyphae yellow to pale rusty brown, simple septate, frequently branched, firmly interwoven and 3-7.5 μm in the context, firmly agglutinated, rarely branched and 3-5 μm wide in the trama; setae and setal hyphae absent; basidia cylindrical, 4-sterigmate, 7.5-10.5 x 5-6 μm; spores abundant, oblong ellipsoid to ellipsoid, dark rusty brown, thick-walled, uniguttulate, 5-6.5(7) x 3.5-4.5 μm, IKI-.

Habitat and Distribution

Mostly on the base of living or dead tree trunks of *Quercus semicarpifolia*, *Betula utilis* and *Castanea sativa* Mill. never on conifers; causing a white rot; a

cosmopolitan species growing from warmer temperate forests (less common) to tree line forests (more common), more frequently found in Western Himalayas than the Sikkim and Eastern Himalayas.

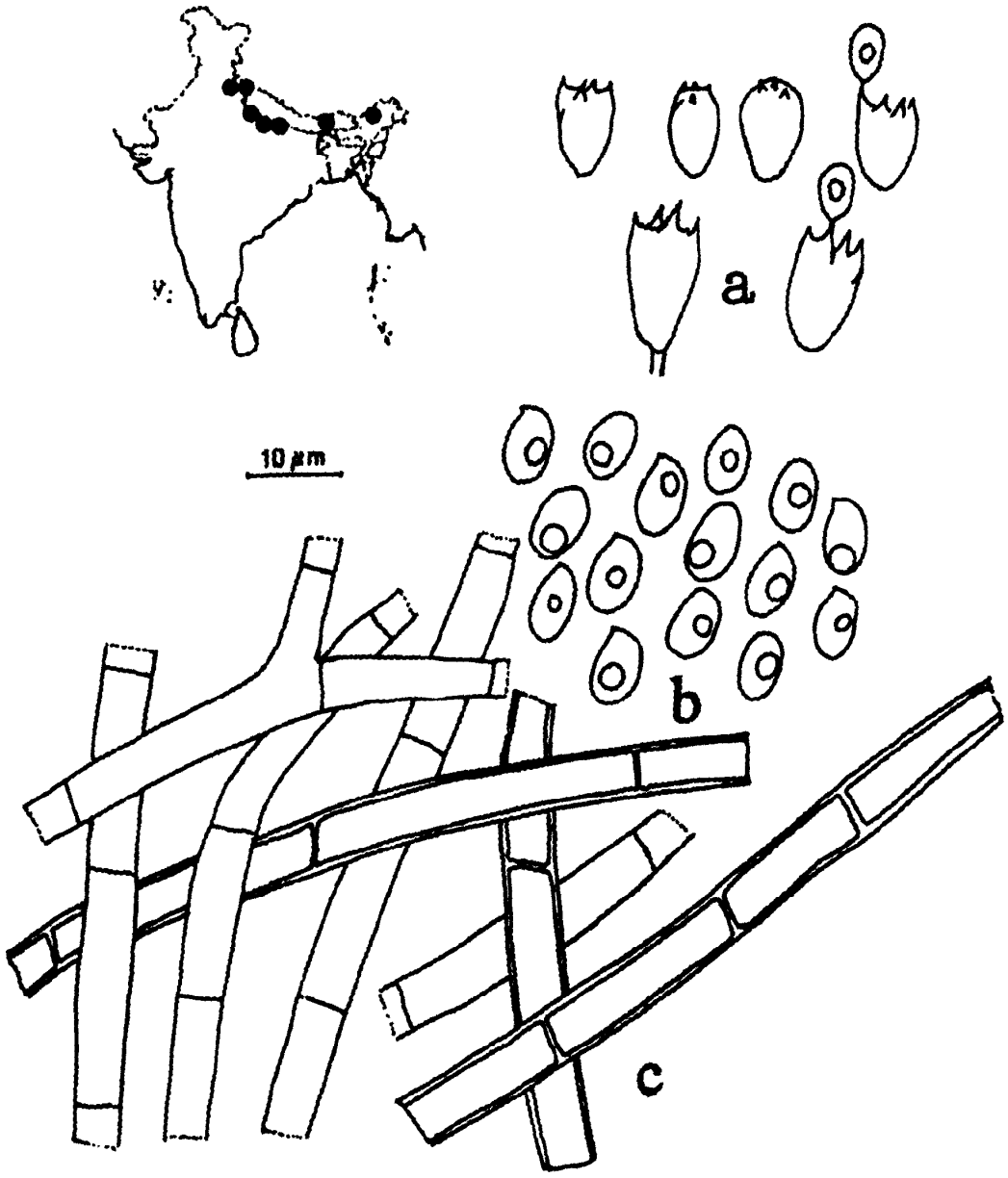


Fig. 44. *Inonotus tenuicarnis* (JRS 582) a. basidia, b. spores, c. generative hyphae.

Remarks

The size of the basidiocarps varies to a great extent. Usually they are smaller as compared to those growing near tree line and also mostly they grow single in lower altitudes and imbricate to groups of several pilei from the common base at higher altitudes. The absence of a granular core at the base of pielus and a glabrous crusty surface separate this species from *I. rheades* to which it resembles in spore size and absence of setal elements. This species may be readily recognised by large flabelliform pileus, thin context, coloured spores and absence of any setal elements.

Inonotus tomentosus (Fr.) Teng Fig. 45

Fungi of China, p. 763, 1964 - *Polyporus tomentosus* Fr., Syst. Mycol. 1: 351, 1821.

Basidiocarps annual, stipitate to substipitate, subcoriaceous to often spongy and more or less watery when fresh, rigid and brittle on drying; pilei centrally adpressed, circular, reniform or sometimes of irregular shape, 3-12 cm in diameter and up to 10 mm thick, solitary to mostly several pilei from the common branching base; upper surface yellowish brown when young, pale reddish brown to rusty brown in matured fruitbodies, with a thin layer of tomentum, faintly concentrically zonate or azonate; margin thin somewhat undulate or spathulate, inturned on drying, sterile below, usually lighter than the pilear surface; stipe central or lateral to rudimentary, cylindric, soft tomentose, 2-3.5 cm long and 1-1.5 cm thick; pore surface yellowish brown, when young, deep to rusty brown with age; tubes up to 6 mm deep, more or less decurrent, dark brown; pores angular or elongated, 2-3 per mm, dissepiments entire becoming thin and lacerate with age; context up to 8 mm thick, duplex, upper layer, soft, spongy and the lower layer firm, fibrous, golden brown to dark yellowish brown.

Hyphal system monomitic; generative hyphae thin walled, 3-7 μm wide, pale yellowish in the upper context and usually thick walled, yellowish brown, simple septate, 2.5-5 μm wide in the lower part; tramal hyphae pale yellowish, thin walled, 3-4 μm wide; hymenial setae abundant, irregularly distributed, usually subulate to rarely ventricose, tips straight and pointed, 45-65(70) x 7-12 μm, projecting up to 50 μm beyond the basidia, dark reddish brown; basidia 12-16 x 4.5-6 μm, clavate, 2-4 sterigmate; spores hyaline to pale yellowish at maturity, ellipsoid to ovoid, 4.5-6 x 3-4 μm, acyanophilous, IKI-.

Habitat and Distribution

On living (roots, tree trunks) and on dead (stumps, buried wood) of conifers particularly *Pinus wallichiana* in Western Himalayas and *P. kesiya* in Eastern

Himalayas; less frequently also found on species of *Larix*, *Cedrus*, *Abies* and *Picea;* causing a white root rot (Stand opening disease, Whitney 1962) of living conifers, leading to the death of infected trees; a common temperate species.

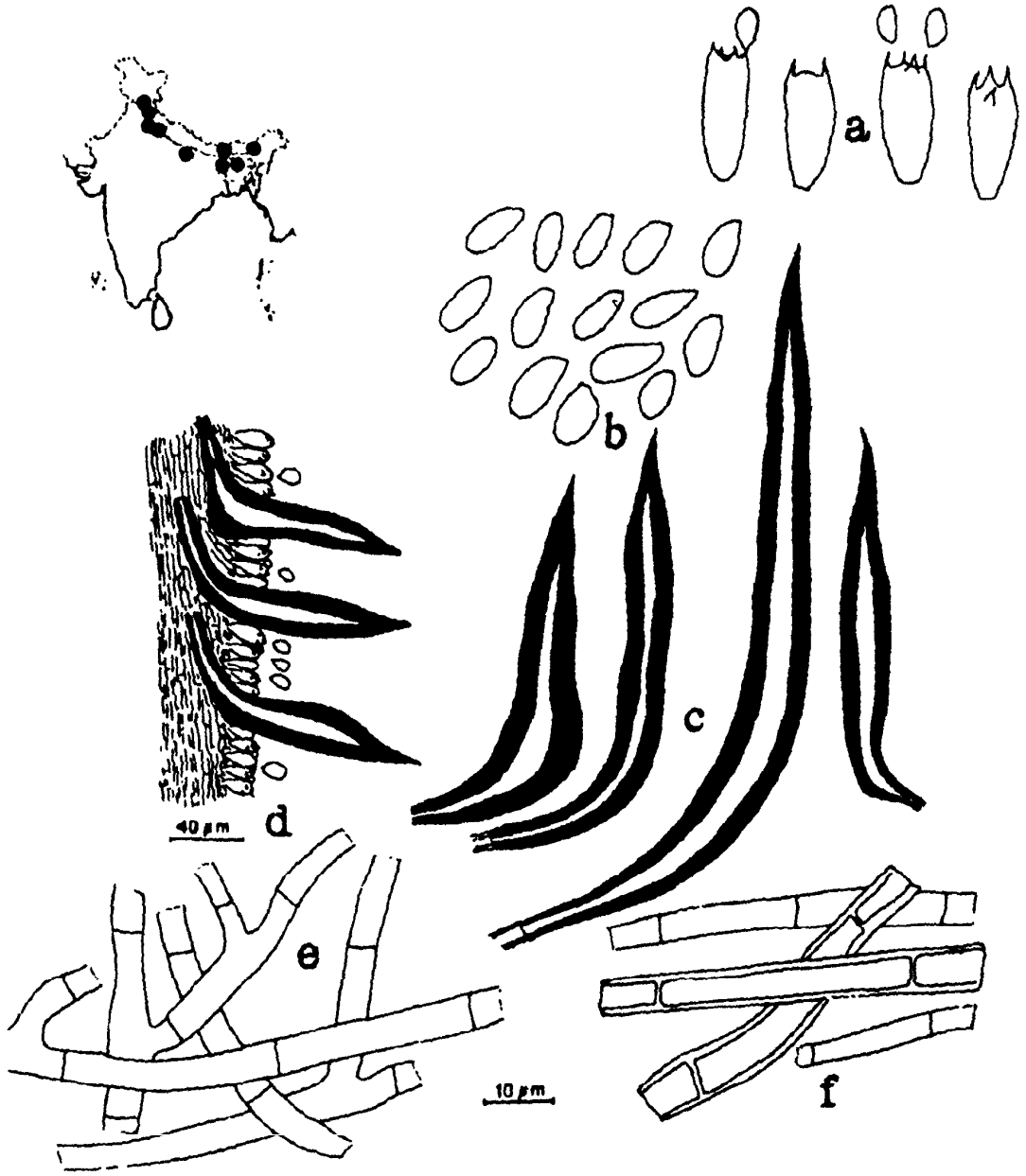


Fig. 45. *Inonotus tomentosus* (JRS 63180) a. basidia, b. spores, c. setae, d. section through tube, e. tramal hyphae, f. contextual hyphae.

Remarks

The large number of basidiocarps developing usually from the common base and large hymenial setae with straight tips make this species distinct and also distinguish it from the closely related *P. circinatus* whose basidiocarps usually grow single with hymenial setae having curved tips.

PHELLINUS Quel.
Ench. Fung. p. 172, 1886.

Basidiocarps usually perennial; pileate to resupinate, sessile, single or imbricate, corky soft to woody hard; pilear surface velutinate-tomentose or becoming glabrous often with a black cuticle, frequently concentrically sulcate and radially cracked, yellowish brown to blackish brown to greyish black or black; margin rounded, obtuse to acute, mostly sterile below; pore surface ferruginous brown to dull brown; tubes usually stratified; pores 3-10 per mm, regular to rarely irregular; context thin to thick, dark reddish brown to yellowish brown, often with a thin crust-like black cuticle on upper side, zonate to azonate; hyphal system dimitic; generative hyphae hyaline, simple septate, branched; skeletal hyphae thick walled, golden to reddish brown; setal hyphae when present thick walled, golden to reddish black; hymenial setae and tramal setae present or absent; cystidia absent; cystidioles sometimes present; spores globose, subglobose, broadly ellipsoid to rarely cylindrical, hyaline or yellowish to brown, rarely dextrinoid, never amyloid; causing white rots of various kinds in live standing or dead angiospermous/gymnospermous woods; cosmopolitan genus occurring from tropical to sub-alpine forests; fifty two species in india; about 155 species in the world (Larsen and Cobb-poulle 1990).

Type species : *Phellinus torulosus* (Pers.) Bourd. & Galz.

KEY TO THE INDIAN SPECIES

1. Setal hyphae and/or tramal setae present 2
1. Setal hyphae and/or tramal setae absent 11

2. Hymenial setae present 3
2. Hymenial setae absent 10

3. Basidiocarps resupinate 4
3. Basidiocarps effused-reflexed to pileate 6

4. Contexual setal hyphae present; tramal setae absent; spores broadly ellipsoid **P. ferruginosus**
4. Contexual setal hyphae absent, tramal setae present; spores not broadly ellipsoid 5

5. Pores 2-4 per mm; spores oblong ellipsoid, 5-7 x 3-3.5 μm; tamal setae up to 150 μm long; hymenial setae not misshapen **P. contiguus**
5. Pores 5-6 per mm; spores globose to subglobose, 5-6.5 μm in diam; tramal setae up to 50 μm long; hymenial setae mishapen **P. conchatus**

6. Pilear surface persistent-velutinate; context duplex with intermittent dark layer; spores pale brown to rusty brown **P. portoricensis**
6. Pilear surface velutinate when young, glabrous with age; context homogeneous without an intermittent black layer; spores hyaline to pale yellow 7

7. Pores 3-4 per mm; context and tubes much different in colour; spores 7-8.5(9) μm in diam **P. hoehnelii**
7. Pores 5-10 per mm; context and tubes concolorous; spores up to 6.5 μm in diam 8

8. Tramal setae present; contexual setal hyphae absent; spores 5-6.5 μm in diam; in tropical to temperate forests **P. conchatus**
8. Tramal setae absent; contexual setal hyphae present; spores 4-5 μm in diam; in tropical forests 9

9. Basidiocarps effused-reflexed to applanate; setal hyphae with obtuse ends, up to 7 μm wide and not much different from the skeletal hyphae **P. lamaensis**
9. Basidiocarps ungulate to rarely applanate; setal hyphae with acute ends, up to 25 μm wide, much darker and thicker than the skeletal hyphae **P. pachyphloeus**

10. Basidiocarps effused-reflexed to subapplanate; setal hyphae with obtuse ends, running all along the dissepiments and frequently projecting into the lumen of tubes **P. noxius**
10. Basidiocarps ungulate; setal hyphae with acute ends, running parallel in the middle of the dissepiments and usually not projecting into the lumen of the tubes **P. melanodermus**

11. Hymenial setae present 12
11. Hymenial setae absent 37

12. Basidiocarps resupinate 13
12. Basidiocarps pileate 20

13. Spores cylindrical, 6-7.5(8.5) x 2.5-3 μm, hyaline; temperate species **P. ferreus**
13. Spores globose to broadly ellipsoid, usually up to 7.5 μm in diam., hyaline to coloured; tropical to temperate subalpine species 14

14. Spores golden to rusty brown; tropical species **P. carteri**
14. Spores hyaline to pale yellowish; tropical to temperate species 15

15. Hymenial setae up to 30 μm long 16
15. Hymenial setae up to 50 μm long 19

16. Spores 6-7 (7.5) x 5-6.5 μm, strongly dextrinoid **P. punctatus**
16. Spores up to 5 μm in diameter, nondextrinoid 17

17. On *Betula utilis* only **P. laevigatus**
17. On other hosts in tropical zones 18

18. Pore surface reddish brown; pores receding and margin up to 10 mm wide; hymenial setae abundant, 12-18 μm long; spores 2.5-4 x 2-2.5 μm **P. ferrugineo-velutinus**
18. Pore surface pale yellowish brown; pores not receding and margin up to 2 mm wide; hymenial setae rare, 18-28 μm long; spores 3.5-5 x 3-3.5 μm **P. glaucescens**

19. Pore surface purplish brown; pores 6-7 per mm; spores 3.5-4.5 x 3-3.5 μm **P. purpureogilvus**
19. Pore surface pale yellowish brown; pores 4-6 per mm; spores 4-5 x 2-3 μm **P. cereus**

20. Hymenial setae 12-25 μm 21
20. Hymenial setae 30-90 μm 25

21. Species occurring from temperate zones to tree line in the Himalayas; pilear surface glabrous, crusty and deeply cracked 22
21. Species occurring in tropical zones; pilear surface persistently tomentose to glabrous, crusty and weakly rimose 23

22. Basidiocarps mostly effused-reflexed with pilear surface black; margin acute; always on *Betula utilis* **P. nigricans**

22. Basidiocarps pileate to rarely effused-reflexed with pilear surface greyish to reddish black; margin obtuse; on other angiospermous hosts **P. igniarius**

23. Spores hyaline . . **P. rhabarbarinus**
23. Spores pale to rusty brown 24

24. Basidiocarps pendent with a distinct tapering base; not persistently tomentose, with irregular black crust becoming rimose with age **P. dependens**
24. Basidiocarps applanate to subungulate, persistently tomentose with a smooth black crust underneath **P. extensus**

25. Spores up to 8.5(9) μm in the longest dimensions 26
25. Spores up to 6 μm in the longest dimensions 29

26. Spores 6-8.5 (9) x 2.5-3 μm, oblong ellipsoid to cylindrical, hyaline . . . . . **P. cinchonensis**
26. Spores globose to subglobose, hyaline to yellowish or pale brownish 27

27. Spores strongly dextrinoid in Melzer's **P. robustus**
27. Spores negative in Melzer's . 28

28. Known mostly on species of *Pinus*, less frequently on other coniferous hosts in temperate forests; pores sinuous to daedaleoid, 2-4 per mm; hymenial setae straight **P. pini**
28. Known on dead angiospermous hosts, mostly from tropical zones; never on conifers; pores round and regular, 5-7 per mm; hymenial setae straight or with curved tipes **P. setulosus**

29. Hymenial setae frequently hooked or curved . . **P. wahlbergii**
29. Hymenial setae straight 30

30. Spores rusty brown 31
30. Spores hyaline to pale yellowish 32

31. Basidiocarps effused-reflexed; spores 3.5-4 x 2.5-3 μm **P. johnsonianus**
31. Basidiocarps applanate to ungulate; spores 4.5-5 (5.5) x 3.5-4.5 μm **P. linteus**

32. Hymenial setae up to 35(-40) μm long 33
32. Hymenial setae up to 70(-90) μm long 35

33. Pileus hispid to scrupose or radiate-striate to glabrous with irregular warts or protuberances near the base **P. gilvus**
33. Pileus glabrous to persistently tomentose 34

34. Basidiocarps usually applanate, persistent-velutinate in narrow concentric zones; spores 4-5.5 μm long; tropical species **P. senex**
34. Basidiocarps usually ungulate, soon glabrous, rough due to excessive cracking from the base; spores 3-4(4.5) μm long; temperate species . **P. sanfordii**

35. Basidiocarps bright yellow to chestnut brown; pores 4-5 per mm; hymenial setae 40-70 (-90) μm long; only on Oaks in temperate forests **P. xeranticus**
35. Basidiocarps reddish to greyish black; pores 6-8 per mm; hymenial setae 28-50 μm long; on dead angiospermous/coniferous woods in tropical to temperate forests 36

36. Hymenial setae 5-9 μm wide; pileus persistently tomentose to adpressed hispid; pore surface purplish red to reddish brown with age. **P. torulosus**
36. Hymenial setae 8-15 μm wide; pileus finely tomentose, soon glabrous; pore surface yellowish to dark brown with age . **P. inamaenus**

37. Basidiocarps resupinate 38
37. Basidiocarps pileate 40

38. Pores 7-9 per mm; basidiocarps resinous hard and heavy on drying **P. allardii**
38. Pores 4-6 per mm; basidiocarps hard, brittle, light in weight on drying 39

39. Spores golden brown, 4-5 x 3.5-4 μm **P. melleoporus**
39. Spores reddish to rusty brown, 4.5-6 (6.5) x 4-5 μm **P. inermis**

40. Spores up to 3.5 (-4) μm in longest dimensions. . . 41
40. Spores up to 7(-7.5) μm in the longest dimensions 42

41. Basidiocarps pileate, applanate, up to 20 cm broad and wide; pore surface yellowish or golden brown, receding; spores hyaline to pale yellowish **P. pectinatus**
41. Basidiocarps effused-reflexed, up to 6 cm broad and wide; pore surface rusty to greyish brown, not receding; spores golden to rusty brown **P. caryophyllii**

42. Spores cylindrical to oblong ellipsoid, hyaline **P. discipes**
42. Spores globose to subglobose or rarely broadly ellipsoid 43

43. Spores hyaline to pale golden brown 44
43. Spores rusty brown 45

44. Pilear surface cracking radially and concentrically at maturity; tubes indistinctly stratified; pores 7-9 per mm; spores 5-6.5 μm, globose to drop-shaped **P. adamantinus**
44. Pilear surface smooth or weakly rimose; tubes distinctly stratified; pores 4-6 per mm; spores broadly ellipsoid to subglobose **P. grenadensis**

45. Spores olivaceous brown in KOH **P. sublinteus**
45. Spores dark brown to reddish brown in KOH 46

46. Basidiocarps pendent to subpendent; species occurring from temperate zone to tree-line in the Himalayas 47
46. Basidiocarps not pendent; species tropical 48

47. Basidiocarps pendent, hard, brittle and light in weight on drying; always on *Rhododendrons* near tree line **P. acontextus**
47. Basidiocarps subpendent to dimidiate with a contracted base, dense, hard and heavy on drying; mostly on Oaks in temperate forests **P. allardii**

48. Spores up to 7-7.5 μm long 49
48. Spores up to 6 μm long 50

49. Pilear surface glabrous, rimose with age; context with a reddish black core at base; skeletal hyphae up to 5 μm wide; usually parasitic on leguminaceous trees **P. badius**
49. Pilear surface glabrous, deeply cracked radially and concentrically forming polygon-like woody scales; granular core absent; skeletal hyphae up to 8 μm wide; on other hosts **P. rimosus**

50. Pores 4-5 per mm **P. merrillii**
50. Pores 7-10 per mm 51

51. Pilear surface persistently velutinate-tomentose, remaining so or becoming glabrous from base **P. fastuosus**

51. Pilear surface not as above 52

52. Skeletal hyphae up to 4 μm wide; pilear surface becoming rough, woody-scaly; spores 5-6 x 4.5-5 μm **P. robiniae**
52. Skeletal hyphae up to 8 μm wide; pilear surface smooth to weakly rimose; spores smaller 53

53. Spores 4.5-5.5 x 4-4.5 μm; pilear surface smooth; on dead angiospermous woods; tropical to temperate forests **P. nilgheriensis**
53. Spores 3.5-4.5 (5) x 3.5-4 μm; pilear surface nodulose, usually parasitic on species of *Swietenia, Mimusops* and *Casuarina*; in tropical forests . . **P. durissimus**

Phellinus acontextus Ryv. **Fig. 46**
In Hjort. et Ryv., Mycotaxon 20 : 147, 1984.

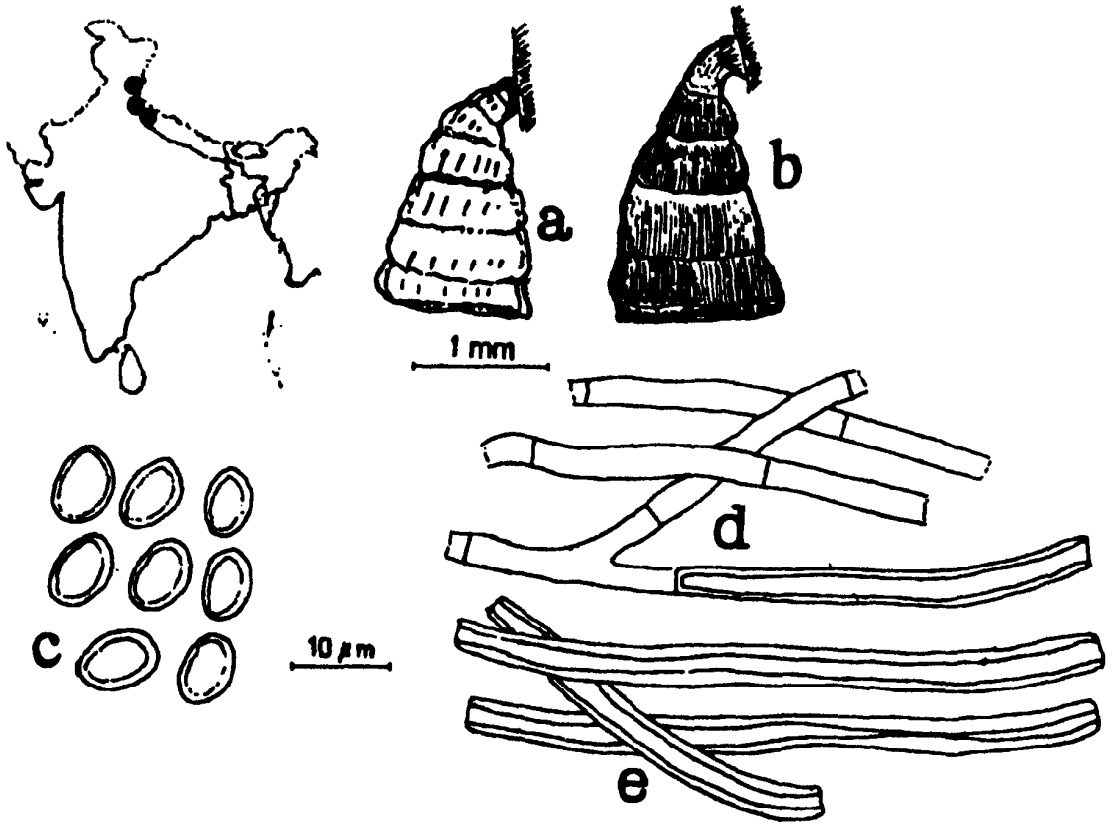


Fig. 46. ***Phellinus acontextus*** **(JRS 485) a. basidiocarp, b. section through basidiocarp, c. spores, d. generative hyphae, e. skeletal hyphae.**

Basidiocarps perennial, pendent, ungulate, up to 8 cm high and 6 cm wide and broad, irregular in section, coriaceous tough when fresh, hard, brittle and light in weight on drying, velutinate-tomentose in narrow concentric zones with sharp ridges; upper surface reddish brown, soon reddish black to almost black near the base, with a thin black cuticle, usually covered with mosses at base; margin sharp, narrow; pore surface depressed, yellowish brown soon rusty brown with age; tubes indistinctly stratified, up to 4 mm in each layer, totally up to 4 cm deep, reddish brown; pores 5-7 per mm, regular, dissepiments rather thick, oblique in certain specimens; context very thin, up to 1 mm thick, pale reddish brown.

Hyphal system dimitic; generative hyphae hyaline, simple sptate, 2-3 μm wide; skeletal hyphae thick walled, 2-5 μm wide, pale reddish or rusty brown; hymenical setae absent; basidia 7-9 x 4.5-6 μm, clavate; spores rusty brown, subglobose to ellipsoid, slightly thick walled, 5-6 (6.5) x 3.5-4 μm.

Habitat and Distribution

On living or dead tree trunks of Rhododendrons only; causing a white pocket rot with wood becoming lighter than the normal colour of unaffected wood; a rare species in the subalpine forests of Western Himalayas only.

Remarks

This species known earlier only from Nepal (loc. cit.) is very interesting in having pendant, ungulate basidiocarps with context lacking or very thin. Above all, it grows on Rhododendrons only and has been repeatedly collected from the subalpine zones of Western Himalayas. Further, the absence of hymenial setae and abundant, rusty brown and fairly larger ellipsoid spores are also characteristic. These features make it rather unique in the genus *Phellinus*.

Phellinus adamantinus (Berk.) Ryv. Fig. 47

Norw. J. Bot. 19: 234, 1972 - *Polyporus adamantinus* Berk., Hook., J. Bot. 6: 141, 1854; *Fomes adamantinus* (Berk.) Sacc., Saccardo 6: 204, 1888; *Pyrrhoderma adamantinum* (Berk.) Imaz., Trans. Mycol. Soc. Japan 7(1): 5, 1966.

Basidiocarps perennial, pileate, solitary, applanate, semicircular to usually dimidiate, up to 12 cm wide, 8 cm broad, 2 cm thick at base, woody hard; pileus glabrous, dark brown to greyish black, with a thick crust, uneven with rather wide, rounded and sulcate zones, cracking radially and concentrically with age;

margin thick, obtuse, pale yellowish brown; pore surface greyish to deep brown; tubes indistinctly stratified, dark greyish brown; pores small, 7-9 per mm; context up to 5 mm thick, dark yellowish brown, shiny with a lustre, limited on upper surface by a black line, hard and rigid on drying with radial white strands in the lower part.

Hyphal system dimitic; generative hyphae simple septate, 1-3 μm wide; skeletal hyphae thick walled, pale yellow to rusty brown, 3-6 μm wide; hymenial setae none; spores globose to drop shaped, thin walled to slightly thick walled, hyaline to pale yellow, 5-6.5 μm in diameter.

Habitat and Distribution

Both on dead and living deciduous woods, causing a white rot; cosmopolitan species occurring from tropical to temperate forests.

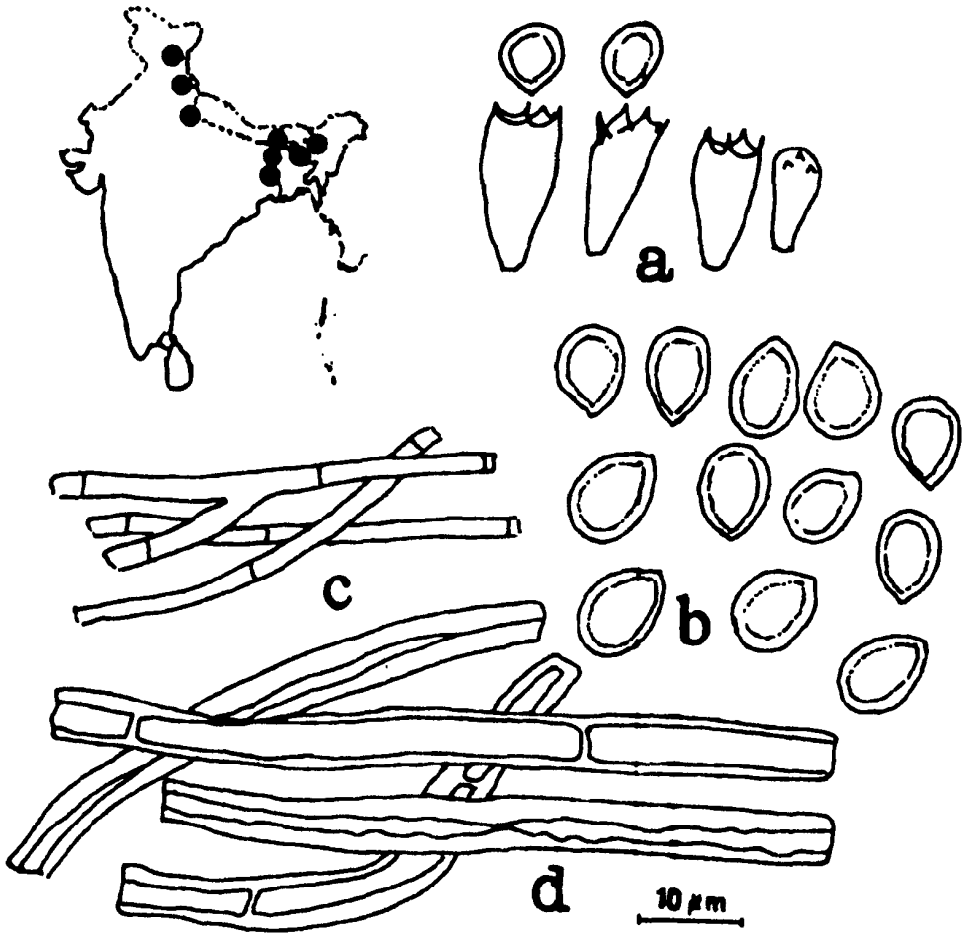


Fig. 47. *Phellinus adamantinus* (JRS 58908) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae.

Remarks

The glabrous, black crust, which cracks both longitudinally and radially, yellowish brown context with a lustre and the globose to drop shaped spores are distinctive features of this species. For differences with *Pyrrhoderma sendaiense* (Yas.) Imaz., please see under *Pyrrhoderma*.

Phellinus allardii (Bres.) Ahmad Fig. 48

Monogr. Biol. Soc. Pakistan 6: 57, 1972 - *Fomes allardii* Bres., Bull. Jard. Bot. Bruxell. 4: 19, 1910.

Basidiocarps perennial, usually imbricate, pileate and then more or less triquetrous in section and with sharp and undulating margin, broadly attached and elongated to semicircular to subpendant and dimidiate with a contracted base, frequently subresupinate with a steep margin and thickened in the central part, up to 20 cm wide, 10 cm broad and 4 cm thick, consistency very hard, dense, heavy; pilear surface narrowly sulcate with numerous narrow ridges and zones, first deep reddish brown and covered with a tomentum under which there is a distinct black line, with age this tomentum falls off and exposes a black crusty surface which soon cracks up

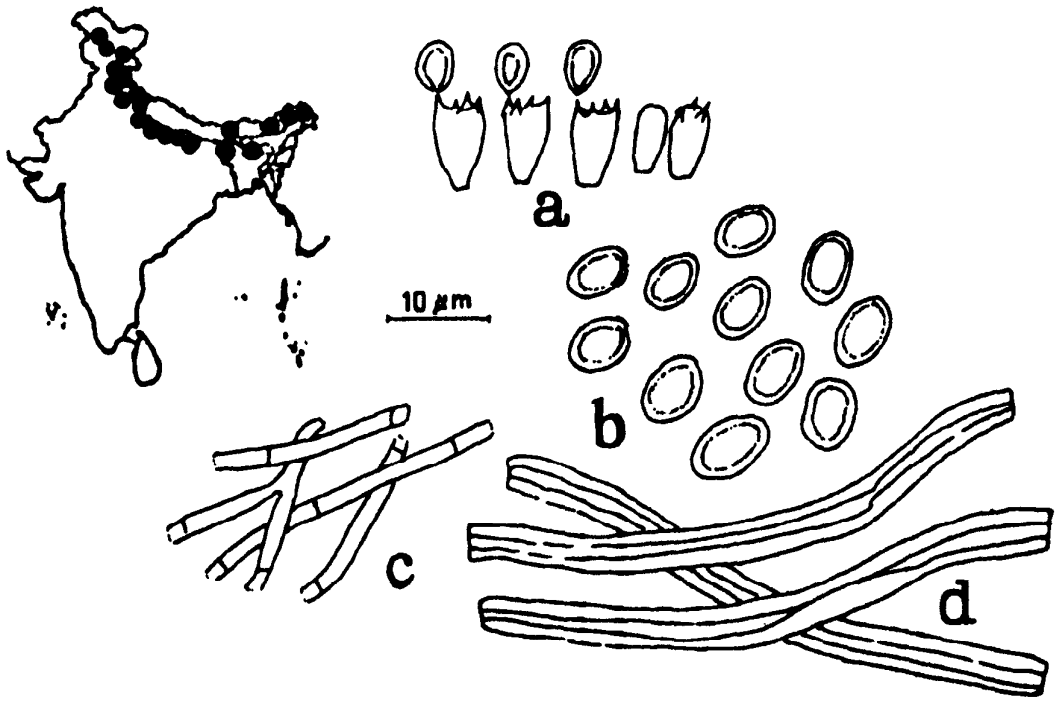


Fig. 48. *Phellinus allardii* (JRS 423) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae.

both radially and concentrically; margin sharp, undulating, velvety; pore surface yellowish brown when young, fulvous to umber brown in old basidiocarps, glancing when turned in incident light; tubes umber brown, distinctly stratified with many close layers, up to 1 mm deep in each layer, often filled up with white lint-like material; pores 7-9 per mm; context reddish brown to umber brown, very thin, sometimes almost absent and only a black zone may be observed on the top of tubes.

Hyphal system dimitic; generative hyphae thin walled, simple septate, 1.5-2 μm wide; skeletal hyphae thick walled, golden brown to rusty brown, 2-3.5 μm wide; hymenial setae none; basidia 7-8 x 4-5 μm; 4-sterigmate; spores normally abundantly present, broadly ellipsoid, pale rusty brown at maturity, thick walled, 5.5 (6) x 4-5 μm, IKI-.

Habitat and Distribution

Widely spread, particularly in the temperate forests and is one of the most common polypores on the roots, stumps and bases of tree trunks of Indian oaks in Eastern and Western Himalayas, causing white stringy rot.

Remarks

Though *P. allardii* is a variable species with regard to the form and size of fruit body yet the habitat and black line below the tomentum together with the fairly heavy weight of basidiocarps are good field characters. Microscopically, the abundantly present coloured spores and lack of setae are characteristic. The presence of many layered tubes and larger spores separate it from the closely related *P. caryophyllii* which is confined to tropical zones only.

Phellinus badius (Berk.: Cke.) Cunn. Fig. 49
New Zealand Dept. Sci. Ind. Res. Bull. 164: 233, 1965-*Polyporus badius* Berk., Ann. Mag. Nat. Hist. 7: 453, 1841. (Nom. illeg., non. *P. badius* (Pers.) Schw. 1821); *Fomes badius* Berk. : Cke.,,Grevillea 14 : 18, 1885.

Basidiocarps perennial, sessile, hoof-shaped to ungulate or appearing somewhat pendent, easily detachable from the host, up to 10 cm broad, 8 cm broad and 2 cm thick, hard woody; pilear surface yellowish brown when young, soon brownish black, glabrous, weakly zonate, rimose, crust up to 0.2 mm thick; margin obtuse, paler than the pilear surface, sterile; pore surface dark brown to reddish brown, glancing; tubes ferruginous brown, paler than pore surface, stratified distinctly, up to 3 mm deep in each layer; pores 4-6 per mm, angular,

pore walls thick; context bright, lustrous, yellowish brown, corky when fresh, hard on drying, up to 1.5 cm thick, faintly zonate, granular core of dull yellowish brown mycelium with patches of white mycelium and dark reddish brown, hard glossy granules scattered throughout.

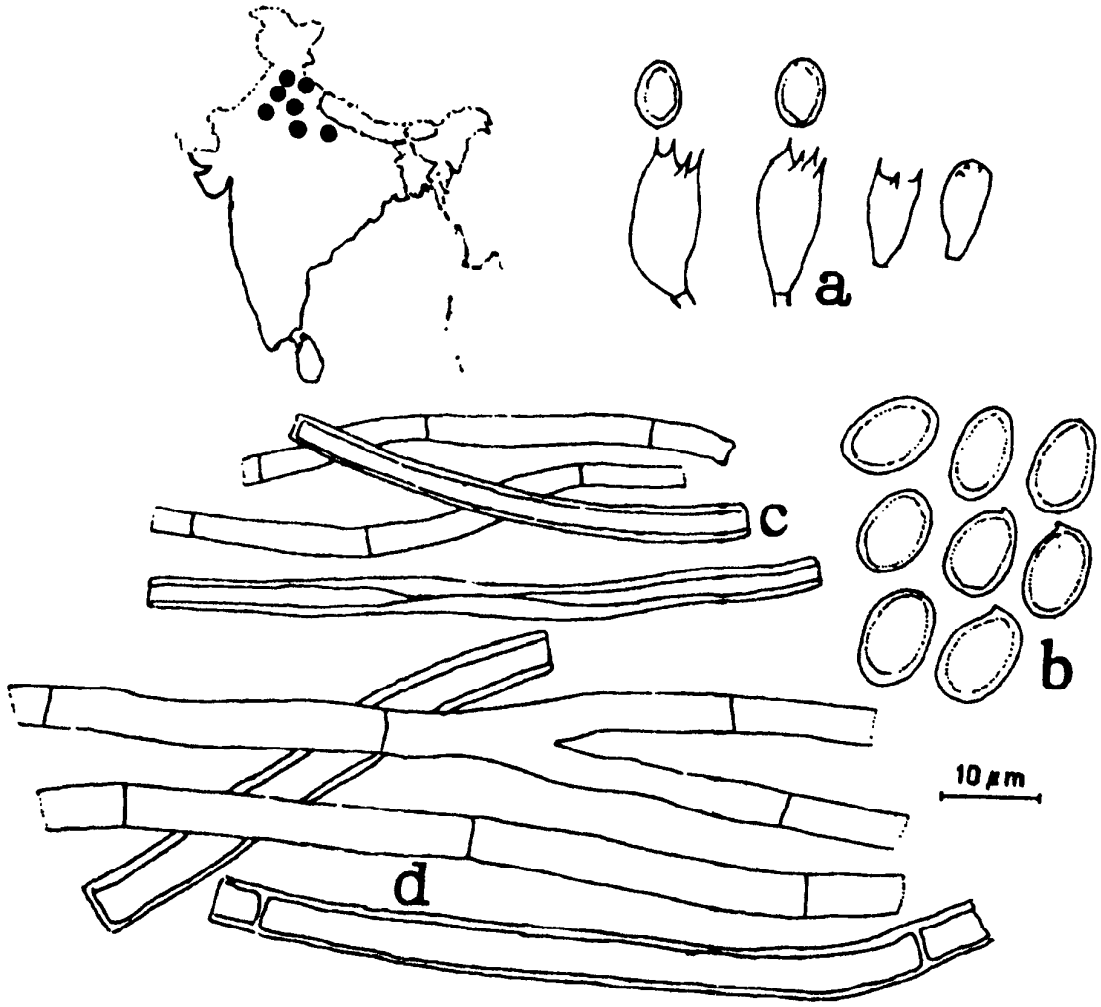


Fig. 49. *Phellinus badius* (JRS 771) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae.

Hyphal system dimitic; generative hyphae hyaline to pale yellow, simple septate, moderately branched, 3-4 µm wide; skeletal hyphae thick walled, 4-5 µm wide; hymenial setae absent or very rarely present in older specimens, ventricose, 15-25 x 4-8 µm, dark reddish brown; basidia broadly clavate, 12-14 x 6-7 µm, 4-sterigmate; spores broadly ellipsoid to subglobose, moderately thick walled, 6.5-7.5 (8) x 6-6.5 µm, yellowish brown, dark reddish brown in KOH.

Habitat and Distribution

A common and a serious parasite on *Acacia catechu* Wild., less oftenly also found on *Acacia arabica* Willd., *Albizzia* sp. and other living leguminaceous trees;

causing a white rot of heartwood; widely distributed in the tropical to subtropical forests of India.

Remarks

The ungulate basidiocarps, their occurrence primarily on leguminous trees, golden brown lustrous context with a granular core. absence of setae and large subglobose, coloured spores are the features which help in its easy identification.

Phellinus carteri (Cke.) Ryv. Fig. 50
Norw. J. Bot. 19: 234, 1972- *Poria carteri* Cke., Grevillea 15: 25, 1886.

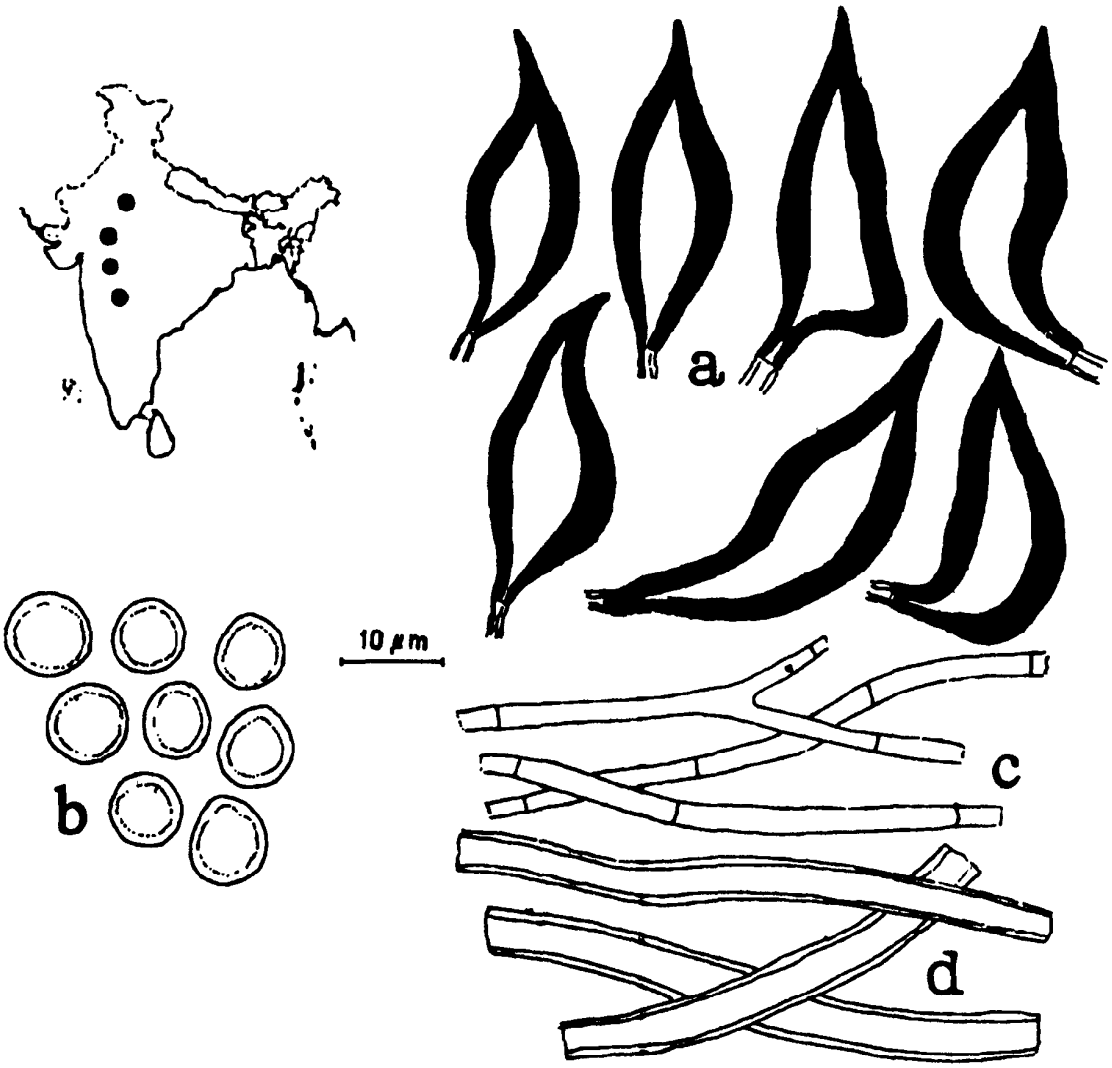


Fig. 50. ***Phellinus carteri*** **(JRS 63129) a. setae, b. spores, c. generative hyphae, d. skeletal hyphae.**

Basidiocarps perennial, resupinate, effused, woody hard on drying, up to 7 mm thick; margin narrow and finely velutinate; pore surface dark brown to reddish brown; tubes concolorous with pore surface, up to 4 mm deep in each layer, indistinctly stratified; pores round, small, 7-9 per mm; context thin, up to 1 mm thick, fulvous to deep brown.

Hyphal system dimitic; generative hyphae hyaline, simple septate, 2-3 μm wide; skeletal hyphae yellow to rusty brown, 2-5 μm wide, thick walled; hymenial setae 20-28 (-35) μm x 8-10 μm, thick walled, dark brown, subventricose; spores globose, 4.5-6 (6.5) μm in diameter, golden brown to rusty brown, difficult to find in old collections.

Habitat and Distribution

On dead angiosperms, causing white rot, a rare tropical species.

Remarks

The species is easily recognised by its resupinate basidiocarps, large, globose and rusty brown spores.

Phellinus caryophyllii (Racib.) Cunn. Fig. 51

New Zealand Dept. Sci. Ind. Res. bull. 164: 238, 1965- *Trametes caryophyllii* Racib., Paras. Algen Pilze Javas III, p. 17, 1900; *Fomes caryophyllii* (Racib.) Bres. Ann. Mycol. 10: 498, 1912.

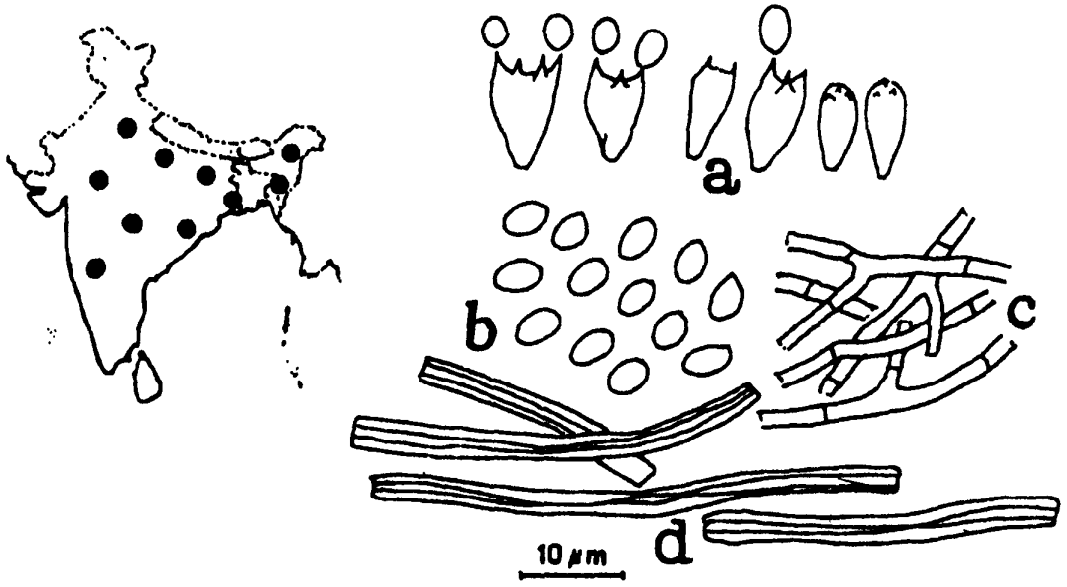


Fig. 51. *Phellinus caryophyllii* (JRS 463) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae.

Basidiocarps annual to perennial, resupinate to effused-reflexed, applanate or subungulate, semicircular, broadly attached, up to 4 cm wide and long and 1.5 cm thick at base, woody hard; pilear surface first velvety, ferruginous to rusty brown in concentric narrow zones, soon glabrous with a distinct black crust becoming sulcate with numerous narrow zones in sharp edges; pore surface rusty brown to greyish brown, with a sterile reddish brown border; tubes dark brown, indistinctly stratified, up to 1 mm deep in each layer; context concolorous with tubes, limited on the upper surface by a black crust, up to 2 mm thick.

Hyphal system dimitic; generative hyphae hyaline, simple septate, 1.5-2.5 μm wide; skeletal hyphae golden brown to pale rusty brown, up to 2 μm wide, thick walled; hymenial setae none; basidia 10-14 x 5-7 μm, subclavate, 2-4 spores; spores ellipsoid, golden to pale rusty brown, 3-4 x 2.5-3 μm.

Habitat and Distribution

A common and a serious sap and heart rot parasite on many deciduous trees (Bakshi 1957, Bakshi *et al* 1963, Bagchee 1961), in the tropical forests; causing a white rot.

Remarks

Smaller spores and absence of many layered tubes separate this species from *P. allardii* to which otherwise it is closely related.

Phellinus cereus (Berk.) Ryv. Fig. 52

Norw. J. Bot. 19: 234, 1972 - *Polyporus cereus* Berk., Hook. J. Kew Misc. 6: 163, 1854.

Basidiocarps annual to perennial, resupinate, widely effused, not separable, up to 2 mm thick; margin variable, thinning to more or less abrupt, yellowish brown, paler than pore surface; pore surface yellowish brown to brown, uneven; tubes usually not stratified, brown, up to 2 mm deep; pores round to oval, 4-6 per mm, dissepiments thin, finely velutinate; context yellowish brown, fibrous, thin, homogeneous.

Hyphal system dimitic; generative hyphae hyaline to pale yellow, 2.5-3 μm wide, branched, simple septate; skeletal hyphae thick walled, golden to dark brown 2.5-5.5 μm wide; hymenial setae dark brown, subulate, thick walled, straight, apices pointed, 35-50 x 7-10 μm, abundant; basidia clavate 9-12.5 x 5-5.5 μm, 4-sterigmate spores hyaline, thin walled, smooth, ellipsoid 4-5 x 2-3 μm.

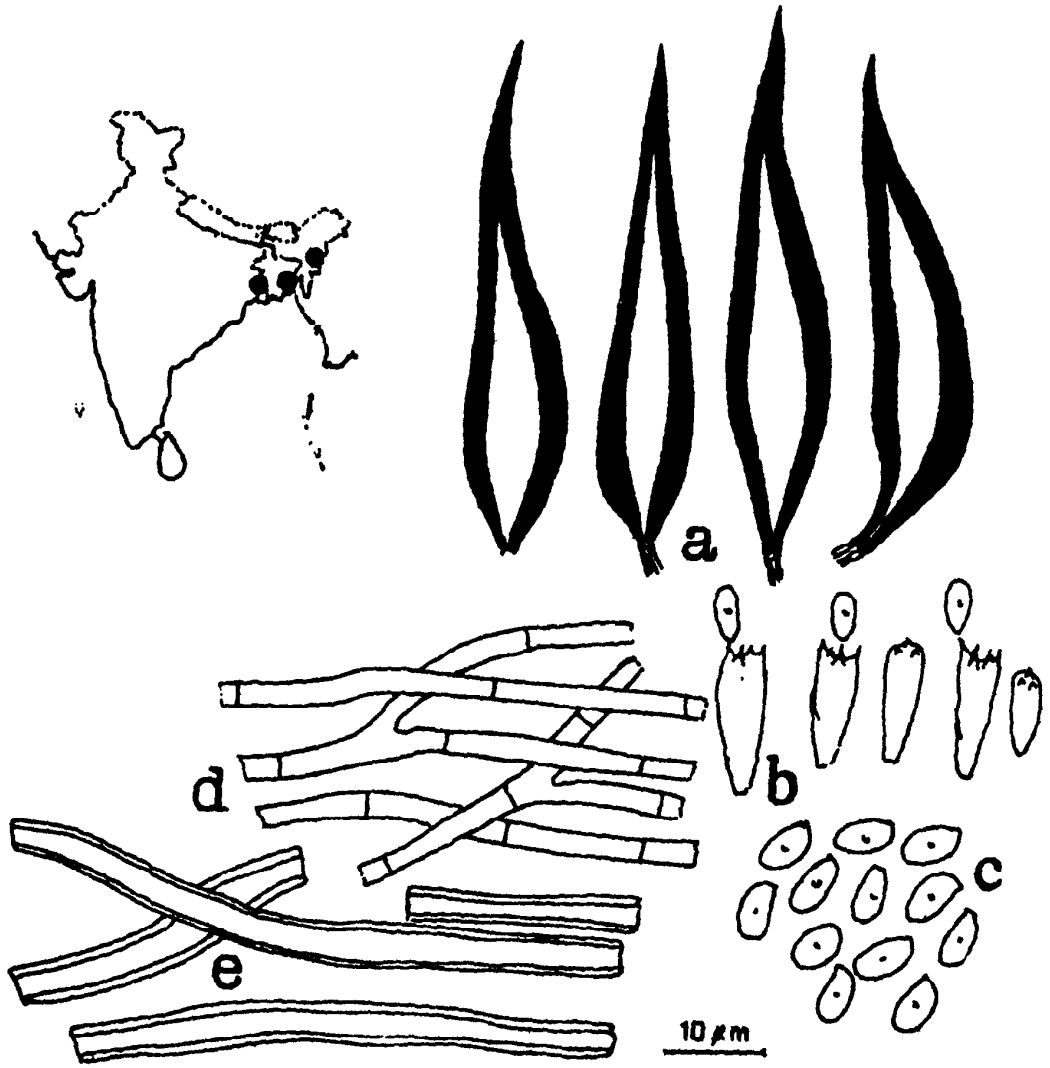


Fig. 52. *Phellinus cereus* (JRS 58669) a. setae, b. basidia, c. spores, d. generative hyphae, e. skeletal hyphae.

Habitat and Distribution

On dead angiospermous woods, causing white rot, rare tropical species.

Remarks

Larger pores and abundant subulate setae are the characteristic features of this species.

Phellinus cinchonensis (Murr.) Ryv. Fig. 53

Norw. J. Bot. 19: 234, 1972 - *Pyropolyporus cinchonensis* Murr., Mycologia 2: 195, 1910; *Fomes cinchonensis* (Murr.) Sacc. & Trott., Syll. Fung. 21: 286, 1912.

Basidiocarps perennial, to sessile, imbricate, mostly broadly attached, semiapplanate to ungulate, up to 20 cm wide, 15 cm long and 4 cm thick at base, woody hard, light in weight; pilear surface reddish brown, finely velvety, soon glabrous, smooth or concentrically sulcate with some cracks, crust thin; margin narrow, rounded, velvety; pore surface golden to reddish brown; tubes concolorous with pore surface, fragile, up to 3 mm deep in each layer, distinctly stratified with a thin layer of context in between, sometimes filled with a white material in older specimens; Pores round, regular 5-7 per mm, dissepiments rather thick; context up to 3 cm thick, bright reddish brown, radially fibrous, limited on upper surface with a thin crust.

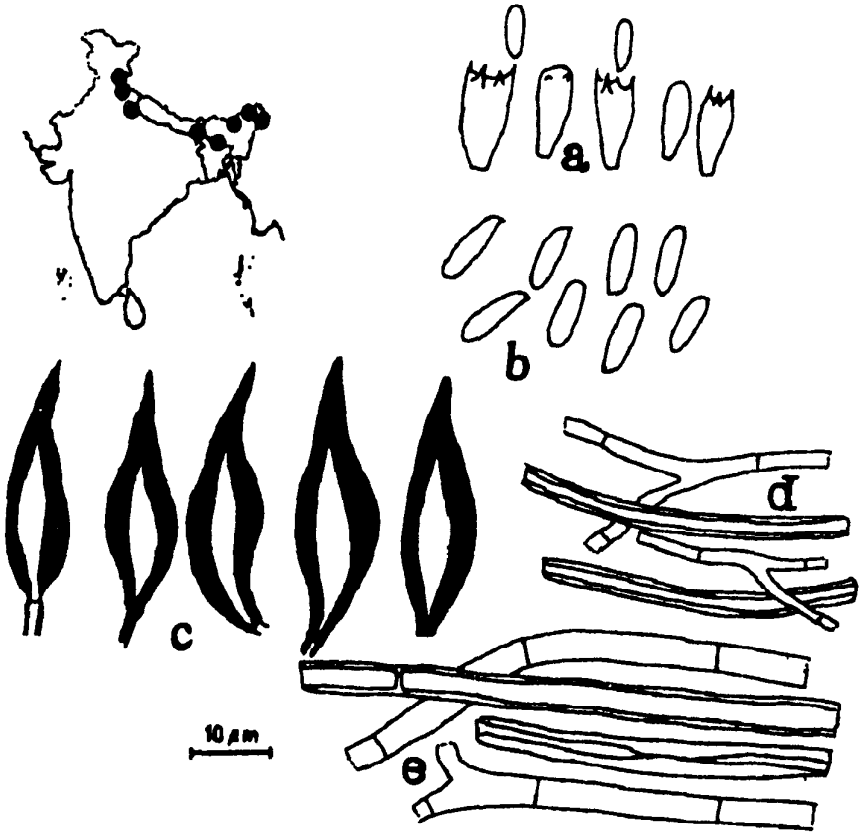


Fig. 53. *Phellinus cinchonensis* (JRS 6) a. basidia, b. spores, c. setae, d. contexual hyphae, e. tramal hyphae.

Hyphal system dimitic; generative hyphae thin walled, simple septate, 2-4 μm wide; skeletal hyphae pale to rusty brown, 3-5 μm wide; hymenial setae abundant, subulate, acuminate, thick walled, dark brown, 22-30 (35) x 4-8.5 (9) μm; basidia clavate, 8.5-11 x 5-6 μm; spores cylindrical to oblong ellipsoid, hyaline, thin walled, 6-8.5 (9) x 2.5-3 μm.

Habitat and Distribution

Grows on both dead and living angiosperms, causing a white rot; widely spread in temperate forests of Eastern and Western Himalayas.

Remarks

Semiapplanate to ungulate and glabrous basidiocarps together with hyaline, cylindrical spores make this species distinct.

Phellinus conchatus (Pers. : Fr.) Quel. Fig. 54

Ench. Fung. p. 173, 1886 - *Boletus conchatus* Pers., Obs. Mycol. 1: 24. 1796; *Polyporus conchatus* Pers.: Fr., Syst. Mycol. 1: 376. 1821; *Fomes conchatus* (Pers. : Fr.) Gill., Champ. France, p. 685, 1878.

Basidiocarps perennial, sessile, effused-reflexed to resupinate, solitary to often imbricate, semicircular, connate to convex, pileus up to 6 cm broad, 4 cm wide and 1 cm thick at base, woody hard; upper surface cinnamon brown, tomentose, with age becoming greyish brown to black, glabrous with a distinct thick crust in narrow, sharp sulcate zones, finely cracked radially, often covered with moss at base; margin rounded, wide to narrow yellowish brown; pore surface yellowish to cinnamon brown; pores 5-6 per mm; tubes sepia brown, indistinctly straitified, paler than the pore surface; context concolorous with the tubes, up to 5 mm thick with one or more black layers.

Hyphal system dimitic; generative hyphae thin walled, hyaline, septate, 1.5-2 μm wide; skeletal hyphae 2-3 μm wide, unbranched, thick walled; hymenial setae abundant, 30-60 x 5.12 μm, subulate to ventricose, dark reddish brown, misshaped with irregular or broken tops or sides; tramal setae present, up to 50 μm long and 3-6 μm wide, straight; basidia 8-15 x 4-7 μm, clavate; spores globose to subglobose, 5-6.5 x 4-5.5 μm, hyaline to pale brown, uniguttulate, IkI-.

Habitat and Distribution

Frequently on the dead branches of standing and living trees of *Salix* and *Pyrus pashia;* less common on the dead woods of *Mangifera indica; Cotoneaster*

becillaris Wall.: Lind.; *Mallotus philippinensis* (Lamk.) Muell.-Arg.; *Quercus incana* & *Q. semicarpifolia* Sm.; *Rhus parviflora* Roxb. & *R. punjabensis* J.L. Stew: Brand.; *Lyonia ovalifolia* (Wall.) Drude; *Toona ciliata* and rarely also on the species of *Viburnum*, *Populus* and *Betula;* causing a uniform white rot, and killing the branches and ultimately the entire trees; a common and widely spread species occurring from tropical to warmer temperate forests.

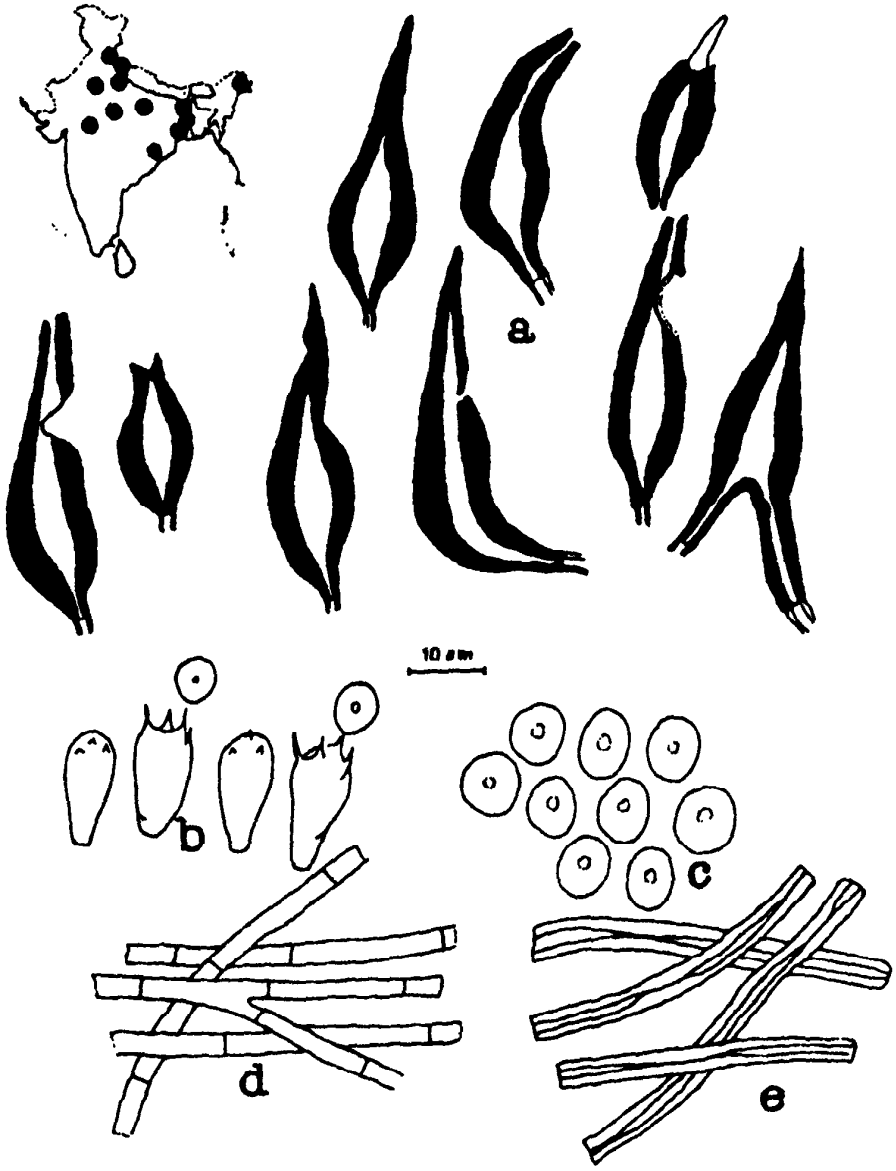


Fig. 54. *Phellinus conchatus* (JRS 513) a. setae, b. basidia, c. spores, d. generative hyphae, e. skeletal hyphae.

Remarks

This species shows a great variation in the form of its basidiocarps varying from resupinate to effused-reflexed or completely sessile. The most important characteristic is the misshapen hymenial setae. This together with the pale brownish, fairly larger spores and presence of tramal setae help in its easy recognition.

Phellinus contiguus (pers. : Fr.) Pat. Fig. 55

Essai Taxon., p. 97, 1900 - *Boletus contiguus* Pers., Synop. Meth. Fung., p. 544, 1801; *Polyporus contiguus* Pers.: Fr., Syst. Mycol. 1: 378, 1821; *Poria contigua* (Pers. : Fr.) Karst., Rev. Mycol. (Toulouse) 3 (9): 19, 1881.

Basidiocarps perennial, resupinate, up to 15 cm long, 5 cm wide and .5-1 cm thick, smooth and even or nodulose, adnate, spongy when fresh, hard and brittle on drying; margin narrow, rusty brown, faintly floccose; pore surface greyish brown to umber brown, often greyish and pruinose; pores angular, 2-4 per mm, sinuate to irregular on oblique surface; tubes indistinctly stratified, up to 10 mm deep, greyish white from inside; context up to 1 mm thick; spongy, soft fibrous, continuing unchanged into the trama.

Hyphal system dimitic; generative hyphae thin walled, hyaline, 2-3 μm wide; skeletal hyphae yellowish to rusty brown, straight, thick walled, 2-3 μm wide; tramal setae acute, tapering from the base, slightly swollen towards the tip, thick walled, more easily seen near the margin of fresh specimens, up to 150 μm long and 5-10 μm wide; hymenial setae abundant, subulate, thick walled, 40-70 x 5-7 μm often with a bent bulbous base; basidia 10-18 x 5-7 μm, ovate; spores 5-6.5 (7) x 3-3.5 μm, hyaline, oblong elliptoid to cylindrical, thin walled, IkI-.

Habitat and Distribution

Ond ead angiospermous or rarely on coniferous logs; causing a white rot; widely spread and common from tropical to temperate zones.

Remarks

This species is characterised by its resupinate basidiocarps, greyish white lining of tubes, larger subulate to subventricose hymenial setae, presence of tramal setae and oblong ellipsoid spores. It can easily be confused with *P. ferruginosus*

but that species has a floccose, setulose margin, setal hyphae in the context, no tramal setae in the tube trama, without greyish white lining, smaller pores (5-6 per mm), hymenial setae (25-45 x 5-8 μm) and spores (4-6 x 3-3.5 μm).

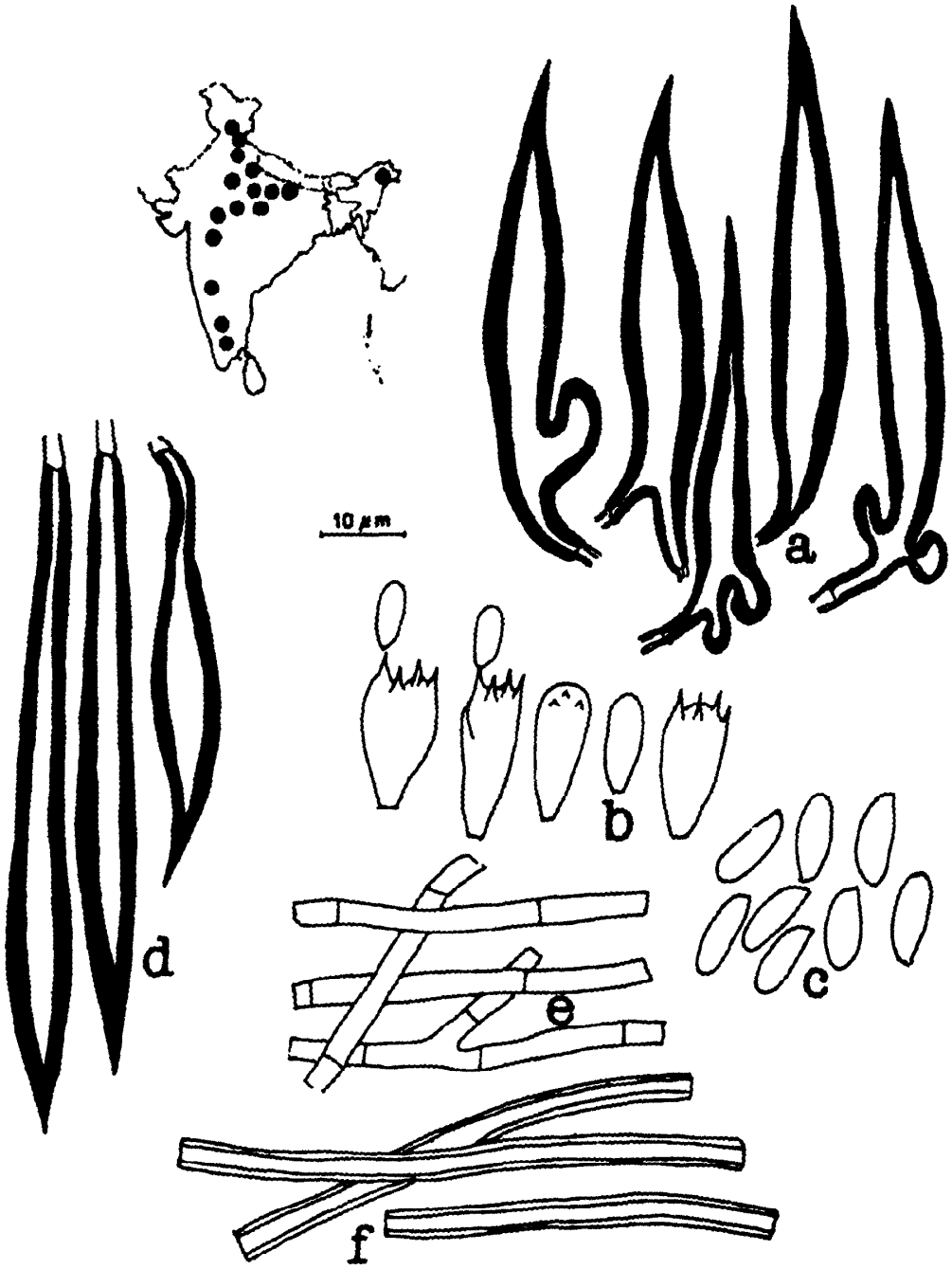


Fig. 55. *Phellinus contiguus* (JRS 27) a. hymenial setae, b. basidia, c. spores, d. tramal setae, e. generative hyphae, f. skeletal hyphae.

Phellinus dependens (Murr.) Imaz. Fig. 56
Bull. Govt. Forest Exp. Sta. 57: 117, 1952- *Pyropolyporus dependens* Murr., North Amer. Flora 9: 106, 1908; *Fomes dependens* (Murr.) Sacc. & Trott., Syll. Fung. 21: 292, 1912.

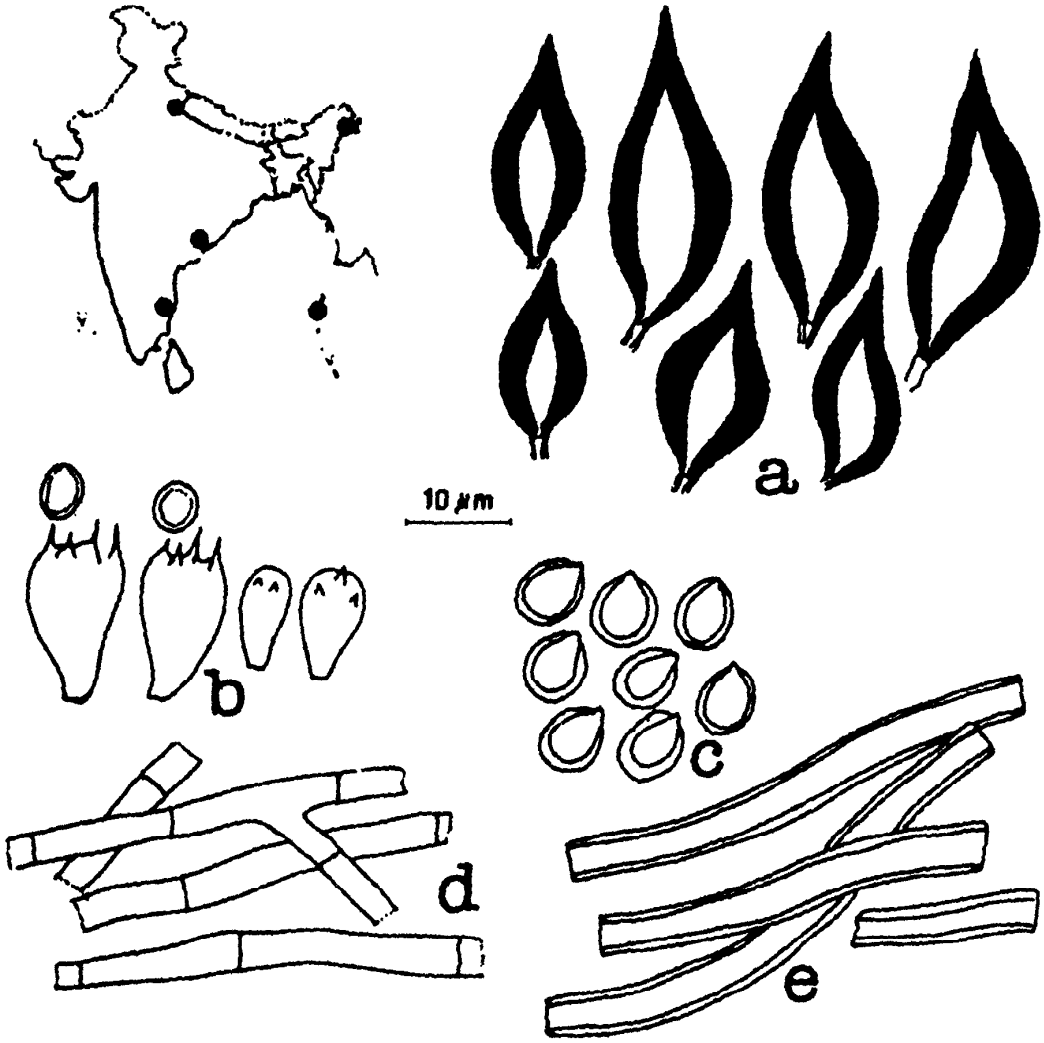


Fig. 56. *Phellinus dependens* (JRS 709) a. setae, b. basidia, c. spores, d. generative hyphae, e. skeletal hyphae.

Basidiocarps perennial, sessile to mostly pendant with a distinct tapering base, ungulate, up to 8 cm wide and long, 4 cm thick at base, woody hard and heavy; pileal surface finely tomentose when young, soon with an irregular, black crust, sulcate, cracked and rimose in older specimens; margin velvety, reddish to greyish brown, rounded and obtuse; pore surface reddish to umber brown with a

silky lustre; tubes concolorous with context, indistictly stratified, up to 3 mm deep near the base.

Hyphal system dimitic; generative hyphae thin walled, simple septate, 2-3.5 μm wide; skeletal hyphae thick walled, yellow to pale rusty brown, 3-4.5 μm wide; hymenial setae ventricose, straight, thick walled, apex acute, 15-22 x 6-8.5 μm; basidia broadly clavate, 4-sterigmate, 10-12 x 5-6 μm; spores subglobose, pale rusty brown, thick walled, 3.5-4.5 (5 μm) in diameter, IkI-.

Habitat and Distribution

On living trees of *Mallotus philippinensis, Schleichera oleosa* and also on dead angiospermous woods; causing white pocket rot; a rare species in the tropical forests.

Remarks

The pendent habit of growth, heavy basidiocarps irregular black crust on upper surface and smaller rusty brown spores are characteristics of this species. In the coloured spores and size of hymenial setae, it resembles *P. linteus* except for the larger spores (4.5-5.5 μm) in the latter. Also *P. linteus* is known to occur at high altitudes.

Phellinus discipes (Berk.) Ryv. Fig. 57

Kew Bull. 31: 88, 1976 - *Polyporus discipes* Berk., Hook.J. Bot. 6: 449, 1847; *Polystictus malaiensis* Cke., Grevillea 14: 13, 1885.

Basidiocarps annual to rarely perennial, substipitate, solitary or imbricate, pileate, narrowly attached with a short stipe, pilei flabelliform to spathulate, up to 6 cm broad and long and 5 mm thick, several pilei sometimes arising from the common base, coriaceous tough when fresh, hard and rigid on drying; upper surface reddish brown to rusty brown or deep cinnamon, concentrically zonate especially near the margin, sulcate, glabrous and glossy in older specimens, with age becoming wrinkled and thin-crustaceous, often covered with warts and pads spreading from the base towards margin; margin thin, entire or incised, usually bright or golden yellow below; sterile; pore surface greyish black to dark brown, darker than the pilear surface; tubes golden yellow, lighter than the pore surface and context, up to 3 mm deep; pores uniform round 5-7 per mm; context up to 3 mm thick, dark brown to golden brown, fibrous.

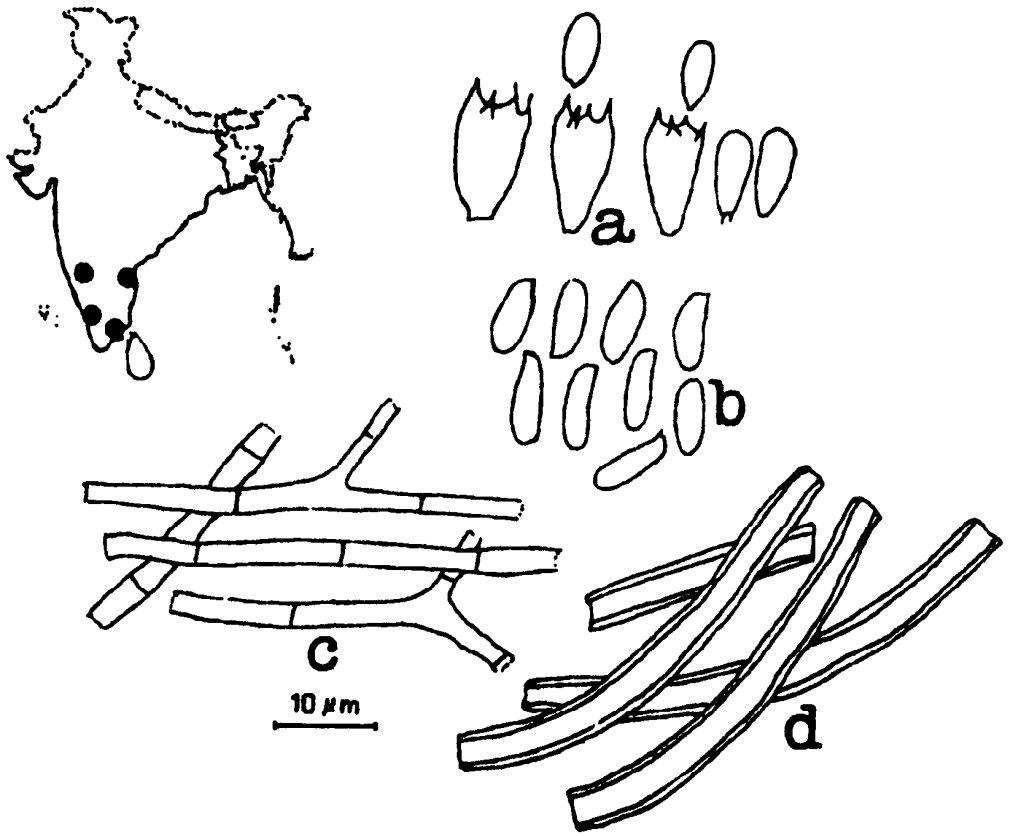


Fig. 57. *Phellinus discipes* (JRS 79) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae.

Hyphal system dimitic; generative hyphae hyaline to pale yellow, thin walled, 2-3 µm wide, branched; skeletal hyphae 3-5.5 µm wide, golden to cinnamon brown; thick walled; hymenial setae absent; basidia clavate, 10-12 x 5-6 µm; spores 4.5-6 x 2-3 µm, cylindrical to oblong ellipsoid, thin walled, hyaline, IkI-.

Habitat and Distribution

On dead angiospermous trees, causing white rot; rare in the tropical forests.

Remarks

Thin, annual basidiocarps with glabrous surface, often scattered with warts, absence of hymenial setae and cylindrical spores make this species easily recognisable. In the colour and warty nature it reminds of *P. gilvus* but is easily separated from the latter by its cylindrical spores and the absence of hymenial setae.

Phellinus durissimus (Llyod) Roy Fig. 58

Mycologia 71: 1006, 1979 - *Fomes durissimus* Llyod, Mycol. Writ. 6: 943, 1920.

Basidiocarps perennial, sessile, attached by a thick, broad base, solitary or imbricate, heavy, usually 10-18 cm broad, 8-10 cm wide and 3-6 cm thick at base, gradually thinning out towards margin; pilear surface soft, minutely tomentose when young, soon becoming glabrous and exposing a hard black crust, brown when young, black when old, zonate, usually nodulose with many knob-like projections, cracking when old; margin acute, sterile, yellowish pore surface dark yellowish brown, smooth or rough; tubes dark brown, stratified indistinctly, up to 4 mm deep in each layer; pores minute, invisible to naked eyes, round to angular, 7-10 per mm; pore walls thick; context yellow to yellowish brown, fibrous with a silky sheen, up to 3 cm thick.

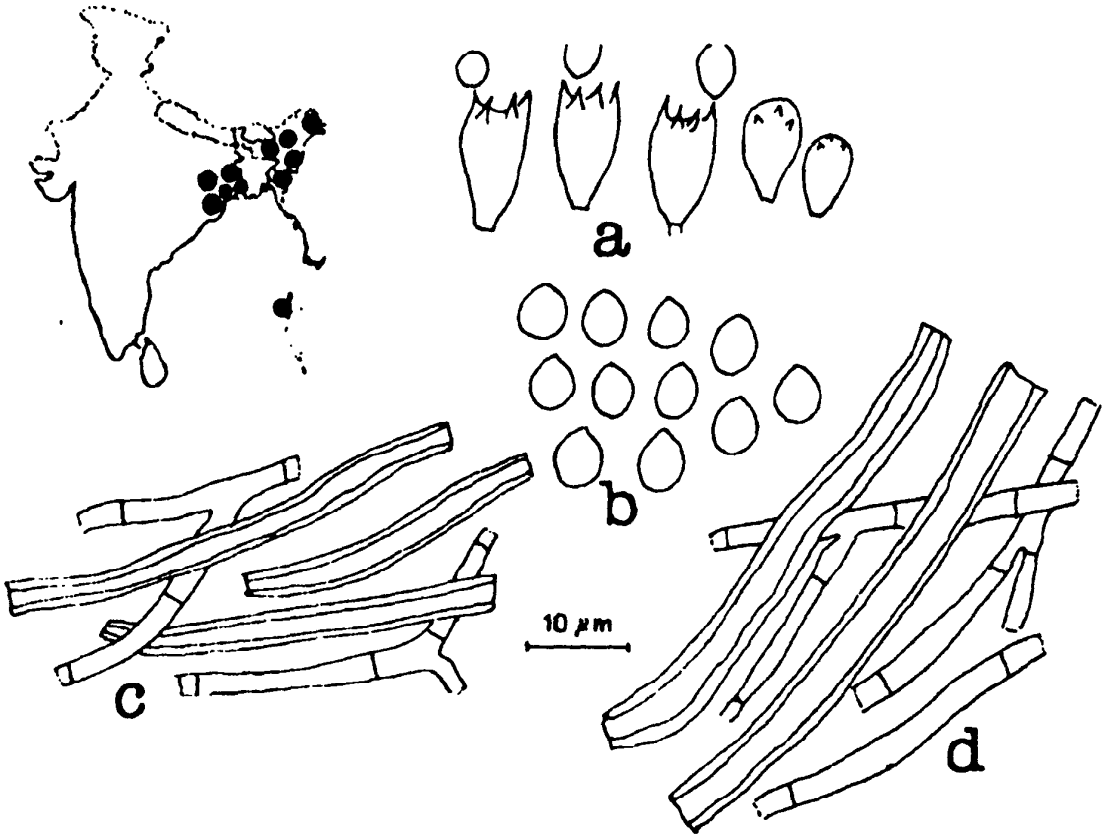


Fig. 58. *Phellinus durissimus* (JRS 58926) a. basidia, b. spores, c. contexual hyphae, d. tramal hyphae.

Hyphal system dimitic; generative hyphae hyaline to pale yellows, 2-3 µm wide, thin walled, branched; skeletal hyphae thick walled, 3-5.5 µm wide, up to

8 μm wide in the context, dark to yellowish brown; hymenial setae absent; basidia clavate, 12-15 x 4-7.5 μm; spores subglobose, thin walled, pale brown to distinctly brown, 3.5-4.5 (5) x 3.5-4 μm.

Habitat and Distribution

Mostly found as a parasite on hardwood trees especially *Swietenia mahogani* Jacq., *Casuarina equisetifolia* L: J.R. et G. Forst and *Mimusops elengi* L.; causing white pocket rot; widely spread species in tropical forests of India.

Remarks

This species is easily recognised in the field by its massive fruitbodies growing at the bases (ground level) of hosts, rough and black thick crusty pilear surface and obtuse thick margin. Microscopically smaller, subglobose spores and absence of hymenial setae are characteristic. It turns the infected wood yellow with distinct or indistinct pockets.

Phellinus extensus (Lev.) Pat. Fig. 59

Essai Taxon., p. 97, 1900 - *Polyporus extensus* Lev., Ann. Sci. Nat. Bot. 5: 129, 1846.

Basidiocarps perennial, usually solitary, sessile, pileate, broadly attached, dimidiate, conchate to applanate, up to 5 cm wide, 6 cm broad and 1 cm thick at base; pilear surface reddish brown to reddish black, adpressed tomentose when young, with a distinct black cuticle underneath, partly becoming glabrous in concentric zones in older specimens; margin entire, thin, acute to subobtuse, sterile, velvety, reddish brown; pore surface dark reddish brown; tubes up to 5 mm deep, indistinctly stratified; pores round and small, 7-10 per mm, dissepiments rather thick; context dark to reddish brown, limited on upper side by a thick black line, fibrous, shiny, up to 4 mm thick.

Hyphal system dimitic; generative hyphae hyaline to pale yellow, 3-6 μm wide darker and wider in context, moderately branched, simple septate; skeletal hyphae golden brown to dark brown, 4-6 μm wide; hymenial setae scattered to abundantly present, strongly ventticose, thick walled, dark brown, 15-20 x 5-9 μm, tips straight and acute; basidia broadly clavate, 9.5-12.5 x 5-7 μm, hyaline; spores globose, pale brown, slightly thick walled, 3.5-4 (4.5) μm in diameter, IkI-.

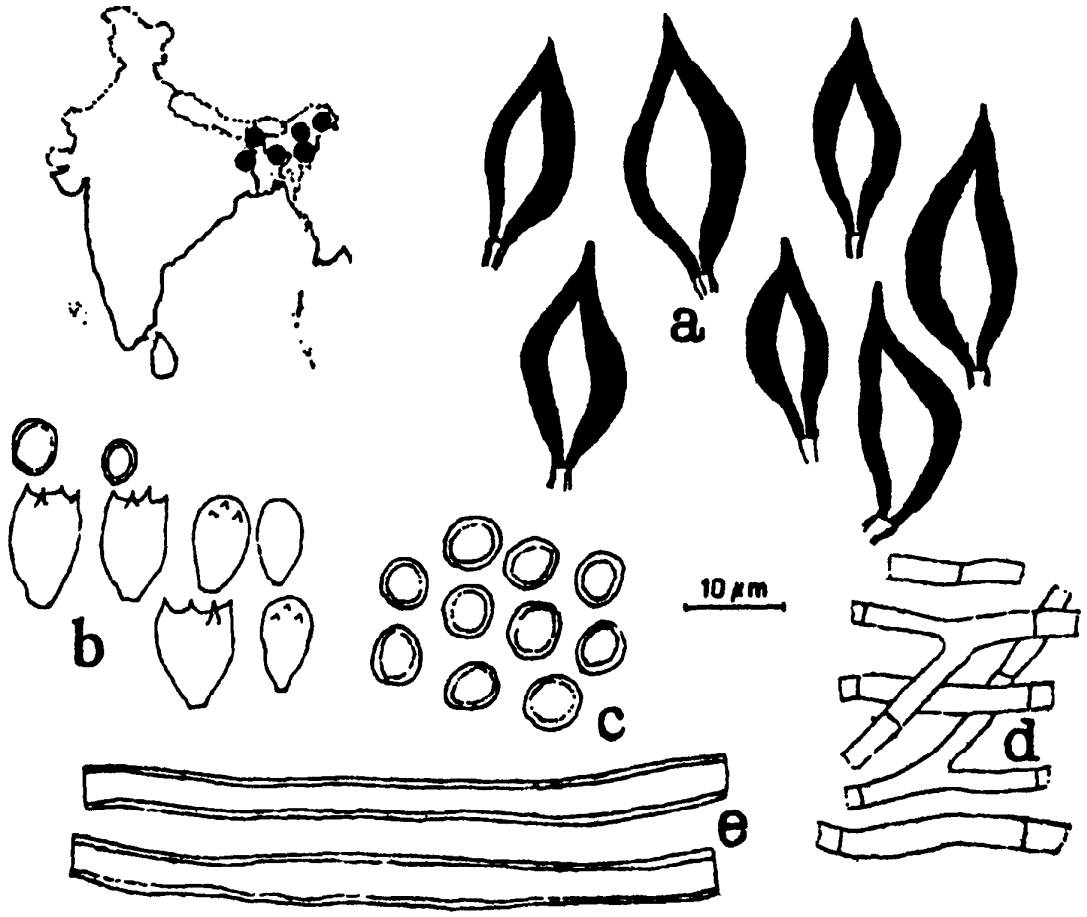


Fig. 59. *Phellinus extensus* (JRS 452) a. setae, b. basidia, c. spores, d. generative hyphae, e. skeletal hyphae.

Habitat and Distribution

On dead angiospermous wood, also on living *Prunus* and *Quercus* species; causing a white pocket rot; a rare species in tropical and subtropical forests of India.

Remarks

Externally, the applanate, reddish brown basidiocarps with a thick crust under the adpressed tomentum are essential characters of this species. Microscopically, the small, tinted spores and typically ventricose, smaller hymenial setae with acute tips are characteristics.

Phellinus fastuosus (Lev.) Ryv. Fig. 60

Norw. J. Bot. 19: 234, 1972 *Polyporus fastuosus* Lev., Ann. Sci. Nat. Bot. 2: 190, 1844; *Fomes fastuosus* (Lev.) Cke., Grevillea 14: 18, 1885.

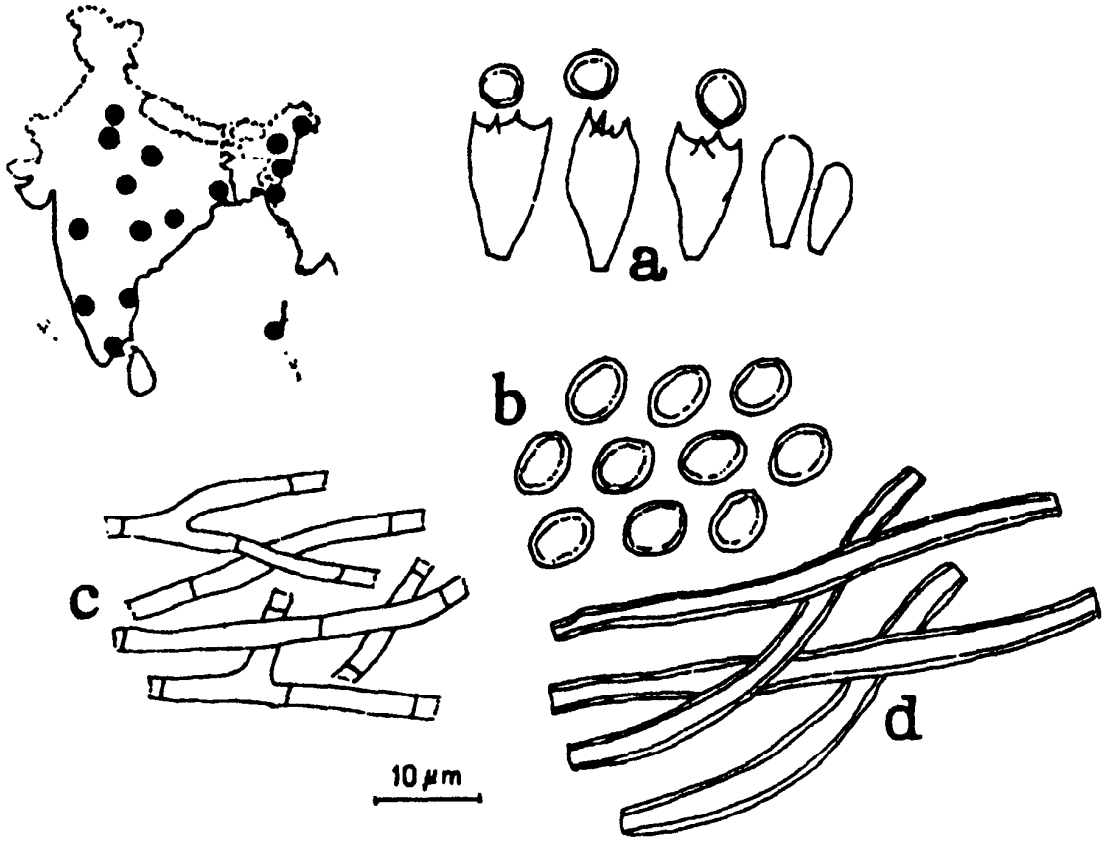


Fig. 60. *Phellinus fastuosus* (JRS 60007) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae.

Basidiocarps perennial, usually imbricate, sessile, broadly attached, conchate to applanate, woody hard and brittle when dry; pileus up to 15 cm broad, 20 cm wide and 4 cm thick; upper surface dark brown, or rusty brown to rusty black, velvety to matted tomentose in narrow concentric zones, later remaining so or becoming glabrous from base with a distinct, up to 1 mm thick black crust; margin usually thick and obtuse, velutinate, golden yellow to ferruginous, sterile underneath; pore surface golden yellow to rusty brown, reddish brown in older specimens; tubes concolorous or darker than the pore surface, distinctly stratified, 1-3 mm thick in each layer; pores round or angular, 7-10 per mm, dissepiments entire and fairly thick; context golden brown to cinnamon or ferruginous in older specimens, up to 2 cm thick, limited on upper surface with a black thin, line.

Hyphal system dimitic; generative hyphae simple septate, hyaline to pale yellow, 2-3 µm wide; skeletal hyphae yellow to dark brown, 3-7 µm wide; hymenial setae absent; basidia clavate, 8-12 x 6-7 µm; spores broadly ellipsoid to

almost subglobose, yellow to rusty brown, 5-6 x 4.5-5 μm, thin to moderately thick walled.

Habitat and Distribution

Mostly on living hardwoods particularly on species of *Terminalia, Sweitenia, Casuarina* and *Shorea* at butt regions; rarely on dead/stumps of hardwoods; causing a white pocket rot of heartwood; widely spread and a common parasitic species in tropical forests of India.

Remarks

Large applanate, concentrically zoned, dark rusty brown to greyish black, glarbous, sulcate basidiocarps with a thick crust are good field characters, while microscopically, the absence of hymenial setae and fairly large, coloured subglobose spores are its distinguishing features.

Phellinus ferreus (Pers.) Bourd. & Galz. Fig. 61
Bull. Soc. Mycol. France. 41: 247, 1925 -*Polyporus ferreus* Pers., Mycol. Europ. 2: 89, 1825.

Basidiocarps annual to perennial, resupinate, becoming widely effused, not easily separable, coriaceous tough when fresh, rigid and hard when dry; margin up to 2 mm wide, narrowly sterile, tomentose, yellowish brown, paler than pore surface; pore surface yellowish brown or cinnamon to umber brown in dried specimens; tubes totally up to 12 mm deep, white greyish within, usually paler than the pore surface; pores round to angular, 4-6 per mm, dissepiments entire, moderately thin; context yellowish brown to reddish brown in older specimens, fibrous, very thin, continuing without change into dissepiments.

Hyphal system dimitic; generative hyphae simple septate, hyaline to pale yellow, thin walled, much branched, 2-3 μm wide; skeletal hyphae thick walled, golden brown, 3-6 μm wide; hymenial setae occasional to frequent, subulate, dark ferruginous, thick walled, apex straight, acute, 25-40 (45) x 6-12 μm; basidia clavate, 12-14 x 5-6 μm, hyaline; spores cylindrical, hyaline, smooth, thin walled, 6-7.5 (8.5) x 2.5-3 μm, IkI-.

Habitat and Distribution

On dead thin branches of standing trees of angiosperms especially Oaks; causing white rot; widely spread and one of the commonest species in Himalayan temperate to subalpine forests.

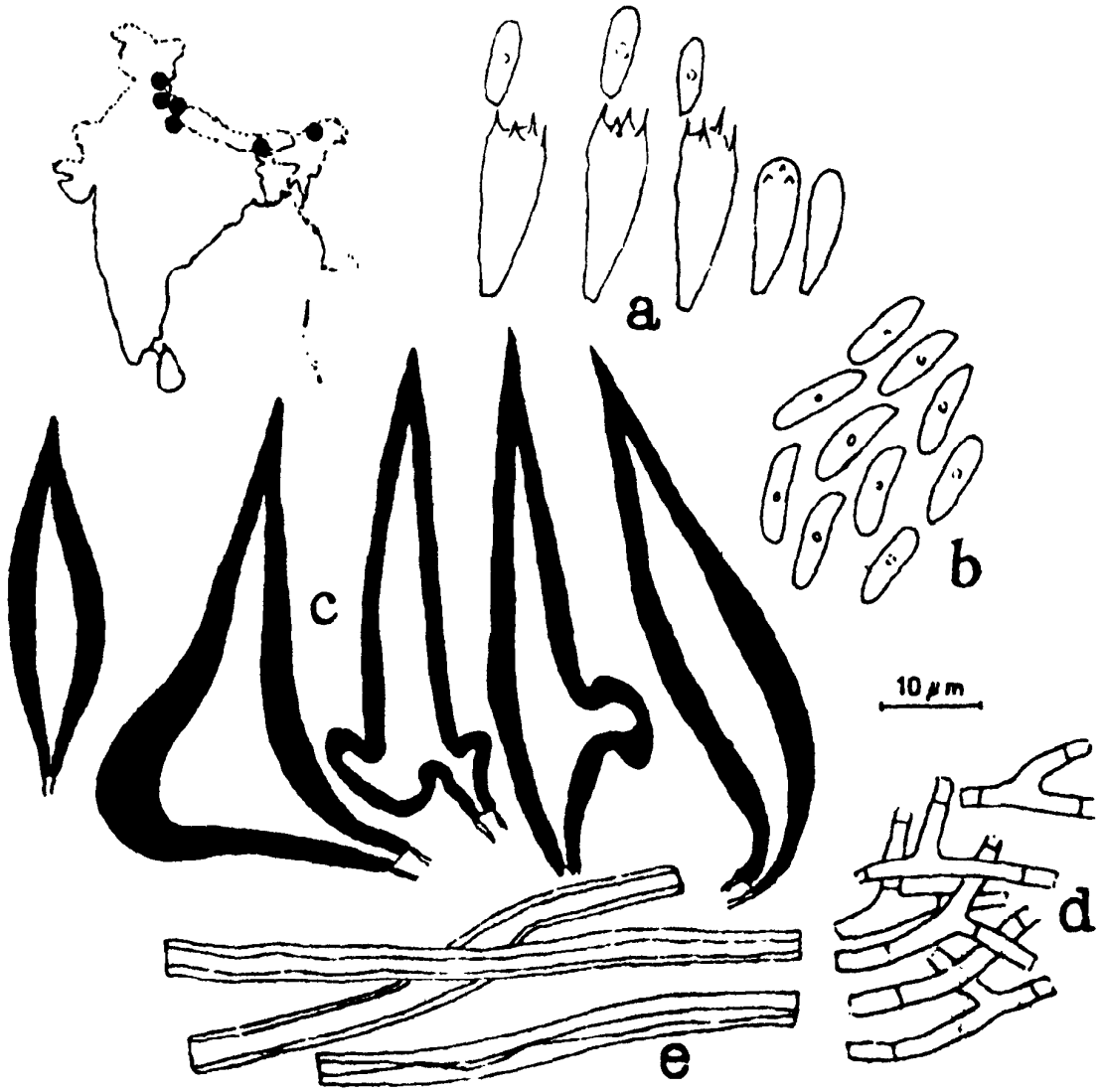


Fig. 61. *Phellinus ferreus* (JRS 430) a. basidia, b. spores, c. setae, d. generative hyphae, e. skeletal hyphae.

Remarks

Fairly larger pores and hymenial setae together with the hyaline cylindrical spores help in easy identification of this species. Further, the habit, colour and corky basidiocarps with greyish white tubes from within are good field characters. In the outlook it appears closer to *P. punctatus* and *P. ferruginosus* both tropical species. But *P. punctatus* has rare to scattered setae, dextrinoid and subglobose spores (6-7.5 µm) while *P. ferruginosus* has setal hyphae and smaller ellipsoid spores (4-6 x 3-3.5 µm).

Phellinus ferrugineo-velutinus (Henn.) Ryv. Fig. 62
Norw. J. Bot. 19: 234, 1972 *Poria ferrugineo-velutina* Henn., Hedwigia 44. 59, 1905.

Basidiocarps perennial, resupinate, elongated, up to 20 cm long, 4-10 cm broad and 2-4 mm thick, adnate; margin reddish brown to black; pore surface reddish brown when fresh, darker on drying; pores 7-8 per mm, oblique, receding with age and making the margin wider up to 10 mm; tubes stratified, 1-2 mm deep in each layer, reddish brown; context purple reddish brown.

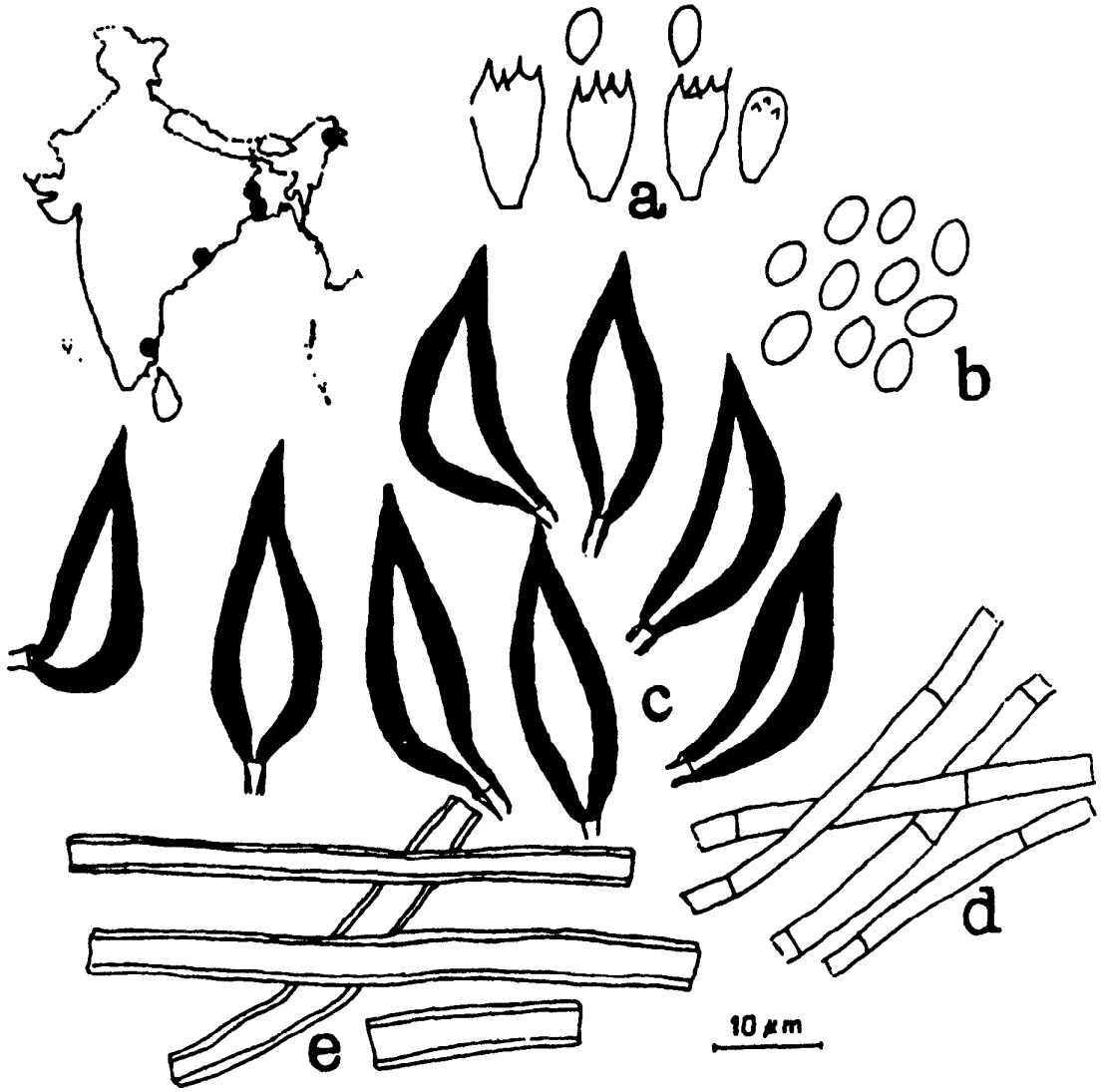


Fig. 62. *Phellinus ferrugineo-velutinus* (JRS 78312) a. basidia, b. spores, c. setae, d. generative hyphae, e. skeletal hyphae.

Hyphal system dimitic; generative hyphae hyaline to pale yellow, 3-4 μm wide, septate; skeletal hyphae dark brown, unbranched, thick walled, 3-5 mm wide; hymenial setae common to abundant, pale reddish brown, acuminate, straight 12-18 (22) x 4-7 μm; basidia hyaline, 10-13.5 x 5-6 μm; spores subglobose to broadly ellipsoid, 2.5-3.5 (4) x 2-2.5 μm, non-amyloid.

Habitat and Distribution

On dead and living angiosperms; causing a white rot; a rare tropical species.

Remarks

Reddish brown, resupinate basidiocarps with narrow margin, abundant hymenial setae and small globose hyaline spores are the diagnostic features of this species. This species is close to *P. glaucescens* in both macroscopic and microscopic characters. However, the latter has thicker, yellowish brown basiocarps, very rare but larger hymenial setae (18-30 x 6-9 μm) and spores (Sharma & Ghosh 1989).

Phellinus ferruginosus (Schrad. : Fr.) Pat. Fig. 63

Essai Taxon. p. 97. 1900 - *Boletus ferruginosus* Schrad., Spic. Fl. Germ., p. 172, 1794; *Polyporus ferruginosus* Schard.: Fr., Syst. Mycol. 1: 378, 1821; *Poria ferruginosus* (Schrad. : Fr.) Karst., Rev. Mycol. (Toulouse) 3(9): 19, 1881.

Basidiocarps annual to perennial, resupinate, tough to soft spongy, not easily separable, sometimes nodulose at the upper margin, up to 40 mm long, 10-15 mm wide and 2-4 mm thick; margin floccose, setulose under a lens, reddish brown on drying, up to 2 mm wide; pore surface ferrutinous to dull brown, even to nodulose or slightly undulating; pores 5-6 per mm, round and regular on horizontal and split on oblique substrates; tubes concolorous with pores surface, 1-5 mm thick in each layer, weakly stratified in older specimens; context rusty brown, corky to cottony, 1-3 mm thick, azonate.

Hyphal system dimitic; generative hyphae hyaline, septate, 2.5-3 μm wide; skeletal hyphae thick walled, rusty brown, 2.5-5 μm wide; setal hyphae present in the lower subiculum and cottony margin, not protruding into the lumen of tubes, thick walled, unbranched, ends pointed, easily observed in the floccose margin of fresh specimens, 200-300 μm long, dark reddish brown; hymenial setae abundant subulate, 25-45 x 5-8 μm; basidia clavate, 9-15 x 4-6 μm; spores broadly ellipsoid, 4-6 x 3-3.5 μm, thin walled, IkI-.

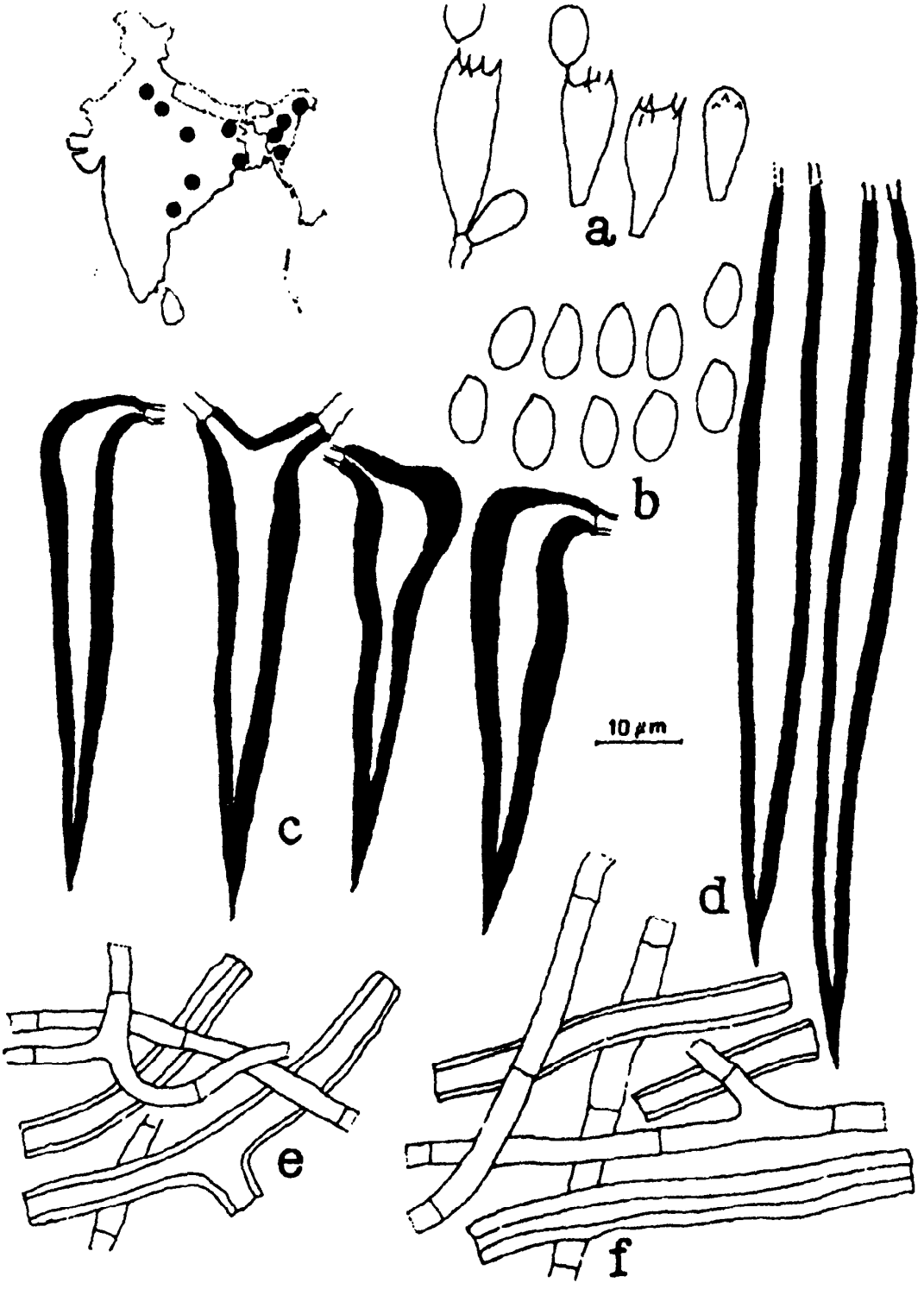


Fig. 63. *Phellinus ferruginosus* (JRS 31) a. basidia, b. spores, c. setae, d. setal hyphae, e. contexual hyphae, f. hyphae from floccose margin.

Habitat and Distribution

On dead hard woods especially *Alnus*, *Shorea*, *Prunus*, Bamboo, etc. and on dead coniferous woods of *Cedrus* and *Pinus;* causing a white laminated rot; widely spread throughout the tropical and subtropical zones.

Remarks

The species can easily be recognised by the light to dark reddish brown resupinate basidiocarps having soft-spongy and floccose margin appearing setulose under a lens. The presence of setal hyphae in the floccose margin and in the lower part of context adjacent to tubes and abundant hymenial setae are characteristic microscopic features of this species. It is most easily confused with *Phellinus ferreus* but the latter differs in having cylindrical spores (6-7.5(8.5) x 2.5-3 μm) and being distributed in temperate zones.

Phellinus gilvus (Schw. : Fr.) Pat. Fig. 64

Essai Taxon., p. 97, 1900 - *Boletus gilvus* Schw., Schrift. Nat. Ges. Leipzig 1: 96, 1882 : *Polyporus gilvus* Schw. : Fr., Elench. Fung. 1: 104, 1828; *Polyporus illicicola* Henn., Bot. Jahrb. Syst. 32: 39, 1902; *Polyporus scruposus* Fr., Epicr. Syst. Mycol., p. 473, 1838; *Polyporus cupreus* Berk., Ann. Nat. Hist. 3: 393, 1839 (Type loc. India); *Polyporus hookeri* Berk., In Llyod Mycol. Writ. 4: 348, 1915; *Fomes scruposus* (Fr.) Cunn., New Zealand Dept. Sci. Ind. Res. Pl. Dis. Div. Bull. 79: 11. 1948; *Polyporus licnoides* Pl. Cell. Cuba, p. 401, 1842; *Polyporus gilvoides* Henn., In Llyod, Mycol. Writ. 4: 349, 1915; *Fomes gilvus* (Schw.) Llyod, Lett. 42: 6, 1912.

Basidiocarps annual to less often perennial, imbricate to rarely single, sessile to effused reflexed, coriaceous, hard and brittle on drying; pileus dimidiate to horse-shoe shaped, up to 10 cm broad, 8 cm wide and 102 cm thick near the base, applanate to weakly convex; upper surface golden brown to dark yellowish brown, lighter towards margin, usually with a distinct reddish tint especially near the base, azonate to weakly zonate, first finely velutinate, soon either glabrous, smooth to finely and densely warted with irregular protuberances or more usually coarsely velutinate or strigose to radiate-striate; margin thin to rather thick, acute to blunt, even to crenate or lobed, usually inturned with age; pore surface dark purplish brown, fertile up to the margin, glancing when fresh; tubes reddish brown, usually with a purplish tint, single layered, 2-4 mm deep; pores round and regular, 5-6 per mm, dissepiments entire, relatively thick; context bright yellowish to pale reddish brown, up to 6 mm thick, zonate, fibrous, with a thin cuticle, on upper side in older specimens.

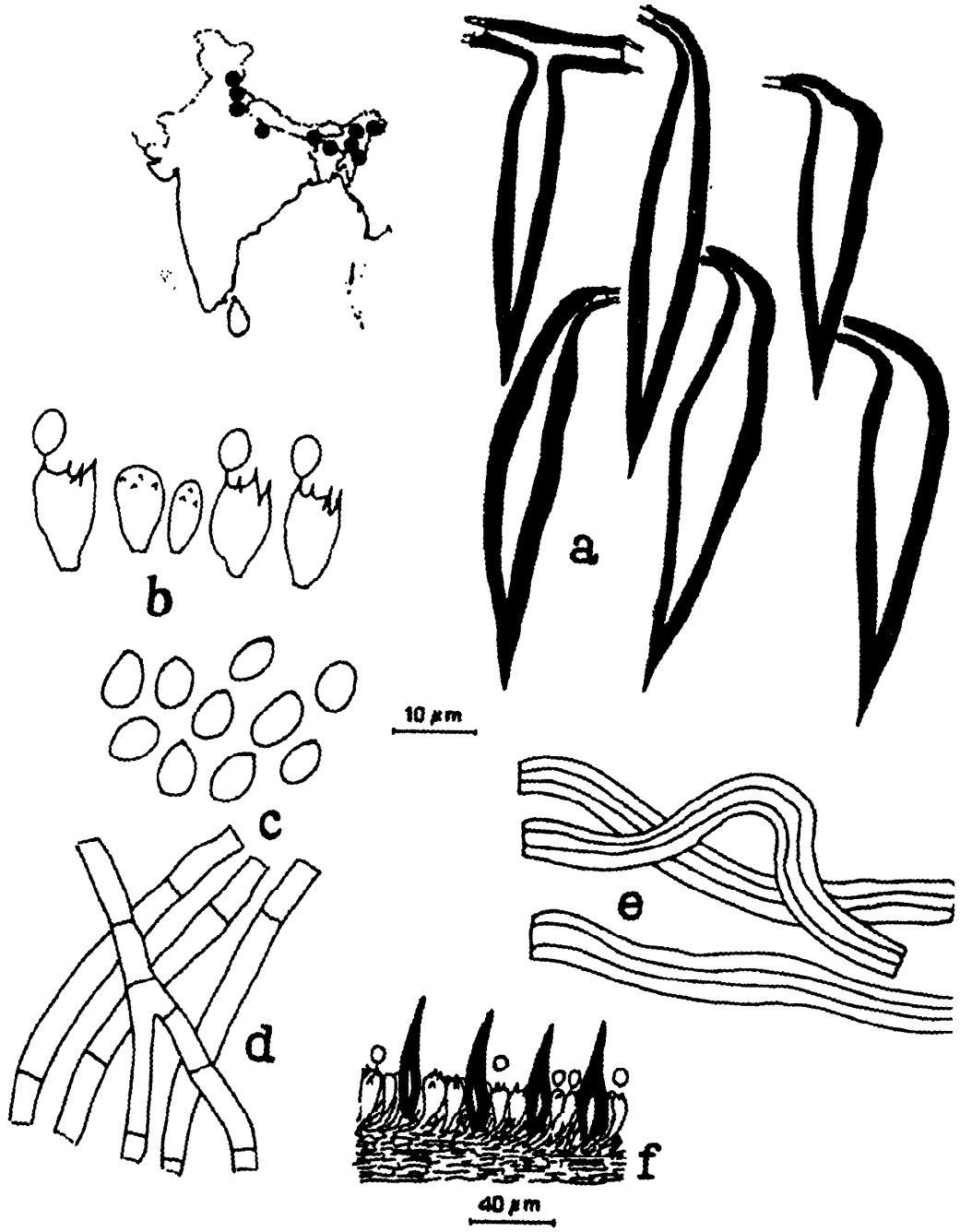


Fig. 64. *Phellinus gilvus* (JRS 337) a. setae, b. basidia, c. spores, d. generative hyphae, e. skeletal hyphae, f. section through tube.

Hyphal system dimitic; generative hyphae septate, branched, 3-4 μm wide, pale yellowish brown, hyaline to pale yellow; skeletal hyphae thick walled, dark ferruginous in KOH, 3-5 μm wide; hymenial setae abundant, 25-35 (40) x 6-9 μm, subulate, sharp, thick walled, dark reddish brown in KOH; basidia 5-12 x 4-7 μm, broadly clavate; spores ellipsoid to ovoid, hyaline to pale yellow, thin walled, 4-5 (5.5) x 3-4 μm, more or less flattened at one end.

Habitat and Distribution

On living and dead angiospermous wood in many genera, more common on *Quercus*, *Eucalyptus*, *Cornus*, *Acacia*, *Shorea*, *Cassia* and *Dalbergia;* usually not found on coniferous wood; causing a uniform white rot of dead woods and heartrot of living trees; widely distributed in the tropical and warmer temperate forests.

Remarks

P. gilvus is a variable species as far as the nature of the pilear surface is concerned. These variations led the past workers to name it under many new species. Corner (1932) recognised two varieties viz. var. *scruposus* and var. *licnoides* based mainly on the characters of the pilear surface. The distinct reddish tint in the pilear surface and purplish brown pore surface together with noncrusty and usually imbricate habit of fruiting bodies help in distinguishing this species in the field. Microscopically, abundant hymenial setae and ellipsoid spores are characteristic.

Phellinus glaucescens (Petch) Ryv. Fig. 65
Norw. J. Bot. 19: 234, 1972 - *Poria glaucescens* Petch. Ann. Roy. Bot. Gard. Peradeniya 6: 139, 1916.

Basidiocarps resupinate, widely effused, adnate, up to 2 cm thick, coriaceous tough when fresh, woody hard on drying; margin tomentose, thin, narrow (up to 2 mm wide) light to dark olivaceous brown; pore surface light brown to light yellowish brown; pores entire to sinuate with age, 4-6 per mm, indistinctly stratified; context up to 1 mm thick, yellowish brown.

Hyphal system dimitic; generative hyphae hyaline to pale yellow, septate, 2-3.5 μm wide; skeletal hyphae pale rusty brown, 3-5 μm wide; hymenial setae absent to scattered, subventricose to acuminate, 18-28 x 5-8 μm; basidia 6-8 x 3-4 μm hyaline; spores subglobose to broadly ellipsoid, 3.5-4.5 (5) x 3-3.5 μm, IkI-.

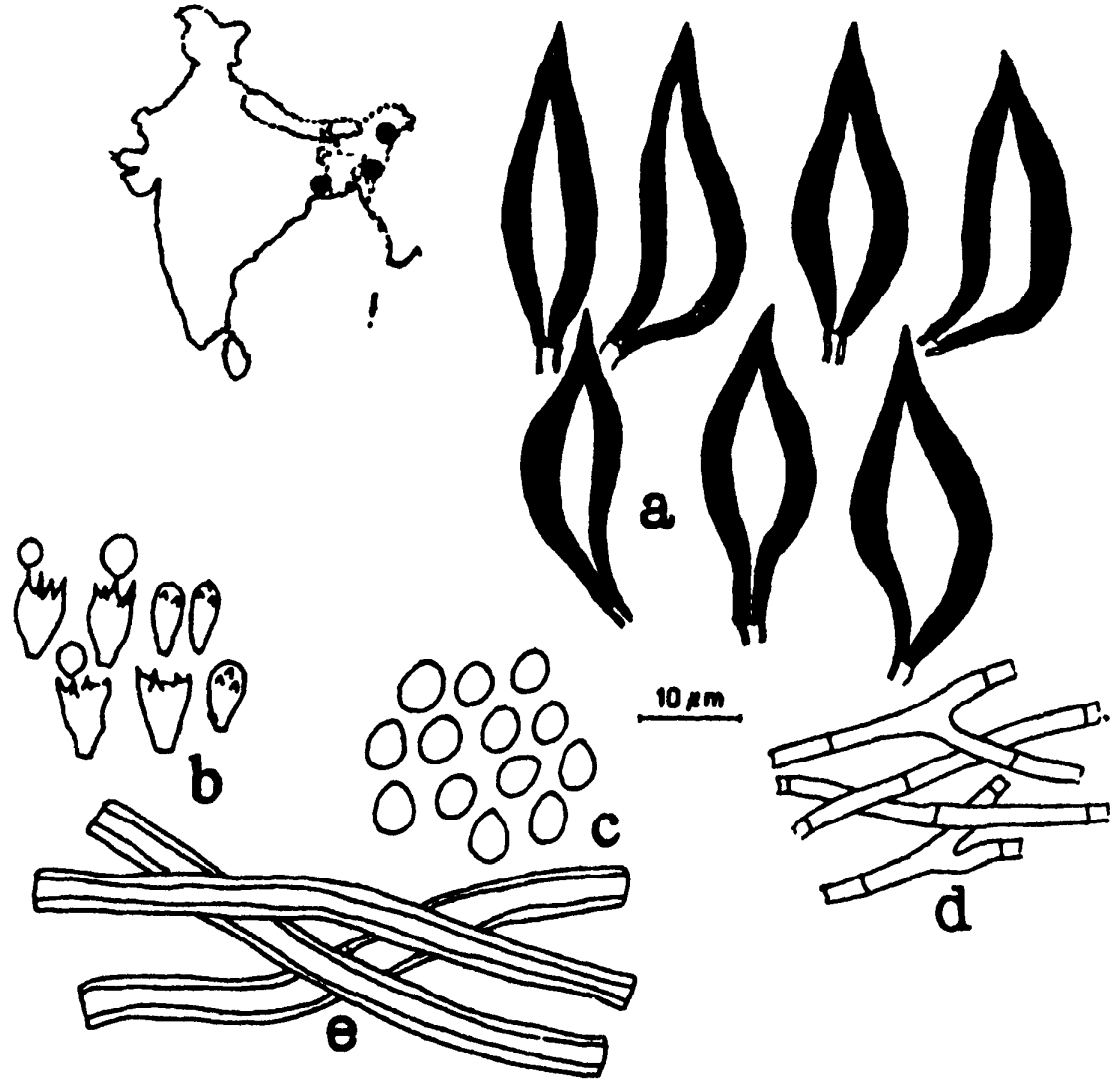


Fig. 65. *Phellinus glaucescens* (JRS 78314) a. setae, b. basidia, c. spores d. generative hyphae, e. skeletal hyphae.

Habitat and Distribution

On dead angiospermous woods; associated with a white rot; a rare tropical species.

Remarks

The presence of hymenial setae is a very variable character of this species. Petch (1916) reported setae absent while Ryvarden and Johnsen (1980) found them in African collections. In the Indian specimens, the setae are rare to scattered and are difficult to observe sometimes. *P. glaucescens* is close to *P. ferrugineo-velutinus* (Henn.) Ryv. in both micro and macroscopic characters. But the latter has a reddish brown and a thinner fruitbody (up to 5 mm) and regular pores. Further, *P. ferrugineo-velutinus* has smaller (12-18 (22) x 4-7 µm) but abundant setae and smaller spores (2.5-3.5(4) x 1.5-2.5 µm).

Phellinus grenadensis (Murr.) Ryv. Fig. 66

Norw. J. Bot. 18 : 234, 1972 - *Pyropolyporus grenadensis* Murr., North Amer. Flora 9: 107, 1908.

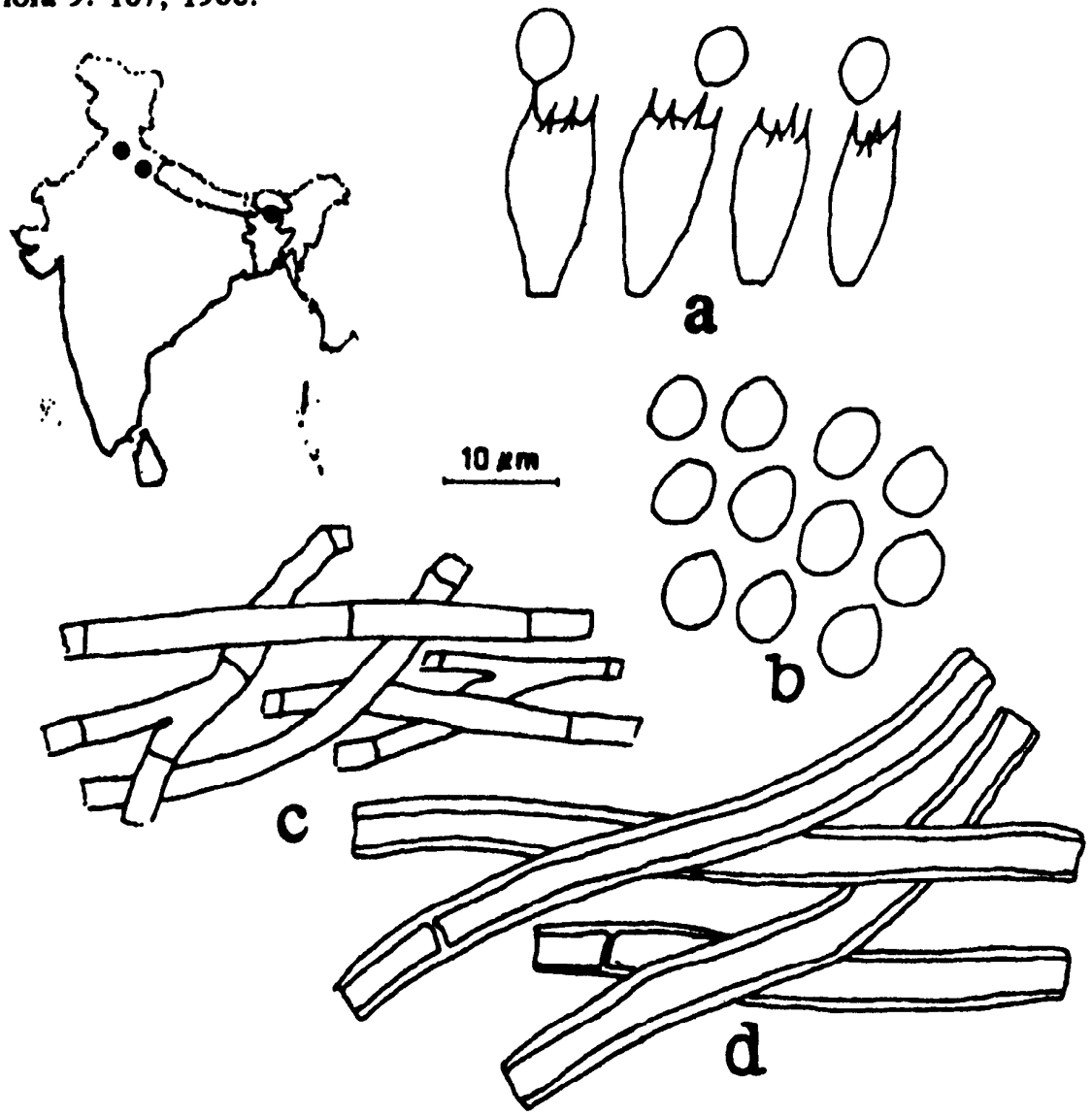


Fig. 66. *Phellinus grenadensis* (JRS 189) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae.

Basidiocarps perennial, solitary, pileate, broadly attached, applanate, light to medium in weight, woody hard when dry pileus dimidiate to semicircular, convex to more or less ungulate, up to 10 cm broad, 8 cm wide and 3 cm thick near the base; upper surface first velutinate to tomentose, reddish brown, then becoming crustose with a dark brown to black crust, narrowly concentrically sulcate and weakly zonate, smooth or weakly rimose from base; margin golden yellow, soon dark reddish brown, acute or obtuse, entire; pore surface yellowish brown to dark reddish brown; tubes distinctly stratified with a thin context layer

in between, up to 3 mm deep in each layer; pores round to angular, 4-6 per mm, dissepiments entire, thin to fairly thick walled; context dark yellowish to reddish brown, up to 2.5 cm thick, fibrous, homogeneous or faintly concentrically zonate, with a thick dark crust on upper side, crust up to 1 mm thick.

Hyphal system dimitic; generative hyphae simple septate, hyaline to pale yellow, thin to fairly thick walled, 2-4.5 μm wide; skeletal hyphae golden yellow to brown, thick walled, 3-5 μm wide, wider and darker in context; hymenial setae absent; basidia 10-13 x 5.5-7 μm, broadly to narrowly clavate; spores broadly ellipsoid to subglobose, pale yellow to golden brown, 4.5-6 x 3-4 μm in diameter.

Habitat and Distribution

On dead deciduous wood; causing a white rot; a rare species confined to subtropical to temperate zones.

Remarks

Dark to reddish brown, crusty, and concentrically sulcate smooth to weakly rimose upper surface, distinctly layered tubes together with golden brown subglobose spores are features enough to distinguish this species.

Phellinus hoehnelii (Bres.) Ryv. Fig. 67
In Ryv. et Johan., Pre. Polyp. Flora of East Africa p. 173. 1980 *Fomes hoehnelii* Bres., Ann. Mycol. 10: 499, 1912.

Basidiocarps perennial, pileate, subapplanate, sessile, broadly attached, irregular, woody hard on drying; pilear surface glabrous, encrusted, dark brown to black, rugulose; margin obtuse, thick, entire, finely velutinate; pore surface cinnamon brown; pores 3-4 per mm; tubes up to 1 cm deep, dark brown; context bright yellowish to medium brown, delimited on upper surface by a black, up to 0.3 mm thick crust.

Hyphal system dimitic; generative hyphae simple septate, 2-5 μm wide, hyaline; skeletal hyphae 2-6 μm wide, dark brown, thick walled; setal hyphae present in context and dissepiments, frequent, ferruginous, thick walled to solid, up to 400 μm long, 5-10 μm wide, more or less straight, projecting obliquely into the hymenium and the tubes, tips acute; hymenial setae 18-27 x 6-9 μm, ventricose, dark brown, projecting 5-15 μm beyond the hymenium, mostly present near the base of tubes; basidia 9-18 x 5-8 μm, clavate; spores 7-8.5 (9) x 6-7.5 μm, subglobose, slightly thick walled, hyaline to pale yellow, IkI-.

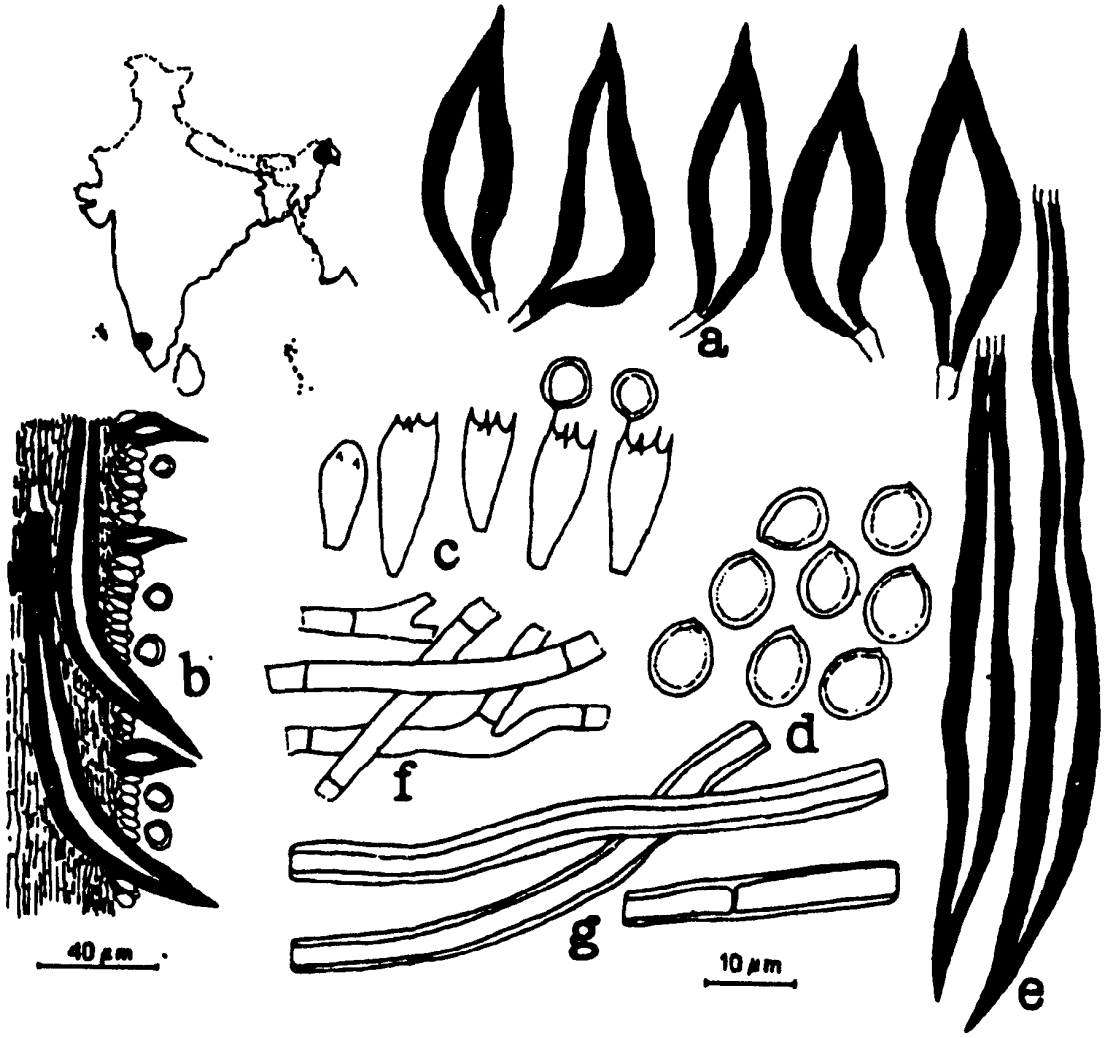


Fig. 67. *Phellinus hohnelii* (JRS 68910) a. setae, b. section through tube, c. basidia, d. spores, e. setal hyphae, f. generative hyphae, g. skeletal hyphae.

Habitat and Distribution

On living *Terminalia;* causing a white rot; a rare species found in the tropical forests of Kerala and Arunachal Pradesh only.

Remarks

The species is very close to *P. pachyphloeus* but the size of spores and pores separate it from this and all other species of the group (Ganesh and Leelavathy 1986; Sharma 1994b). The setae reported to be absent by Humphrey & Leus (1932) are, frequently present in the Indian collections especially near the tube bases. Llyod (1920) wrongly reported spores to be 11-12 µm diam.

Phellinus igniarius (L.: Fr.) Quel. Fig. 68

Ench. Fung., p. 172, 1886 *Boletus igniarius* L., Species Plant., p. 1176, 1753: *Polyporus igniarius* L.: Fr., Syst. Mycol. 1: 375, 1821; *Fomes igniarius* (L. : Fr.) Fr., Summa Veg. Scand. 2: 321, 1849.

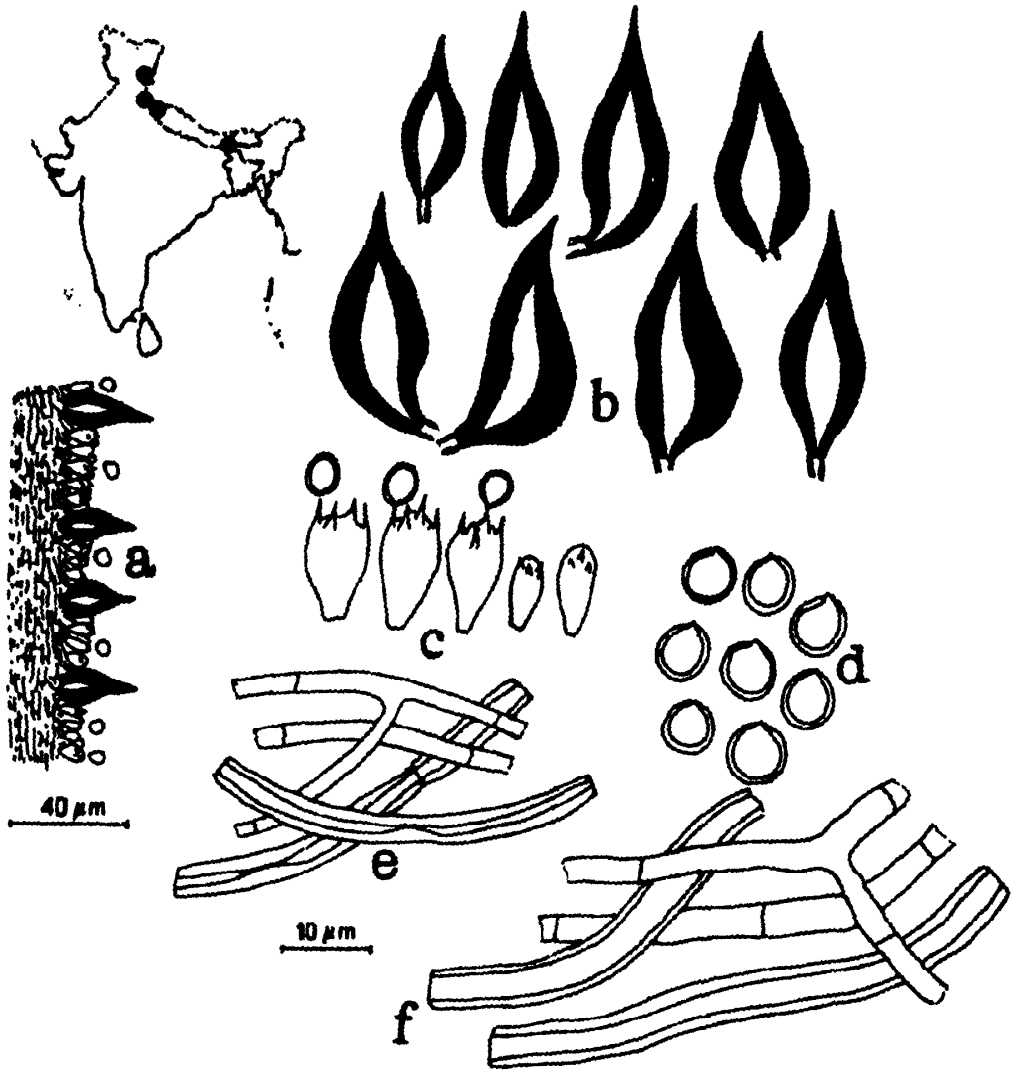


Fig. 68. *Phellinus igniarius* (JRS 625) a. section through tube, b. setae, c, basidia, d. spores, e. generative hyphae, f. skeletal hyphae.

Basidiocarps perennial, usually solitary, sesile or rarely effused-reflexed, woody hard on drying, applanate to ungulate, up to 10 cm broad 12 cm wide and 2-5 cm thick; upper surface grey to black, glabrous, sulcate in narrow concentric zones, smooth at first, becoming deeply rimose and incrusted with age; margin

obtuse, yellowish brown; pore surface yellowish to pale cinnamon brown, depressed; tubes concolorous with context, in distinct layers, 2-4 mm deep in each layer, white stuffed when old; pores 5-6 per mm, circular, dissepiments thick and entire; context dark or pale reddish brown, zonate, woody, up to 2 cm thick near base.

Hyphal system dimitic; generative hyphae hyaline, thin walled, septate, branched; skeletal hyphae thick walled, 2-5 μm wide, branching rare, dark brown; hymenial setae abundant, strongly ventricose, projecting up to 6 μm beyond the hymenium, deeply embedded, tips straight, 12-18 (20) x 4-6 μm, dark brown; basidia broadly clavate, 8-11 x 5-6.5 μm; spores broadly ovoid to subglobose, 5-6.8 (7) x 4-6 μm, hyaline.

Habitat and Distribution

This species is a dangerous parasite of many deciduous tree belonging to the species of *Viburnum, Salix, Alnus, Populus, Acer, Quercus* and quite rarely on *Abies, Ulmus* and *Betula;* less frequently also found on dead woods; causing a uniform white rot of heartwood; a widely distributed and common species in the temperate boreal zones.

Remarks

The applanate to ungulate basidiocarps with narrowly sulcate and greyish black pilear surface and yellowish brown, depressed pore surface are the good field characters. Microscopically, the short ventricose setae and globose to subglobose spores make this species distinct. For other features by which it can be differentiated from other species of this complex, see under *P. nigricans.* Darker context, abundant ventricose hymenial setae and smaller, non-dextrinoid spores separate it from the closely related *P. robustus.*

Phellinus inamaenus (Mont.) Ryv. Fig. 69

Norw. J. Bot. 19: 234, 1972 - *Polyporus inamaenus* Mont., Ann. Sci. Nat. (Ser. 2); 18: 22, 1842.

Basidiocarps perennial, pileate, imbricate, sessile, semicircular, applanate; pileus up to 2.5 cm wide, 5 cm broad and 1.5 cm thick at base, woody hard; upper surface dark reddish brown, with age grey to black from base, finely tomentose to matted with some scattered raised tufts, soon glabrous, sulcate in concentric zones, no distinct black line between the tomentum and context, upper layer may become indurated from the base; pore surface yellowish to pale reddish

brown; tubes concolorous with pore surface, indistinctly stratified, up to 10 mm deep; pores small, round, 6-8 per mm; context homogeneous, corky to woody, golden brown to dark brown, up to 8 mm thick, no dark black line at upper surface.

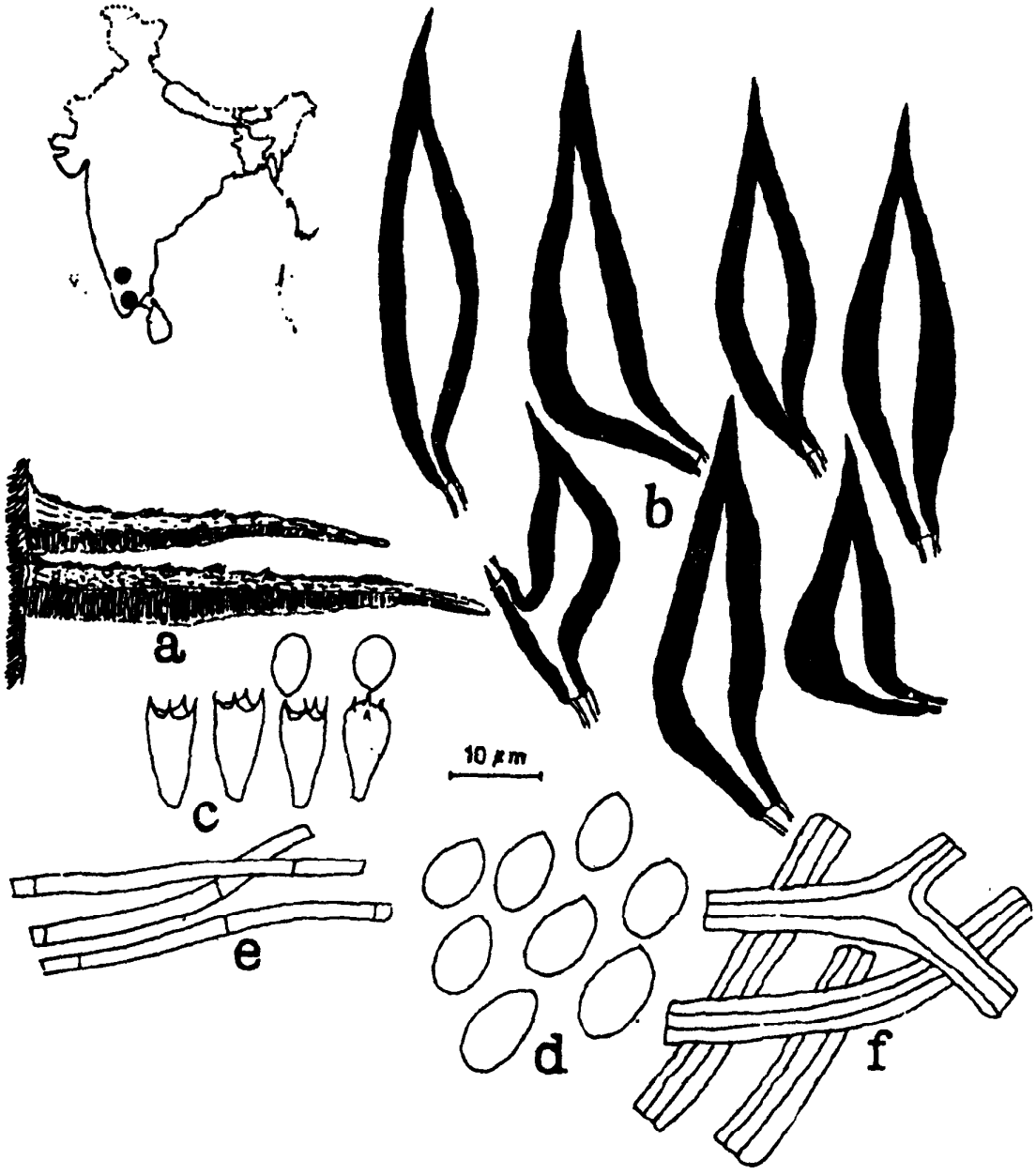


Fig. 69. *Phellinus inamaenus* (JRS 468) a. section through tube, b. setae, c. basidia, d. spores, e. genrative hyphae, f. skeletal hyphae.

Hyphal system dimitic; generative hyphae hyaline to pale yellow, simple septate, 2-3.5 μm wide; skeletal hyphae 3-5 μm wide, thick walled, golden brown; hymenial setae abundant, accuminate, 28-45 (50) x 8-15 μm, evenly tapering with a broad base; spores subglobose, hyaline to pale yellow, 5-6 x 4-5 μm.

Habitat and Distribution

On dead angiosperms; causing white rot; a rare species in tropical forests.

Remarks

The imbricate growth habit and absence of any black line between the tomentum and context, large abundant, acuminate hymenial setae and pale yellowish subglobose spores are the distinguishing features of this species. It is closely related to *P. linteus* and *P. setulosus* externally. But *P. linteus* besides being a temperate species has much smaller and strongly ventricose setae while in *P. setulosus*, the ventricose setae are hooked and spores are larger (5-7 x 4-6 μm).

Phellinus inermis (Ell. et Everh.) Cunn. Fig. 70

New Zealand Dept. Sci. Ind. Res. Bull. 164: 234, 1965 *Poria inermis* Ell. et Everh., Acad. Nat. Sci. Philadelphia Proc. for 1894, p. 322, 1894.

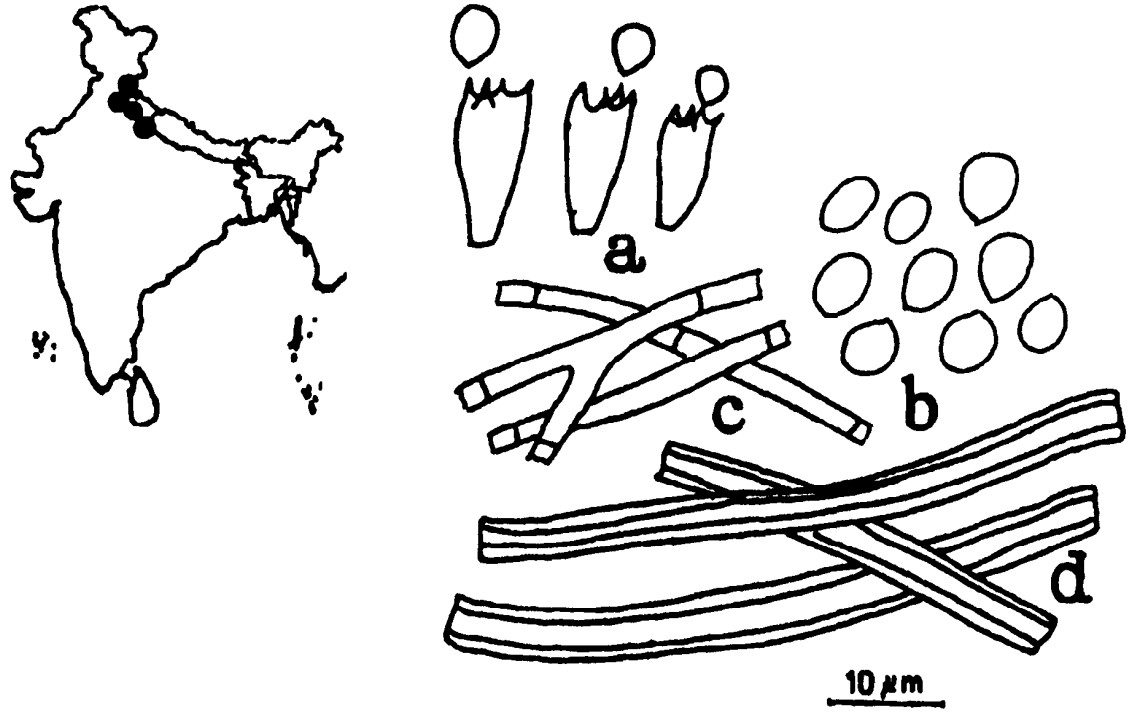


Fig. 70. *Phellinus inermis* (JRS 767) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae.

Basidiocarps perennial, resupinate becoming widely effused along the branches, up to 20 cm long, 5 cm broad and 1 cm thick at centre, coriaceous when fresh, woody hard and brittle on drying, inseparable; margin narrowly sterile, concolorous with age, glancing deeply, rimose on drying; tubes indistinctly stratified, concolorous with context, resinous hard and brittle on drying, up to 3 mm deep in each layer; pores round to angular, 4-6 per mm; context dark reddish brown, thin, up to 5 mm thick, firm, continuing into the trama.

Hyphal system dimitic; generative hyphae 2-3 μm wide, moderately branched, thin walled, hyaline to pale yellowish, septate; skeletal hyphae thick walled, 2-5 μm wide, golden brown, branching rarely; hymenial setae absent; basidia clavate, 8-14 x 5-7 μm; spores globose to subglobose 4.5-6 (6.5) x 4-5 μm, thin walled, rusty to pale reddish brown.

Habitat and Distribution

On dead angiospermous woods; causing white rot; a rare species found in tropical to temperate forests of Western Himalayas.

Remarks

In the resupinate habit and absence of hymenial setae this species can be confused with *P. melleoporus*. But the latter has paler and smaller spores (4-5 x 3.5-4 μm). The darker spores and absence of setae characterizes this species, and also differentiates it from the closely related *P. johnsonianus*.

Phellinus johnsonianus (Murr.) Ryv. Fig. 71

Norw. J. Bot. 19: 234, 1972 *Fomitiporella johnsoniana* Murr., North Amer. Flora 9: 13, 1907; *Fomes johnsonianus* (Murr.) Lowe, State Univ. Coll. For. Techn. Publ. 80: 36, 1957.

Basidiocarps perennial, sessile to effused-reflexed up to 4 cm broad, 4 cm wide and 1-2 cm thick near base; upper surface brownish to black, glabrous, narrowly and concentrically sulcate, deeply rimose on drying; margin acute, entire yellowish brown to dark reddish brown, pubescent, narrow; pore surface yellowish to dark reddish brown; tubes concolorous with context, indinstinctly strafified, hard and woody on drying, totally up to 7 mm deep, up to 2 mm in each layer; pores 7-9 per mm, circular to angular; context bright yellowish brown to reddish brown, hard, woody, azonate, limited on upper surface by a crust-like black layer, up to 8 mm thick.

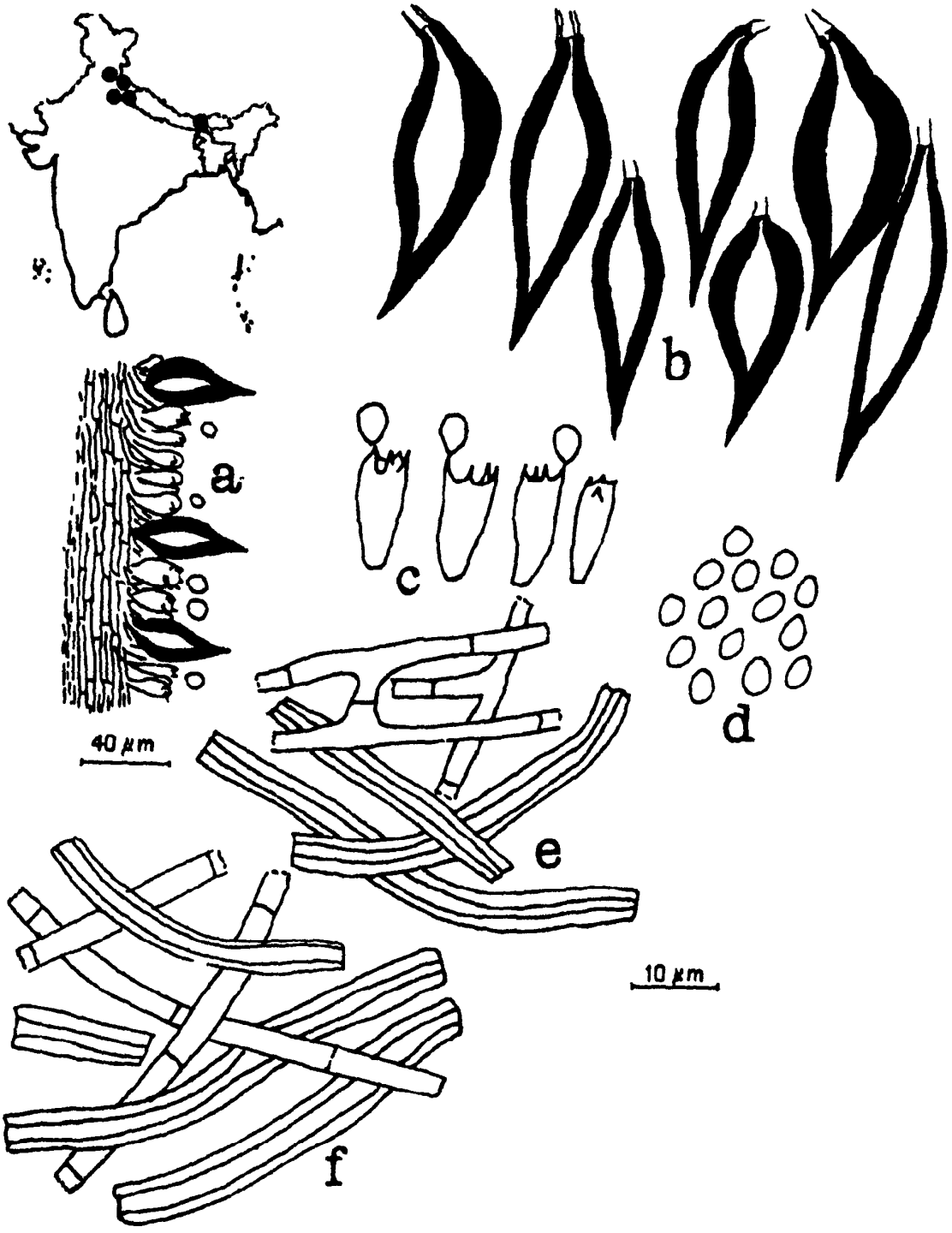


Fig. 71. *Phellinus johnsonianus* (JRS 584) a. section through tube, b. setae, c. basidia, d. spores e. tramal hyphae, f. contexual hyphae.

Hyphal system dimitic; generative hyphae 2-3.5 μm wide, thin walled, hyaline to pale yellow, simple septate, with rare to frequent branching; skeletal hyphae thick walled, 2-4.5 μm wide, rarely branched; hymenial setae abundant, thick walled, dark reddish brown, subulate to ventricose 23-30 (34) x 6-8 μm; spores ellipsoid to ovoid, pale golden to rusty brown, 3.5-4 x 2.5-3 μm, slightly thick walled in KOH.

Habitat and Distribution

On dead wood of angiosperms, causing white laminated rot; widely spread from tropical to temperate zones.

Remarks

Externally, this speceis looks closer to *P. dependens* which however is heavier, pendant with smaller setae, (15-22 x 6-8.5 μm). The presence of setal hyphae and misshapen hymenial setae separate the closely related *P. conchatus* from this species. The effused-reflexed fruitbodies, abundant setae, small pale yellowish ovoid spores are the chief distinguishing features of this species.

Phellinus laevigatus (Fr.) Bourd. et Galz. Fig. 72

Hym. France, p. 624, 1928 - *Polyporus laevigatus* Fr., Hymen. Europ. p. 571, 1874; *Poria laevigata* Fr.: Karst., Meddeland. Soc. Faunna Fl. Fenn. 6: 10, 1881.

Basidiocarps perennial, resupinate, becoming widely effused up to 40 cm long, 10 cm wide and 1-3 cm thick at centre, first appearing in small roundish patches, then slowly coalesing into larger ones, adnate; margin up to 2 mm wide, tomentose to velutinate, yellowish to pale reddish brown, separating from substratum on drying, acute to obtuse; pore surface dull reddish brown, lighter than the margin, becoming deeply cracked into angular blocks on drying or with age; tubes up to 2 mm in each layer, indistinctly stratified, concolorous with the margin or slightly paler; pores small, invisible to naked eyes, 8-10 per mm, dissepiments thick and entire; context thin, up to 2 mm thick, pale or grey reddish brown, azonate.

Hyphal system dimitic; generative hyphae thin walled, hyaline, up to 3 μm wide, septate, branched; skeletal hyphae 2.5-5 μm, thick walled, dark brown, rarely branched, arranged parallelely in the trama; hymenial setae 15-25 (30) x 5-7 μm, dark brown, thick walled, subulate to strongly ventricose; basidia clavate, 8-11.5 x 4-5.5; spores hyaline to pale yellow, 4-5 x 3-4 μm, broadly ellipsoid to subglobose, thin walled.

Habitat and Distribution

On living or dead tree trunks of *Betula utilis;* causing white laminated rot; found abundantly on *Betula* only in subalpine forests of Himalayas.

Remarks

The species is very characteristic in its occurrence on *Betula utilis* only (Niemela 1972). The resupinate fruitbodies with a greyish brown pore surface which cracks excessively into blocks with age and on drying are good field characters. Strongly ventricose hymenial setae and parallelaly arranged tramal skeletal hyphae are microscopic features by which the species becomes distinct in the *P. igniarius* complex. For further differences with *P. nigricans* and *P. igniarius* please see under *P. nigricans.*

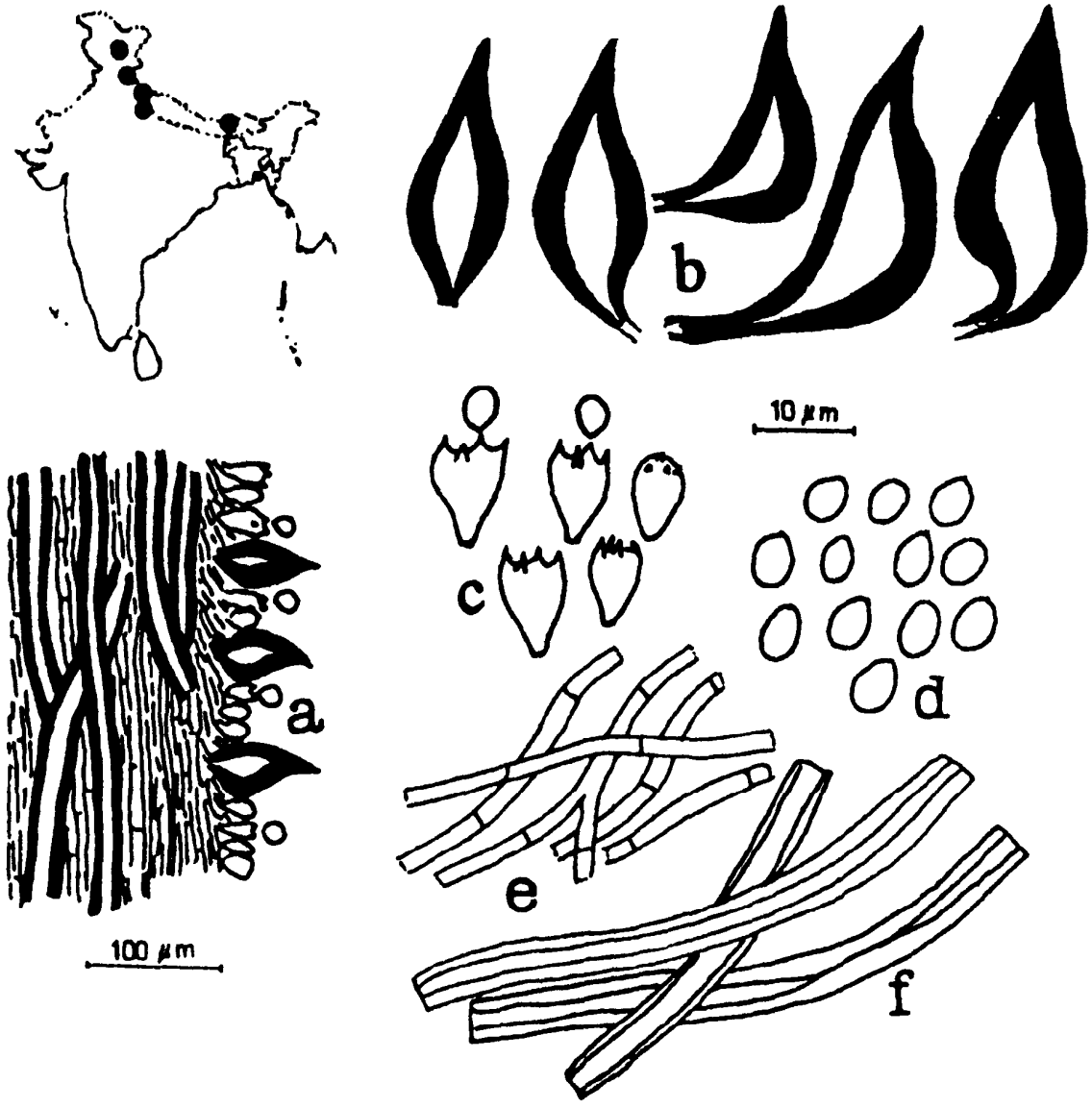


Fig. 72. *Phellinus laevigatus* (JRS 482) a. section through tube, b. setae, c. basidia, d. spores, e. generative hyphae, f. skeletal hyphae.

Phellinus lamaensis (Murr.) Pat. Fig. 73

Bull. Mus Hist. Nat. (Paris) 29: 336. 1923 *Pyropolyporus lamaensis* Murr., Bull. Torrey Bot. Club 34(9): 479. 1907; *Fomes lamaensis* (Murr.) Sacc. et Trott., in Sacc., Syll. Fung. 21: 287, 1912.

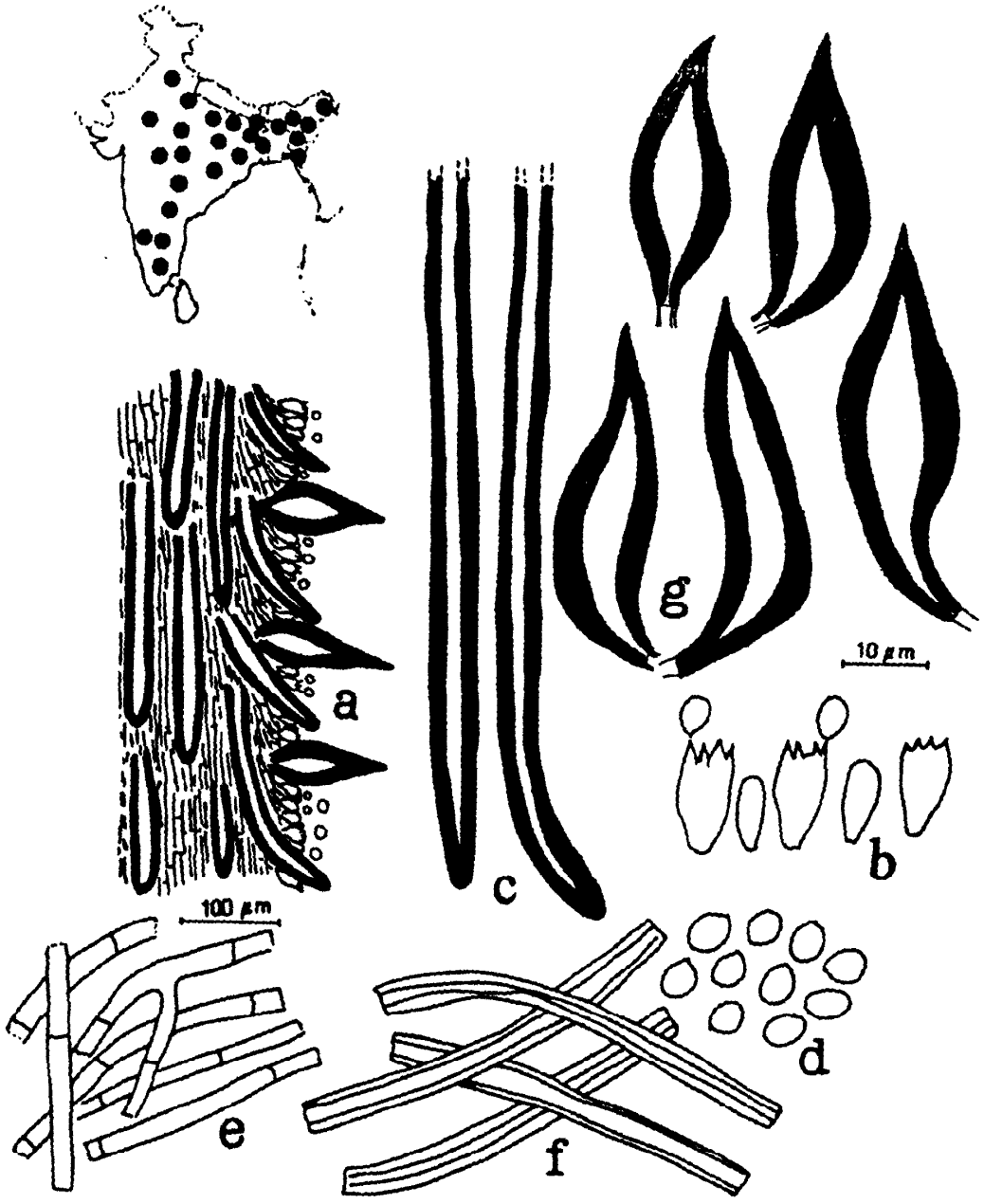


Fig. 73. *Phellinus lamaensis* (JRS 56221) a. section through tube, b. basidia, c. setal hyphae, d. spores, e. generative hyphae, f. skeletal hyphae, g. setae.

Basidiocarps perennial, applanate, solitary to imbricate, dimidiate to lobate, sessile to effused-reflexed, woody hard, light in weight on drying; pileus up to 10 cm broad, 4-12 cm wide and 1-2 cm thick, surface dark brown to reddish black, covered with a depressed tomentum but soon glabrous with a thick crust, strongly and concentrically sulcate in narrow to wider zones; margin paler than pilear surface, entire or lobed, obtuse; pore surface dark reddish to deep brown; tubes layered, up to 1 cm deep, separated by a thin white context, much darker than the context; pores round, 8-10 per mm, regular and circular, usually darker than the context; context woody, paler, than the tubes, semiglossy, bright yellowish brown to dark brown, with white mycelial strands, limited by a black crust on upper side.

Hyphal system dimitic, generative hyphae septate, hyaline to pale yellow, thin walled, 3-5 μm wide; skeletal hyphae abundant and dominating, golden to rusty brown, thick walled, 2-4 μm wide; setal hyphae present, golden to rusty brown, thick walled, up to 250 μm long and 4-8 μm wide, with obtuse ends, running parallel to the tube walls and frequently projecting into the lumen of the tubes, not easily distinguished from the skeletal hyphae; hymenial setae abundant, acuminate to ventricose with acute tips, dark reddish brown, 15-45 x 4-9 μm; basidia 8-12.5 x 4-6.5 μm, hyaline, 4-sterigmate; spores subglobose to broadly ellipsoid, smooth, thin walled, hyaline, 3.5-4.5 μm in diam, IkI-.

Habitat and Distribution

Parasitic on species of *Terminalia, Dipterocarpus, Hopea, Shorea, Havea, Erithrina, Macaranga, Garcinia, Mesua, Cinnamomum, Aleurites, Albizzia, Cassia, Dalbergia, Poinciana, Eriodendron, Artocarpus, Grevillea, Cinchona, Coffea, Sterculia, Camellia, Schima, Rhizophora,* and also common on dead hardwoods; never found on conifers; causing a white rot, honey comb rot of *Camellia sinensis* (Bagchee & Singh 1960); a widely spread and common tropical species.

Remarks

The applanate basidiocarps with adpressed tomentum are good field characters. The presence of hymenial setae in abundance and lighter colour of the setal hyphae separate it from the closely related *P. noxius.*

Phellinus linteus (Berk. & Curt.) Teng. Fig. 74

Fungi of China p. 467, 1964 *Polyporus linteus* Berk. & Curt., Proc. Amer. Acad. Arts (Boston) 4: 122, 1860; *Fomes linteus* (Berk. & Curt.) Cke., Grevillea 14 : 20, 1885; *Fomes ostricoloris* Llyod, Mycol. Writ. 4: 257, 1915.

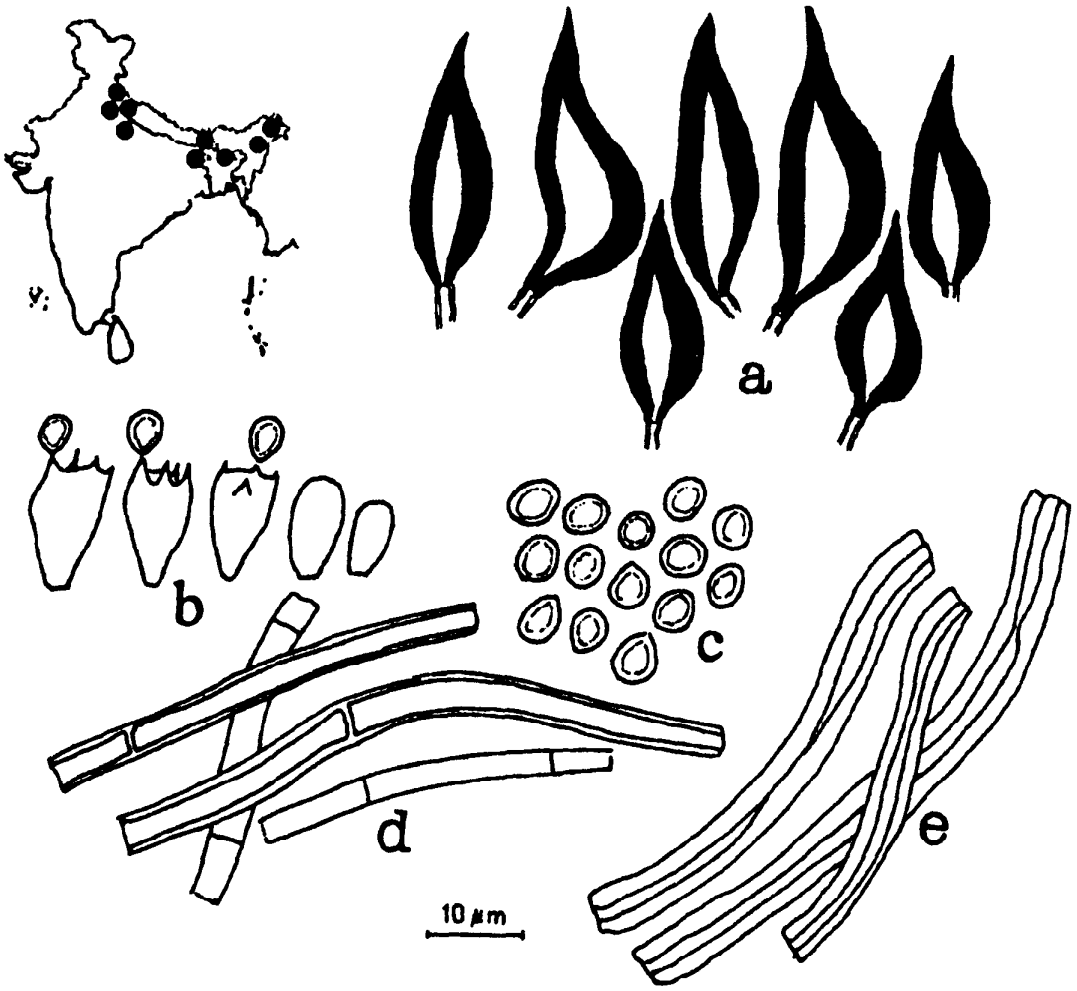


Fig. 74. *Phellinus linteus* (JRS 274) a. setae, b. basidia, c. spores, d. generative hyphae, e. skeletal hyphae.

Basidiocarps perennial, solitary to imbricate, sessile, broadly to narrowly attached, rigid and woody hard when dry; pileus dimidiate to semicircular, applanate to ungulate, up to 12 cm wide, 15 cm broad and 5 cm thick near the base; upper surface first matted tomentose, dark reddish brown to dark chestnut brown, concentrically zoned and sulcate, later glabrous and grey to black from the base, concentrically and radially cracked forming rectangular blocks, frequently covered with mosses from the base; margin acute to rounded, velutinate, entire, usually paler than the rest of the upper surface; pore surface yellowish to reddish brown; tubes slightly paler than the context, distinctly stratified, up to 15 mm deep, separated by a thin context layer, sterile margin up to 3 mm broad; pores round to weakly angular, 5-7 per mm, dissepiments fairly thin and entire; context golden to dark brown, fibrous, shiny, up to 12 mm thick.

Hyphal system dimitic; generative hyphae thin walled, hyaline to pale yellow, moderately branched, 2-3.5 μm wide, wider and darker in context; skeletal hyphae 3-4 μm wide, golden brown, thick walled; hymenial setae ventricose to rarely subulate, abundant to infrequent, 25-32 (35) x 6-11 μm, thick walled, dark brown; basidia 10-12 x 6-7 μm, broadly clavate; spores ovoid to subglobose, pale golden yellow to rusty brown, slightly thick walled, 4.5-5 (5.5) x 3.5-4.5 μm.

Habitat and Distribution

On dead and living hardwood trees especially belonging to the genera *Quercus, Cassia, Lonicera, Pyrus, Prunus, Rhus, Albizzia, Corylus*, etc.; causing white pocket rot; widely spread in tropical to temperate forests.

Remarks

The ungulate to subapplanate blackish fruitbodies with indurations and mosses growing from base are good field characters of this species. Older basidiocarps are glabrous except for a narrow marginal zone. Microscopically, ovoid to subglobose coloured spores and hymenial setae being more ventricose in Indian specimens, are characteristic.

Phellinus melanodermus (Pat.) O. Fidalgo Fig. 75
Mem. New York Bot. Gard. 17 : 135, 1968 - *Xanthochrous melanodermus* Pat., Ann. Jard. Bot. Buitenzorg, Suppl. 1: 113, 1897.

Basidiocarps perennial, sessile, ungulate, 12-20 cm wide. 8-10 cm broad and up to 15 cm thick, woody hard when dry, heavy; pileus glabrous with a distinct horny crust, radially and concentrically cracked, distantly sulcate, dark grey to dull black; margin round, entire, finely velutinate, yellowish brown, paler than pore surface and pilear surface; pore surface light brown becoming darker with age, with drops of honey-like exudation when actively growing; tubes distinctly layered, darker than the context, up to 5 mm deep in each layer; pores minute, 7-9 per mm, round; context up to 10 cm thick, homogeneous, chestnut brown, delimited on upper surface by a distinct black crust.

Hyphal system dimitic, generative hyphae hyaline to pale yellow, 2-4 μm wide, branched, septate; skeletal hyphae dominating, pale rusty brown, 2.5-5 μm wide, thick walled; setal hyphae common in context and dissepiments, dark reddish brown with distinct acute tips, rarely branched, thick walled to solid, 8-14 μm wide, up to 300 μm long in context, usually running parallel in the middle portion of the dissepiments and never or very rarely curving and projecting into

the lumen of the tubes; hymenial setae absent; basidia hyaline, clavate, 4-sterigmate, 5-8 x 3-5 μm; spores subglobose, hyaline to pale yellow, 4-5 x 3.5-4.5 μm, IkI-.

Habitat and Distribution :

On living tree trunks of *Schleichera oleosa* Oken and *Casuarina equisetifolia* L., never collected on dead wood and conifers; causing a white pocket rot; a rare species in tropical forests.

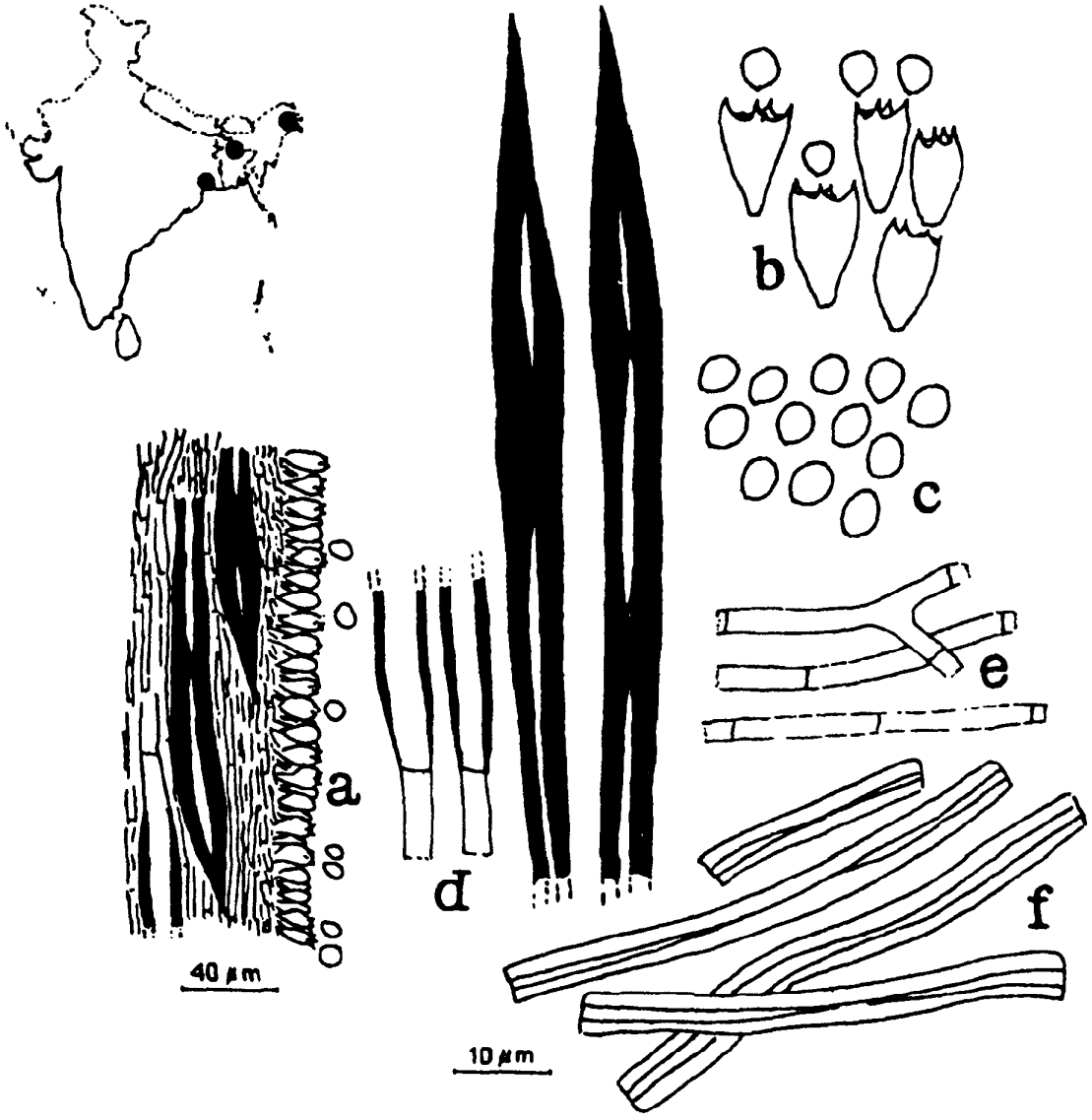


Fig. 75. *Phellinus melanodermus* (JRS 58906) a. section through tube, b. basidia, c. spores d. setal hyphae, e. generative, hyphae, f. skeletal hyphae.

Remarks

In the field *P. melanodermus* can be confused with *P. pachyphloeus* as both these species have crusted ungulate fruitbodies. But the basidiocarps of the former

are usually heavier in weight, grey to dull black and have excessively cracked pilear surface while in the latter the fruitbodies are comparatively lighter, light greyish brown to dark brown and have slightly cracked pilear surface. Microscopically absence of hymenial setae differentiates *P. melanodermus* from *P. pachyphloeus, P. lamaensis* and *P. portoricensis. P. noxius* differs from this species in having setal hyphae with obtuse ends running all along the dissepiments and frequently projecting into the lumen of the tubes.

Phellinus melleoporus (Murr.) Ryv. Fig. 76
Mycotaxon 23: 177, 1985 - *Fomitiporella melleopora* Murr., North Amer. Flora 9: 13, 1907; *Poria melleopora* (Murr.) Sacc. et Trott., Syll. Fung. 21: 330, 1912.

Basidiocarps perennial, first appearing in small patches, then coalesing and widely effused up to 15 cm long, and 8 mm thick, inseparable; margin bright to golden yellow, thinning, myceloid, rather narrow; pore surface golden brown to dark purplish brown, dark brown on bruising; tubes indistinctly stratified, concolorous with context, up to 6 mm deep, subwoody; pores 4-6 per mm, angular to round, dissepiments entire; context very thin, up to 2 mm thick, reddish brown, tough fibrous, continuing without change into the trama, azonate, sometimes with a black crustose layer next to the substratum.

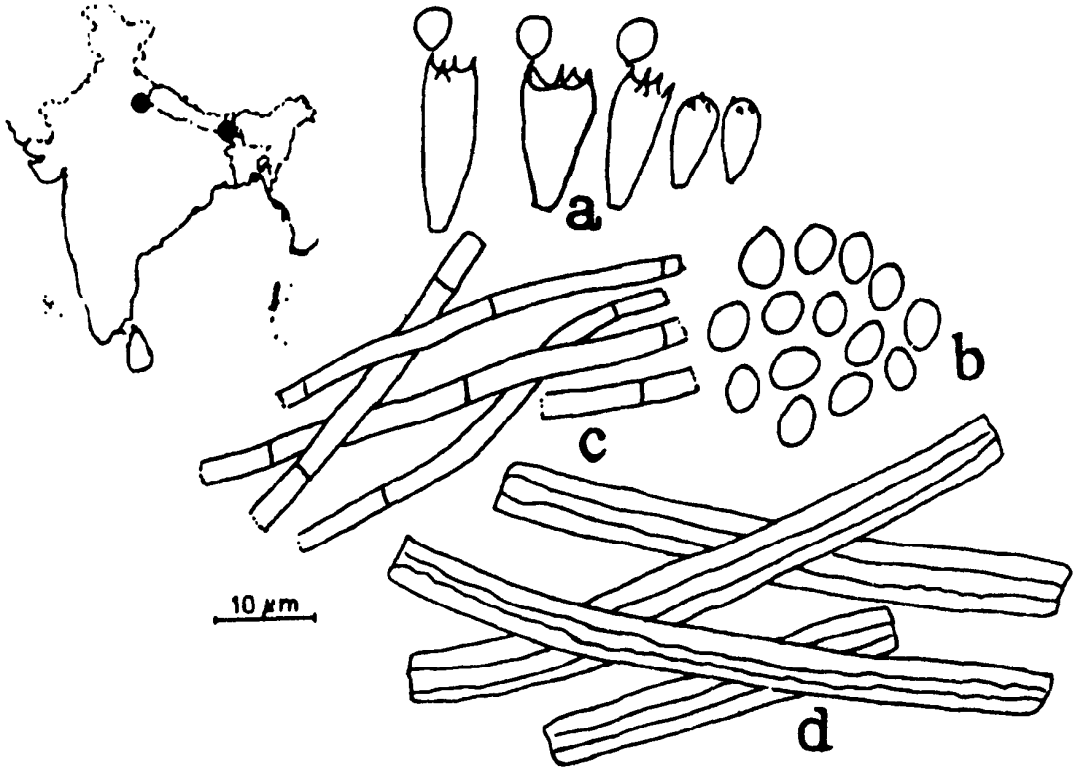


Fig. 76. *Phellinus melleoporus* (JRS 689) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae.

Hyphal system dimitic, generative hyphae hyaline to pale yellow, septate, branching rare, 2-3.5 μm wide; skeletal hyphae thick walled, golden to pale reddish brown; 3-6.5 μm wide; hymenial setae none; basidia cylindrical to clavate, 6-10 x 4-5.5 μm; spores ovoid to ellipsoid, pale brown to pale golden brown, smooth, thin walled, often flattened at one end, 4-5 x 3.5-4 μm.

Habitat and Distribution

On dead angiospermous woods especially on *Quercus* and *Acer;* causing white rot; a very rare species in temperate zones of Himalayas.

Remarks

The golden brown resupinate basidiocarps with fimbriate margin together with lack of hymenial setae and small pale brown spores are the features which make the species distinct. The lack of hymenial setae and slightly larger spores separate it from *P. johnsonianus* which sometimes is also found in resupinate form.

Phellinus merrillii (Murr.) Ryv. Fig. 77

Norw. J. Bot. 19 : 234, 1972 - *Pyropolyporus merrillii* Murr., Bull. Torrey Bot. Club 34: 479, 1907; *Fomes merrillii* (Murr.) Sacc. & Trott., Syll. Fung. 21: 287, 1912.

Basidiocarps perennial, sessile, solitary, pileate, broadly attached, woody hard when dry; pileus ungulate to conchate, up to 10 cm wide, 8 cm broad and 5 cm thick near the base; upper surface dark yellowish brown to reddish brown, matted tomentose to coarsely scrupose, concentrically sulcate in broad to narrow zones, in age becoming glabrous and blackish from the base, sometimes covered with mosses, more or less weakly cracked, crust as a distinct layer only in older and glabrous specimens; margin round, entire, yellowish brown, velutinate to tomentose in actively growing specimens; pore surface dark cinnamon to dark purplish brown, glancing; tubes indistinctly stratified, up to 8 mm thick, yellowish brown; pores round, regular, 4-5 per mm, dissepiments entire and thick; context up to 2 cm thick, shiny, golden brown, hard, woody, concentrically zonate, mostly dense and resinous on drying.

Hyphal system dimitic, generative hyphae simple septate, thin to slightly thick walled, hyaline to pale yellow, 2-3.5 μm wide; skeletal hyphae thick walled, dark brown; hymenial setae absent; basidia 10-14 x 6-7.5 μm, broadly clavate; spores ovoid to subglobose, pale yellow to rusty brown, 5-6 x 4-5 μm in diameter.

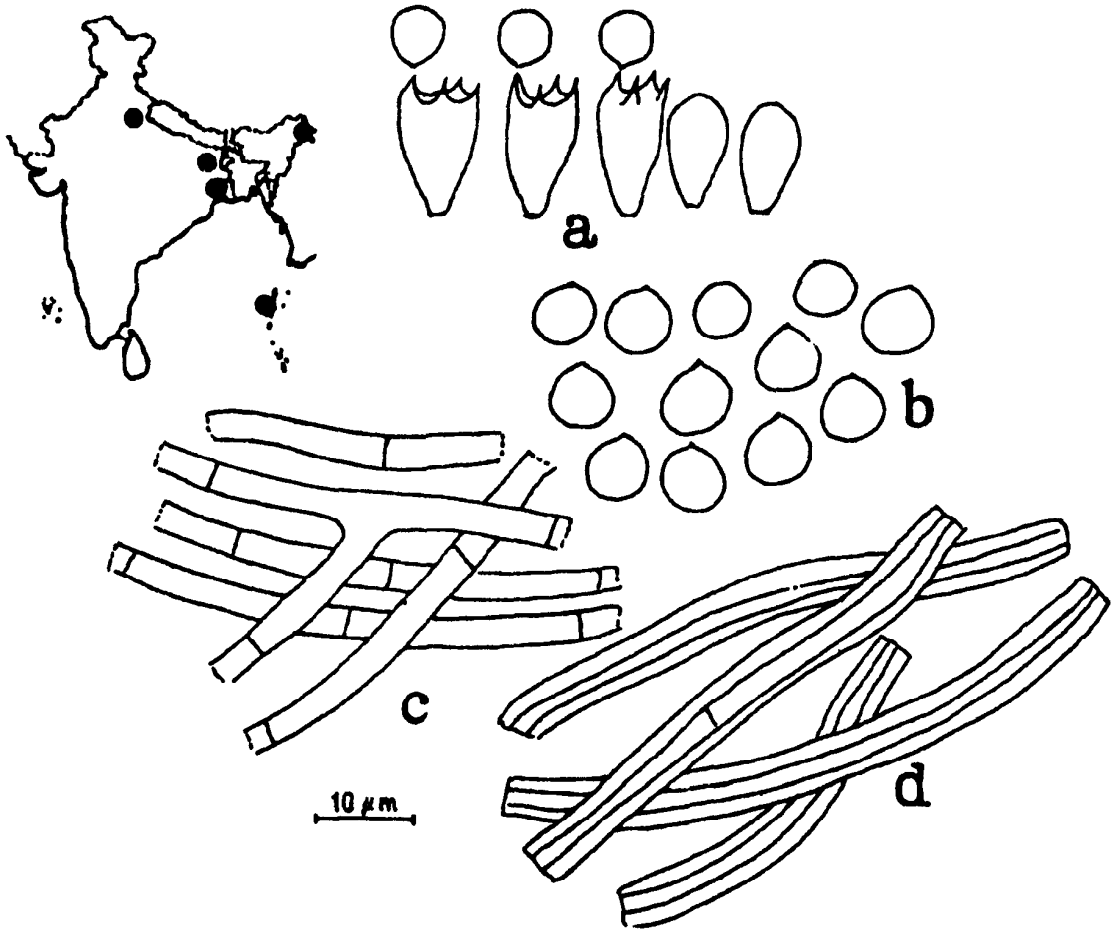


Fig. 77. *Phellinus merrillii* (JRS 64187) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae.

Habitat and Distribution

On dead wood of angiosperms; causing a white pocket rot; a rare tropical species.

Remarks

This species is characterised by the thick, almost ungulate, sulcate, matted tomentose pileus, medium sized pores, absence of hymenial setae and subglobose coloured spores. Distinctly sulcate and more or less persistently matted tomentose pilear surface which is also less rimose and ultimately does not form polygon shaped scales separate this species from the closely related *P. rimosus*.

Phellinus nigricans (Fr.) Karst. Fig. 78

Soc. Fauna Flora Fenn. 1: 134, 1899 - *Polyporus nigricans* Fr., Syst. Mycol. 1: 375, 1821.

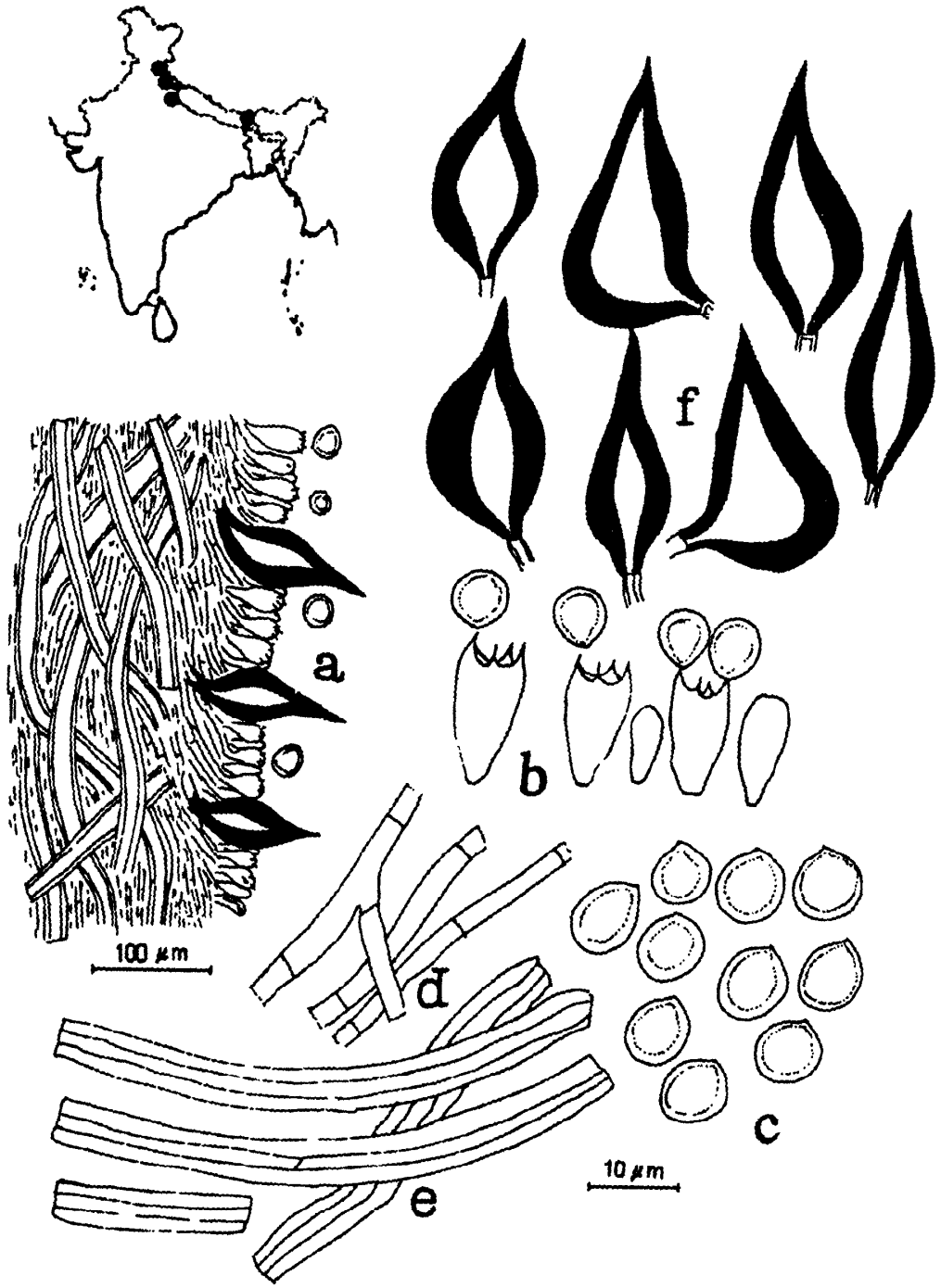


Fig. 78. *Phellinus nigricans* (JRS 61237) a. section through tube, b. basidia, c. spores, d. generative hyphae, e. skeletal hyphae, f. setae.

Basidiocarps perennial, single, effused-reflexed to sessile, semicircular to elongated, adnate, triquetrous in section, up to 15 cm broad, 8 cm wide and 1-3 cm thick near base, woody hard, heavy; upper surface greyish black to black with

a thick crust, with narrow and distinct growth zones, cracked both radially and concentrically when old; margin acute, greyish brown; pore surface cinnamon brown to deep rusty brown or greyish brown; tubes concolorous with context or paler, indistinctly stratified, up to 2 cm deep; pores round or somewhat ellipsoid, 5-7 per mm; context dark rusty or reddish brown, dense, up to 10 mm thick, woody hard on drying, homogeneous.

Hyphal system dimitic, generative hyphae hyaline to pale yellow, branched, simple septate, 2-3 μm wide; skeletal hyphae thick walled, interwoven in the trama; 4.5-5 μm wide; hymenial setae numerous, strongly ventricose, dark brown, 12-20 (24) x 4-7 μm, often with a basal side projection; protruding 6-10 μm above hymenium; basidia clavate 8-15 x 5-6 μm, 4-sterigmate; spores globose to subglobose, thick walled, walls thick up to 1 μm, darker in KOH, (5.5) 6-7 x 5-6.5 μm, hyaline.

Habitat and Distribution

On dead wood of *Betula utilis;* causing intensive white rot; widely spread in the subalpine *Betula* forests of Himalayas.

Remarks

The species is characteristic in its host specificity and range of occurrence coinsides with the *P. laevigatus* and *P. igniarius* (Niemela 1975). The pileate dark greyish black crusty fruitbodies and larger thick walled spores however make the species distinct in the *P. igniarius* group. *P. nigricans, P. laevigatus* and *P. igniarius* are very close and can be separated as follows :

	P. nigricans	*P. laevigatus*	*P. igniarius*
1.	Effused-reflexed to rarely sessile	resupinate	sessile to rarely effused -reflexed
2.	Pilear surface black	--	greyish black
3.	Margin acute	acute to obtuse	obtuse
4.	Pore surface greyish to rusty brown	pore surface greyish brown	pore surface yellowish to pale cinnamon brown
5.	Skeletal hyphae in trama inter-twined	parallel	intertwined

6.	Spores 6-7 x 5-6.5 μm, walls thick up to 1 μm.	Spores 4-5 x 3-4 μm, thin walled	Spores 5-7 x 4-6μm, slightly thick walled.
7.	On *Betula*	on *Betula*	on other angiospermous trees.

Phellinus nilgheriensis (Mont.) Cunn. Fig. 79

New Zealand Dept. Sci. Ind. Res. Bull. 164: 26, 1965- *Polyporus nilgheriensis* Mont., Ann. Sci. Nat. Bot. 18: 12, 1842; *Polyporus garckeanus* P. Henn., Hedw. 40: 330, 1901; *Fomes pseudosenex* Murr., North Amer. Flora 9; 107, 1908.

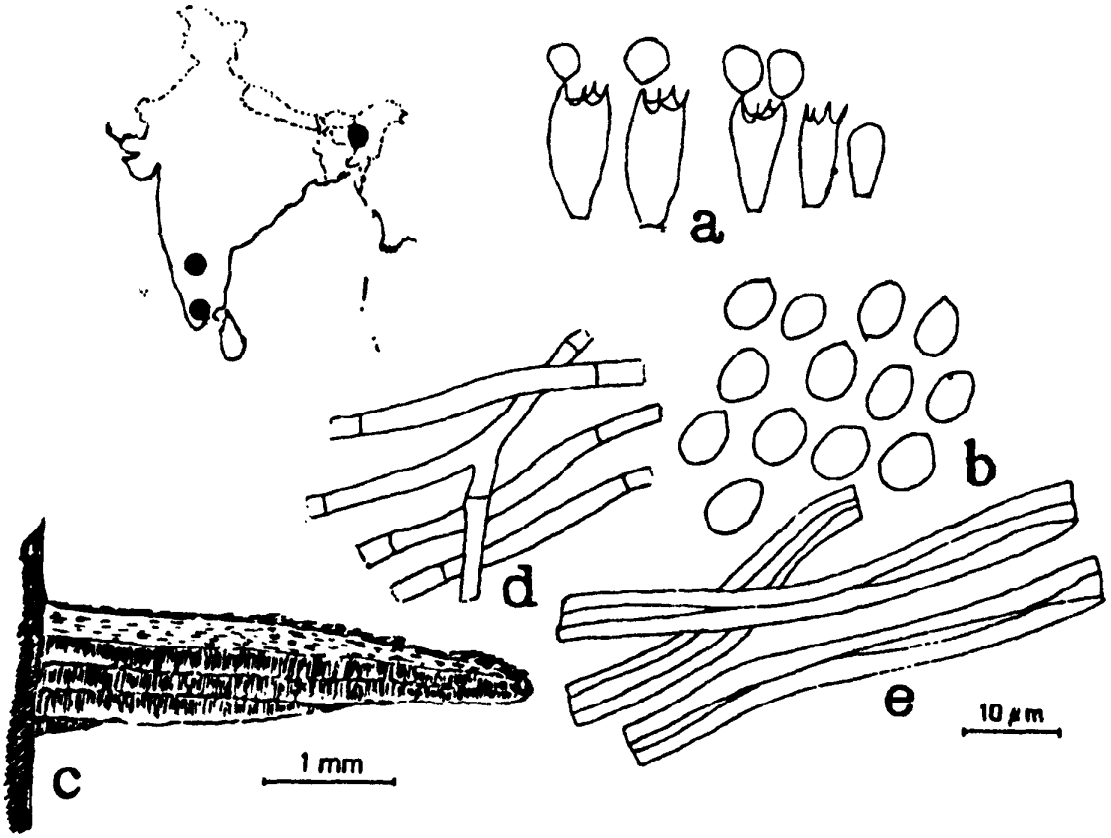


Fig. 79. *Phellinus nilgheriensis* (JRS 299) a. basidia, b. spores, c. section through basidiocarp, d. generative hyphae, e. skeletal hyphae.

Basidiocarps perennial, solitary, sessile, applanate, semicircular, up to 12 cm broad, 8 cm wide and 2-3 cm thick at the base, woody hard, first tomentose, soon glabrous, except for a thin zone along the margin, pale reddish brown, blackish brown at the base, with a thick black crust becoming thicker with age, sulcate in wide and mostly rounded zones; margin round to sharp pore surface dark

yellowish brown to dark reddish brown; tubes dark brown, distinctly stratified, up to 2 cm thick near base; pores round, 8-10 per mm; context golden brown, shiny, fibrous and easily fragmented, with several black lines throughout and a dense dark brown to almost black line at the upper surface.

Hyphal system dimitic, generative hyphae hyaline to pale yellow, simple septate, 2-3 μm wide; skeletal hyphae golden to dark brown, 3-6 μm wide, with a wide lumen, darker and up to 8 um in the context; hymenial setae none; basidia narrowly clavate, 8-12.5 x 5-6 μm, 4-sterigmate; spores subglobose, 4.5-5.5 x 4-4.5 μm, rusty brown.

Habitat and Distribution

On dead angiospermic wood; causing a white stringy rot; a rare species found from tropical to temperate forests.

Remarks

Applanate fruitbodies, absence of black lines next to substratum and wider skeletal hyphae separate this species from the closely related *P. allardii*. Further, the basidiocarps are denser heavier and with many layered tubes, in the latter. This species also resembles with *P. extensus*. But usually, the pilear surface in the latter remains adpressed tomentose for a longer period and also it has hymenial setae.

Phellinus noxius (Corner) Cunn. Fig. 80

New Zealand Dept. Sci. Ind. Res. Bull. 164: 221. 1965 - *Fomes noxius* Corner, Gard. Bull. Straits, Sett. 5: 324, 1932.

Basidiocarps perennial, solitary to imbricate, effused-reflexed to sessile, woody hard, light in weight when dry; pileus up to 10 cm wide, 5-6 cm broad and 3-4 cm thick near the base; upper surface reddish brown to reddish black or black, glabrous with a resinous hard crust, azonate to sometimes faintly and irregularly zonate, frequently nodulose at the centre; margin obtuse, entire, somewhat undulate, yellowish brown to pale ochraceous when fresh, concolorous with pileus in age; pore surface greyish or pale brownish when young, reddish brown with age; tubes distinctly layred, 1-3 mm deep in each layer; pores small, 6-8 per mm, subcircular to subangular, dissepiments moderately thick walled, entire; greyish to chocolate brown, darker than the context; context 1-2 cm thick at base, zoned, pale to golden brown, up to 200 μm thick crust above, radially firbous.

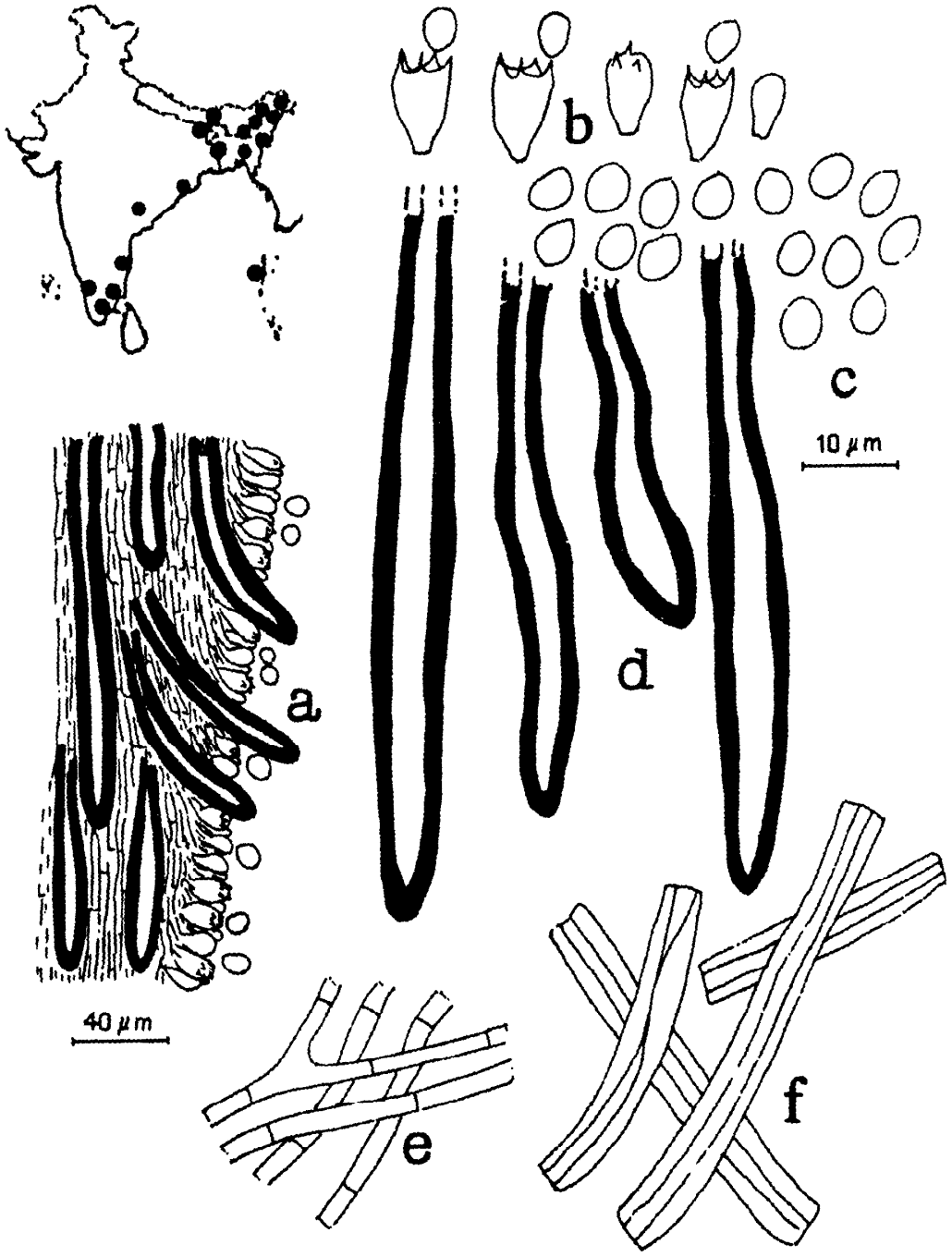


Fig. 80. *Phellinus noxius* (JRS 60861) a. section through tube, b. basidia, c. spores, d. setal hyphae, e. generative hyphae, f. skeletal hyphae.

Hyphal system dimitic, generative hyphae hyaline to pale yellow, 2-3.5 µm wide; skeletal hyphae thick walled, dominating, rusty brown, 5-6.5 µm wide; setal hyphae present, 7-16 µm wide, up to 450 µm long, rare and narrower in context,

abundant and wider in dissepiments, frequently projecting into the lumen of tubes, dark reddish brown, tips obtuse; hymenial setae absent; basidia hyaline, 4-sterigmate, 6-9.5 x 3-4.5 μm; spores hyaline, subglobose to broadly ellipsoid, smooth, thin walled, 3.5-4.5(5) x 3-3.5 μm, not seen in dried herbarium specimens.

Habitat and Distribution

On dead angiospermous woods, also found as a parasite on species of *Poinciana, Cinchona, Acacia, Coffea* and *Thea;* causing a white rot, a common tropical to subtropical species especially in Eastern Himalayas, plains of Eastern and Southern India.

Remarks

The effused-reflexed to sessile, black, crusty, nodulose basidiocarps becoming lighter on drying together with obtuse-tipped setal hyphae frequently projecting into the lumen make this species distinct.

Phellinus pachyphloeus (Pat) Pat. Fig. 81
Essai Taxon. Hymeno p. 97. 1900. *Polyporus pachyphloeus* Pat., J. Bot. (Morot) 3 : 257, 1889; *Fomes pachyphloeus* (Pat.) Bres., Bull. Soc. Mycol. France 6: 41, 1890.

Basidiocarps perennial, solitary, woody hard, light in weight on drying, ungulate to applanate, broadly attached, sessile; pileus up to 80 cm broad, 60 cm wide and 10-20 cm thick near the base; upper surface velvety to tomentose, yelowish to greyish brown, watery when young, soon glabrous, with a thick hard crust, dark brown to greyish black, sulcate to rugulose in wide concentric zones, irregularly cracking and light in weight on drying; margin obtuse, entire, persistently velutinate; pore surface cinnamon to greyish brown; tubes distinctly to indistinctly stratified, usually concolorous with the context, up to 5 mm in each layer; pores small, invisible to the naked eyes, 8-10 per mm, dissepiments fairly thick; context medium to light yellowish brown, with white mycelial strands, woody, up to 8 cm thick, limited by a black crust at upper surface.

Hyphal system dimitic, generative hyphae hyaline to pale yellow, thin walled, 2-4 μm wide; skeletal hyphae thick walled, yellowish to golden brown, 3-5 μm wide; setal hyphae present in the context and dissepiments, dark brown, up to 25 μm wide and 300 μm long, tips pointed, thick walled to solid, frequently projecting into the lumen of the tubes; hymenial setae present, projecting above

the hymenium, thick walled, dark brown, subventricose to ventricose, 10-30 (35) x 4-10 μm; basidia clavate, 4-sterigmate, hyaline, 6-9 5 x 3.5-5 μm; spores subglobose to globose, thin walled, hyaline to pale yellow, 4.5-5.5 x 4-4.5 μm, nonamyloid, usually not found in dried herbarium specimens.

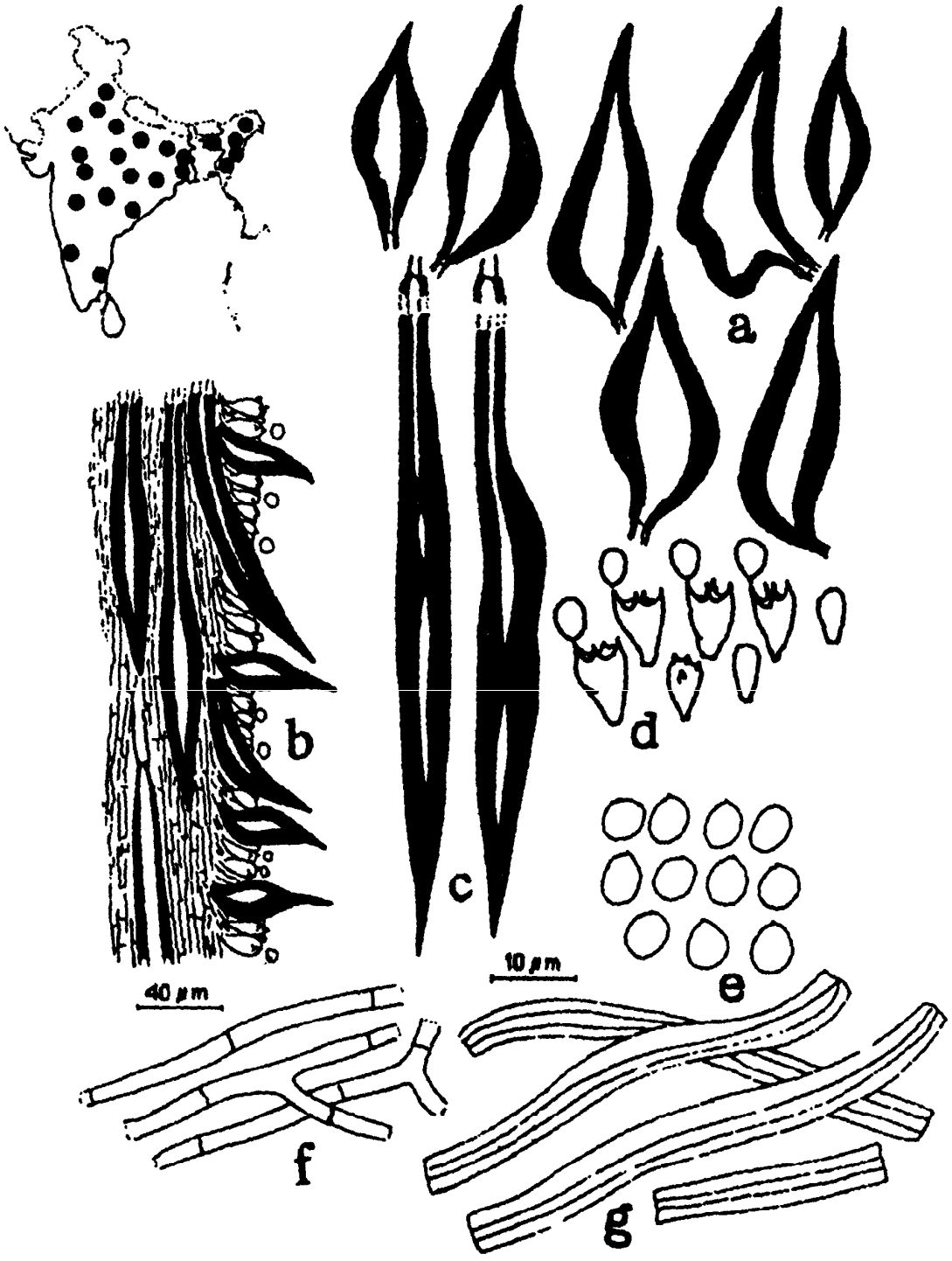


Fig. 81. *Phellinus pachyphloeus* (JRS 239) a. setae, b. section through tube, c. setal hyphae, d. basidia, e. spores, f. generative hyphae, g. skeletal hyphae.

Habitat and Distribution

On both dead and living tree trunks and branches of angiospermous trees especially the species of *Ficus* and *Mangifera* and less frequently on species of *Anogeissus, Terminalia, Cassia, Bruguiera, Acer Rhizophora, Albizzia, Shorea,* etc; never collected on conifers; causing a white stringy rot of sap wood and heart wood; common species in the plains of India.

Remarks

The basidiocarps are the largest among all the Indian aphyllophoraceous fungi. The margin is persistently velutinate and somewhat watery. The ungulate basidiocarps which become remarkably lighter on drying, a thick crust and yellowish brown punky context are the good field characters. The abundant and wider setal hyphae with pointed tips are other important characters of this species.

Phellinus pectinatus (Kl.) Quel. Fig. 82

Ench. Fung., p. 173, 1886 *Polyporus pectinatus* Kl. Linnaea 8: 485, 1833; *Fomes pectinatus* (Kl.) Gill., Champ. Franch 1: 686, 1878; *Polystictus haskarlii* (Lev.) Cke., Grevillea 14: 86, 1886.

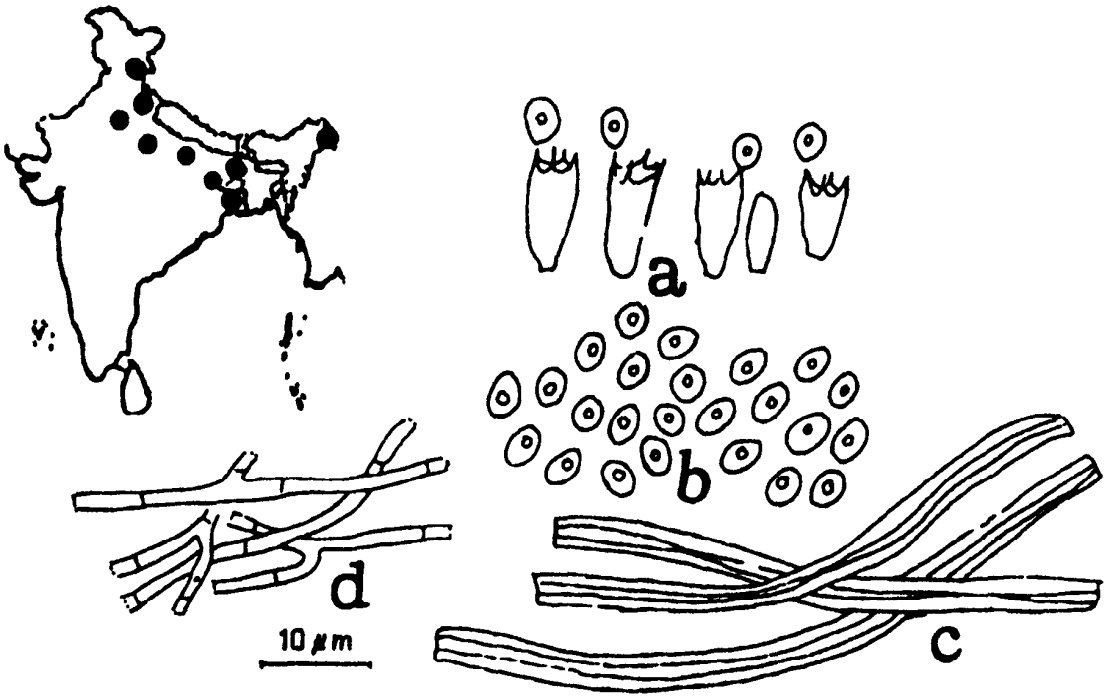


Fig. 82. *Phellinus pectinatus* (JRS 14466) a. basidia, b. spores, c. skeletal hyphae, d. generative hyphae.

Basidiocarps perennial, pileate, applanate to conchate or subungulate, frequently imbricate with several pilei from a common base, up to 20 cm wide, 15 cm broad and 2-3 cm thick near the base, woody hard and heavy when dry; upper surface with a compressible tomentum when young, cinnamon to rusty brown, with age a black surface is exposed from the base, finely sulcate with a thin black crust; margin entire or lobed, usually paler than the basal part of the pileus; pore surface yellowish brown to golden yellow, glancing on turning to incident light, the pore surface recedes typically in older and thicker fruitbodies; tubes distinctly stratified, 1-2 mm deep in each layer, thin context present between tube layers, totally up to 20 mm deep, yellowish brown; pores tiny, invisible to the naked eye, 8-10 per mm; context duplex in younger specimens, the lower part very dense and dark reddish brown, up to 1 mm thick, the upper part of more loose consistency than the lower part, a distinct black line separating the upper tomentum and lower denser part.

Hyphal system dimitic, generative hyphae thin walled, simple septate, 1.5-3 μm wide; skeletal hyphae thick walled, golden to rusty brown, 2.5-5 μm wide; hymenial setae none; basidia 7-9 x 4-5 μm, 4-sterigmate; spores abundantly present, globose to subglobose, hyaline to pale yellow, one-guttulate, often collapsed, 3-3.5 x 2-3 μm, IkI-.

Habitat and Distribution

On living trees of angiosperms belonging to genera *Murraya, Carissa, Pyrus, Prunus, Eugenia;* causing a white stringy rot; a common tropical species, extending up to warmer temperate zones.

Remarks

The species is usually recognised in the field by closely sulcate pilear surface, duplex context, a thin black line below the tomentum, glancing and often receding pore surface from the margin and microscopically by globose to subglobose spores and absence of any setal organs.

Phellinus pini (Thore : Fr.) Ames Fig. 83

Ann. Mycol. 11: 246, 1913 *Boletus pini* Thore, Essai Chloris Dep. Landes. p. 487, 1803 : *Daedalea pini* Thore : Fr., Syst. Mycol. 1: 336, 1821; *Fomes pini* (Thore : Fr.) Karst., Bidrag Kannedom Finnlands Natur Folk 37 : 79, 1882; *Trametes pini* (Thore : Fr.) Fr., Epicr. Syst. Mycol., p. 489, 1836-1838.

Basidiocarps resupinate to effused reflexed or pileate, sessile, attached by a broad base, conchate to ungulate, solitary to imbricate, woody hard, up to 10 cm

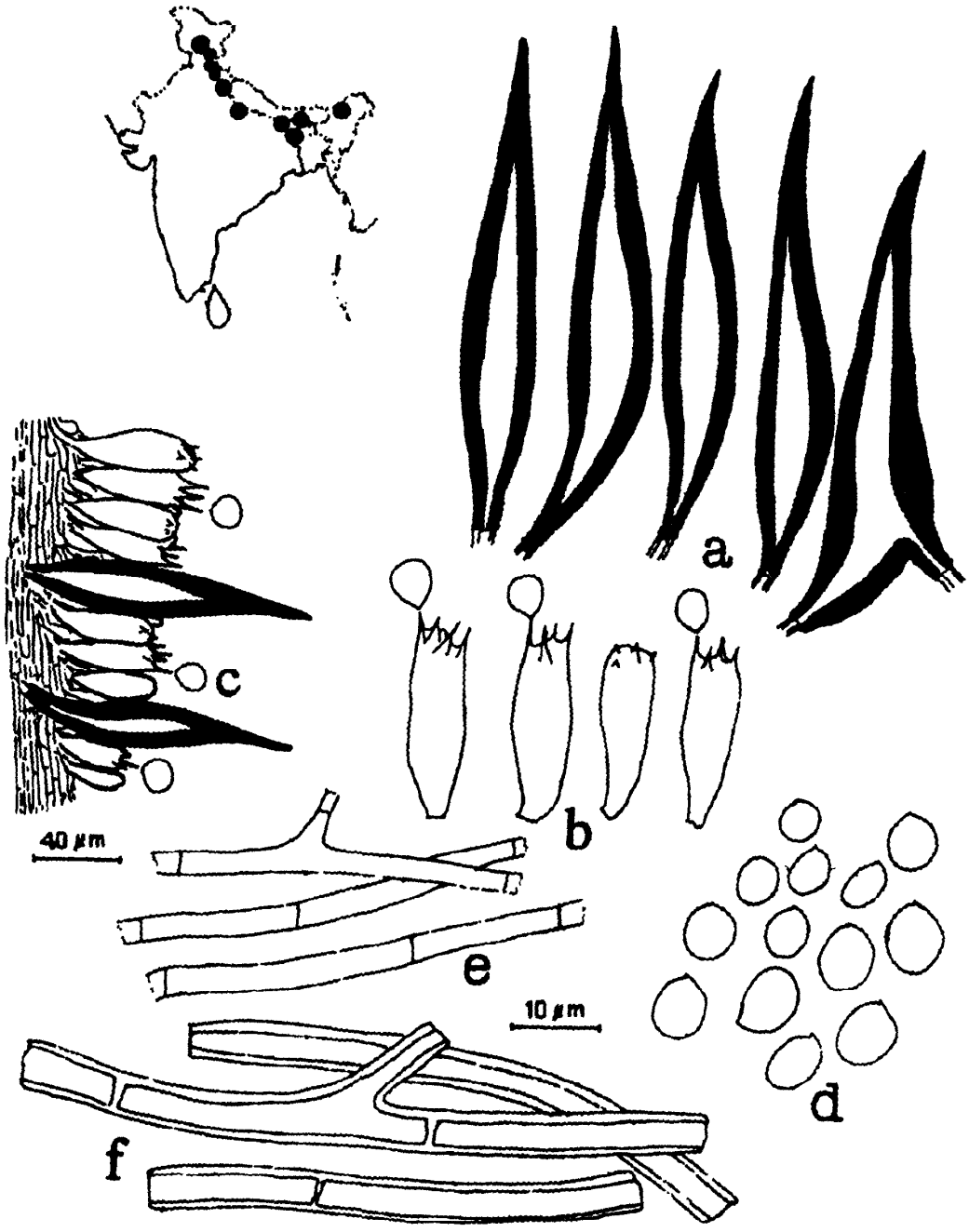


Fig. 83. *Phellinus pini* (JRS 60132) a. setae, b. basidia, c. section through tube, d. spores, e. generative hyphae, f. skeletal hyphae.

broad, 8 cm wide and 4-5 cm thick; upper surface first yellowish brown to reddish brown becoming greyish black to brownish black or black from the base, zonate, first adpressed tomentose, becoming glabrous at places, cracking and becoming rough; margin usually acute and even, maroon, blackish when old; pore surface yellowish to reddish brown; tubes distinctly stratified, up to 6 mm deep

in each layer, firm, corky to rigid; pores angular to sinuous or deadaleoid, 2-4 per mm; context yellowish brown to reddish brown, woody hard, with a thin black line in between context and tomentum, shiny, 3-4 mm thick.

Hyphal system dimitic; generative hyphae simple septate, thin walled, hyaline to pale yellow, branched; skeletal hyphae thick walled, golden to rusty brown, 3-5 μm wide; hymenial setae abundantly present, reddish brown to brownish black, subulate, thick walled, 35-55 x 6-11 μm, projecting up to 40 μm beyond the hymenium; basidia narrowly clavate, 7-11 x 4-5.5 μm, 4-sterigmate; spores hyaline to pale yellow, thin walled, globose to subglobose 5.5-6.5(7) x 4-5.5 μm.

Habitat and Distribution

Common on conifers mainly *Pinus Wallichiana* less frequently on *Abies pindrow* (Royle) Spach and species of *Cedrus* and *Larix;* causing a destructive white pocket rot; widely spread and a common species in the temperate coniferous forests of Himalayas.

Remarks

This species is very confusing with regard to variation in the shape and size of basidiocarps and pores. However, its occurrence on conifers only, cracked and rough pilear surface, sinuous to deadaleoid pores, abundant and fairly large hymenial setae are features which make it distinct.

Phellinus portoricensis (Overh.) O. Fidalgo. Fig. 84
Mem. New York Bot. Gard. 17: 111, 1968 - *Fomes portoricensis* Overh. in Seav & Chard., Sci. Surv. Puerto Rico & Virgin Is. 8: 158, 1926.

Basidiocarps perennial, sessile, applanate to rarely effused-reflexed, up to 5 cm broad, 4 cm wide and 1-1.5 cm thick at base; upper surface dark reddish brown, reddish black with age, persistently velutinate in narrow concentric sulcate zones; margin entire, obtuse, sterile, yellowish brown; pore surface yellowish to deep brown; tubes brown, layers distinct with brown context in between, 1-3 mm deep much darker than the context; pores minute, round to angular, 7-8 per mm; context duplex, lower part up to 3 mm thick, fibrous, yellowish brown, limited upwards by a black line over which lies 0.5 mm thick, soft layer of looser reddish brown tomentum, in old and weathered basidiocarps, the upper loose layer is removed and the black zone form the crusty upper surface.

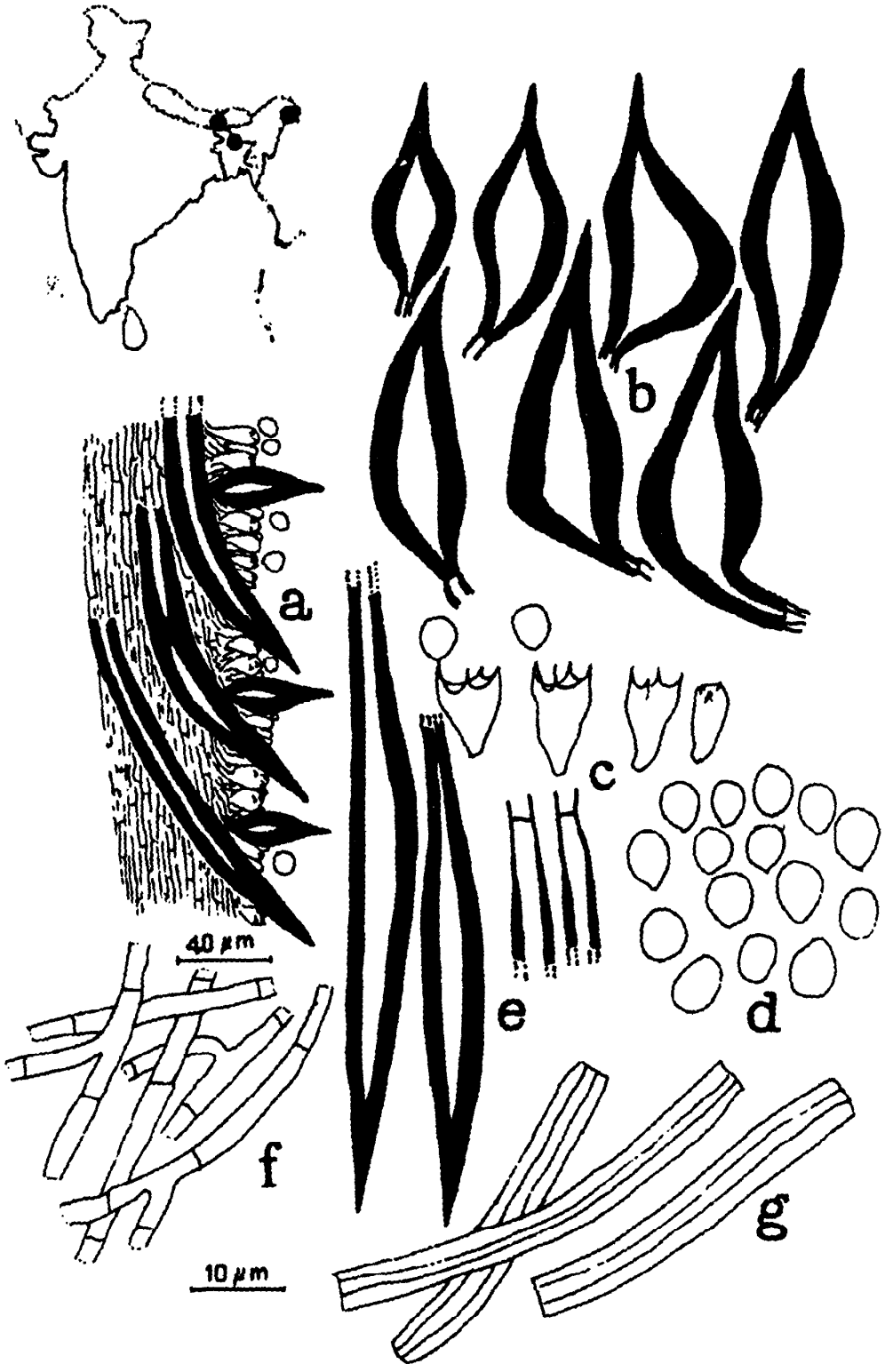


Fig. 84. *Phellinus portoricensis* (JRS 60105) a. section through tube, b. setae, c. basidia, d. spores, e. setal hyphae, f. generative hyphae, g. skeletal hyphae.

Hyphal system dimitic, generative hyphae hyaline to pale yellow, 2-3.5 μm wide; skeletal hyphae thick walled, pale rusty brown, 3-5 μm wide; setal hyphae present both in context, and dissepiments; 100-300 μm long and 8-16 μm broad, dark ferruginous, unbranched with straight acute tips, frequently projecting into the lumen of the tubes; hymenial setae abundant, ventricose to subulate with straight and acute tips, dark ferruginous, solid with narrow lumen, 25-42 x 6-7.5 μm; absent; basidia hyaline, clavate, 4-sterigmate; spores abundant, subglobose to broadly ellipsoid, thin walled, pale to rusty brown, 3.5-5 x 3-4 μm, IkI-.

Habitat and Distribution

Parasitic on *Schima wallichii* and *Shorea robusta* in Eastern and Sikkim Himalayas; causing a white heart-rot of standing trees; a rare species found in tropical to warmer temperate zones.

Remarks

Persistently velutinate pilear surface and duplex context are good field characters. Microscopically, the presence of abundant setal hyphae, fairly large hymenial setae and coloured spores are quite unique and make this species easily recognisable in its group.

Phellinus punctatus (Fr.) Pilat Fig. 85

Atl. Champ. Europe 3: 530, 1942 - *Polyporus punctatus* Fr., Hymen. Europe p. 572, 1874; *Poria punctata* (Fr.) Karst., Bidr. Kannedom Finl. Natur. Folk. 37: 83, 1882.

Basidiocarps perennial, resupinate, widely effused, elongated up to 15 cm long and 1-4 cm wide, cushion shaped to pulvinate, distinctly thickened up to 2 cm in the centre, woody hard, not easily separable; margin yellowish brown to grey reddish brown, up to 1 cm wide, tomentose, receding, blackish and rimose in older specimens, loosening when dry; pore surface smooth; greyish brown, dull, cracking when old and dry; tubes distinctly strtified, usually with thin bands of context in between layers, up to 4 mm deep in each layer; pores round and small, 5-6 per mm, mostly oblique; context golden to dark reddish brown, thin, firm.

Hyphal system dimitic, generative hyphae hyaline to light yellowish, simple septate, 2.5-4 μm wide; skeletal hyphae thick walled with a distinct lumen, yellowish to rusty brown, 3-6 μm wide; hymenial setae present, rare to scattered, ventricose, 14-25 x 4-8 μm, rusty brown to almost black, scarcely projecting;

cystidioles present in the hymenium, thin walled, hyaline, narrowly clavate to bottle shaped or ventricose with tapering, acute or tubular whiplike tips projecting beyond the hymenium, difficult to observe in dry specimens; basidia broadly clavate, 8-12 x 7-8 μm; spores broadly ovoid to subglobose, hyaline to pale yellowish, thin walled, strongly dextrinoid, 6-7 (7.5) x 5-6.5(7), one-guttulate.

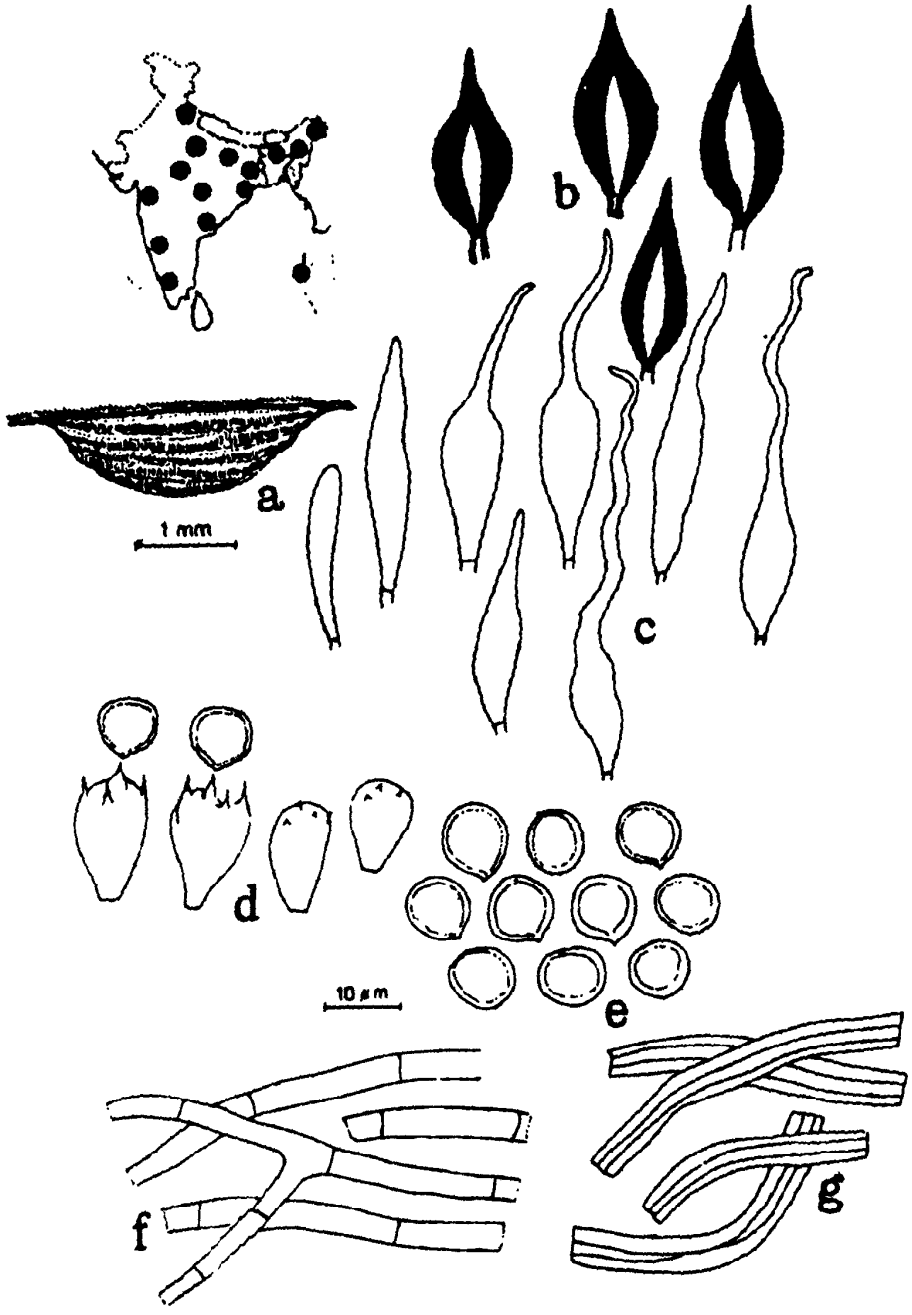


Fig. 85. *Phellinus punctatus* (JRS 78311) a. section through basidiocarp, b. setae, c. cystidioles, d. basidia, e. spores, f. generative hyphae, g. skeletal hyphae.

Habitat and Distribution

Mostly on dead, rarely on living branches and trunks of standing deciduous trees; causing a uniform white rot; common and widely spread species in tropical regions.

Remarks

The occurrence of hymenial setae is quite a variable character. In Indian collections of this species, the hymenial setae have always been found present though very rare and scattered. The cushion-shaped, resupinate, grey reddish brown basidiocarps are good field characters. It is only the resupinate habitat which separates it from *P. robustus*. Microscopically both have large hyaline, strongly dextrinoid spores, and bottle-shaped to ventricose cystidioles in the hymenium.

Phellinus purpureogilvus (Petch) Ryv. Fig. 86
Norw. J. bot. 19: 235, 1972 - *Poria purpureogilva* Petch, Ann. Roy. Bot. Gard. Peradeniya 6: 138, 1916.

Basidiocarps perennial, widely effused, first in small cottony patches and later coalesing into 10-15 cm long, 4-6 cm broad and 2-5 mm thick, adnate; margin thin, soft, velutinate when young, smooth, reddish brown on drying; pore surface purplish dark brown; pores 6-7 per mm; tubes not stratified, up to 6 mm deep; context reddish brown, up to 1 mm thick.

Hyphal system dimitic, generative hyphae hyaline to pale yellow, septate, 2-3.5 μm wide; skeletal hyphae golden to dark brown, unbranched, 3-4 μm; hymenial setae abundant, 30-40 (50) x 5-7 μm, thick walled, acuminate, dark brown; cystodioles hyaline, clavate to ventricose or bottle shaped with a tubular tip, up to 20 μm long; basidia clavate, 9-12 x 5-6.5 μm; spores subglobose to broadly ellipsoid, 3.5-4.5 x 3-3.5 μm, hyaline to pale yellow, non-amyloid.

Habitat and Distribution

On dead thin branches of standing angiospermous trees; causing a white rot; widely spread and common in the tropical forests.

Remarks

The purplish colour is quite prominent in Indian collections and is diagnostic of this species in the field. Microscopically, the larger size of the setae and presence of cystidioles separate it from the related *P. glaucescens* and *P. ferrugineo-velutinus*.

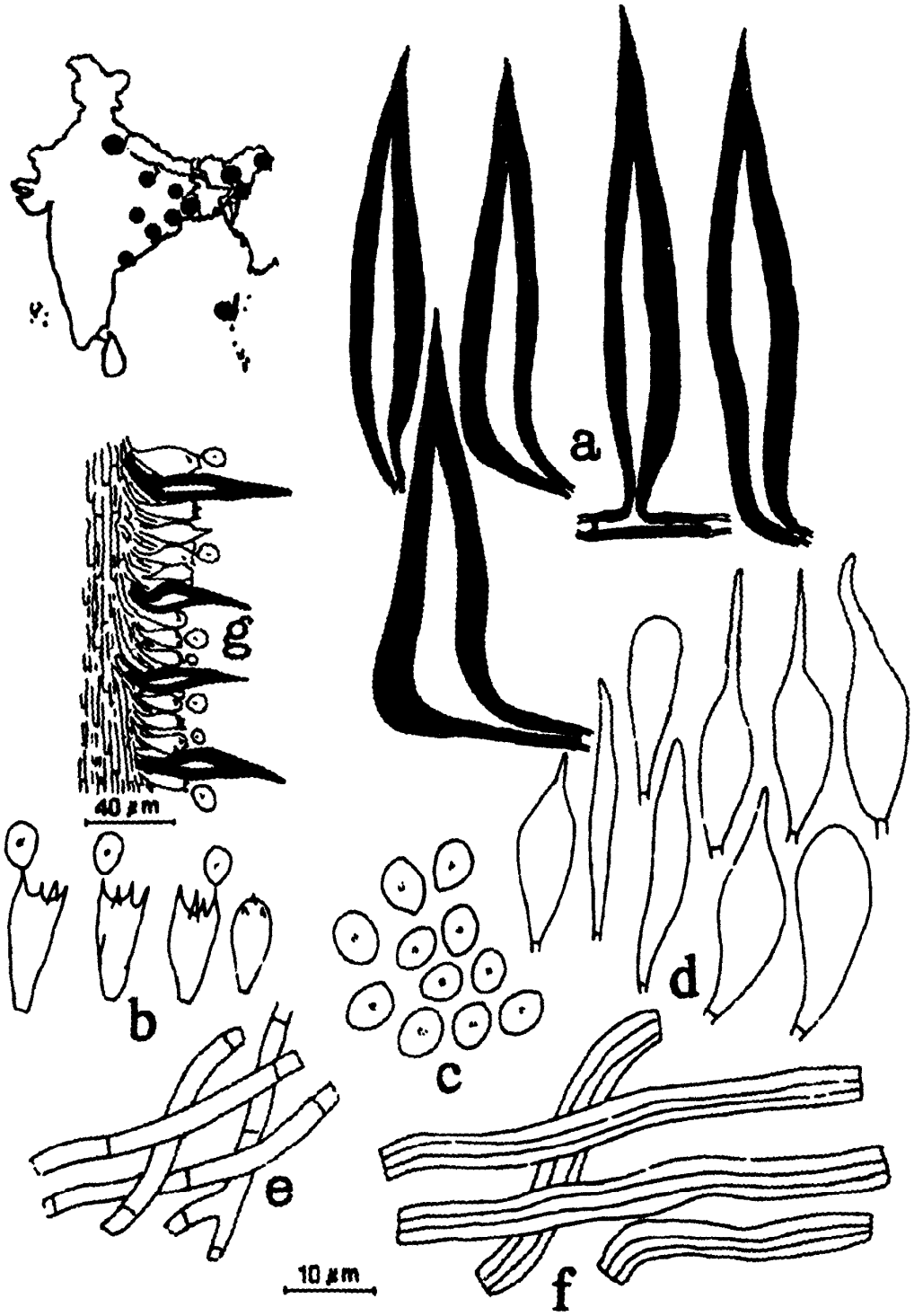


Fig. 86. *Phillinus purpureogilvus* (JRS 78313) a. setae, b. basidia, c. spores, d. cystidioles, e. generative hyphae, f. skeletal hyphae, g. section through tube.

Phellinus rhabarbarinus (Berk.) Cunn. Fig. 87

New Zealand Dep. Sci. Ind. Res. Bull. 164 : 229, 1965 - *Polyporus rhabarbarinus* Berk., Ann. Nat. Hist. 3: 388, 1839; *Fomes rhabarbarinus* (Berk.) Sacc., Syll. Fung. 6: 16, 1888.

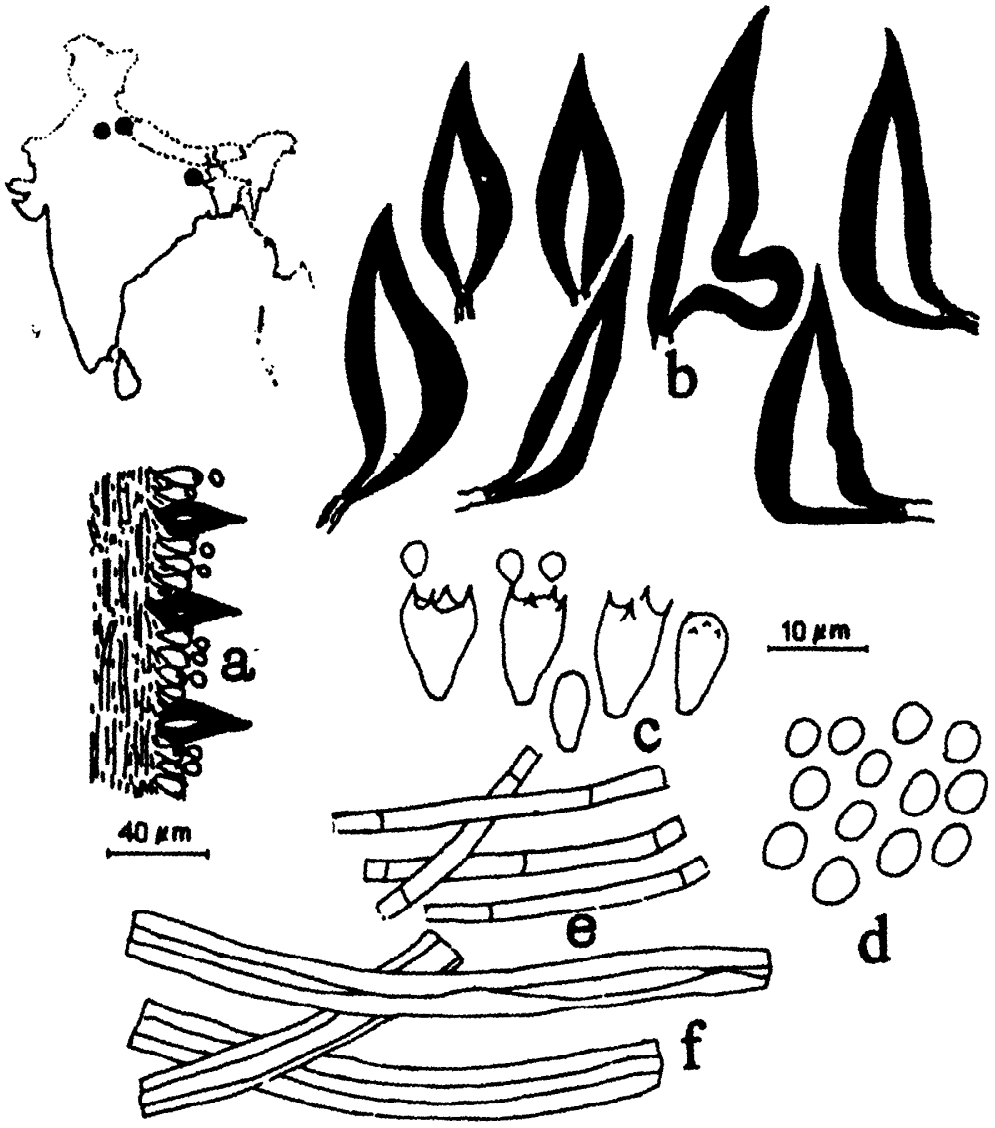


Fig. 87. *Phellinus rhabarbarinus* (JRS 358) a. section through tube, b. setae, c. basidia, d. spores, e. generative hyphae; f. skeletal hyphae.

Basidiocarps perennial, solitary, pileate, applanate to subungulate, attached by a broad lateral base, semicircular to elongated, up to 6 cm wide and broad, 1-1.5 cm thick at base, woody hard when dry; pileus glabrous, concentrically sulcate in variable zones, first date brown, then reddish black, greyish to almost

black with age, with a distinct black crust; margin round to acute, matted tomentose, narrowly sterile, lighter than the pileus; pore surface first pale cinnamon, later dark reddish brown; tubes concolorous with pore surface, 1-3 mm deep in each layer, indistinctly stratified; pores round, small, 7-10 per mm, entire; context dark yellowish to chestnut brown when young, darkening with age to umber brown with a silky lustre, fibrous, up to 10 mm thick at base.

Hyphal system dimitic, generative hyphae thin to slightly thick walled, 2.5-3.5 μm wide; skeletal hyphae golden to pale rusty brown, thick walled, 3-6 μm wide; hymenial setae abundant, subulate to ventricose, straight, thick walled, dark brown, 14-22 x 5-8 μm; basidia broadly clavate, hyaline 9-11.5 x 5-6 μm; spores subglobose to broadly ellipsoid, hyaline, 2.5-3.5 (4) x 2.5-3 μm in diameter.

Habitat and Distribution

On dead hardwoods; causing a white rot; a rare tropical to subtropical species.

Remarks

This species is characterized by its glabrous pilear surface in sulcate zones, a distinct black crust, brownish context with a silky lustre and smaller pores and hyaline spores.

Phellinus rimosus (Berk.) Pilat Fig. 88

Ann. Mycol. 38 : 80, 1940 - *Polyporus rimosus* Berk., Lond. J. Bot. 4: 54, 1845; *Fomes rimosus* (Berk.) Fr., Act. Rov. Soc. Sci. Upsala (Ser. 3) 1: 56, 1851; *Fomes rimosus* (Berk.) Cke., Grevillea 14: 18, 1885.

Basidiocarps pileate, perennial, solitary, mostly ungulate, semicircular and dimidiate with a contracted base, up to 8 cm wide, 6 cm broad and 1-3 cm thick at base, dull greyish brown to greyish black; pilear surface glabrous, except for a narrow marginal zone, faintly sulcate with a few wider zones, in age the surface cracks up irregularly or somewhat fissured, forming irregular black polygon shaped scales becoming more prominent in older specimens; margin obtuse, thick, somewhat lighter than the pileus; pore surface yellow brown, concave, undulating and irregular; tubes fulvous brown, distinctly stratified, up to 7 mm deep, separated by blackish layers of context; pores round, 4-5 per mm, dissepiments thick; context rusty brown, dense, shiny, 1-3 cm thick.

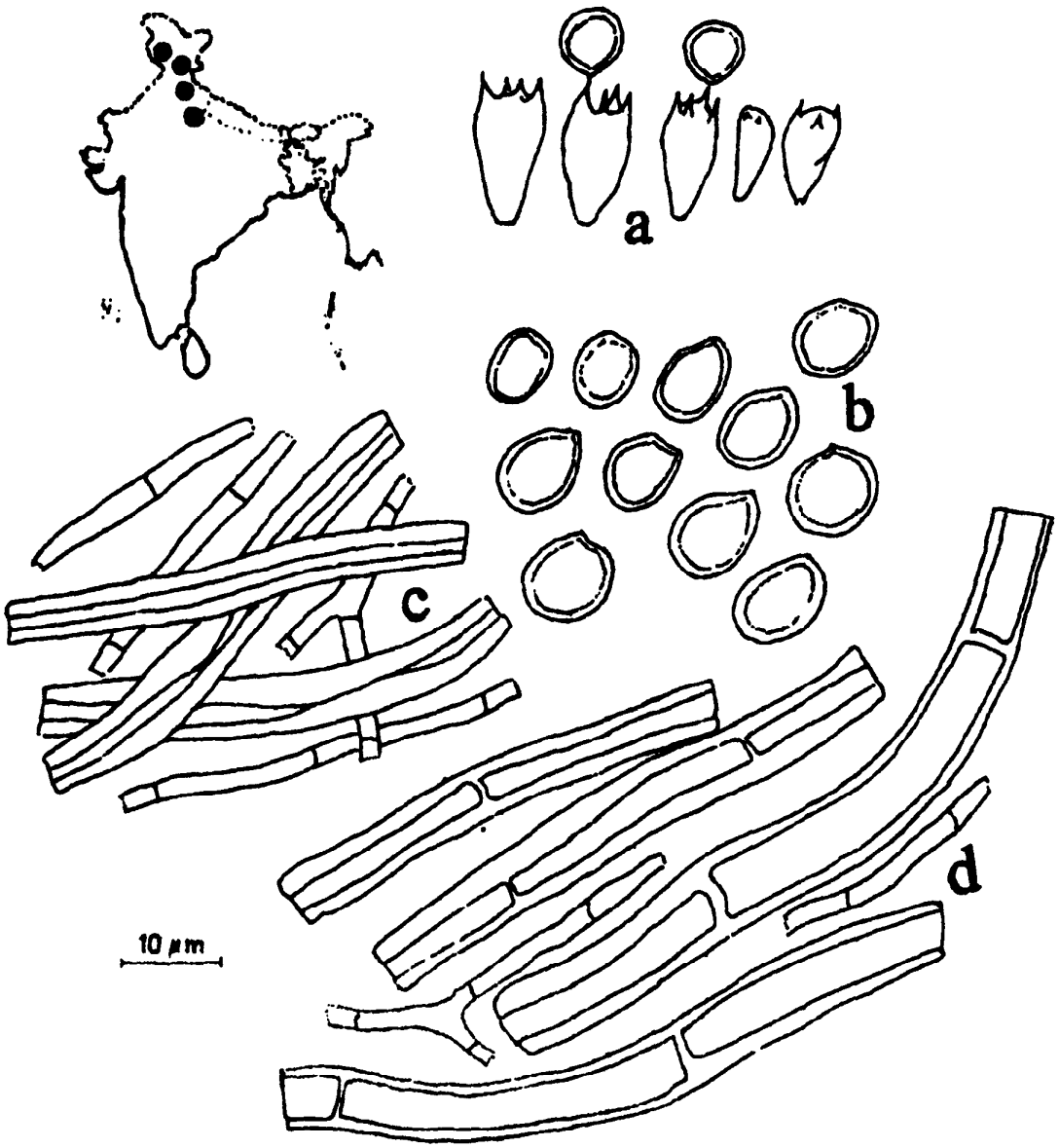


Fig. 88. *Phellinus rimosus* (JRS 58991) a. basidia, b. spores, c. tramal hyphae, d. contextual hyphae.

Hyphal system dimitic, generative hyphae thin walled, 2.5-4 µm wide, pale yellowish, simple septate, branched; skeletal hyphae 5-8 µm wide, thick walled, dark reddish brown, slightly more thick walled and wider up to 8 µm with secondary septa in the trama; hymenial setae none; basidia hyaline clavate 7-9.5 x 4-5 µm; spores present abundantly, moderately thick walled, pale brown to rusty brown at maturity, broadly ellipsoid to subglobose, 6-7 (7.5) x 5-6 µm, IkI-.

Habitat and Distribution

On dead or living trees of angiosperms particularly the species of *Dalbergia, Acacia, Anogeissus, Eugenia, Terminalia, Quercus, Mallotus, Elaeodendron, Shorea,* etc; causing a white stringy rot; widely spread from tropical to temperate forests preferring sunny and open places.

Remarks

P. rimosus is very close to *P. badius* and *P. robiniae.* The distinguishing characters are given below.

	P. badius	*P. rimosus*	*P. robiniae*
1.	Pilear surface glabrous rimose with age	Pilear surface glabrous, deeply cracked forming polygon-like woody scales with age	Same as in *P. rimosus*
2.	Surface weakly zonate	weakly zonate	azonate
3.	Context lustrous with a granular core with patches of white mycelium	context shiny granular core absent	context dull, granular core absent
4.	Setae occasionally present in older specimens	setae absent	setae absent
5.	Skeletal hyphae up to 5 μm wide	up to 8 μm wide	Skeletal up to 4 μm wide
6.	Spores 6.5-7.5(8) x 6.6.5 μm	Spores 6-7(7.5) x 5-6 μm	Spores 5-6 x 4.5-5 μm
7.	Mostly on leguminous trees in tropical forests	On other hosts, from tropical to temperate forests	On other hosts from tropical to temperate forests

Phellinus robiniae (Murr.) Ames Fig. 89

Ann. Mycol. 11 : 246, 1913 *Pyropolyporus robiniae* Murr., Bull. Torrey Bot, Club 30: 114, 1903; *Fomes robiniae* (Murr.) Sacc., Syll. Fung. 17: 117, 1905.

Basidiocarps perennial, sessile, applanate to ungulate, heavy, woody hard, up to 12 cm broad, 8 cm wide and 2-4 cm thick at base; upper surface yellowish brown, finely tomentose when young, azonate, later becoming glabrous, black, deeply rimose both radially and concentrically, becoming woody, scaly, sulcate; margin yellowish brown, finely tomentose, in older specimens thick, rounded and greyish black to typically black; pore surface reddish brown; tubes distinctly stratified, with blackish layers of context in between, 1-3 mm in each layer, reddish to deep brown; pores 7-9 per mm, round; context light reddish brown, dull, woody, azonate.

Hyphal system dimitic, generative hyphae thin walled, simple septate, moderately branched, 2.5-3 μm, wider and darker in trama; skeletal hyphae thick walled dark brown, unbranched, 3-4 μm wide; hymenial setae absent; basidia 8-10 x 5-6 μm; broadly clavate; spores ovoid to subglobose, pale yellow to reddish brown at maturity, appearing flattened at one side, 5-6 x 4.5-5 μm.

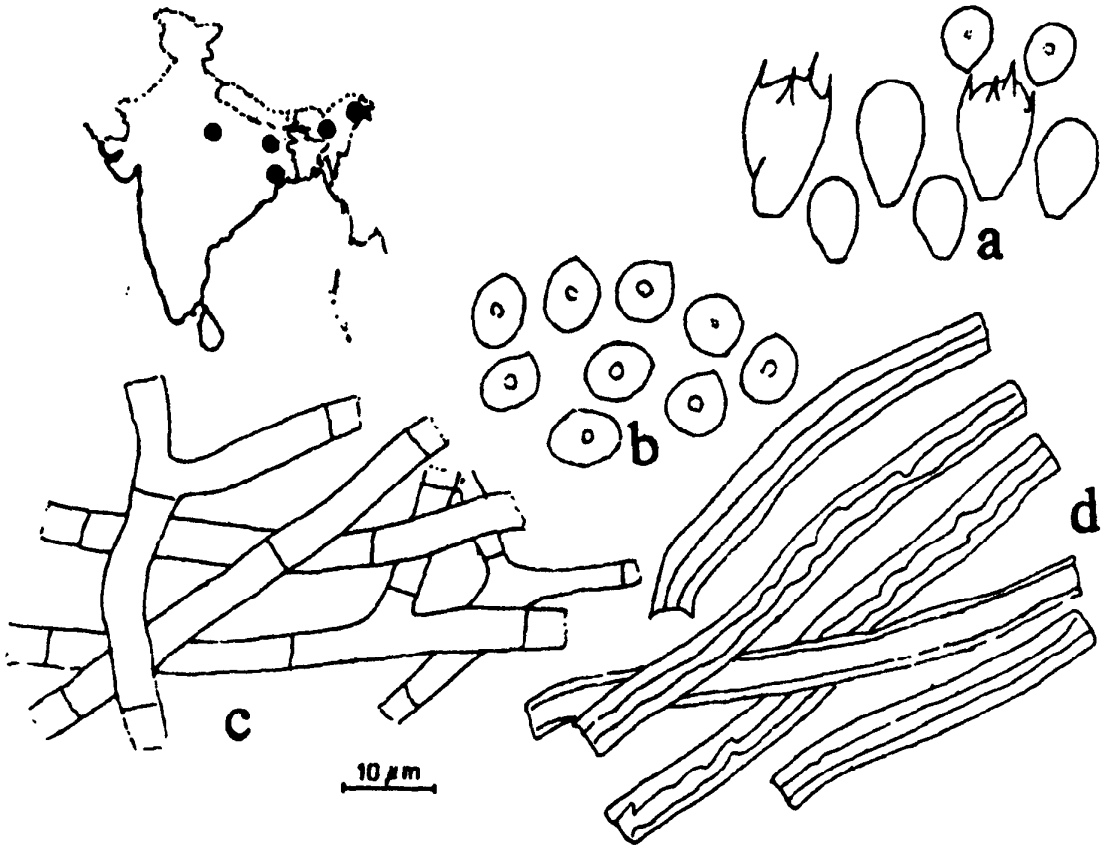


Fig. 89. *Phellinus robiniae* (JRS 17) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae.

Habitat and Distribution

On living trees of angiosperms particularly speices of *Terminalia, Anogeissus, Acacia* and *Lagerstroemia;* causing a white rot with indistinct pockets; widely distributed in tropical forests.

Remarks

The basidiocarps of this species resemble externally with *P. badius* and *P. rimosus*. The smaller spores of the present species differentiate it from the later two. For further differences please see under *P. rimosus*.

Phellinus robustus (Karst.) Bourd. & Galz. Fig. 90
Bull. Soc. Mycol. France 41: 188, 1925 *Fomes robustus* Karst., Bidrag Kannedom Finlands Natur Folk 48: 467, 1889.

Basidiocarps perennial, effused-reflexed or sessile, first cushion-like then ungulate to applanate, up to 20 cm wide, 25 cm broad and 15 cm thick; upper surface first finely tomentose, brown, to light rusty brown, with age becoming greyish black to black, glabrous, dull, crusty, zoned in broad rounded sulcate bands, deeply rimose when dry; margin rounded, finely tomentose to glabrous, light rusty brown to cinnamon, fertile below; pore surface yellowish to deep greyish brown; tubes distinctly stratified, totally up to 12 cm deep, 2-4 mm deep in each layer, thin layer of context in between, pale to light rusty brown, woody, more or less stuffed in older layers; pores small, circular, 4-6 per mm; context yellowish brown, shiny, distinctly stratified, woody hard, up to 6 cm thick at base with white streaks of hyphae present near the base.

Hyphal system dimitic, generative hyphae thin walled, hyaline, 2-4 μm wide, simple septate, branched; skeletal hyphae thick walled, 3-5 μm wide, yellowish to deep rusty brown, darker in trama; hymenial setae rare to scattered, but always present in all Indian collections, subulate to ventricose, thick walled, reddish brown, 18-30 x 5-10 μm, apices acute; cystidioles hyaline, narrowly clavate, ventricose to bottle-shaped with tips elongated up to 100 μm and projecting into the tubes; basidia broadly clavate 7-5-13.5 x 6-8 μm; spores globose to subglobose, often apiculate, hyaline, smooth, 6-8.5 x 5-7.5 μm in diameter, strongly dextrinoid.

Habitat and Distribution

Most common on living trees of *Abies pindrow* Royle, *Picea smithiana* Boiss. and less frequently on species of *Quercus, Salix, Acer, Juglans, Aesculus*

and *Taxus;* causing a white heart- rot of living trees; very rarely on stumps/dead rotting woods; widely spread and one of the commonest species in temperate forests of Himalayas.

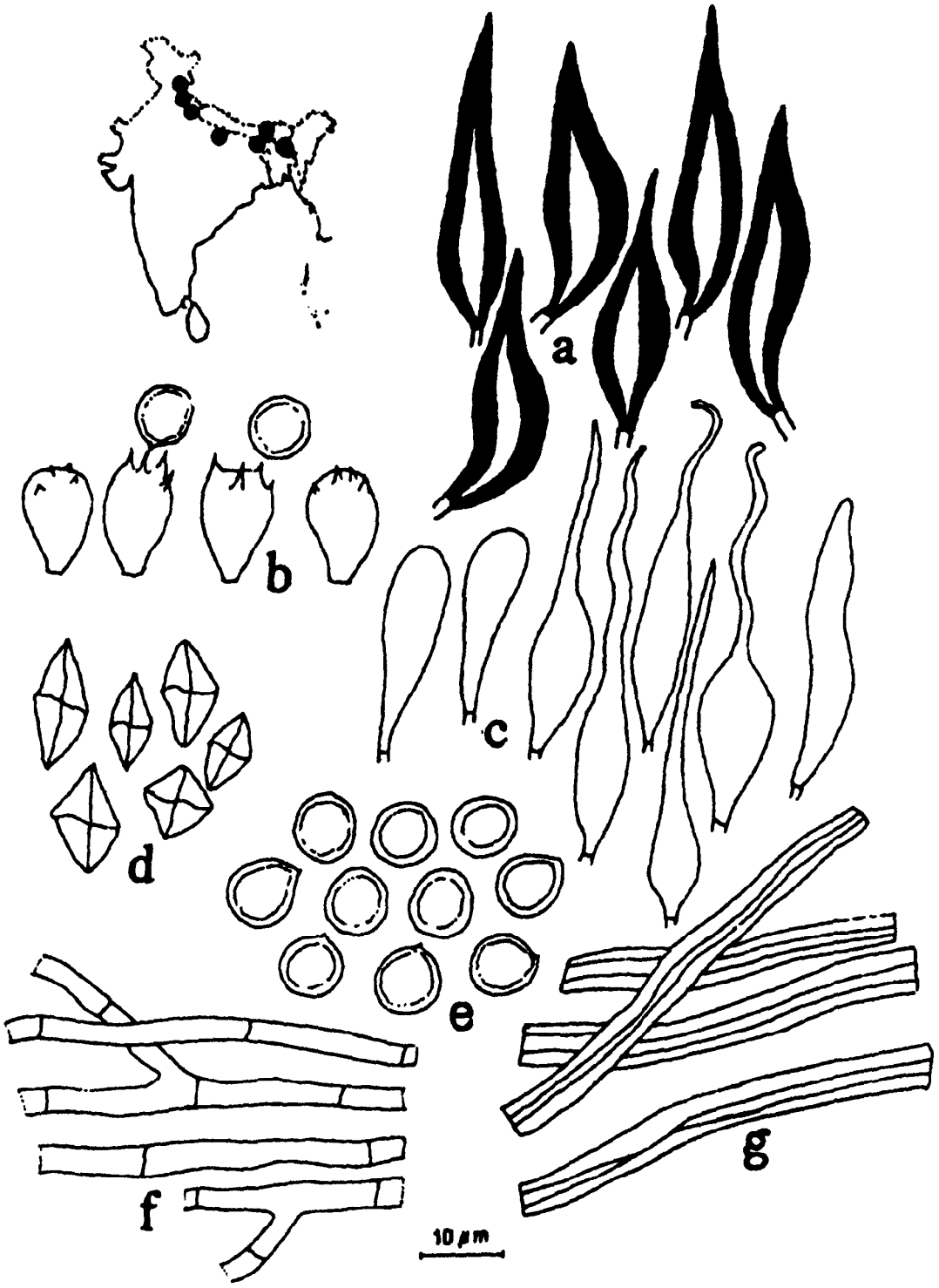


Fig. 90. *Phellinus robustus* (JRS 61106) a. setae, b. basidia, c. cystidioles, d. crystals in the hymenium, e. spores, f. generative hyphae, g. skeletal hyphae.

Remarks

The cushion-shaped to ungulate crusty fruitbodies, yellowish brown shining zonate context, rare to scattered ventricose setae and hyaline, large globose and strongly dextrinoid spores are the main identifying characters of this species.

Phellinus sanfordii (Llyod) Ryv. Fig. 91

Norw. J. Bot. 19: 235, 1972 *Fomes sanfordii* Llyod, Mycol. Writ. 4: 258, 1915.

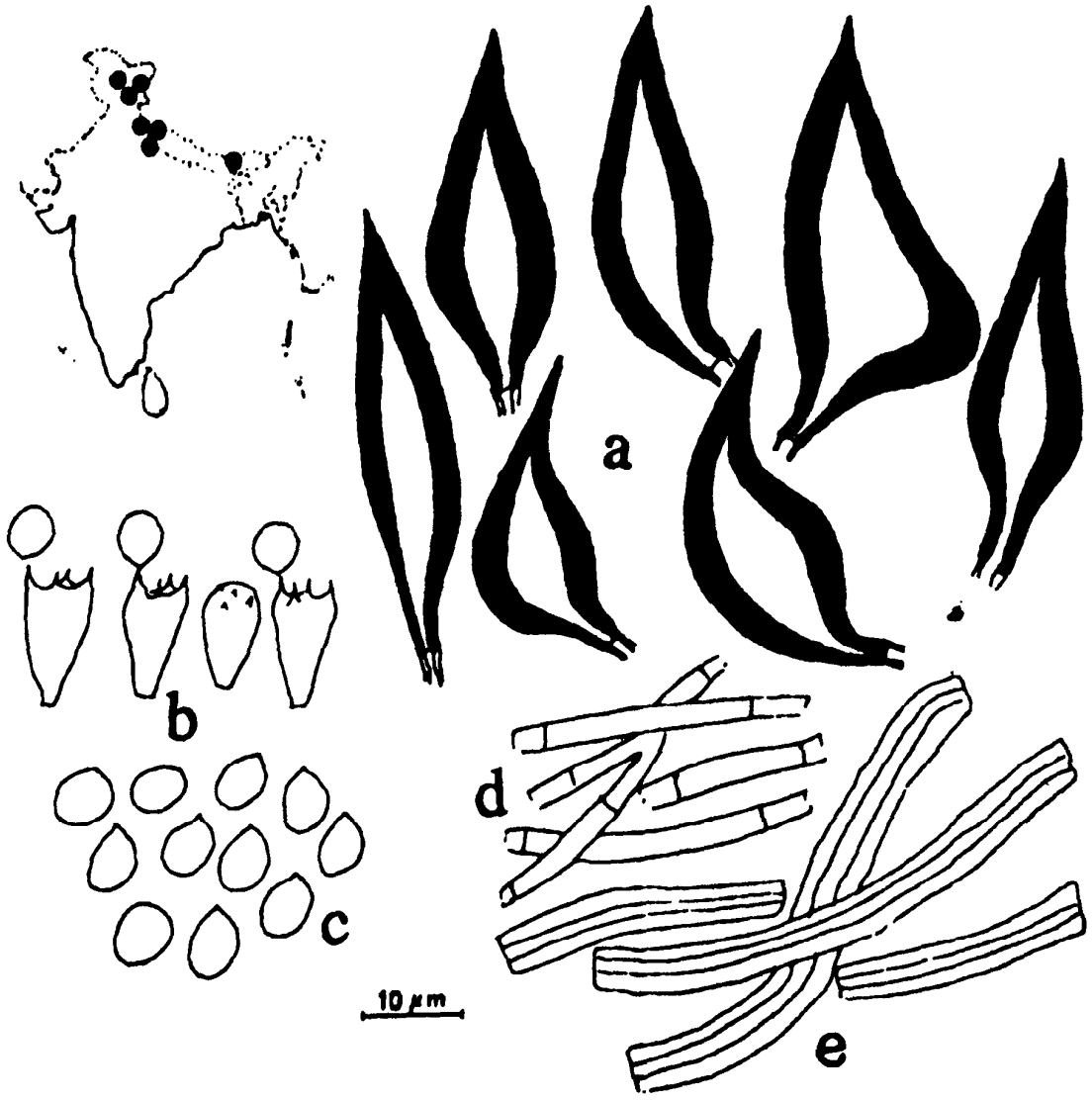


Fig. 91. *Phellinus sanfordii* (JRS 61226) a. setae, b. basidia, c. spores, d. generative hyphae, e. skeletal hyphae.

Basidiocarps perennial, pileate, imbricate to rarely single, dimidiate to semicircular, applanate to convex or more usually ungulate, up to 10 cm wide, 8 cm broad and 3-4 cm thick at base, woody hard; pilear surface tomentose, rusty

brown in narrow sulcate zones, becoming glabrous in older parts, with age grey to black with a distinct crust, deeply rimose radially and becoming rough at basal parts; margin fairly thin, sterile, lighter than the pileus; pore surface rusty to snuff brown, greyish brown in older specimens; tubes concolorous with pore surface, indistinctly stratified, up to 3 mm deep in each layer; pores round to subangular, small, 7-9 per mm; context dark rusty to cinnamon brown, hard, fibrous, up to 4 mm thick, limited on upper surface by a thick black crusty line.

Hyphal system dimitic, generative hyphae thin walled, hyaline, simple septate, 2-3 μm wide; skeletal hyphae yellow to pale rusty brown, thick walled, 3-4.5 μm wide; hymenial setae abundant, subulate to ventricose, dark brown, thick-walled, straight, 22-30 (32) x 8-10 μm; basidia broadly clavate 6-9 x 4-5 μm; hyaline; sporse broadly ellipsoid, pale yellow to light brownish, 3-4(4.5) x 2.5-3 μm.

Habitat and Distribution

On dead branches or trunks of angiospermic trees especially belonging to the species of *Quercus*, *Betula*, *Rhododendron*, *Viburnum* and *Rhus;* causing a white spongy rot; widely spread and a common species in temperate to subalpine forests in Himalayas.

Remarks

The species is characteristic in its occurrence up to tree line. The fruitbodies become greyish black and are more ungulate as compared to *P. extensus*. In the latter, the fruitbodies are reddish brown, more applanate and usually confined to warmer temperate zones. Further, the strongly ventritrose and smaller setae (15-20 x 5-9 μm) separates *P. extensus* from *P. sanfordii*.

Phellinus senex (Nees & Mont.) Imaz. Fig. 92

Bull. Govt. Forests Exp. Sta. 57: 115, 1952 - *Polyporus senex* Nees and Mont., Ann. Sci. Nat. Bot. 5: 70, 1836; *Fomes senex* (Nees & Mont.) Itsumi & Sigeyasu, Wood Decay Fungi, p. 373, 1945.

Basidiocarps perennial, usually imbricate, effused-reflexed to mostly sessile, broadly attached, up to 10 cm broad, 6 cm wide and 1-2 cm thick, consistency coriaceous when fresh, woody hard on drying, dimidiate to semicircular, applanate to weakly convex; upper surface velvety to persistently tomentose in narrow concentric, sulcate zones, first fulvous ferrugenous, then dark reddish brown to greyish black with age, paler towards margin, older specimens darker

and partly glabrous, often with green algae or mosses from the base, crust absent; margin thin to rather thick, acute to obtuse, sterile below, entire; pore surface fulvous to bay; tubes concolorous with the pore surface stratified, thin layer of context present in between tube layers, margin sterile below, usually paler than the pore surface; pores round, small, 7-10 per mm, invisible to the naked eyes, dissepiments thin and entire; context fibrous to woody, yellowish to dark reddish brown, up to 8 mm thick, usually with a dark thin line at the upper surface.

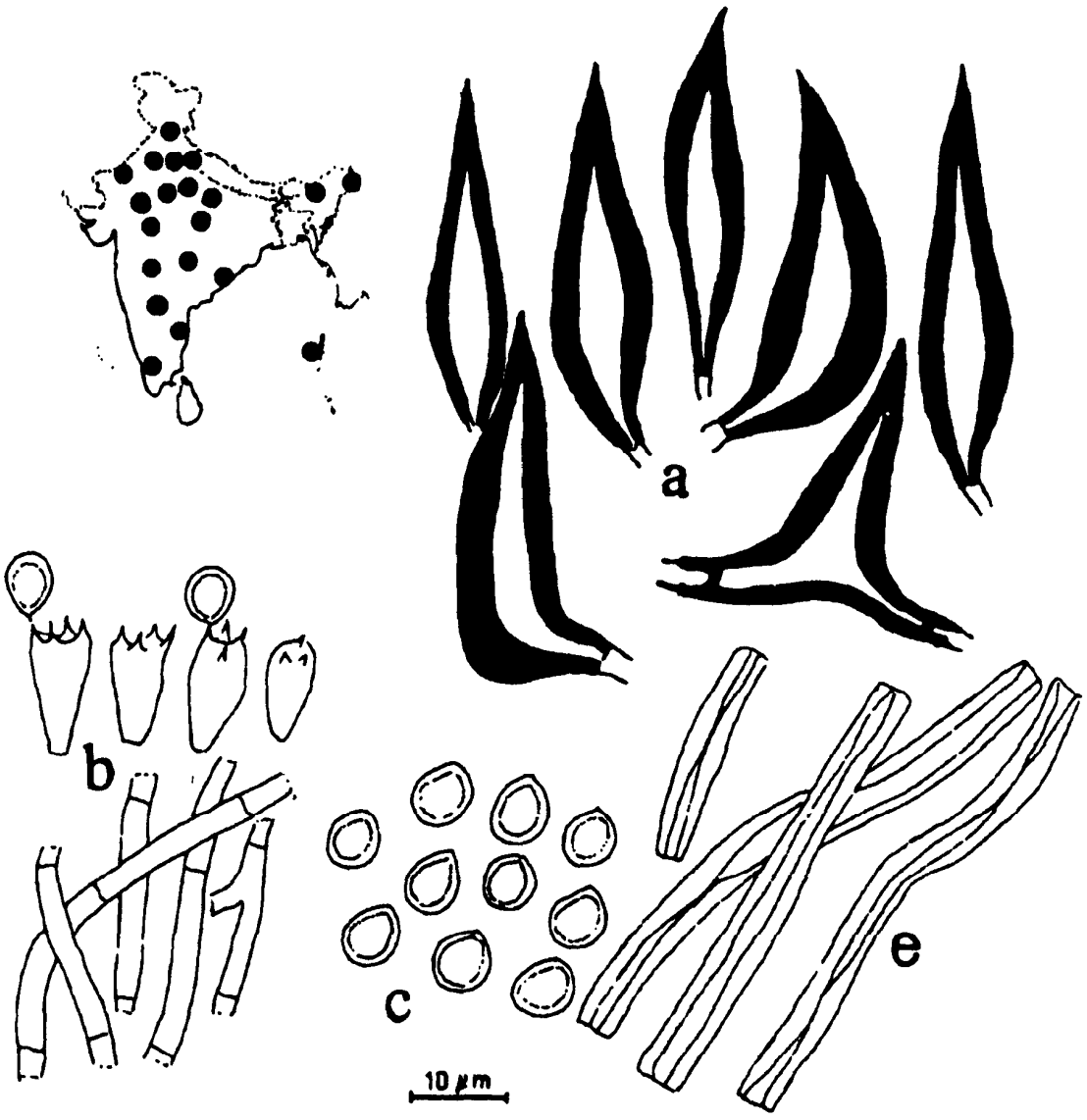


Fig. 92. *Phellinus senex* (JRS 60005) a. setae, b. basidia, c. spores, d. generative hyphae, e. skeletal hyphae.

Hyphal system dimitic, generative hyphae hyaline, simple septate, branched, 2-3.5 µm wide; skeletal hyphae abundant, yellow to golden brown, 3-4.5 µm wide; hymenial setae abundant, straight, thick walled, acuminate to subulate, 30-

35(40) x 5-8 μm, straight, dark brown; basidia 8-12 x 4-5 μm, clavate; spores broadly ellipsoid to subglobose, 4-5.5 x 3-3.5 μm, thin walled, smooth.

Habitat and Distribution

This species grows as a serious wound parasite on many angiospermic trees belonging to the species of *Toona*, *Swietenia*, *Chukrasia*, *Aesculus*, *Pyrus*, *Morus*, and *Melia*; causing white stringy rot; commonest species in the plains, extending up to subtropical zones.

Remarks

Persistently tomentose, narrowly concentrically sulcate pileus without any cuticle, long, abundant, subulate hymenial setae, and hyaline, broadly ellipsoid spores make its identification easier.

Phellinus setulosus (Llyod) Imaz. Fig. 93
Bull. Tokyo Sci. Mus. 6: 104, 1943 - *Fomes setulosus* Llyod, Mycol. Writ. 4: 243, 1915.

Basidiocarps perennial, solitary or mostly imbricate, effused-reflexed to sessile, broadly attached, woody hard when dry, applanate, convex to ungulate, up to 10 cm broad, 8 cm wide and 1-1.5 cm thick near the base; upper surface finely tomentose, slowly glabrous, dull, yellowish to reddish brown becoming greyish or dull black, covered with mosses at base, concentrically zoned, sulcate, rimose, without a distinct crust; margin yellowish brown, thin, obtuse, velutinate; pore surface fulvous to ferruginous; tubes single layered to stratified, 2-3 mm deep in each layer, with a greyish tint, margin sterile; pores round and regular, 5-7 per mm, dissepiments entire and fairly thick; context golden to reddish brown, lacking a distinct cuticle above, fibrous, faintly zoned, up to 5 mm thick.

Hyphal system dimitic, generative hyphae thin walled, simple septate, hyaline to pale yellow, 3-3.5 μm wide, more yellowish in the context; skeletal hyphae thick walled, yellow to golden brown, 3-6 μm wide; hymenial setae abundant, subulate to ventricose, often strongly swollen at the base, apex straight or weakly curved, dark brown, thick walled with a narrow lumen, 25-40 x 10-12 μm; basidia 7-12 x 5-6 μm, clavate, 4-sterigmate; spores broadly ellipsoid to subglobose, pale yellow or golden brown at maturity, thin walled, 5.5-7 (7.5) x 4.5-6μm.

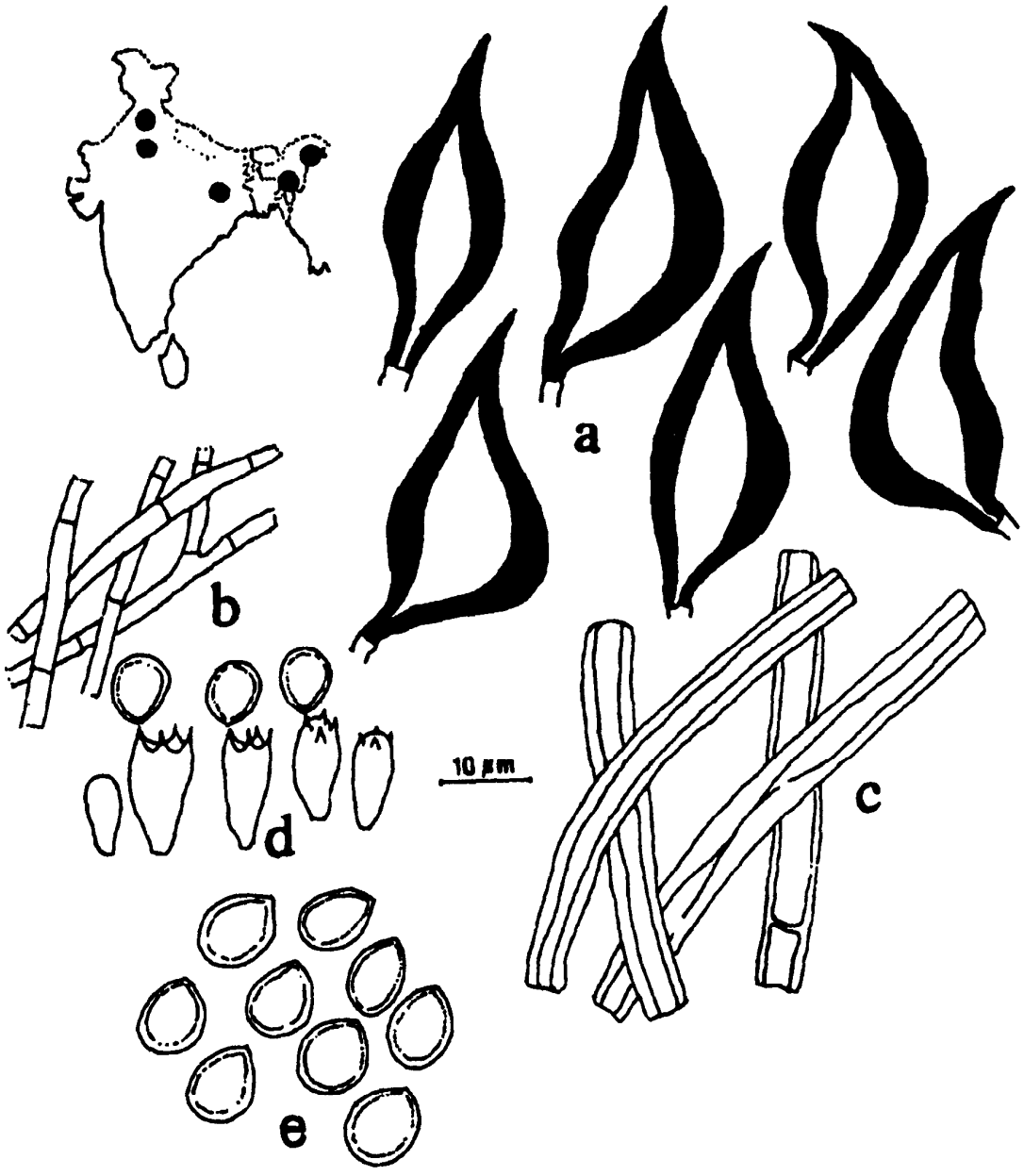


Fig. 93. *Phellinus setulosus* (JRS 759) a. setae, b. generative hyphae, c. skeletal hyphae, d. basidia, e. spores.

Habitat and Distribution

On dead angiospermous woods; causing white pocket rot; a rare species in the tropical forests.

Remarks

More or less ungulate, reddish brown fruitbodies without a crust, fairly large ventricose setae and large sized spores are the diagnostic features of this species.

Phellinus sublinteus (Murr.) Ryv. Fig. 94

Norw. J. Bot. 19: 235, 1972- *Pyropolyporus sublinteus* Murr., North Amer. Flora 9: 110, 1908.; *Fomes sublinteus* (Murr.) Sacc. & Trott., Syllo. Fung. 21 : 291, 1912.

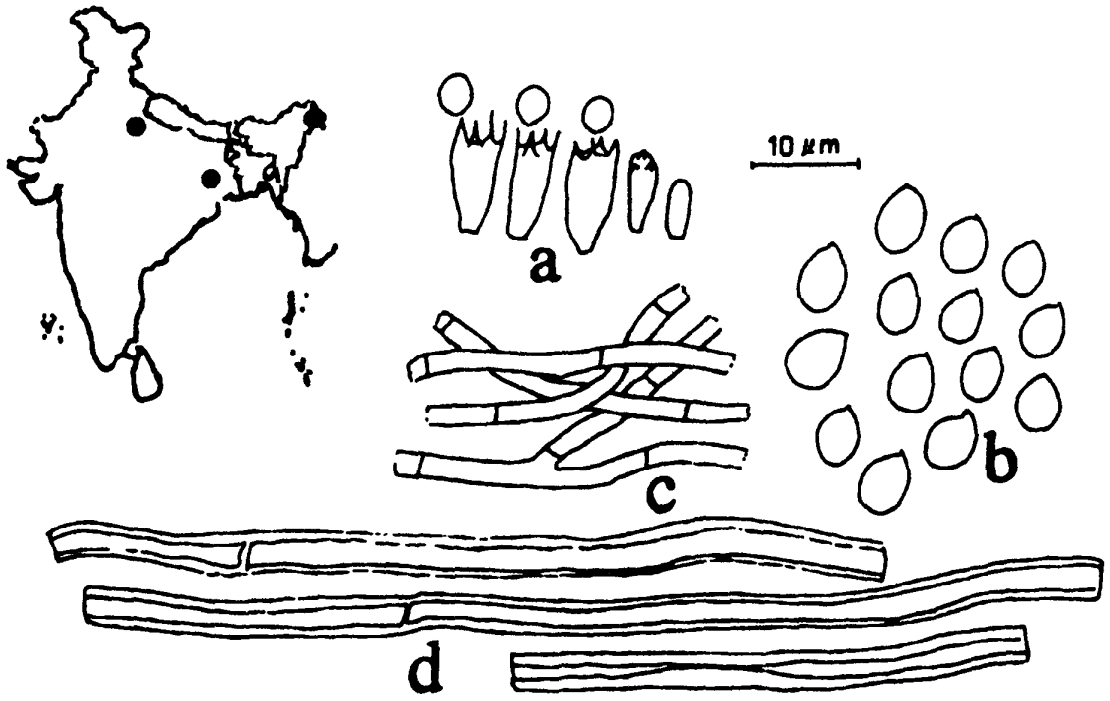


Fig. 94. *Phellinus sublinteus* (JRS 58971) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae.

Basidiocarps annual to perennial, sessile, pileus applanate to convex, semicircular, up to 10 cm wide, 12 cm broad and 2-4 cm thick, brittle and light in weight on drying; upper surface glabrous, brown to blackish, smooth or warted, azonate to faintly zoned, crusty from base; margin tomentose, rather thick, concolorous or lighter than pileus, entire or rarely lobed; pore surface dark brown; tubes concolorous with pore surface, darker than the context, indistinctly stratified, up to 2.5 mm deep in each layer; pores angular, 5-7 per mm, thin walled, entire; context yellowish brown, slightly soft and fragile, up to 5 mm thick, with a black line of cuticle above.

Hyphal system dimitic, generative hyphae hyaline moderately branched, 2-3 µm wide; skeletal hyphae thick walled, 3-5 µm wide, golden brown; hymenial setae absent; basidia clavate 8-11 x 4-6 µm; spores globose to subglobose, thick walled, rusty brown or snuff brown, olivaceous brown in KoH, 4.5-5 x 3.5-4.5 µm.

Habitat and Distribution

On living or dead deciduous trees like *Anogeissus latifolia* Wall. and *Aglaia* sp.; causing white rot, a rare species confined to tropical forests.

Remarks

Applanate to convex fruitbodies with warty upper surface, without a distinct crust together with snuff brown spores remarkably turning olivaceous brown in KOH are the distinguishing features of this species.

Phellinus torulosus (pers.) Boud. & Galz. Fig. 95
Bull. Soc. Mycol. France 41: 191, 1925 - *Polyporus torulosus* Pers., Mycol. Europ. 2: 79, 1825; *Fomes torulosus* (Pers.) Llyod, Mycol. Notes, Polyp. Issue no. 3: 48, 1910.

Basidiocarps perennial, solitary or imbricate, pileate, broadly attached, flat, conchate to dimidiate, up to 20 cm broad, 15 cm wide and 1-4 cm thick near the base, weakly coriaceous to woody hard when dry; upper surface yellowish brown, rusty brown or maroon rusty to greyish black, spongioseporus when dry, crust absent, tomentose to adpressed hispid or slightly strigose matted in age, concentrically zonate, distinctly sulcate, not rimose; margin round, entire to weakly lobed, concolorous or paler than the pileus; pore surface usually purplish red when young, shiny, becoming reddish brown or brown fuscous with age; tubes indistinctly stratified, up to 6 mm deep in each layer, grey rusty brown, paler than the context; pores round, regular, 5-6 per mm, dissepiments entire, rather thick; context soft to quite hard on drying, light in weight, readily impacted when pressed, rusty brown to fuscous, fibrous, faintly zoned, 1-2 cm thick.

Hyphal system dimitic, generative hyphae simple septate, hyaline to pale yellow, thin walled, 2-3.5 μm wide; skeletal hyphae yellow to reddish brown in bulk, 2-4 μm wide, wider in context; hymenial setae awl-shaped or subulte to slightly ventricose, 28-50 x 5-9 μm, projecting up to 15 μm into the tubes, dark brown, thick walled; basidia 9-13 x 5-7 μm, hyaline; spores broadly ellipsoid to subglobose, hyaline, thinwalled, 4.5-5.5 x 3-3.5 μm.

Habitat and Distribution

On dead angiospermous and coniferous woods, rarely at the bases of living tree trunks of *Quercus, Acer* and *Pyrus;* causing a white pocket rot or heartwood in roots and lower stems of living trees; a common species in the subtropical to temperate Himalayan forests.

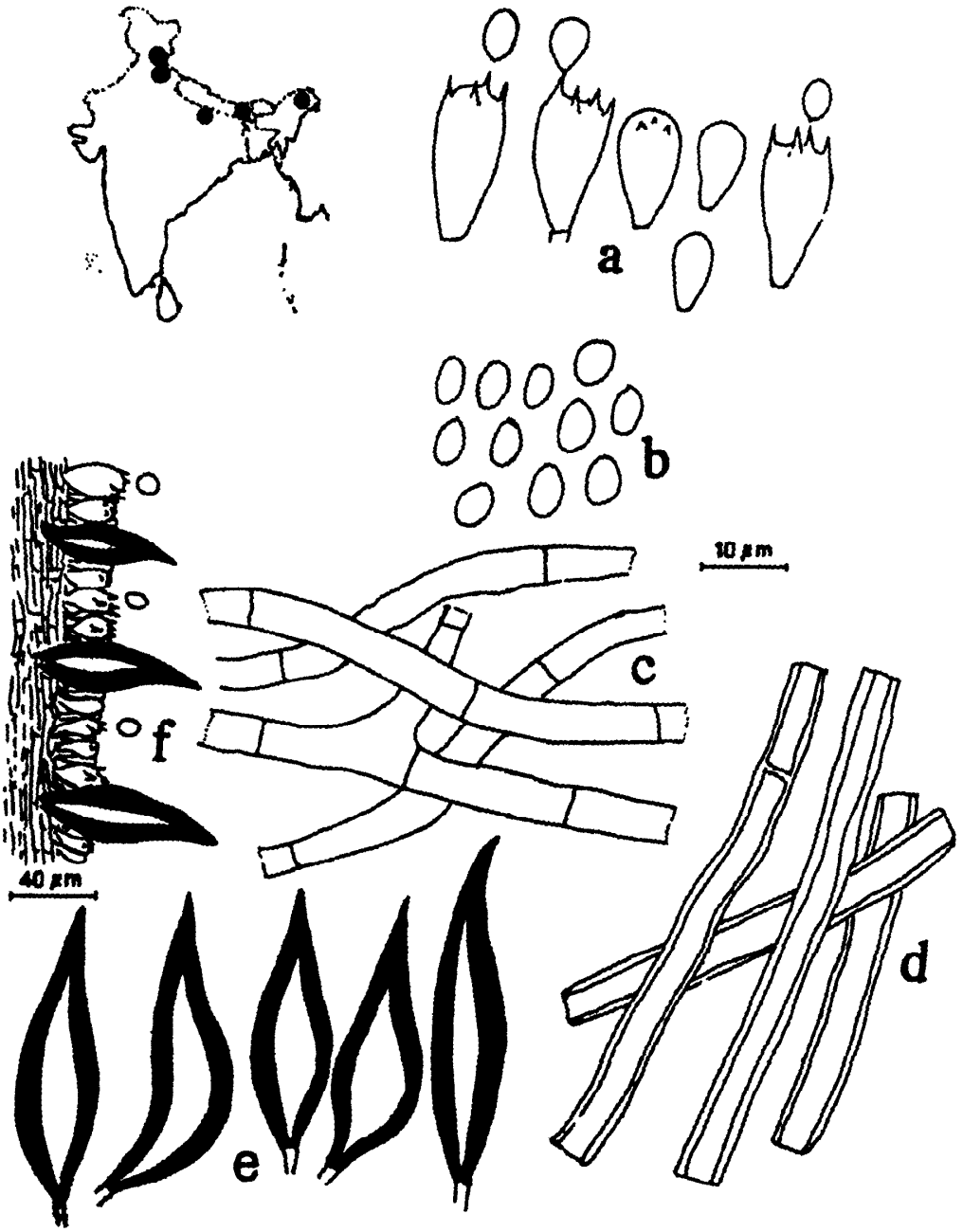


Fig. 95. *Phellinus torulosus* (JRS 778) a. basidia, b. spores, c. generative hyphae, d. skeletal hyphae, e. Setae, f. section through tube.

Remarks

This species is distinctive in its conchate to dimidiate dark maroon, persistently tomentose to adpressed hispid or strigose basidiocarps with broad rounded sulcate zones but without a crust. Its larger setae and pores separate it from the closely related *P. senex.*

Phellinus wahlbergii (Fr.) Reid Fig. 96

Contr. Bolus Herb. 7: 97, 1975 *Trametes wahlbergii* Fr., Kongl. Vetensk. Acad. Handl. P. 131, 1848; *Fomes zealandicus* (Fr.) Cke., Grevillea 8 : 55, 1879; *Phellinus laurencii* (Berk.) Aoshima, Trans. Mycol. Soc. Japan 7: 88, 1966.

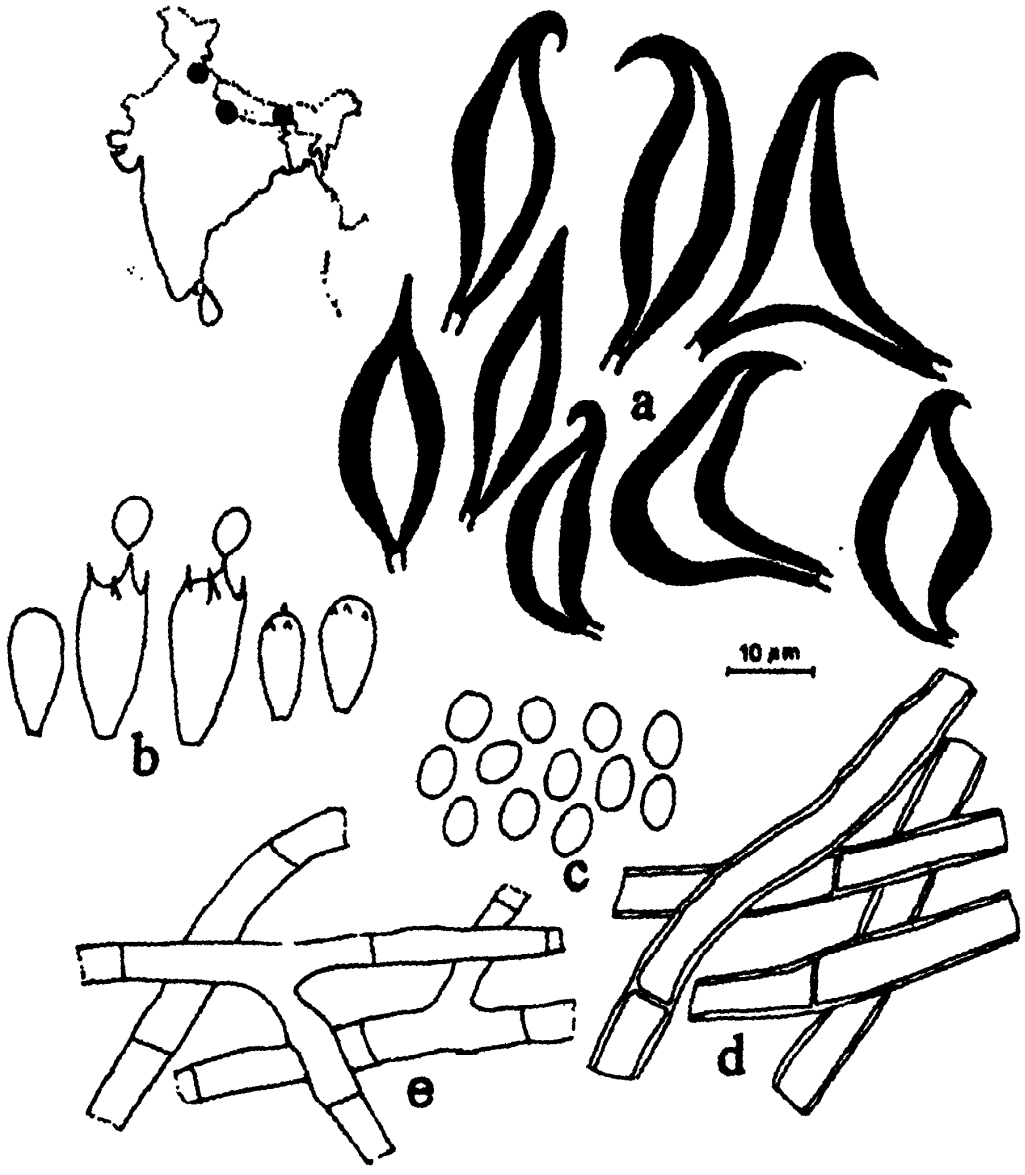


Fig. 96. *Phellinus wahlbergii* (JRS 201) a. setae, b. basidia, c. spores, d. skeletal hyphae, e. generative hyphae.

Basidiocarps perennial, pileate, solitary or imbricate, rarely effused-reflexed, applanate to slightly conchate, up to 12 cm wide, 16 cm broad 2-4 cm thick at base, semicircular to elongated shelf-like, woody, hard and brittle on drying;

upper surface reddish to blackish or purplish brown, tomentose, becoming glabrous in parts with age, smooth or pitted, narrowly sulcate, cuticle absent; margin first velvety, later glabrous, thin, lighter than the pilear surface; pore surface deep rusty brown to reddish brown; tubes concolorous with pore surface or dark reddish brown in older parts, distinctly stratified; up to 5 mm deep in each layer; pores small, 6-8 per mm; context chestnut brown, up to 5 mm thick, homogeneous.

Hyphal system dimitic, generative hyphae simple septate, hyaline, 2-3.5 μm wide, branched; skeletal hyphae golden to pale rusty brown, 2.5-5 μm wide, thick walled; hymenial setae subulate to ventricose, apices straight or mostly hooked, thick walled, dark brown, 25-30 (35) x 5-9 μm; basidia 8-12 x 5-6 μm, 2-4 sterigmate; spores subglobose, 4-5 x 3.5-4.5 μm, hyaline to pale yellow, thin walled.

Habitat and Distribution

On dead angiosperms; causing a white pocket rot; a rare species in the temperate Himalayan forests.

Remarks

The species is characterized by the absence of any cuticle, tomentose to partially glabrous upper surface together with subulate and ventricose setae having straight or curved apices. Externally, this species is close to *P. senex* but the presence of curved or hooked setae in the former differentiate both the species. Further, *P. senex* grows in tropical zones. This species can also be confused with *Inonotus flavidus* but the dimitic hyphal system and hooked setae separate *P. wahlbergii* from *I. flavidus*, though both are confined to temperate zones of Himalayas. Though the hooked or uncinate setae are aso found in *P. setulosus* but the broader setae (10-12 μm wide) and larger spores (5.5-7.5 μm) separate *P. setulosus* from *P. wahlbergii*.

Phellinus xeranticus (Berk.) Pegler Fig. 97

Kew Bull. 21: 44, 1967 - *Polyporus xeranticus* Berk., Hook. J. Bot. 6: 161, 1854; *Polystictus xeranticus* Cke., Grevillea 14: 85, 1886; *Inonotus xeranticus* (Berk.) Imaz. et Aoshima, The Fl. of East. Himalayas vol. I, 622, 1966.

Basidiocarps annual to perennial, effused-reflexed to sessile, solitary to imbricate,semicircular to elongated, often laterally confluent, up to 8 cm broad, 6 cm wide and 5-10 mm thick, coriaceous and flexible; upper surface first bright

yellow, then cinnamon and finally chestnut brown, occasionally sulcate with faint concentric zones, tomentose, soon smooth with a cottony consistency, easily compressible, more dense with age; margin thin, with a distinctive bright sulphur yellow to honey yellow coloration, wavy and lobate; pore surface first bright ochraceous to yellow, becoming more cinnamon with age; tubes concolorous with pore surface, distinctly stratified, thin layers of context present in between tube layers, older tube layers are darker than the new layers, rather brittle; pores first entire and round, 4-5 per mm, with age becoming irpicoid, irregular and larger, context thin, dense, bright yellow, up to 5 mm thick, distinctly separated from the more cinnamon and looser pilear tomentum by a dark line.

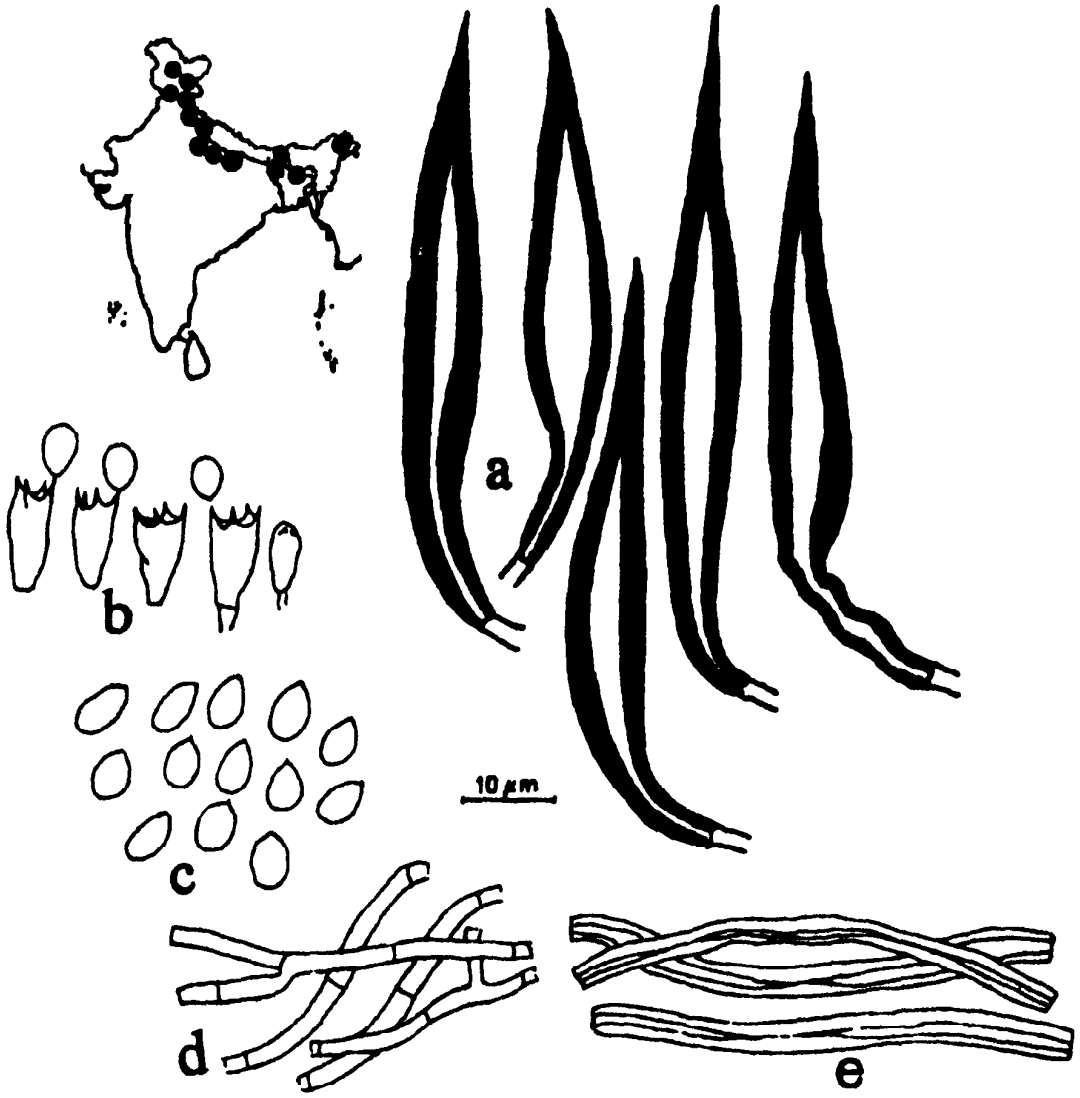


Fig. 97. *Phellinus xeranticus* (JRS 188) a. setae, b. basidia, c. spores, d. generative hyphae, e. skeletal hyphae.

Hyphal system dimitic, generative hyphae thin walled, slightly thick walled in the context, hyaline to pale yellow, 1.5-3 μm wide, simple septate; skeletal hyphae up to 4.5 μm wide, golden brown, wider and darker in the tomentum, thick walled; hymenial setae numerous, projecting, acuminate to lanceolate, straight, dark to rusty brown, 40-70 (90) x 5-11 μm, emerging out of hymenial layer up to two-third of their length; basidia 7-10 x 4-5 u, claviform; spores ellipsoid to subglobose, 3.5-5 x 2.5-4 μm, hyaline to pale yellow, IkI-.

Habitat and Distribution

On the bases of dead trees/stumps of Oaks; causing white pocket rot with firm brown areas; one of the commonest Hymenochaetaceae in the temperate forests of Himalayas.

Remarks

This species is host specific as it is always found on Oaks. Further, the bright yellow colour of the pore surface, margin and lower context and compressible, cottony consistency of the pilear surface are features which help in distinguishing this species in the field. Microscopically the long acuminate to lanceolate hymenial setae are distinctive.

PHYLLOPORIA Murr.
Torreya 4 : 141 , 1904.

Basidiocarps annual, effused-reflexed to sessile, applanate to nudular, soft when fresh, flexible to woody on drying; pilear surface cimnamon to yellowish brown to dark reddish brown, tomentose and spongy; pore surface brown to reddish brown; tubes concolorous with pore surface; pores angular to round; context light to dark brown, separated from a thick tomentum by a thin black line; hyphal system monomitic; hyphae light to golden brown, simple septate; hymenial setae absent; spores abundantly present, ellipsoid, up to 5 μm in the longest dimension, light yellowish to brownish, slightly thick walled; on living bushes and living or dead thin branches of standing angiospermous trees, never on conifers; causing a white rot; cosmopolitan genus with two species in India; *ca* 8 species in the world.

Type species : *Phylloporia parasitica* Murr.

The closest relatives of *Phylloporia* are *Inonotus* and *Cyclomyces*. From *Inonotus* it differs by having pale yellowish spores and a thick tomentum separated from the context by a dark zone. Absence of hymenial setae separate it from *Cyclomyces*. Above all, *Phylloporia* species are remarkable in their ability to grow on thin branches of living trees and bushes.

KEY TO THE INDIAN SPECIES

1. Basidiocarps up to 10 cm broad; pores 7-10 per mm; spores 3-4 x 2.5-3 μm **P. ribis**
1. Basidiocarps up to 20 cm broad; pores 4-6 per mm; spores 3-5 x 2.5-3.5 μm **P. weberiana**

Phylloporia ribis (Schum. : Fr.) Ryv. Fig. 98
Polyp. North Europe 2: 371. 1978 - *Boletus ribis* Schum., Enum. Plant. Saell. 2: 386. 1803: *Polyporus ribis* Schum. : Fr., Syst. Mycol. 1: 375, 1821; *Phellinus ribis* (Schum. : Fr.) Quel., Ench. Fung. p. 173, 1886; *Fomes ribis* (Schum. : Fr.) Gill., Champ. France p. 685, 1878.

Basidiocarps annual to biennial, solitary to usually imbricate, attached by a broad base, effused-reflexed to sessile, applanate to conchate, flexible corky when fresh, woody hard on drying, up to 10 cm broad, 4 cm wide and 1 cm thick near

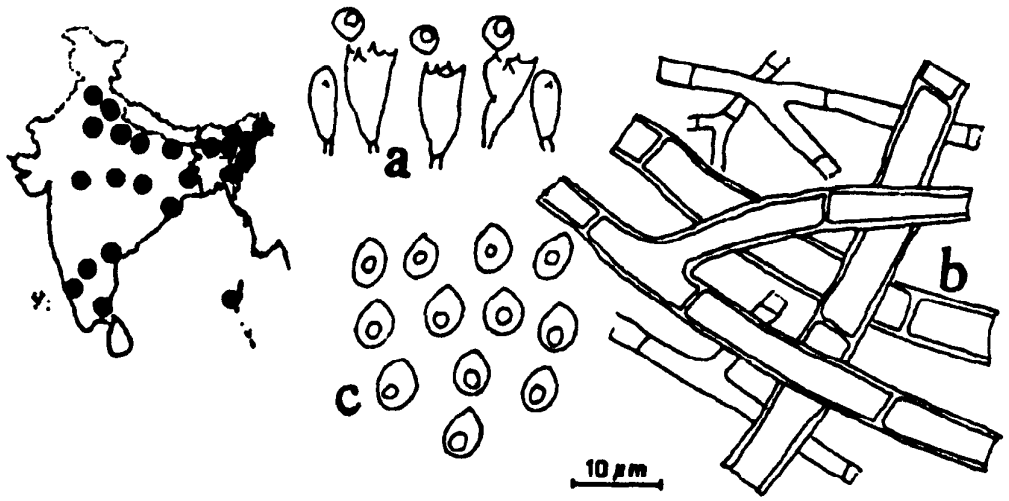


Fig. 98. *Phylloporia ribis* (JRS 673) a. basidia, b. generative hyphae, c. spores.

base; upper surface yellowish brown, dark brown to brownish black from base with age, finely tomentose to densely pubescent, becoming glabrous slowly, uneven, intensely verrucose, sulcate in wide zones; margin undulating, acute, frequently spathulate, velvety, pale yellowish to rusty brown, soon concolorous with the pileus; pore surface yellowish brown, rusty on drying or when old, slightly uneven, with a silky sheen; tubes up to 5 mm deep, concolorous with the context, usually in a single layer; pores invisible to the naked eyes, 7-10 per mm, circular to angular; context up to 6 mm thick, corky, rusty brown to dark yellowish brown, fibrous, shining on breaking, duplex, lower part separated from the upper thicker tomentum by a distinct black line.

Hyphal system monomitic; generative hyphae simple septate, thin to thick walled, sparingly branched, 3-7 µm wide, pale golden brown to dark rusty brown in the trama, more or less hyaline to pale yellow in the hymenium; hymenial setae none; basidia 6-10 x 3-4.5 µm, broadly clavate; spores broadly ellipsoid to subglobose, slightly thick walled, pale yellowish 3-4 x 2.5-3 µm, IkI-.

Habitat and Distribution

Usually at the bases of living deciduous shrubs, most frequently on species of *Murraya*, *Mallotus*, *Bauhinia*, *Rosa*, *Lonicera*, *Berberis*, *Cornus*, *Prunus*, etc.; causing a white pocket rot; a common species in the tropical forests.

Remarks

Unlike Larsen & Cobb-poulle (1990), the author prefers to keep this species under *Phylloporia* following Gilbertoon and Ryvarden (1987) and Ryvarden

(1978). The duplex context with a black line in between the two layers, abundantly present, small, thick walled pale yellowish spores and monomitic hyphal system with thin to thick walled, sparingly branched septate generative hyphae are the distinguishing features of this species and point towards its exclusion from *Phellinus*. Among the closely related species, *P. conchatus* has hymenial setae and larger spores (5-6.5 x 4=5.5 μm) while *P. pectinatus* has homogeneous context, and smaller spores (3-3.5 x 2-3 μm) besides both these species have a dimitic hyphal system.

Phylloporia weberiana (Bres. & Henn. : Sacc.) Ryv. Fig. 99
Norw. J. Bot 19; 235, 1972 *Fomes weberiana* Bres. & Henn. : Sacc. Syll. Fung. 9: 174, 1891.

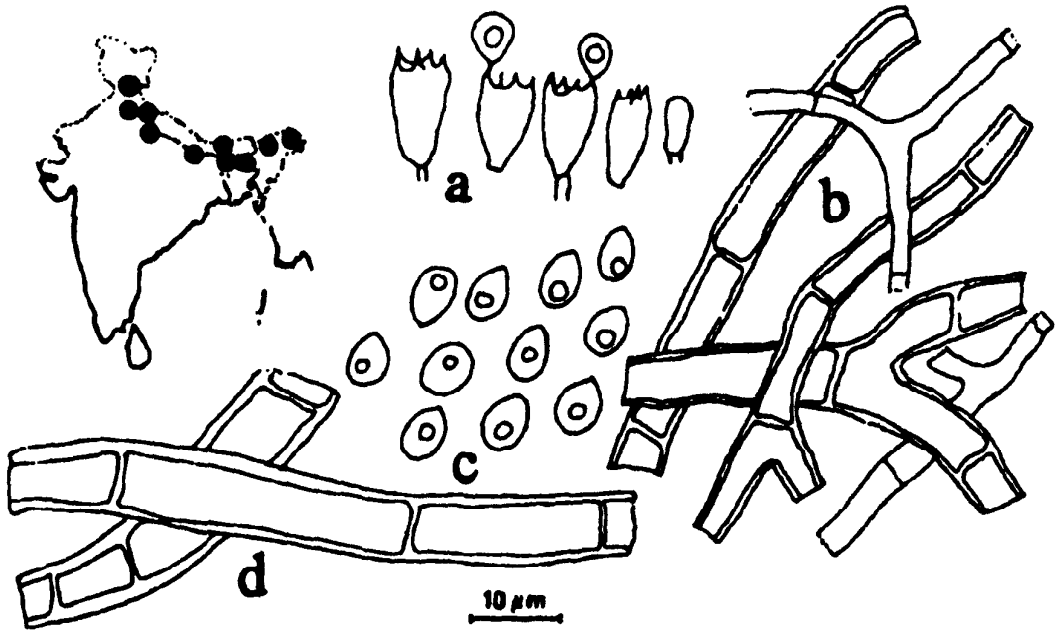


Fig. 99. *Phylloporia weberiana* (JRS 60136) a. basidia, b. generative hyphae, c. spores, d. hyphae from tomentum.

Basidiocarps annual, solitary, sessile, broadly attached, soft, spongy, corky on drying; pileus applan..te to conchate, up to 20 cm broad, 15 cm wide and 1-2 cm thick, brown to dark clay coloured when young, becoming dark to reddish brown to blackish at maturity, tomentose, tomentum cottony to corky, up to 1 cm thick at base becoming thinner towards the base, coarsely nodose, broadly zonate; margin wavy, rounded, concolorous with pilear surface; pore surface clay coloured to dark brown, lighter towards the margin; tubes up to 6 mm deep,

concolorous with pore surface; pores round to angular, 4-6 per mm; context yellowish to dark brown, separated from the tomentum by a dark black line, more fibrous and darker than the tomentum, up to 5 mm thick.

Hyphal system monomitic; generative hyphae simple septate, in the context and trama 2.5-6 μm wide, thin to thick walled; more flexuous and branched than the tomentum, in the tomentum straight, up to 10 μm wide, yellowish to rusty brown, usually unbranched, thick walled with narrow lumen; basidia clavate, 8-16 x 4-6 μm, 4-sterigmate; spores broadly ellipsoid to subglobose, light yellowish brown, thick walled, 3-4.5 (5) x 2.5-3.5 μm, IkI-.

Habitat and Distribution

On dead or living thin branches, tree trunk, stumps of angiosperms especially oaks; never on coniferous woods; causing yellow conk; widely distributed and a common species in the subtropical and temperte forests.

Remarks

This species is easily recognised in the field by the presence of a thick, reddish brown, soft spongy tomentum in broad sulcate zones and a black line separating it from the context proper. The abundant, yellowish brown spores are characteristic microscopically. The older specimens of this species are sometimes confused with *Phellinus pectinatus* in blackish colour of pilear surface with broader sulcate zones. However, *P. pectinatus* has denser, harder fruitbodies with dimitic hyphal system and smaller spores (3-3.5 x 2-3 μm).

PYRRHODERMA Imaz.
Trans. Mycol. Soc. Japan 7: 4, 1966.

Basidiocarps annual to perennial, laterally stipitate, woody hard when dry; pileus semicircular to spathulate, grey brown or dull brown, glabrous with a thick crust, often sulcate; stipe encrusted, glabrous, concolorous with pileus; context hard, shiny, cinnamon brown, white streaks often present; pore surface brown; pores minute; hyphal system monomitic; generative hyphae with simple speta, thick walled, pale to yellowish brown; hymenial setae usually absent; sproes rare, to subglobose to drop-shaped up to 8.5 μm in diameter, hyaline; on living oaks causing white rot; a rare genus confined to temperate forests; one species in India.

Type species : *Pyrrhoderma sendaiense* (Yas.) Imaz.

The genus as circumscribed here clearly belongs to the family Hymenochaetaceae because of the stipitate, crusty, xanthochroic basidiocarps causing white rots. Further, the monomitic septate hyphae and larger hyaline, subglobose to drop-shaped spores make it more natural and distinguishable from *Phellinus*. The smooth spores and monomitic hyphae separate it from Gandodermataceae.

Pyrrhoderma sendaiense (Yas.) Imaz. Fig. 100
Trans. Mycol. Soc. Japan 7: 4, 1966; *Polyporus sendaiensis* Yas., Bot. mag. (Tokyo) 37: 125-134, 1923.

Basidiocarps annual to perennial, pileate, laterally stipitate, solitary, woody hard and brittle on drying; pileus 8-10 cm wide, 6-8 cm broad and 1-1.5 cm thick near the base; upper surface dull, grayish to brownish black, velutinate-soft when young, soon glabrous with a thick crust, sulcate with narrow concentric zones, becoming radially wrinkled on drying; margin obtuse, concolorous with pilear surface; stipe irregular, 1-3 cm long, up to 1 cm thick, concolorous with pilear surface, crusty, wrinkled and nodulose when dry; pore surface deep brown; tubes yellowish to deep brown, 3-5 mm deep; whitish from within; pores round, regular, 5-6 per mm, dissepiments entire, thick; context yellowith to golden brown, 1-1.5 cm thick near base, delimited on upper side by a thick crust becoming thinner towards the margin often interspersed with white patches or flecks of mycelium, zonate, shiny.

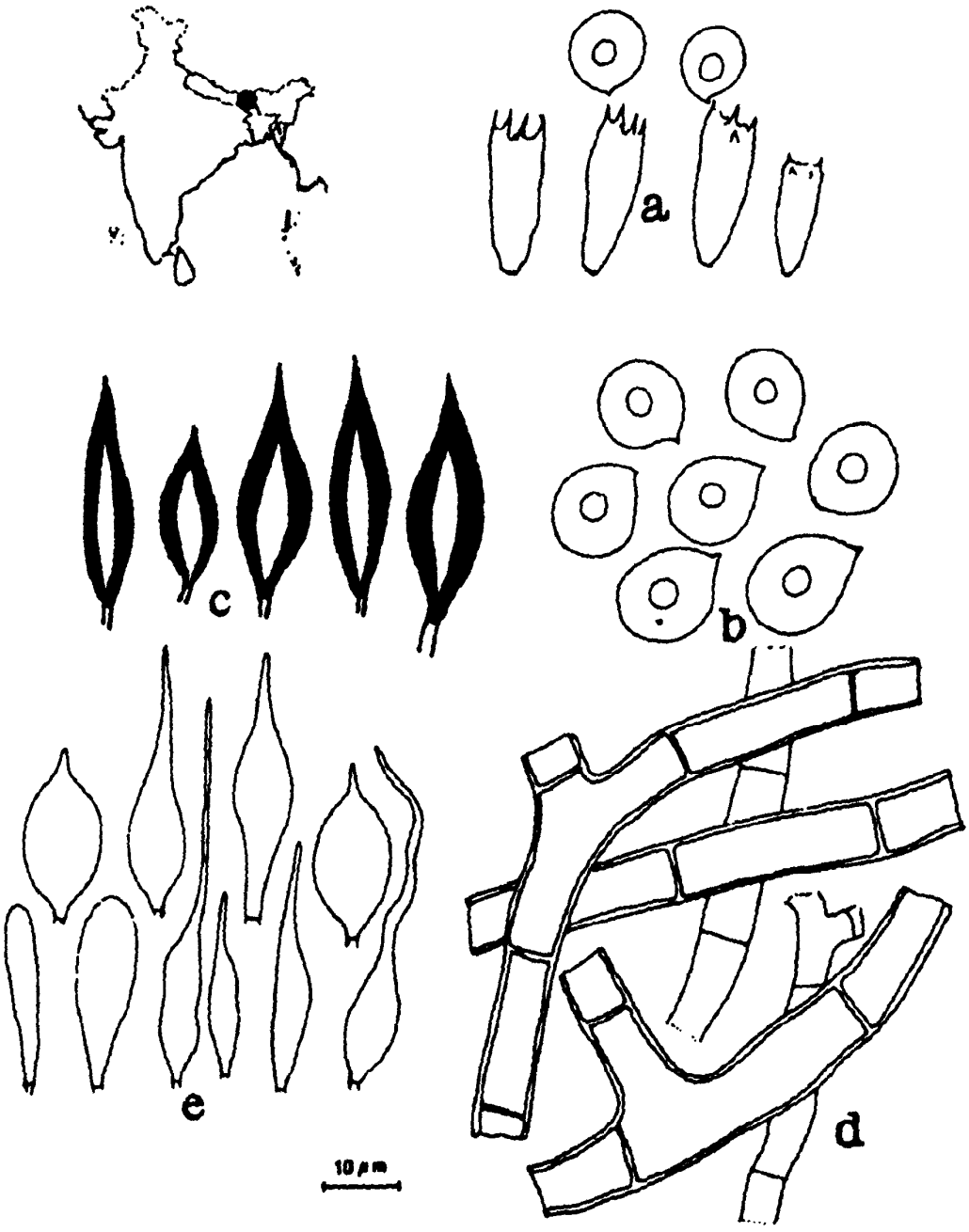


Fig. 100. *Pyrrhoderma sendaiense* (JRS 60532) a. basidia, b. spores, c. setae, d. generative hyphae, e. cystidioles.

Hyphal system monomitic, generative hyphae golden brown, thick walled, rarely branched, simple septate, 4-6 µm wide, hyphae in context up to 8 µm wide; hymenial setae absent to very rare, when present subventricose, straight, golden to dark brown, 15-25 x 6-10 µm; cystidioles present, clavate or pyriform, to

ventricose-mucronate or bottle-shaped with tips protruding up to 30 μm beyond the hymenium and in age these tips elongate into long hyphae filling the tubes with dense white tangle; basidia hyaline, clavate, 12-18 x 5-7 μm, 4-spored; spores subglobose to drop-shaped, 6-8.5 μm in diameter, hyaline, IkI-.

Habitat and Distribution

At bases of living trees of *Quercus* and *Acer*, never found on dead woods; causing a white rot of heartwood of living trees; a very rare temperate polypore confined to Sikkim Himalayas only.

Remarks

Unlike Imazeki (1966), Yasuda (1923) and Ryvarden (1990) the hymenial setae have occasionally been found in some specimens of Indian collections also deposited at (O) and (BAFC). The spores are quite rare while the cystidioles are a constant feature. Yasuda (1923) reported spores to be Ganodermatoid (*Amauroderma* type) which is doubtful. Similarly, Ryvarden (1990) recorded spores (probably immature) to be 5-6 x 4.5-5-5 μm and it does not hold true to Indian specimens. In the Indian collections, the spores, though not found abundantly but are present in all stages of development in fully matured basidiocarps only. The drop-shaped, hyaline spores are up to 8.5 μm in diameter.

The genus *Pyrrhoderma* Imaz. was proposed by Imazeki (1966) to accommodate two species of polypores i.e. *P. adamantinum* (Berk.) Imaz. (= *Polyporus adamantinus* Berk.) and *P. sendaiense*, the latter being the type species and endemic to Japan only. Both these species have a palisadodermous, well differentiated, thick crust and hayline spores. However, *P. adamantinum* is sessile to substipitate with a thick brown-black crust which cracks both longitudinally and radially and have smaller spores i.e. 5-6.5 μm in diameter, above all the dimitic hyphae and absence of cystidioles show that the species is better places under the genus *Phellinus*. In contract, *P. sendaiense* with stipitate basidiocarps, smooth thick greyish brown crust, monomitic hyphae, larger drop-shaped spores and cystidioles in the hymenium remains the lone representative of this genus from India.

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