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GENUS *PHLEBIA* FR. IN THE EASTERN HIMALAYA

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An account of eight species of genus *Phlebia* Fr., based on the collections made from the Eastern Himalaya is given. All the eight species are new records for the study area. Of these, *Ph. interjacenoides, Ph. kamengii. Ph. microspora, Ph.singularisa* and *Ph. thindii* are proposed as new species, while *Ph. rufa* is a new record for India. An illustrated detailed account has been given for the new species and new record for India, for rest of the taxa only brief taxonomic notes are given. A key to distinguish all the eight species is also provided.

Key words : *Phlebia*, Corticiaceae, Aphyllophorales, Eastern Himalaya

The genus *Phlebia* (Corticiaceae, Aphyllophorales) was introduced by Fries (1821) to include four species with *Ph. radiata* as the type. Three of his species (Ph. *merismoides* Fr.: Fr., *Ph. radiata* Fr. and *Ph. contorta* Fr.) are now often taken to be conspecific. The fourth species, *Ph. vaga* Fr. is the type species of the genus *Phlebiella* Karst. Donk (1957) emended the genus *Phlebia* Fr., and established a more natural genus, composed of species of genus *Corticium* sect. *Ceracea* Bourd. & Galz., and related species from other genera. The genus was originally described for the species (*Ph. radiata* Fr.) with a radiately folded hymenium. However, its close relationship with *Corticium lividum* with smooth or tuberculate hymenium, suggested inclusion of other species in the genus which do not have the phlebioid hymeniurn but resemble *Ph. radiata* in waxy-gelatinous consistency of the fruitbodies and narrow basidia in a dense palisade. Christiansen (1960) and Parmasto (1968) followed the above concept. Eriksson, Hjortstarn and Ryvarden (1981) have treated the genus in these lines with some changes. They are of the opinion that above characters, along with variability in the cystidial elements, do not give the genus a proper circumscription, and described the delimitation of the genus merely provisional. In the wider sense the genus includes, besides the original *Phlebia*, mainly *Corticium* sec. *Ceracea* Bourd. & Galz, and parts of *Peniophora* sec. *Ceraceae* Bourd. & Galz. In this paper concept of Eriksson, Hjortstam and Ryvarden (1981) has been followed.

Prior to the explorations in the Eastern Himalaya, 6 species were reported to occur in India, of which *Ph. roumeguerii* has been shifted to the genus *Phlebiopsis* Julich. During the present studies, as many as eight species are being described, of which, 5 are proposed as new species, and one new record for India. The materials of all these taxa have been deposited in the Herbarium, Botany Department, Panjab University, Chandigarh, India (PAN), and parts of some of the collections have been deposited in other herbaria as indicated within parenthesis after the collection number. The abbreviations used for herbaria follow Holmgren and Keuken (1974), while the color standards used are according to Kornerup and Wanscher (1978).

MATERIALS AND METHODS

This paper is based on the collections made from the Eastern Himalaya during the monsoon months. A good hand lens, sharp knife, chisel, small hammer, and small saw are important tools required in the field for making collections. A field note concerning locality, date of collection, substratum, type of hymenial surface and abhymenial surface in case of reflexed materials, is written on every specimen. It is then put in paper packet, given a temporary number and taken to the temporary laboratory in a bag where observations regarding the colour of the

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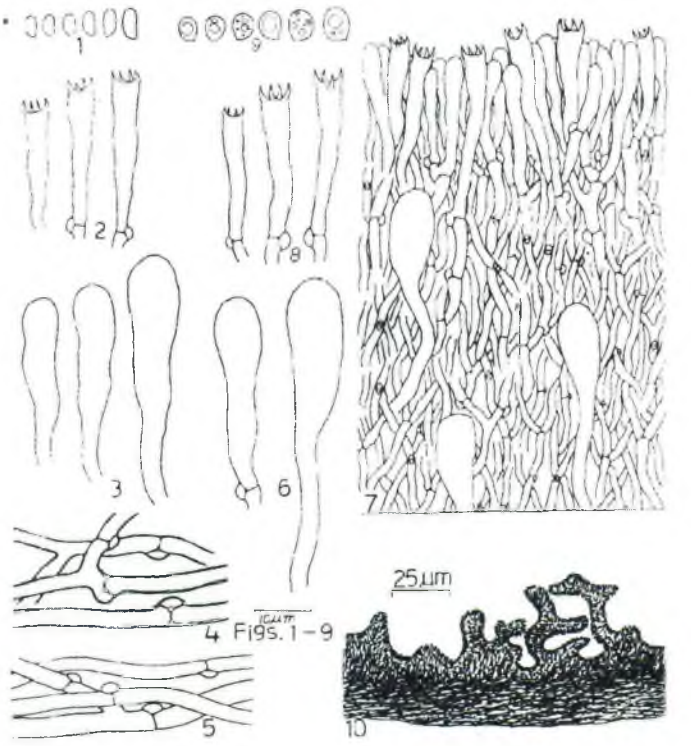
hymenial and abhymenial surfaces, type of hyphae, cystidia, basidia, basidiospores, and their reactions with cotton blue, melzer's reagent and sulpho-vanillin are made and noted down using a compound microscope. A spore print is taken for every specimen. The specimens are dried either in the sun or in artificial air driers. The dried collections are packed in bond paper packets and stacked in card board boxes. Effort is also made to photograph the specimens in the field or at the temporary lab.

A detailed study of every material is made by making crush mounts and free hand section cutting using different stains e.g. .5% cotton blue in lactophenol, 1% congo red in water, 1% phloxine in water, melzer's reagent and sulpho-vanillin. Diagrams of different structures are made using camera-lucida. All the data is compiled into the description, which is compared with the published literature. Interesting and unidentified specimens are sent to other herbaria for comparison with the type before publication.

KEY TO THE SPECIES

1. Hymenium reticulately folded to almost poroid 2
1. Hymenium smooth, tuberculate, phlebioid or odontioid.....3
2. Basidiospores suballantoid, 4.2-6 x 2-2.5 mm. ....1. *Ph. rufa*
2. Basidiospores broadly ellipsoid, 4.5-6.5 x 3-4.5 mm...2. *Ph. kamengii*
3. Hymeniurn odontioid ..... 4.*Ph. microspora*
3. Hymeniurn smooth, tuberculate or phlebioid 4
4. Hymeniurn distinctly phlebioid, orange-red ....3. *Ph. radiata*
4. Hymenium smooth or tuberculate 5
5. Basidiospores narrowly ellipsoid to subfusiform 6
5. Basidiospores ellipsoid to suballantoid or al lantoid 7
6. Cystidia present .....5.*Ph. singularisa*
6. Cystidia absent..... 6. *Ph. thindii.*
7. Fruitbodies crustaceous -corneous when-dry; subhymenial hyphae winding, with irregular constrictions and dilations and with oily contents ..... 7. *Ph. interjacenoides*
7. Fruitbodies horny when dry; subhymenial hyphae not as above. ..... 8. *Ph. livida*

1. *Phlebia rufa* (Fr.) M.P. Christ., Dansk bot. ark.19: 2 p.164, 1960. = *Merulius rufus* Pers.: Fr., Syst. mycol. I p. 327, 1821. (Figs. 1 – 4)



Figs. 1-4 *Phlebia rufa* 1. Basidiospores 2. Basidia 3. Cystidia 4. Generative hyphae Figs. 5-10 *Ph. hhamengii* Generative hyphae 6. Cystidia 7. Portion of hymenium and subhymenium 8. Basidia 9. Basidiospores 10. V.S.Fruitbody

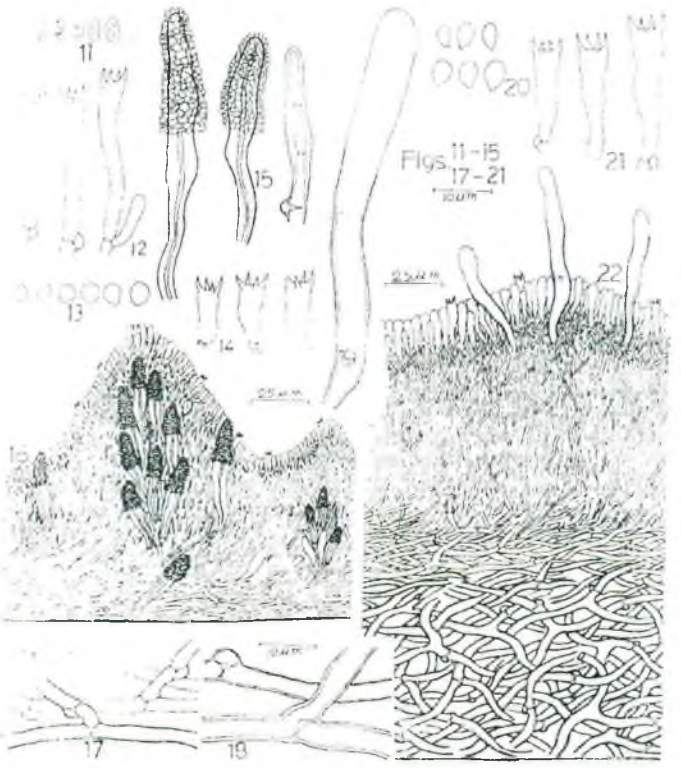
Fruitbody resupinate, closely adnate, effused, ceraceous-fleshy when fresh, corneous on drying; hymenial surface pale yellowish to brownish, darker on drying, reticulately folded to almost poroid; margin thinning, somewhat determinate, paler concolorous. Hyphal system monomitic; generative hyphae clamped; subicular hyphae 3 - 4.5 mm wide, somewhat thick-walled, horizontal; in the subhymenium hyphae 2 - 3 mm wide, thin-walled,

densely united, vertical; the zone between subiculum and subhymenium almost gelatinized. Cystidia 30 - 50 x 6 - 9 mm, clavate or narrowly clavate, thin-walled, horizontal in the transition layer and vertical in the subhymenium. Basidia 22 - 30 x 4.5 - 4.8 mm, narrowly clavate, 4-sterigmate, with a basal clamp; sterigmata up to 3 mm long. Basidiospores 4.2 - 6 x 2 - 2.5 mm, suballantoid, smooth, thin-walled, non-amyloid, acyanophilous, with one or more oil drops.

Collection examined: Meghalaya: Shillong, Risa Colony, on a decaying angiospermous log, G.S.Dhingra 19002 (PAN), June 27,1978.

Phlebia rufa is closely related to *Ph. radiata* in having almost similar microstructures, but differs in having merulioid-poroid hymenial surface as compared to radially folded, orange-red hymenial surface in *Ph.radiata*. This is the first report of this species from India.

2. ***Phlebia kamengii*** Dhingra sp. nov. (Figs. 5 – 10)



Figs.11-12 *Phlebia radiata* 11. Basidiospores 12. Basidia
Figs.13-17 *Ph. microspora* 13. Basidiospores 14. Basidia 15. Cystidia 16. V.S. Fruitbody 17. Generative hyphae
Figs. 18-22 *Ph. singularsia* 18.Generative hyphae 19. Cystidium 20. Basidiospores 21. Basidia 22.V.S. Fruitbody

Fructificatio resupinata, effusa, laxe adnata, ceracea-pulposa cum vegeta, membranacea-coriacea ad cornea cum arida; superficies hymenialis reticulatus plicatus, flavido-albus ad griseolus flavus cum vegetus, rufobrunneus ad brunneus post exsiccatonis. Hyphae nodoso-septatus. Cystidii 35 - 65 x 7 - 10 mm, anguste clavatus, tenuitunicatus, inclosus in sybhymenium. Basidii 25 - 35 x 3.5 - 4.8 mm, anguste clavatus, 4-sterigmatibus et fibula basali instructa. Basidiosporii 4.5 - 6.5 x 3 - 4.5 mm late ellipsoideus

Holotypus- India, Arunachal Pradesh, West Kameng, Bomdila, Wang Basti, cola putrescens angiospermicum lignum, G.S.Dhingra 19690 (PAN), Augustus 24, 1981.

Fruitbody resupinate, loosely-adnate, loosening from substrate on drying, effuse, up to 1000 mm thick in section, ceraceous-fleshy when fresh, membranous-coriaceous to corneous when dry; hymenial surface yellowish-white to grayish-yellow when fresh, reddish-brown to brown after drying, reticulately folded to almost poroid; margin thinning to abrupt, sometimes finely fimbriate. Hyphal system monomitic, generative hyphae septate, clamped; subiculum composed of 3 - 4.5 mm wide, thin to somewhat thick-walled, compactly packed hyphae running almost parallel to the substrate; subhymenial hyphae richly branched and interwoven into a dense texture, 2 - 3 mm wide, thin-walled; in mature fruitbodies the hyphae are gelatinized. Cystidia 35 - 65 x 7 - 10 mm, narrowly clavate, thin-walled, embedded in the subhymenium. Basidia 25 - 35 x 3.5 - 4.8 mm, narrowly clavate, with 4-sterigmata and a basal clamp; sterigmata up to 4 mm long. Basidiospores 4.5 - 6.5 x 3 - 4.5 mm, broadly ellipsoid, smooth, thin-walled, non-amyloid, acyanophilous, with one or more oil drops.

Holotype: Arunachal Pradesh: West Kameng, Bomdila, Wang Basti, on a decaying angiospermous log, G.S.Dhingra 19690 (PAN), August 24, 1981. Paratype: Arunachal Pradesh: Bomdila, about two km from Bomdila towards Tawang, on a decaying angiospermous stump, G.S.Dhingra 19693 (PAN), August 24,1981.

Phlebia kamengii, differs from *Ph. rufa* in lacking closely adnate fruitbodies and suballantoid basidiospores and from *Ph.radiata* in lacking radially irregularly plicate, orange-red hymenial surface.

3. *Phlebia radiata* Fr., Syst. myc. I p. 427, 1821; Elench. Fung, I p. 154, 1828. (Figs. 11-12)

This species is marked by the radially-irregularly plicate, orange-red to violaceous-gray hymenial surface; richly branched, clamped generative hyphae (3 - 4.5 mm wide); thin-walled, tube-like, horizontal or vertical cystidia (50 - 75 x 7 - 9.5 mm); narrowly clavate, 4-sterigmate with basal clamp basidia (25 - 35 x 4 - 4.5 mm), arranged in dense palisade; and suballantoid, smooth, thin-walled, non-amyloid, acyanophilous basidiospores (4 - 5 x 1.5 - 2.3 mm).

Collections examined: Arunachal Pradesh: West Kameng, Bomdila, Wang Basti, on a decaying angiospermous stump, G.S.Dhingra 19694 (PAN), August 24, 1981: West Kameng, Bomidia, Wang Basti, on a decaying angiospermous log, G.S.Dhingra 19695 (PAN), August 24, 1981.West Bengal: Darjeeling, Senchal lake, on a decaying angiospermous stump, G.S.Dhingra 19223 (PAN), August 16,1980.

Rattan (1977) reported this species for the first time from India on the basis of two collections from N. W. Himalaya. But here it is being reported as a new record for the Eastern Himalaya.

4. *Phlebia microspora* Dhingra sp. nov. (Figs 13-17)

Fructificatio resupinata, effusa, adnata; superficies hymenialis flavidus albus ad subflavus cum vegetus, subochraceus post exsiccatis, odontoideus. Hyphae nodoso-septatus. Cystidii 30 - 60 x 4.5 - 6 mm, fere fusiformis, tenuitunicatus ad crassitunicatus incrusto. Basidii 10 - 15 x 3.2 - 4.5 mm, clavatus ad subclavatus. Basidiosporii 3.2 - 4.5 x 2.2 - 3.5 mm, late ellipsoideus ad ovoideus.

Holotypus - India, West Bengal, Siliguri, quassi 5 km a Sukna istorsum Rongtong, putrescens angiospermicum ramicola, G.S.Dhingra 19203 (PAN, GH), Augustus 9, 1980.

Fruitbody resupinate, adnate, effuse, thin; hymenial surface yellowish-white to pale yellow when fresh, pale ochraceous after drying, odontoid, with dense, short aculei up to 110 mm long; margin thinning, paler concolorous. Hyphal system monomitic; generative hyphae 2 - 3.5 mm wide, branched, septate, clamped thin- to slightly thick-walled, densely united into a conglutinate tissue both in the subiculum and subhymenium. Cystidia 30 - 60 x 4.5 - 6 mm (without encrustation), numerous, especially in the aculei, generally fusiform, thin-walled when young to thick-walled on maturity, encrusted in the apical half, often secondarily septate. Basidia 10 - 15 x 3.2 - 4.5 mm, clavate to subclavate, generally 4-sterigmate, with a basal clamp; sterigmata up to 3.5 mm long. Basidiospores 3.2 - 4.5 x 2.2 - 3.5 mm, broadally ellipsoid to ovoid, smooth, thin-walled, non-amyloid, acyanophilous.

Holotype: West Bengal: Darjeeling, Siliguri, about 5 km from Sukna towards Rongtong, on decaying angiospermous twigs, G.S.Dhingra 19203 (PAN, GH), August 9,1980.

Phlebia microspora is close to *Phlebia queletii* (Bourd. & Galz.) M. P. Christ., in having odontoid fruitbodies, similar hyphae and cystidia, but differs in having shorter basidia (10 - 15 x 3.2 - 4.5 mm in comparison to 15 - 25 x 4 - 5 mm), and smaller, broadly ellipsoid to ovoid basidiospores 3.2 - 4.5 x 2.2 - 3.5 mm) in comparison to longer narrowly ellipsoid basidiospores (5 - 6 x 3 - 3.5 mm).

5. *Phlebia singularisa* Dhingra sp. nov. (Figs. 18-22)

Fructificatio resupinata, effusa, laxe adnata, ad 650 mm crassa in sectione, membranacea-ceracea cum vegeta, cornea cum arida; superficies hymenialis tuberculatus cum vegetus, glabrescens cum aridus, subluteus ad luteus cum vegetus, subochraceus cum aridus. Hyphae nodoso-septatus. Cystidii 50 - 85 x 5 - 9 mm, subcylindricus. Basidii 18 - 27.5 x 4.5 - 6 mm, clavatus ad subclavatus. Basidiosporii 4.5 - 6 x 2 - 3.5 mm, ellipsoideus ad obovatus.

Holotypus - Bhutan, Thimphu, interjacens Motithang et Fajudin, cola putrescens gymnospermicurn lignum, G. S. Dhingra 19612 (PAN), Augustus 6,1981.

Fruitbody resupinate, loosely adnate, loosening in margins on drying, effused, up to 650 mm thick in section, membranous-ceraceous when fresh, horny on drying; hymenial surface tuberculate when fresh, almost smooth when dried, pale yellow to pastel-yellow when alive, pale ochraceous in herbarium; abhymenial surface yellowish-white, rough; margins abrupt (in old fruitbodies) to thinning, whitish, fibrillose. Hyphal system monomitic; generative hyphae septate, clamped; basal zone composed of 4 - 6 mm wide, thick-walled, less branched, compactly interwoven hyphae; subhymenial hyphae up to 3 mm wide, richly branched and interwoven into a dense to almost agglutinated texture. Cystidia 50 - 85 x 5 - 9 mm, subcylindrical, often widening in the apical part, thin- to slightly thick-walled, projecting up to 60 mm out of the hymenium. Basidia 18 - 27.5 x 4.5 - 6 mm, clavate to subclavate, 4-sterigmate, with a basal clamp; sterigmata up to 4 mm long. Basidiospores 4.5 - 6 x 2 - 3.5 mm, ellipsoid obovate, (generally tapering towards the base) smooth, thin-walled, non-amyloid, acynophilous.

Holotype: Bhutan: Thimphu, on way to Fajudin from Motithang, on a decaying gymnospermous log, G.S.Dhingra 19612 (PAN), August 6,1981.

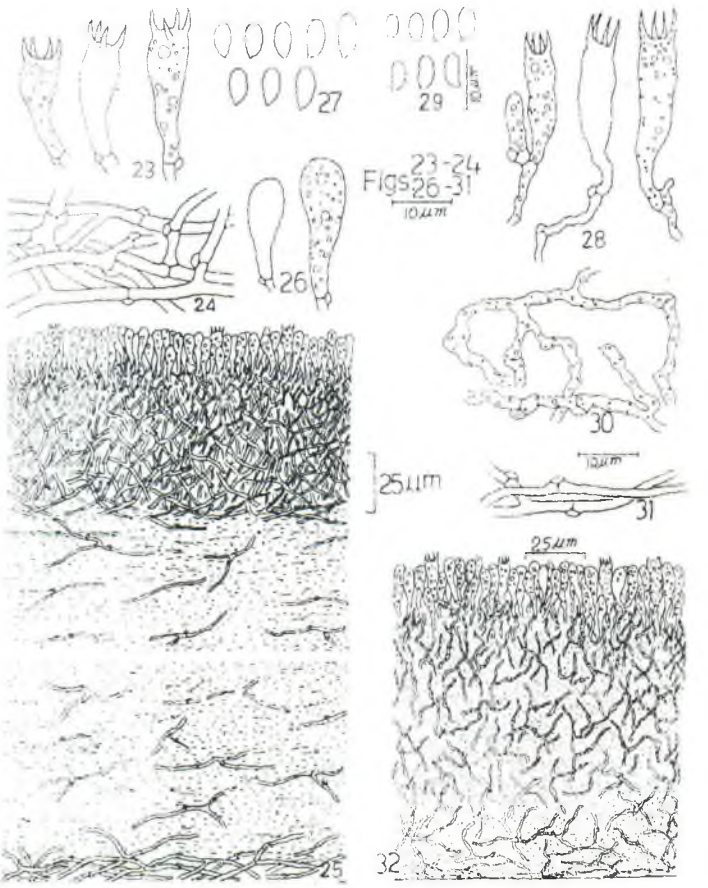
A species close to *Phlebia cornea* (Bourd. & Galz.) Eriksson, in having almost similar type of fruitbodies, and projecting, subcylindrical, thin- to somewhat thick-walled cystidia, but differs considerably in having thick-walled subicular hyphae, shorter basidia (18 - 27.5 x 4.5 - 6 mm in comparison to 40 - 50 x 6 – 8 mm) & shorter basidiospores (4.5 - 6 x 2 - 3.5 mm in contrast to 8 - 12 x 4 - 5.5 mm).

6. *Phlebia thindii* Dhingra sp. nov. (Figs. 23 – 27)

Fructificatio resupinata, effusa, adnata, ad 300 mm crassa in sectione, ceracea cum vegeta crustacea cum arida; superficies hymenialis flavido-ablus ad subflavidus, levigatus ad tuberculatus, rimulosus in vetustus regionis.Hyphae nodoso-septatus. Basidii 17.5 - 24 x 6 - 7 mm, clavatus, angustatus in stilbiformis partis ad basis. Basidiosporii 5 - 7.5 x 2.5 - 3.3 mm, ellipsoideus.

Holotypus - India, W. Bengal, Darjeeling, Tiger Hill, cola angiospermicurn truncus, G.S. Dhingra 19249 (PAN, GH), Augustus 19, 1980.

Etymology: The species is named in honour of Prof. K.S. Thind an eminent mycologist of India.



Figs. 23-27 *Phlebia thindii* Figs. 23. Basidia 24.Generative hyphae 25.V.S. Fruitbody 26. Basidioles 27. Basidiospores
Figs 28-32 *Ph. interjacenoides* 28. Basidia [illegible] ores 30. Generative hyphae in the context [illegible] Subicular generative hyphae 32.V.S. Fruitbo[illegible]

Fruitbody resupinate 300 mm thick in section, cera taceous on drying; hymenial s what tuberculate, continuou versely in the older parts on d. to pale yellow; margins indete into a pruinose periphery or a monomitic; generative hyph. thin-walled, septate, clamped; s row, composed of compactly pac parallel to the substrate, followed pactly packed to agglutinated hyp of densely interwoven, semierect hy sent. Basidia 17.5 - 24 X 6 - 7 mm into a stalk like part at the base

basal clamp; sterigmata up to 5 mm long. Basidiospores 5 - 7.5 x 2.5 - 3.3 mm, ellipsoid, smooth, thin-walled, non-amyloid, acyanophilous, with oily contents.

Holotype: West Bengal: Darjeeling, Tiger Hill, on a decaying angiospermous stump, G.S.Dhingra 19249 (PAN, GH), August 19, 1980. Paratype: Darjeeling, about 5 km from Simana, towards Nepal border, on decaying bark of decaying *Cryptomeria japonica* branches, G. S. Dhingra 19305 (PAN), August 27, 1980.

Phlebia thindii has close affinities with *Ph.griseoflavescens* (Litsch.)Eriksson & Hjortstam, but differs from the same in having yellowish–white to pale yellow hymenial surface, shorter and broader basidia (17.5 - 24 x 6 - 7 mm as compared to 30 - 40 x 5 - 6 mm) and smaller and broader basidiospores (5 - 7.5 x 2.5 - 3.3 mm in comparison to 6 - 9 x 2.5 - 3 mm).

7. ***Phlebia interjacenoides*** Dhingra sp. nov. **(Figs. 28 - 32)**

Fructificatio resupinata, effusa, dense adnata, ad 160 mm crassa in sectione, ceracea subgelatina cum vegeta, crustacea-cornea cum arida, rimulosus in etustus regionis. Hyphae nodoso-septatus. Basidii 18 - 30 x 4.5 – 6 mm, clavatus, angustatus in stilbiformis partis ad basis. Basidiosporii 4 - 6 x 2 - 3 mm, ellipsoideus ad suballantoideus.

Holotypus - Bhutan, Thimphu, Begana, cola putrescens coniferus lignum, G.S.Dhingra 19628 (PAN, GH), Augustus 17, 1981.

Fruitbody resupinate, closely adnate, effuse, up to 160 mm thick in section, ceraceous-subgelatinous when fresh, crustaceous-corneous on drying; hymenial surface smooth, continuous, cracks developing in mature parts on drying, whitish; margin indistinct. Hyphal system monomitic; generative hyphae 1 - 2.5 mmrn wide, thin-walled, septate, clamped, richly branched and intertwined, often gelatinized in mature parts; basal zone not well differentiated, only a few straight, sparsely branched hyphae observed next to substrate; subhymenial hyphae winding, with irregular constrictions and dilatations, and with numerous oil drops. Cystidia absent. Basidia 18 - 30 x 4 - 5 mm, clavate, basally narrowing into a hypha-like part, 4-sterigmate, with a basal clamp; sterigmata up to 6 mm long. Basidiospores 4 - 6 x 2 - 3 mm, ellipsoid to suballantoid, smooth, thin-walled, non-amyloid, acyanophilous.

Holotype: Bhutan: Thimphu, Begana, on a decaying coniferous log, G.S.Dhingra 19628 (PAN, GH), August 7, 1981.

Phlebia interjacenoides is close to *Ph.subceracea* (Litsch.) M.P.Christ. in having similar texture of the fruitbody, generative hyphae and clavate basidia basally narrowing into a distinct stalk (a character similar to *Athelopsis* Ober.:Parm.), but differs from the same in having ellipsoid to suballantoid (4-6 x 2-3 mm) basidiospores in comparison to allantoid (6-7 x 1.3-1.8 mm).

8. ***Phlebia livida*** (Fr.) Bres., Atti Accad. Sci. Lett. Arti Ag. ser III vol.III p.105, 1897. = *Thelephora livida* Fr., Syst. myc. I p. 447, 1821.

This species is marked by closely-adnate fruitbodies; smooth to somewhat tuberculate hymenial surface; clamped generative hyphae; subclavate, 4-spored basidia with a basal clamp and subcylindrical to suballantoid, smooth, thin-walled, non-amyloid, acynophilous basidiospores.

Collections examined: Arunachal Pradesh: West Kameng, Bomdila, Shergaon, on decaying bark of a *Pinus* log, G.S.Dhingra 19826 (PAN), September 6, 1981.

Bhutan: Thimphu, Nawephu, on a decaying angiospermous log, G.S.Dhingra 19372 (PAN), September 18, 1980; Thipmhu, Begana, on a decaying gymnospermous log, G.S.Dhingra 19618 (PAN), August 7, 1981.

A fairly common species in the Himalaya and was first reported from India by Thind and Rattan (1973) from N. W. Himalaya. However, it is a new record for the Eastern Himalaya.

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