

## Studies in *Phlebia*. Six species with teeth

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Six species of *Phlebia* (Meruliaceae, Basidiomycotina) with toothed hymenophores are described and illustrated. The genus name *Mycoacia* is placed in synonymy under *Phlebia*. Four new combinations are proposed: *P. aurea*, *P. fuscoatra*, *P. nothofagi*, and *P. uda*. *Phlebia gilbertsonii* sp. nov. is described from Louisiana and Florida, U.S.A., and *P. albofibrillosa*, from Nepal and northern India, is re-described.

Keywords: Basidiomycetes, Corticiaceae, *Mycoacia*, systematics.

*Phlebia* Fr. is a morphologically diverse genus of principally resupinate, wood decay fungi. The circumscription of the genus is still being determined, although until recently taxa with teeth were excluded. Taxa with *Phlebia*-like phenotypes but with toothed hymenophores were placed in *Mycoacia* Donk (Donk, 1931, 1957). Although this is an arbitrary distinction, it was recognized by many mycologists. Christiansen (1960) was the first to include toothed species in *Phlebia* after *Mycoacia* had been introduced in 1931, namely *P. queletii* (Bourdot & Galzin) M. P. Christ. and *P. hydroides* (Cooke & Masee) M. P. Christ. Subsequently, other hydnceous species were placed in *Phlebia* (Hallenberg & Hjortstam, 1988; Nakasone, 1990; Wu, 1990).

In this paper, four taxa previously assigned to *Mycoacia* are transferred into *Phlebia*, a new species with teeth and encrusted cystidia from southeastern United States is described, and *P. albofibrillosa* is re-described.

### Materials and methods

Microscopic examination of basidiomata was made from free-hand sections mounted in 2% (w/v) aqueous potassium hydroxide and 1% (w/v) aqueous phloxine or in Melzer's reagent (Hawksworth & al., 1983). Color names are from Kornerup & Wanscher (1978), and herbarium designation follow Holmgren & al. (1990). Drawings were

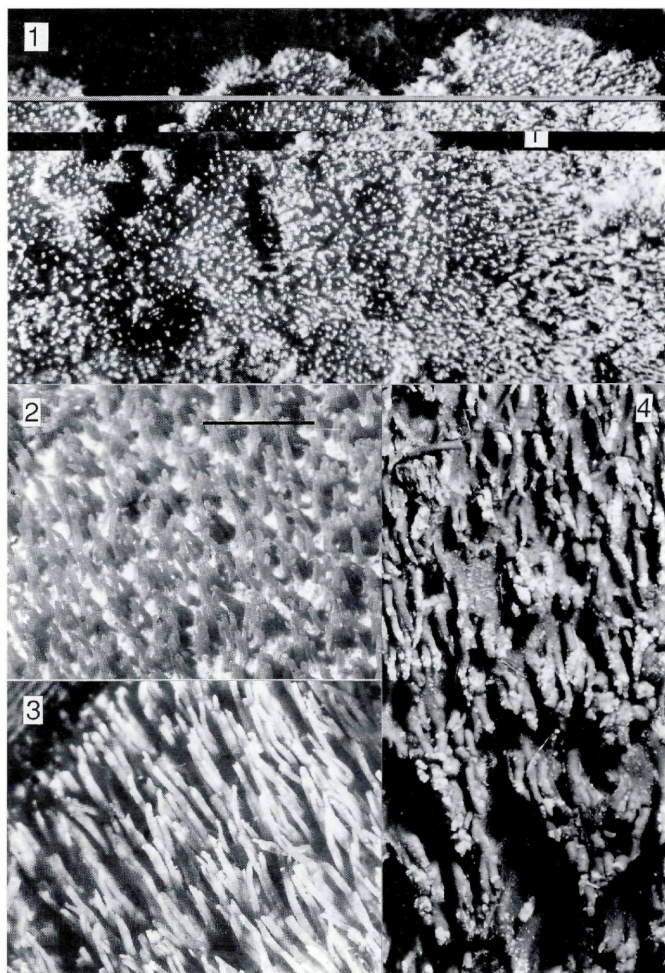
made with the aid of a drawing tube. Photomicrographs were taken on an Olympus BH2 microscope, with or without differential interference contrast, and a PM-10AD photosystem.

### Description of taxa

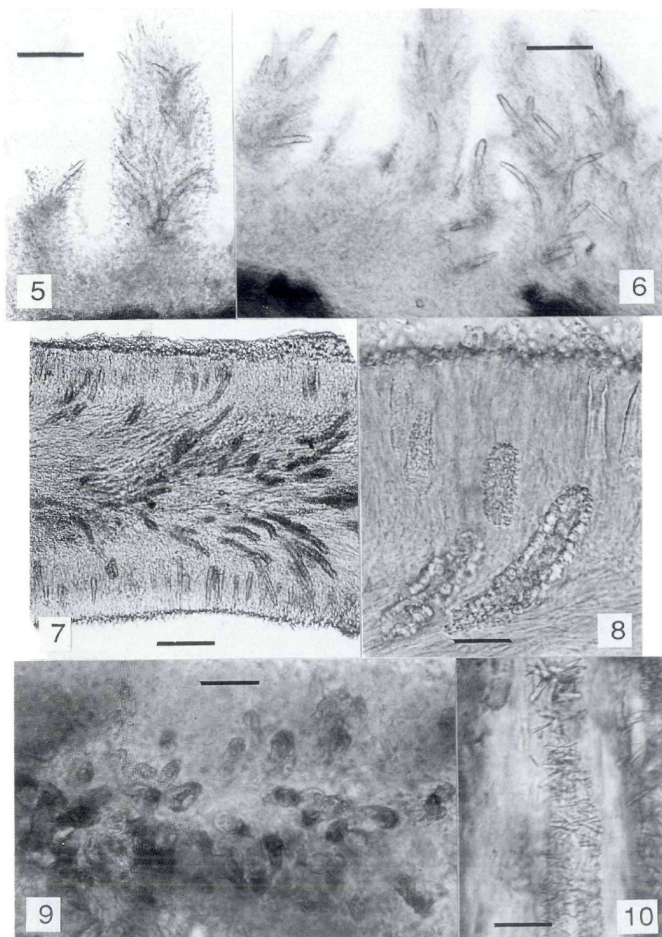
***Phlebia albofibrillosa*** Hjortstam & Ryvarden, Mycotaxon 20: 139. 1984. – Figs. 1, 5, 6, 11.

= *Steccherinum albofibrillosum* (Hjortstam & Ryvarden) Hallenb. & Hjortstam, Mycotaxon 31: 443. 1988.

Basidiomata resupinate, appressed, beginning as small patches, coalescing, up to 2 × 4 cm, thin, up to 200 µm thick, brittle, spinose to odontoid with smooth or finely porose areas between teeth, up to 5 teeth per mm, soft, pale yellow (4A3) to light yellow (4A4); not reacting in KOH; often with fine cracks; context homogeneous, white, membranous; teeth up to 1.5 mm long, becoming smaller toward margins, terete or fused laterally, bristly from protruding cystidia, apices obtuse to acute, penicillate; margins gradually thinning out, up to 2 mm wide, closely appressed, concolorous or paler than hymenium, occasionally translucent, irregular in outline, sterile or appressed and silky, sometimes appressed with scattered raised tufts of mycelia, white to yellowish white (4A2), with fimbriate edges. – Hyphal system monomitic. – Teeth consisting of a central core of subicular hyphae, tramal cystidia, and cystidium-like elements enclosed by thin subhymenial and hymenial layers; cystidium-like elements cylindrical to clavate, up to 150 µm long and up to 12 µm diam, with a basal clamp, often with secondary septa, walls hyaline, thin to slightly thickened, smooth or lightly encrusted with small hyaline crystals, difficult to separate, often observed at tooth apices, rarely embedded in hymenium. Subiculum between teeth up to 125 µm thick, consisting of hyphae and scattered encrusted cystidia arranged parallel to substrate to form a loose, nonagglutinated matrix, then hyphae and cystidia changing to a vertical orientation at subhymenial interface; hyphae 2–6 µm diam, nodose septate, moderately branched, often branching from clamps, walls hyaline, thin, distinct, smooth. – Subhymenium up to 30 µm thick, composed of short-celled, somewhat agglutinated subhymenial hyphae and encrusted cystidia; hyphae 2–3 µm diam, nodose septate, frequently branched, walls hyaline, thin, distinct, smooth. Hymenium composed of basidia, encrusted tramal and hymenial cystidia, and rare cystidium-like elements. – Cystidia of two types: (a) hymenial cystidia fusiform, conical, or clavate, 30–60 × 7–11 µm, tapering to 2–3 µm diam at base, with a basal clamp, embedded or protruding up to 30 µm, walls hyaline, up to 2 µm thick, distal end heavily



Figs. 1-4. - Hymenial surfaces of dried *Phlebia* specimens. - 1. *P. albofibrillosa* (HSK 4205). - 2. *P. aurea* (TAA 126006). - 3. *P. aurea* (TAA 9947). - 4. *P. fuscoatra* (TAA 3410). - Bar = 2 mm.



Figs. 5–10. – Photomicrographs of *Phlebia* species. – 5, 6. *P. albofibrillosa* (HSK 4205): squash mount of teeth showing tramal cystidia. Bar = 65  $\mu\text{m}$ . – 7, 8. *P. nothofagi* (PRM 756721): freehand section through tooth showing embedded tramal and hymenial cystidia. In Fig. 7, bar = 70  $\mu\text{m}$ , and in Fig. 8, bar = 34  $\mu\text{m}$ . – 9, 10. *P. uda* (FP 102252): Bar = 31  $\mu\text{m}$ . – In Fig. 9, squash mount of tooth surface in water shows undifferentiated hyphal tips encrusted with brownish yellow materials. Fig. 10 shows acerose crystals in tooth trama.

encrusted with hyaline crystals, originating in hymenium, best observed in well-squashed mounts; (b) tramal cystidia fusiform with a long stalk, 72–130 × 7–12 µm, tapering to 2.5–3 µm diam at base, clamped at base, often with secondary septa, linear and embedded in tooth trama and subiculum or curved and penetrating through subhymenium and hymenium, embedded in or protruding through hymenium, walls hyaline, up to 2.5 µm thick, encrusted throughout or limited to apex with hyaline crystals, readily observed and abundant throughout teeth, originating in subiculum and tooth trama. – Basidia clavate, 16–24 × 4–5 µm, tapering to 2–2.5 µm diam at base, with a basal clamp, 4-sterigmate, walls hyaline, thin, smooth. – Basidiospores subglobose, 4–5 × 3–3.5(–4) µm, walls hyaline, slightly thickened, smooth, negative in Melzer's reagent.

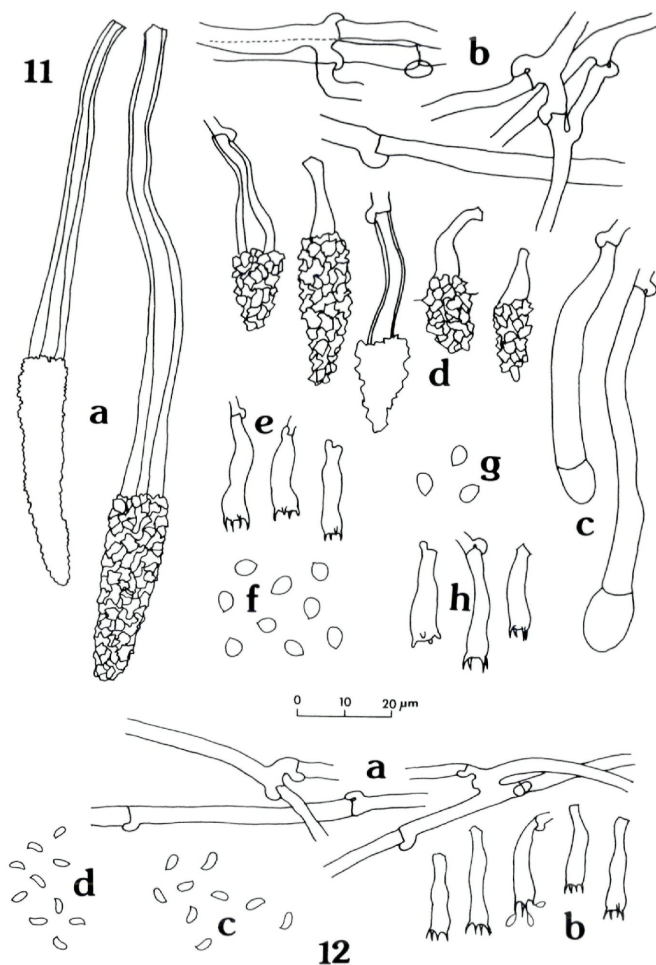
Habitat. – On wood and bark of angiosperms.

Distribution. – Nepal and northern India.

Holotype specimen examined. – NEPAL: Gandaki Prov., Kuldi, Annapurna trek, 2400 m, 7. Nov. 1979, L. Ryvardeen 18979 (O).

Additional specimens examined (collections by H. S. Khara as *Odontia queletii*). INDIA: Himachal Pradesh, Simla, Mashobra–Chharabra Rd., on (decorticate) dead and dry angiospermic twigs, 15. Oct. 1967, H. S. Khara 4205 (BPI US0265948); Simla, Kufri, on (wood and bark of) angiospermic stump and twigs, 26. Sep. 1967, H. S. Khara 4197 (BPI US0265949) and on angiospermic stump and twigs, 16. Sep. 1967, H. S. Khara 4198 (BPI US0265946); Simla, Tara Devi, on bark and wood of angiospermic twigs, 29. Sep. 1967, H. S. Khara 4203 (BPI US0265947); Mahasu, Hattoo Peak, on (decorticate) log of *Quercus semercarpifolia* Sm., 15. Oct. 1967, H. S. Khara 4219 (BPI US0265957) and on (decorticate) angiospermic log, 15. Oct. 1967, H. S. Khara 4220 (BPI US0265950). Uttar Pradesh, Nainital, Cheena Peak, on dead wood of *Viburnum* sp., 29. Sep. 1968, H. S. Khara 4283 (BPI US0265958) and on (decorticate) dead branch of *Viburnum cordifolia* Wallich ex DC., 24. Sep. 1968, H. S. Khara 4280 (BPI US0265959); – NEPAL: Gandaki Prov., Ghorapani, 2600 m, (on wood and bark), 30. Oct. 1979, L. Ryvardeen 18613 and 18737 (paratypes: O); Kuldi, Annapurna trek, 2400 m, (on wood and bark), 7. Nov. 1979, L. Ryvardeen 18905, 18932, 18934, and 18986 (paratypes: O).

The encrusted cystidia, subglobose basidiospores, and restricted distribution distinguish *P. albofibrillosa* from similar species. *Phlebia setulosa* (Berk. & M. A. Curtis) Nakasone, *P. nothofagi*, and *P. gilbertsonii* also develop large encrusted cystidia; these taxa, however, have cylindrical or ellipsoid spores. *Phlebia albofibrillosa* is the same species that Rattan (1977) described as *Metulodontia queletii* (Bourdot & Galzin) Parmasto from northwestern Himalayas. Eight of the thirteen collections cited by Rattan (1977, p. 316) examined were conspecific with *P. albofibrillosa*. The generic placement of *P. albofibrillosa* is debatable. Based upon morphological data of the



Figs. 11–12. – Microscopic elements of *Phlebia* species. – 11. *P. albofibrillosa* (HSK 4198): (a) tramal cystidia, (b) subicular hyphae, (c) cystidium-like elements in teeth, (d) hymenial cystidia, (e) basidia, (f) basidiospores, (g) basidiospores, and (h) basidia (LR 18905, paratype). – 12. *P. aurea* (TAA 18601): (a) subicular hyphae, (b) basidia, (c) basidiospores, (d) basidiospores (FP 133219).

basidiomata, *P. albofibrillosa* appears to be best placed in *Phlebia* although it lacks a ceraceous texture and a well-developed thickening subhymenium. Hallenberg & Hjortstam (1988), however, transferred *P. albofibrillosa* to *Steccherinum* despite the fact that it lacks a dimitic hyphal system, which is one of the principal characters of the genus *Steccherinum*.

***Phlebia aurea* (Fr.) Nakasone, comb. nov. – Figs. 2, 3, 12.**

- = *Hydnum aureum* Fr., Elench. fung. 1, p. 137. 1828.
- = *Acia aurea* (Fr.) P. Karst., Medd. Soc. Fauna Fl. Fenn. 5: 42. 1879 (*nom. illegit.*).
- = *Odontia aurea* (Fr.) Quél., Compt. Rend. Assoc. Franç. Avancem. Sci. (Grenoble). 14: 450. 1885 (1886).
- = *Mycoacia aurea* (Fr.) J. Erikss. & Ryvarde, Corticiaceae N. Europe 4: 877. 1976.
- = *Hydnum membranaceum* Bull.: Fr. \* *stenodon* Pers., Mycol. Eur. 2, p. 188. 1825.
- = *Odontia stenodon* (Pers.) Bres., Atti. Imp. Regia Accad. Rovereto, ser. 3, 3: 96. 1897.
- = *Acia stenodon* (Pers.) Bourdot & Galzin, Bull. Trimest. Soc. Mycol. Fr. 30: 256. 1914 (*nom. illegit.*).
- = *Mycoacia stenodon* (Pers.) Donk, Meded. Ned. Mycol. Ver. 18–20: 151. 1931.
- = *Oxydontia stenodon* (Pers.) L. W. Mill., Mycologia 25: 367. 1933.
- = *Sarcodontia stenodon* (Pers.) Nikol., Flora pl. cryptog. URSS, 6, Fungi (2), p. 178. 1961.
- = *Hydnum membranaceum* Bull.: Fr.  $\beta$  *dryinum* Chaillet: Fr., Elench. fung. 1, p. 135. 1828.
- = *Hericum fimbriatum* Banker, Mem. Torrey Bot. Club 12: 122. 1906.
- = *Hydnum mucidum* Velen., České houby, p. 744. 1922. (*vide* Cejp 1930, p. 56).
- = *Mycocleptodon mycophilus* Pilát, Bull. Trimest. Soc. Mycol. Fr. 51: 398. 1936.
- = *Mycocleptodon microcystidium* M. P. Christ., Friesia 4: 329. 1953.
- = *Steccherinum microcystidium* (M. P. Christ.) M. P. Christ., Dan. Bot. Ark. 19(2): 324. 1960.
- = *Mycoacia stenodon* (Pers.) Donk var. *microcystidium* (M. P. Christ.) Parmasto., Izv. Akad. Nauk Ėst., SSR, Ser. Biol. 16: 388. 1967.

Basidiomata annual, closely adnate, widely effused, up to 13 × 4 cm, thin, up to 350  $\mu$ m thick, denticulate to spinose, ceraceous throughout; not reacting with KOH; cracks absent or extensive and revealing white context; context bilayered, upper layer thin, up to 30  $\mu$ m thick, concolorous with hymenium, ceraceous, lower layer next to substrate thicker, up to 300  $\mu$ m thick, white or translucent, felty; hymenial surface spinose, 3–6 teeth per mm, with smooth areas between teeth, teeth terete, slender, typically single but occasionally fused at base or along entire length, gradually tapering toward apex, up to 2(–6) × 0.4 mm, ceraceous, brittle, snapping off easily, apices acute and entire or blunt, white and tufted, often branched several times, color of teeth and fertile areas between teeth brown [6(DE)(6–7), 7D(7–8)], brownish orange [6C(6–7)], light orange (5A5), greyish orange (5B6), with younger areas greyish orange [5B(4–5)] or orange white (5A2), rarely light yellow (4A4) or yellowish white

(4A2), gradually becoming paler toward apex, sometimes with a whitish cast; margins gradually thinning out, distinct, pulverulent and short odontoid, or 1–3(–8) mm wide, woolly to felty, with short ridges or teeth and short, stiff, appressed or slightly raised, radiating cordons at the edges, white, pale yellow (4A3), light yellow (4A4), light orange (5A4), or pale orange (5A3). – Hyphal system monomitic. – Teeth consisting of a central core of agglutinated, thin to slightly thick-walled, smooth subicular hyphae extending into apex, rarely encrusted with clusters of coarse, hyaline crystals, and enclosed by subhymenium and hymenium. – Subiculum 100–260  $\mu\text{m}$  thick with a duplex structure, lower layer (40–200  $\mu\text{m}$  thick) next to substrate a *textura porrecta*, composed of agglutinated hyphae arranged parallel to substrate, upper layer (30–100  $\mu\text{m}$  thick) a *textura intricata* with hyphae vertically arranged in a loose, open texture with some hyphal segments heavily encrusted with particulate to small hyaline crystals; hyphae 2.2–5.5  $\mu\text{m}$  diam, nodose septate, sparingly branched, walls hyaline, thin to slightly thick, occasionally up to 1  $\mu\text{m}$  thick, smooth but occasionally hyphal segments coated with a thick, even layer of small, hyaline crystals. – Subhymenium thickening, up to 40  $\mu\text{m}$  thick, composed of vertically arranged, compact, dense, indistinct, agglutinated hyphae; hyphae 2.2–3  $\mu\text{m}$  diam, nodose septate, frequently branched, conglutinate, short-celled, walls hyaline, thin, smooth. – Hymenium a dense palisade of basidia and, rarely, cystidia. – Cystidia fusoid to cylindrical, 16–21  $\times$  3–5  $\mu\text{m}$ , tapering to 2–3  $\mu\text{m}$  diam at base, with a basal clamp, walls hyaline, thin, smooth or distal end encrusted with a thin layer of crystalline materials, absent or rare. – Basidia clavate, 10.5–18 (–21)  $\times$  3.5–4(–5)  $\mu\text{m}$ , tapering to 2–3  $\mu\text{m}$  diam at base, with a basal clamp, 4-sterigmate, walls hyaline, thin, smooth. – Basidiospores short allantoid to cylindrical, 3.5–4.5(–5.5)  $\times$  1.5–2(–2.2)  $\mu\text{m}$ , walls hyaline, slightly thickened, smooth, negative in Melzer's reagent.

Habitat. – On wood and bark of angiosperms.

Distribution. – United States, Canada, Costa Rica, Great Britain (Reid, 1958, as *M. microcystidiatus*), Norway, Sweden, Finland, Denmark, Switzerland (Breitenbach & Kränzlin, 1986), Germany, Austria, France, Spain, Czech Republic, Slovak Republic, Ukraine, Estonia, Lithuania, Russia, Armenia, Georgia, Turkey, Iran, Uzbekistan, Kenya and Tanzania (Hjortstam & Larsson, 1994), Nepal (Hjortstam & Ryvarden, 1984), India, Japan.

Type specimens examined. – [FRANCE(?), near Switzerland]: Chêne, entre l'écorce et le bois, Avril, 1822, leg. Chaillat, Herb. Persoon (HOLOTYPE of *Hydnum membranaceum* \* *stenodon*: L 910.262–526). Herb. E. Fries, leg. Chaillat,



det. E. Fries, (HOLOTYPE of *Hydnum membranaceum*  $\beta$  *dryinum*: UPS). – DENMARK: Sjøalland, Hareskoven, on *Fagus*, 5. Oct. 1949, M. P. Christiansen 455 (HOLOTYPE of *Mycocleptodon microcystidium*: C). – RUSSIA: Sibiria, Wasjuganjan, ad corticem *Salicis* sp. et *Fomitopsis ignarium*, 1. Oct. 1934, Krawtzew 83W, PRM 156142 (SYNTYPE of *Mycocleptodon mycophilus*: PRM). – SWEDEN: Småland, Femsjö, no date, E. Fries (NEOTYPE of *Hydnum aureum*: UPS). – UNITED STATES: Pennsylvania, Chamouni, on dead stump, 23. Oct. 1903, H. J. Banker 860 (HOLOTYPE of *Hericium fimbriatum*: NY).

Representative specimens examined. – ARMENIA: Kirovakan, on (decorticate) fallen branch of *Carpinus caucasica* Grossh., 18. Sep. 1962, E. Parmasto, ut *M. stenodon* var. *microcystidia* (TAA 15194). – AUSTRIA: Steiermark, Graz, Leechwald, on (decorticate) fallen branch of *Fraxinus*, 27. Dec. 1981, L. & N. Hallenberg 4197 (GB); Tirol, Erlenan bei Hatting im Oberinntal, on *Alnus incana* (L.) Moench, 9. Aug. 1921, V. Litschauer, ut *A. stenodon* (ISC ISU386845). – CANADA: Ontario, S. E. of Credit Forks, on (decorticate) deciduous wood, 3. Nov. 1934, H. S. Jackson, TRTC 7364, ut *Mycocacia fuscoatra* (DAOM 122959); Kingston, on (decorticate) wood, 10. Sep. 1966, J. H. Ginns 599 (CFMR). – COSTA RICA: San José Province, Jardín, elev. 6400 ft, on (decorticate) hardwood, 8. Jul. 1963, J. L. Lowe 13066 (CFMR). – CZECH REPUBLIC: Bohemia, Studeny orch prope Sbrřbrná Skalice, ad truncum iacentem Fagi silvaticae, 12. Nov. 1963, Z. Pouzar, ut *M. stenodon* (PRM 803584). – DENMARK: Sjøalland, København, Dyrehave, (on decayed wood), 3. Oct. 1955, J. Eriksson 2397 (GB). – ESTONIA: Distr. Polva, Kildjarve, on burnt trunk of (decorticate) *Betula* sp., 8. Sep. 1957, M. & S. Kask, ut *M. stenodon* (TAA 18601); Distr. Pärnu, Kablé, on *Picea abies* (L.) Karst., 13. Oct. 1986, I. Parmasto (TAA 126006). – FINLAND: Prov. Karelia borealis par., Pichjärir, Loc. Loukivaara, infer Kirkisenvaara et Jyrinvaarat, on wood of *Betula*, 12. Jul. 1936, B. Laurila, ut *A. stenodon* (GB). – FRANCE: Gallica, ad lignum Populi, 16. Sep. 1913, ex herb A. Bourdot, ut *A. stenodon* (PRM 169144); Alsace, Haut-Rhin, in forest Hardt near Habsheim, on decayed wood of deciduous tree, 20. Oct. 1982, V. Rastetter (GB). – GEORGIA: Distr. Tshacva, Ciscari, ad ramum Fagi orientalis dejectum, 14. Oct. 1963, E. Parmasto (TAA 16912). – GERMANY: Pechhütte Gruba Krs., Coburg, on (decorticate) *Quercus*, 5. Sep. 1980, H. Engel, MTB 5732 (GB); Hessische Oberrheinebene, Seeheim, on bark of *Fagus*, 19. Oct. 1983, K.-H. Larsson & K. Hjortstam, KHL 4750 (GB). – INDIA: Uttar Pradesh, Chamoli, Gobind Dham., on (decorticate, decayed) coniferous log, 15. Sep. 1968, H. S. Khara 4269, ut *Odontia fuscoatra* (BPI US0265769). – IRAN: Mazanderan, Jangale dormod, near Ramsar, on (corticate) fallen branches of *Pterocarya*, 14. Jul. 1976, L. & N. Hallenberg & D. Ershad, NH 1819 (GB 23595). – JAPAN: Okinawa Pref., Nago City, Mt. Tanodake, on decayed wood (and bark) of broad-leaved tree, 14. Nov. 1988, N. Maekawa 1704 (TMI 12795). – LITHUANIA: Distr. Tshacva (Colchis) Ciscari, alt. 800 m, ad ramum Fagi orientalis dejectum, 14. Oct. 1963, E. Parmasto (TAA 16912). – NORWAY: Hedmark, Stange, Rotlia, on (decorticate) deciduous wood, 22. Aug. 1985, K. Hjortstam 16140 (GB); Oslo, Bygoløy, på løvved, 6. Oct. 1953, F.-É. Eckblad (GB). – RUSSIA: Altaici, regio Montano-Altaica, reservatum Altaicum, apud lacum Telezkce, on (decorticate) fallen trunk of *Salix* sp., 6. Sep. 1959, E. Parmasto (TAA 8847). Sibirici, Krasnoyarsk Terr., Koltshim, on (decorticate) log of *Betula pubescens* Ehrh., 15. Aug. 1958, E. Parmasto (TAA 7044). Kamtshatka, distr. Yelizov, on (decorticate) fallen trunk of *Salix sachaliensis* F. Schidt, 22. Sep. 1960, E. Parmasto (TAA 12497). – SLOVAK REPUBLIC: Carpatossia, in silvis mixtis virgineis, in valle rivi Berlebaš prope vicum Trebušany, alt. 800–1000 m.s.m., on (decorticate) *Acer pseudoplatanus* L., Aug. 1937, A. Pilát, ut *A. stenodon* (PRM 488551). – SPAIN: Huesca, between Gesera-Laquarta, on (corticate) *Pinus* branch, 10. Nov. 1986, N. Hallenberg 9863 (GB). – SWEDEN: Öland, S om Halltorps lund, murken ved av (decorticate) *Corylus avellana* L., 10. Jun. 1964, Å. Strid (GB 9421). Västergötland, Medelplana parish, Råbäck,

Kinneulle, on decayed, deciduous wood, 9. Oct. 1970, K. Hjortstam 5224, ut *M. stenodon* (GB 15001, ARIZ AN002729). – TURKEY: NE Anatolia, Trabzon area, S. of Camlihemsin, on (decorticate) *Alnus* branch, 5. Oct. 1989, N. Hallenberg, NH 11418 (GB). – UKRAINE: Zakarpatskaya reg., Hankovicha, on (decorticate) rotten log of *Fagus sylvatica* L., 9. Aug. 1956, E. Parmasto, ut *M. stenodon* var. *microcystidiata* (TAA 3767). – UZBEKISTAN: Tashkent, on (decayed, decorticate) hardwood (?), 20. Apr. 1982, E. Parmasto (TAA 104260). – UNITED STATES: Montana, Flathead Lake University of Montana Biological Station, on (decorticate) *Betula* sp., 2. Aug. 1964, R. L. Gilbertson 6530 (CFMR). New York, Allegany State Park, on (corticate) *Betula alleghaniensis* Britton, 12. Sep. 1964, R. L. Gilbertson 5075 (CFMR). North Carolina, Macon County, Nantahala National Forest, Scaly School-Dryman Chapel Road, on (corticate) *Fraxinus* (?), 3. Aug. 1969, H. H. Burdsall, Jr. 2646 (CFMR). Oregon, Siskiyou National Forest, Winchuk Campground, on (decayed) hardwood, 15. Sep. 1972, M. J. Larsen, FP 133219 (CFMR). Wisconsin, Dane County, Blue Mound State Park, on (decorticate) *Populus tremuloides* Michx., 18. Sep. 1975, H. H. Burdsall, Jr. 8804 (CFMR).

*Phlebia aurea* is characterized by slender teeth and abundant, small, allantoid or cylindrical basidiospores with slightly thickened walls. This species, however, displays macroscopic and microscopic morphological variability. For example, typically no cystidia are present although in a few specimens encrusted cystidia in the hymenium and tooth trama were observed. Basidiospore shape and width are also variable. The spores are distinctly curved in most specimens, but not all.

Fortunately, many type specimens were available for study. *Hydnum aureum*, however, lacks a type; a neotype is designated herein based on an authentic specimen collected and identified by Fries and discussed by Eriksson & Ryvarden (1976). The holotype of *M. microcystidiatus* was examined, and I agree with Parmasto (1967) and Eriksson & al. (1984, p. 1385) that it is conspecific with *P. aurea*. Similarly, I concur with Nikolajeva (1964) and Maas Geesteranus (1974) that *M. mycophilus* is conspecific with *P. aurea*. The holotype of *Hericium fimbriatum* has long teeth (6–8 mm) with rare fusiform cystidia protruding through the hymenium. Despite these unusual features, *H. fimbriatum* has basidiospores ( $4.3\text{--}5.5 \times 1.5\text{--}2 \mu\text{m}$ ) and other microscopic characters typical for *P. aurea*. Thus, *H. fimbriatum* is placed in synonymy under *P. aurea*. Gilbertson (1964), however, noted that *H. fimbriatum* displayed similarities with *P. setulosa* and *Sarcodontia setosa* (Pers.) Donk. Although *Hydnum fascicularia* Berk. & Curtis has been placed in synonymy under *H. stenodon* by Gilbertson (1965), Nakasone & Burdsall (1995) recognized *H. fascicularia* as a distinct species of *Phlebia*.

Basidioma descriptions, illustrations, and photographs are also available from Breitenbach & Kränzlin (1986), Eriksson & Ryvarden (1976), Maekawa (1993), and Rattan (1977). For cultural descriptions, see Boidin (1958) and Stalpers (1978). Boidin (1958) and Brown (1935) reported that *P. aurea* is homothallic.

***Phlebia fuscoatra*** (Fr.: Fr.) Nakasone, comb. nov. – Figs. 4, 13.

- = *Hydnum fuscoatrum* Fr., Novit. fl. suec. 2, p. 39. 1814.
- = *Hydnum fuscoatrum* Fr.: Fr., Syst. mycol. 1, p. 416. 1821.
- = *Hydnum castaneum* Alb. & Schw.  $\beta$  *atrofuscum* (Fr.) Pers., Mycol. eur. 2, p. 188. 1825.
- = *Acia fuscoatra* (Fr.: Fr.) P. Karst., Meddel. Soc. Fauna Fl. Fenn. 5: 42. 1879 (*nom. illegit.*).
- = *Acia fuscoatra* (Fr.: Fr.) Pat., Essai tax. Hyménomyc., p. 69. 1900 (*nom. illegit.*).
- = *Odontia fuscoatra* (Fr.: Fr.) Bres., Atti Imp. Regia Accad. Rovereto, ser. 3, 3: 95. 1897.
- = *Mycocacia fuscoatra* (Fr.: Fr.) Donk, Meded. Ned. Mycol. Ver. 18–20: 152. 1931.
- = *Mycocoleptodon fuscoater* (Fr.: Fr.) Pilát, Bull. Trimest. Soc. Mycol. Fr. 51: 401. (1935) 1936.
- = *Steccherinum fuscoatrum* (Fr.: Fr.) Gilb., Evol. higher basidiomycetes p. 294. 1971.
- = *Hydnum weinmannii* Fr., Elench. fung. 1, p. 198. 1838 (*sec. Bresadola, 1897*).
- = *Hydnum carbonarium* Peck, New York State Bot. Rep. 40: 55. 1887.
- = *Mycocoleptodon corneus* Pilát, Bull. Trimest. Soc. Mycol. Fr. 49: 306. (1933) 1934.
- = *Steccherinum corneum* (Pilát) Parmasto, Conspectus syst. corticiacearum p. 173. 1968.
- = *Radulum fuscescens* Pilát, Bull. Trimest. Soc. Mycol. Fr. 52: 324. 1936.

Basidiomata annual, resupinate, beginning as small circular patches, coalescing, becoming widely effused, up to 20 × 5 cm, thin, 70–325  $\mu$ m thick, spinose to odontoid, teeth gradually becoming shorter and smaller toward margins, sometimes heavily coated with fine, soft, white crystalline materials; hymenium between teeth smooth to porose, ceraceous to crustaceous; often younger, light-colored basidiomata turning red or dark brown in KOH; cracks infrequent to numerous; context bilayered with a thin (up to 40  $\mu$ m thick), ceraceous upper layer concolorous with hymenium and a thicker (up to 300  $\mu$ m thick), buff-colored lower layer; hymenial surface spinose, 2–4 teeth per mm, occasionally with extensive smooth areas, teeth terete to compressed, single or fused at base, occasionally fused throughout length, gradually tapering toward apex, up to 2 × 0.4 mm, submembranous to ceraceous, with entire or fibrillose to penicillate apices, color variable, hymenium between teeth and bases of teeth greyish orange (5C6), brownish orange [5B6, 6C(6–8)], light brown [6D(5–6)] reddish brown (8D7), brown (7D8), light brown (6D6), or nearly black (6F6), becoming lighter toward apices, sometimes with a white pulveraceous covering over hymenium; margins typically distinct, closely appressed, adherent, abrupt or occasionally gradually thinning out, up to 1 mm wide, smooth to grandinoid, orange white (5A2), light orange (5A5), pale orange (5A3), greyish orange (5B5), or white, edges closely attached, slightly raised, fimbriate to felty, white to pale yellow. – Hyphal system monomitic. – Teeth consisting of a core of parallel, vertically arranged, hyaline to yellowish brown subicular hyphae and brownish

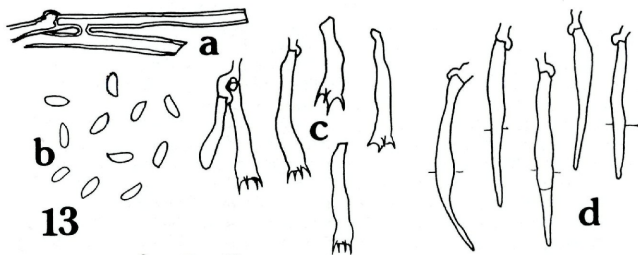
yellow resinous materials enclosed by subhymenial and hymenial layers; subicular hyphae often glassy in appearance, developing numerous H-connections, frequently heavily encrusted with hyaline crystals and protruding through apex, occasionally developing aggregates of coarse, hyaline crystals, crystals up to  $15 \times 15 \mu\text{m}$ . – Subiculum in smooth areas between teeth  $60\text{--}250 \mu\text{m}$  thick, a loose *textura intricata*, arranged parallel to substrate, agglutinated or not, coated with brownish yellow, resinous-like substances; subicular hyphae  $2\text{--}4 \mu\text{m}$  diam, nodose septate, occasionally branched, with frequent H-connections, walls hyaline, thin to slightly thickened, smooth or coated with resinous materials. – Subhymenium slightly thickening,  $20\text{--}40 \mu\text{m}$  thick, hyphae oriented perpendicular to substrate or long axis of teeth, forming a dense, compact layer; hyphae  $1.5\text{--}3.5 \mu\text{m}$  diam, nodose septate, frequently branched, short-celled, walls hyaline, thin, smooth or covered with brownish yellow, resinouslike materials. – Hymenium a dense palisade of basidia and cystidia, often covered with brownish yellow, resinous-like materials, not agglutinated, usually not too difficult to separate individual elements. – Cystidia subulate,  $22\text{--}36\text{--}(54) \times 3\text{--}4.5 \mu\text{m}$ , tapering to  $2.5\text{--}3 \mu\text{m}$  diam at base, with a basal clamp, hyaline, walls hyaline, thin, smooth, arising from subhymenium and hymenium, protruding up to  $25 \mu\text{m}$  beyond hymenium, scarce to numerous. – Basidia clavate,  $(14\text{--})18\text{--}23\text{--}(35) \times 4\text{--}5.5 \mu\text{m}$ , tapering to  $2\text{--}3 \mu\text{m}$  diam at base, clamped at base, 4-sterigmate, walls hyaline, thin, smooth. – Basidiospores short cylindrical, adaxial side straight,  $(4.5\text{--})5\text{--}6 \times 2\text{--}2.2\text{--}(2.5) \mu\text{m}$ , hyaline, walls hyaline, thin, smooth, negative in Melzer's reagent.

**Habitat.** – On wood and bark of angiosperm logs and branches, rarely on gymnosperms; associated with a white rot decay.

**Distribution.** – Canada, United States, Sweden, Finland, Germany, France, Portugal (Melo, 1994), Spain (Tellería, 1990), Czech Republic, Slovak Republic, Estonia, Lithuania, Russia, India (Rattan, 1977), Korea, Japan.

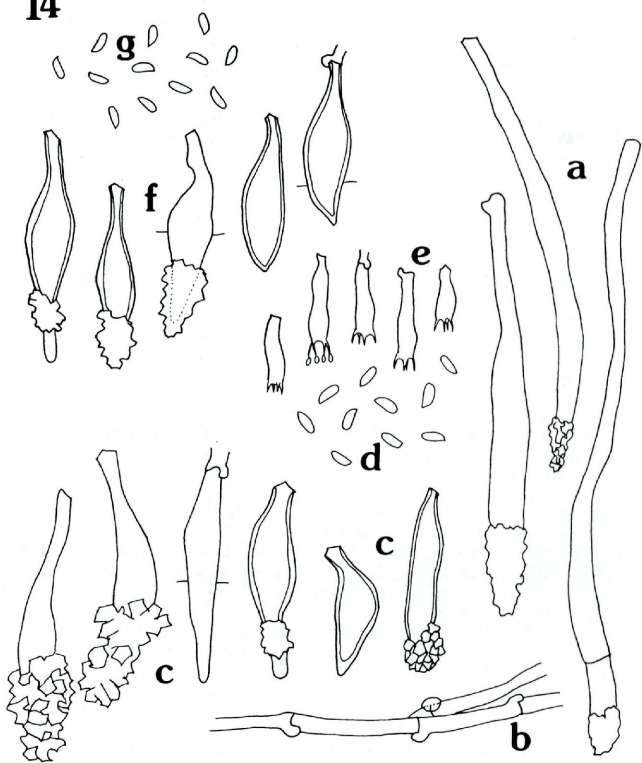
**Type specimens examined.** – RUSSIA: Sibiria, distr. Omsk, ad corticem *Betulae verrucosae* Ehrh., Aug. 1925, K. E. Murashkinisky 25046, PRM 741035 (HOLOTYPE of *Radulum fuscescens*: PRM); Sibiria, distr. Tomsk, ad fl. Tschulym, on *Prunus padus* L., Sep. 1931, Krawtzew, PRM 187749 (HOLOTYPE of *Mycoplepton corneus*: PRM). – SWEDEN: Uppsala, Halmbyboda, Sep. 1853, E. Fries

Figs. 13–14. – Microscopic elements of *Phlebia* species. – 13. *P. fuscoatra* (HHB 5666): (a) hypha from tooth trama, (b) basidiospores, (c) basidia, (d) cystidia. – 14. *P. gilbertsonii* (HHB 9649, holotype): (a) tramal cystidia, (b) subicular hypha, (c) hymenial cystidia, (d) basidiospores, (e) basidia; (from RLG 13319): (f) hymenial cystidia, and (g) basidiospores.



0 10 20  $\mu\text{m}$

14



(NEOTYPE of *Hydnum fuscoatrum*: UPS). – UNITED STATES: New York, Elizabethtown, Sep., C. H. Peck (HOLOTYPE of *Hydnum carbonarium*: NYS).

Representative specimens examined. – CANADA: British Columbia, Vancouver Island, Arbutus Hill, S of Mesachie Lake Forest Exp. Station, on (decorticate) log of *Pseudotsuga menziesii* (Mirb.) Franco, 18. Sep. 1967, B. & J. Eriksson 8257 (GB, DAOM 142124). Manitoba, Winnipeg, on deciduous wood, 16. Oct. 1923, A. H. R. Buller & G. R. Bisby 2338 (ISC ISU386685). Nova Scotia, Colchester County, U. Brookside, on (decorticated) *Fagus* sp., 14. Jul. 1933, L. E. Wehmeyer 1583 (NY). Ontario, Brant County, 1 mi. S of Hatchley, on (bark and wood of) *Acer saccharinum* L., 27. Aug. 1934, R. F. Cain 4780, TRTC 7383 (FH, NY, BPI US0265766, DAOM 163755). Yukon Territory, Klondike Hwy, km 445, 62°41'N, 136°46'W, on decorticate 17 cm log of *P. tremuloides*, 5. Aug. 1980, J. H. Ginns 5463 (DAOM 209959). – CZECH REPUBLIC: Moravica, sylva virginea Bialowieza ap. Hajnówka, loco "Park Narodowy," quadratum no. 224, in alneto gluti. ad ramum iacentum frondosum (decorticate), 29. Aug. 1973, Z. Pouzar (PRM 756716). – ESTONIA: Distr. Viljandi, Tipu, in *A. glutinosa* bog forest, on (decorticated) log of *P. abies*, 18. Aug. 1953, E. Parmasto (TAA 1396). Distr. Haapsalu, Noarootsi, on (decorticate) *Populus tremula* L. log, 21. Jun. 1956, E. Parmasto (TAA 3410). – FINLAND: Etälä-Häme, Padasjoki, Vesijako Nat. Park, on (decorticate) *Betula* sp., 8. Sep. 1979, Kotiranta 1712 (GB). – FRANCE: Aveyron, on (decorticate) *Quercus* sp., Jun. 1910, Galzin 7326 (NY). – GERMANY: Broekostbevern, an sehr feuchtem Laubholz, 1908, Herbst, Nr. 184, W. Brinkmann, Westfälische Pilze, Lief IV (BPI US0265756). – JAPAN: Okayama Pref., Maniwa-gun, Kawakami-son, on decaying (corticate) branch of *Quercus* sp., 18. Sep. 1991, N. Maekawa (TMI 127776). – KOREA: Jeonran-am-do Province, Jiri Mt., on (corticate) twig of *Prunus*, 8. Sep. 1991, H. S. Jung 34 (SNU 91098, CFMR). – LITHUANIA: Kaunas, on (decorticate) deciduous wood, 22. Jul. 1936, A. Minkevicius (TAA 18099). – RUSSIA: Alta, regio MontanoAltaica, reservatum Altaicum, apud lacum Telezkoje, alt. 500–600 m, on fallen trunk of *P. tremula*, 24. Aug. 1959, E. Parmasto (TAA 8897). Caucasia, Regio Karsnodar, Reservatum Caucasicum, Guseripl, alt. 700800 m, on decorticated *Fagus orientalis* Lipsky, 15. Sep. 1966, E. Parmasto (TAA 19420). Regio Primorski, distr. Ternei, Reservatum Sichote-Alinicum, Plagadatnoje, on *Betula costata* Trautv. ex Maxim, ad ramum prolapsum, 24. Sep. 1990, U. Koljalj (TAA 149823). – SLOVAK REPUBLIC: Holíčsky Štátny les ap. Holíč prope Skalice, ad (decorticate) ramum iacentem cf. *Fraxini angustifoliae*, 13. Oct. 1971, Z. Pouzar (PRM 756715). – SWEDEN: Lule Lappmark, Jokkmokk par., S of Muddus National Park, Tuorasetlet, on (bark and wood of) decayed log of *Salix* sp., 5. Aug. 1958, J. Eriksson 8394 (GB). Västerbotten, Degerfors, Överröda, on (bark and wood of) fallen trunk of *A. incana*, 25. Aug. 1971, Å. Strid 8661 (GB). Östergötland, Skedevi sn, Reymyra, H. v. Post, Herb. E. Fries, ut *Hydnum membranaceum* (UPS). – UNITED STATES: Alabama, Montgomery County, on frondose wood, Oct. 1917, R. P. Burke 428, MBGH 65432 (BPI US0265762). Alaska, S end of Harding Lake, on (decorticate) well-decayed log of *Betula papyrifera* Marsh., 29. Jul. 1994, H. H. Burdsall, Jr. 15240 and 15241 (CFMR). Georgia, Saint Simons Island, on (decorticate) *Quercus virginiana* Mill., 4. Aug. 1950, J. L. Lowe 4018 (BPI US0265775). Idaho, Bonner's Ferry, elev. 1773 ft, on (decorticate) fallen trunk of *Populus trichocarpa* Torrey & A. Gray, 22. Jul. 1920, A. S. Rhoads, JRW 14697 (BPI US0259273). Illinois, Jackson County, Shawnee Nat. Forest, Little Grand Canyon, on (decorticate) *Quercus* sp., 29. May 1986, K. K. Nakasone, FP 102084 (CFMR). Iowa, North Liberty, on (bark of) cottonwood, 16. Nov. 1931, L. W. Miller 231 (NY). Louisiana, Caldwell Parish, Copenhagen Prairie, on *Liquidambar styraciflua* L., 20. Apr. 1984, M. Blackwell 1763 (ARIZ AN007034). Maine, Mt. Katahdin, Roaring Brook, on (decorticate) hardwood, Jul. 1965, R. H. Petersen & P. D. Olexia (ARIZ AN002740). Maryland, Laurel, Patuxent Wildlife Refuge, Beech Island, on (decorticate) *Carpinus caroliniana* Walt., 7. Sep. 1968, H. H. Burdsall, Jr. 783 (CFMR, ARIZ AN002752).

Montana, Lake County, Univ. Montana Biological Station, on (decorticate) *P. tremuloides*, 11. Jul. 1971, H. H. Burdsall, Jr. 5666 (CFMR). New Mexico, Jemez Mts., Valle Grande, on *P. tremuloides*, 23. Sep. 1910, E. Knaebel (ARIZ AN002738). New York, Paul Smiths, on (decorticate) hardwood, 27. Sep. 1960, R. M. Jeffers 156 (FH, NYS, BPI US0265754). Ohio, Clermont County, near Loveland, Dark Hollow, in mixed mesophytic woodland, on decayed wood, 4. Dec. 1933, W. B. Cooke 2872 (NY). Oregon, Grants Pass, on (decorticate) *P. trichocarpa*, 4. Sep. 1916, J. R. Weir 8693 (ARIZ AN002739, BPI US0259271). Wisconsin, Fond du Lac County, Kettle Moraine State Forest, Mauthe Lake Recreation Area, North Unit, on (decorticate) *P. tremuloides*, 11. Oct. 1975, H. H. Burdsall, Jr. 8720 (CFMR, GB).

*Phlebia fuscoatra* is characterized by slender, subulate cystidia, cylindrical spores, encrusted hyphae in the tooth trama, and reddish brown basidiomata. Old or overmature specimens are ceraceous with abundant resinous materials that obscure the microscopic characters. In addition, the hymenia in old, dark-colored specimens often are degenerated, which complicates identification. The basidiospores of *P. fuscoatra* are narrower than those of the morphologically similar *P. uda* and *P. nothofagi*.

An attempt was made to examine all type specimens, but no specimens named *H. weinmannii* were found in Fries' herbarium at UPS. Because *Hydnum fuscostrum* lacks a type specimen, a neotype is designated. I agree with Miller (1934), Brown (1935), and Gilbertson (1962) that *H. carbonarium* is conspecific with *P. fuscoatra*. Also, I concur with Nikolajeva (1964) that *M. corneus* is conspecific with *P. fuscoatra*. However, the type specimen of *R. fuscescens* is clearly conspecific with *P. fuscoatra* and not to *Sarcodontia (Phlebia) uda* as reported by Nikolajeva (1964).

*Hydnum membranaceum* Bull. was not included in the synonymy above although it is often associated with *H. fuscostrum*. *Hydnum membranaceum* was described and illustrated in 1791 by Bulliard. I have not seen the original publication but consulted the description (p. 302) and figure (plate 481, Fig. I) in a 1809 (Bulliard, 1809) reissue. Fries (1821) accepted *H. membranaceum* as a distinct species. Bresadola (1897, 1903) and Bourdot & Galzin (1928) followed Fries and noted its similarities to *H. fuscostrum*. Miller (1934) and Lundell & Nannfeldt (Fungi exs. suecici no. 1410) went a step further and synonymized *H. membranaceum* under *H. fuscostrum*. This is a logical conclusion since two of the three collections of *H. membranaceum* examined from Fries' herbarium at UPS, from Sweden are conspecific with *P. fuscoatra*, and the specimen from Norway is a mixed collection of *P. rufa* (Pers.: Fr.) M.P. Christ. that includes one piece of *P. fuscoatra*. However, it is not clear what taxon Bulliard illustrated. Although some aspects of the description, especially the passages relating to basidioma color, appear to refer to *P. fuscoatra*, the illustrations depict a *Steccherinum*, *Radulomyces* or

*Basidioradulum* species. Bresadola (1897) suggested that *H. membranaceum* might be identical to *Radulum molare* Chaillet: Fr. (now *Radulomyces molaris* (Chaillet: Fr.) M. P. Christ.). Because of the uncertainty of what taxon the illustration represents (assuming that the 1809 illustration is similar to that in the original 1791 publication, which is the holotype), *H. membranaceum* is considered a *nomen dubium*.

Other basidioma descriptions, illustrations, and photographs are available in Breitenbach & Kränzlin (1986), Brown (1935), Eriksson & Ryvarden (1976), Maekawa (1993) and Melo (1994). The report of *P. fuscoatra* from India by Rattan (1977) requires confirmation because one of the two cited specimens, HSK 4269, is *P. aurea*. Cultures are described by Nakasone (1990) and Stalpers (1978).

***Phlebia gilbertsonii* Nakasone, sp. nov. – Figs. 14, 15.**

Phlebiae nothofagi et *P. setulosae* affinis sed aculeis gracilibus, teretibus, cystidiis ventricosus-rostratis vel navicularibus, incrustatis, sed praesertim basidiosporis anguste cylindricis, hyalinis, laevibus,  $4.5\text{--}6(-6.5) \times 1.8\text{--}2$  mm praedita.

Holotypus: United States, Florida, Leon County, Tall Timbers Research Station, Sheep Island, ad lignum Liquidambaris styracifluentis L., 21. Jul. 1977, leg. H. H. Burdsall, Jr. 9649 (CFMR, isotypus: BPI).

**Etymology.** – Named for Robert L. Gilbertson in recognition of his numerous contributions to the systematics of wood decay basidiomycetes.

Basidiomata annual (?), resupinate, effused, coalescing up to  $9 \times 3$  cm, thin, up to 200  $\mu\text{m}$  thick, subceraceous to ceraceous, closely adnate, hydneous, with distinct, smooth hymenium between teeth, greyish orange (5B3–4); not reacting to KOH; sometimes developing numerous small cracks that expose a homogenous or bilayered context; context with a thin, subceraceous upper layer which is concolorous with the hymenium and teeth, and a lower layer of thin, white, fibrillose to felty mycelium; teeth slender, terete, tapering gradually to apex, up to 2 mm long  $\times$  0.5 mm diam, single, sometimes fused, brittle, brownish orange (6C6) to light brown (6D5–6), becoming paler at tooth apices, apices acuminate, entire; margins indistinct, gradually thinning out, floccose to pruinose, closely adherent, smooth to papillose, light orange to greyish orange [5(A–B)4]. – Hyphal system monomitic. – Teeth composed of a central core of tramal hyphae and tramal cystidia enclosed by subhymenium and hymenium; hyphae 2.2–4.5  $\mu\text{m}$  diam, nodose septate, long-celled, rarely branched, with a few H-connections, rarely conglomerate, walls hyaline, thin to 1.5  $\mu\text{m}$  thick, smooth. – Subiculum between teeth up to 80  $\mu\text{m}$  thick, composed of agglutinated hyphae arranged



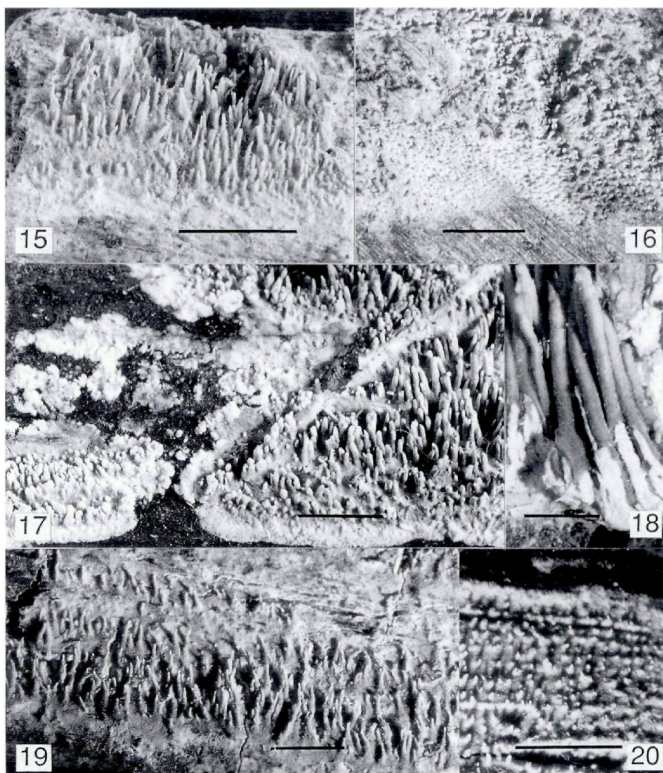
in a loose *textura intricata* with large open cavities next to substrate but becoming denser next to subhymenium; subicular hyphae 2–4.5  $\mu\text{m}$  diam, nodose septate, moderately branched, agglutinated, walls hyaline, thin, smooth. – Subhymenium slightly thickening, up to 50  $\mu\text{m}$  thick, composed of compact, agglutinated hyphae and embedded hymenial cystidia arranged perpendicular to substrate and tooth axis; hyphae 3–4  $\mu\text{m}$  diam, nodose septate, short-celled, frequently branched, conglutinate, walls hyaline, thin to slightly thickened, smooth. – Hymenium a dense, compact, occasionally conglutinate, palisade of basidia, and hymenial and tramal cystidia. – Cystidia of two types: (a) tramal cystidia cylindrical to clavate, up to 140  $\times$  10  $\mu\text{m}$  diam including encrustations, with a basal clamp, often with secondary septa, apex obtuse, walls hyaline, slightly thickened, smooth except upper part encrusted with hyaline crystals, originating in tooth trama, embedded or curving into subhymenium and protruding up to 30  $\mu\text{m}$  through hymenium, best observed in very thin or well-squashed sections; (b) hymenial cystidia fusiform to ventricose-rostrate, 30–70  $\times$  6–15  $\mu\text{m}$  diam, tapering to 4  $\mu\text{m}$  diam at base, hyaline, with a basal clamp, apex obtuse or beaked, walls hyaline, thin to thick, up to 1.5  $\mu\text{m}$  thick, apex lightly to heavily encrusted with coarse, hyaline crystals, arising from subhymenium and hymenium between and on teeth. – Basidia clavate, 12–20  $\times$  4–5  $\mu\text{m}$ , tapering to 2  $\mu\text{m}$  at base, with a basal clamp, 4-sterigmate, walls hyaline, thin, smooth. – Basidiospores narrowly cylindrical to allantoid, sides straight, 4.5–6(–6.5)  $\times$  1.8–2  $\mu\text{m}$ , walls hyaline, distinct, thin to slightly thickened, smooth, negative in Melzer's reagent.

**Habitat.** – On decorticate wood of angiosperms.

**Distribution.** – Florida and Louisiana.

**Additional specimens examined.** – UNITED STATES: Florida, Alachua County, Buzzard's Roost, on (decorticate) *Celtis occidentalis* L., 18. Jul. 1972, H. H. Burdsall, Jr. 6664 (CFMR). Louisiana, Baton Rouge Parish, Ben Hur, Mississippi River banks, on (decorticate) hardwood, 23. Sep. 1981, R. L. Gilbertson 13319 (ARIZ AN002814); Bois Duchamps, (on decorticate wood), 25. Oct. 1899, A. B. Langlois, ut *Hydnum mucidum* (BPI US0259448).

*Phlebia gilbertsonii*, an uncommon species, is characterized by slender teeth, narrowly cylindrical basidiospores and encrusted, fusiform to ventricose-rostrate hymenial cystidia. Only the subhymenium and the subiculum between the teeth are consistently agglutinated. The tooth trama is not agglutinated although the subhymenium developed in the teeth is somewhat agglutinated. This taxon is most similar to *Phlebia nothofagi* and *P. setulosa*, which also have encrusted tramal and hymenial cystidia. However, *P. nothofagi* and *P. setulosa* have larger basidia (20–40  $\times$  4–6  $\mu\text{m}$ ) and wider basi-



Figs. 15–20. – Hymenial surfaces of dried *Phlebia* specimens. – 15. *P. gilbertsonii* (HHB 6664). Bar = 5 mm. – 16. *P. gilbertsonii* (RLG 13319). Bar = 5 mm. – 17. *P. nothofagi* (HHB 12067). Bar = 5 mm. – 18. *P. nothofagi* (PDD 55244). Bar = 2 mm. – 19. *P. uda* (HHB 11828). Bar = 2 mm. – 20. *P. uda* (DAOM 164393). Bar = 2 mm.

diospores (2.2–2.9  $\mu\text{m}$  and 3–3.5  $\mu\text{m}$  diam, respectively) than *P. gilbertsonii*. Furthermore, *P. nothofagi* and *P. setulosa* are robust taxa with well-developed subicula whereas *P. gilbertsonii* has small, slender teeth with a very thin subiculum. Moreover, *Phlebia gilbertsonii* is known only from southeastern United States. In contrast, *P. nothofagi* has a world-wide distribution, and *P. setulosa* is widely distributed in eastern North America.

- Phlebia nothofagi*** (G. Cunn.) Nakasone, comb. nov. – Figs. 7, 17, 18, 21.  
 = *Odontia nothofagi* G. Cunn., Trans. R. Soc. N. Z. 86 (1/2): 88. 1959.  
 = *Odontia nothofagi* G. Cunn. var. *australiensis* D. A. Reid, Kew Bull. 17: 273. 1963.  
 = *Mycoacia nothofagi* (G. Cunn.) Ryvarden in Hjortstam, Tellería, Ryvarden & Calonge, Nova Hedwigia 34: 534. 1981.  
 = *Mycoacia nothofagi* (G. Cunn.) Boidin & A. David, Trav. Sci. Parc Nat. Port-Cros 7: 182. 1981.  
 = *Mycocleptodon fuscoater* (Fr.) Pilát f. *carnicolor* Pilát & Lindtner, Glasn. Skopsk. Nauk. Drustva 18: 188. 1938.

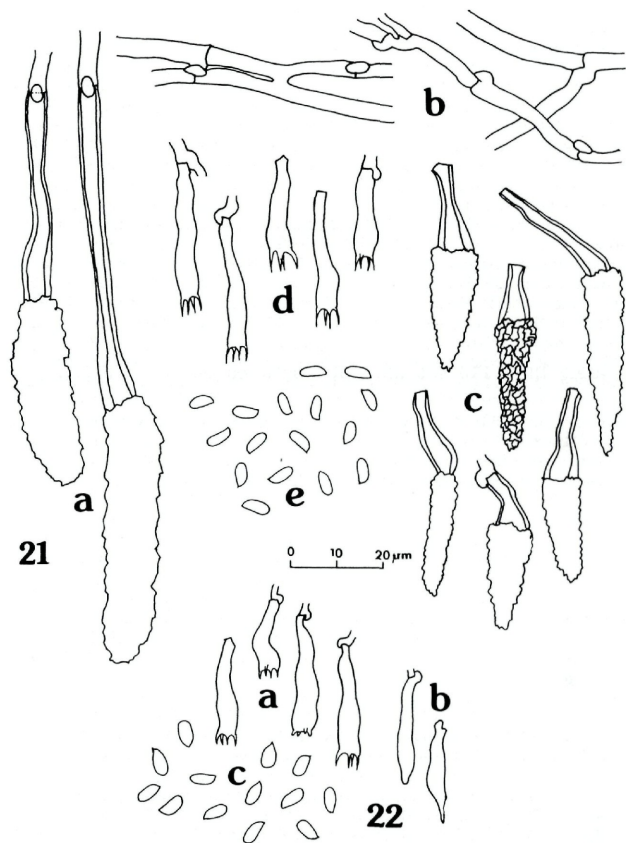
Basidiomata annual, resupinate, beginning as small, coalescing, circular patches that become widely effused, up to 15 × 7 cm, moderately thick, up to 1 mm thick, spinose, subceraceous with a soft, membranous context; light colored specimens turning pinkish red to dark brown in KOH; cracks infrequent, exposing a white, fibrous context; context of teeth and smooth areas between teeth distinctly bilayered, upper layer thin (up to 100 µm thick), concolorous with hymenium, ceraceous, lower layer thicker (up to 530 µm thick), white, soft, fibrous, felty; hymenial surface spinose, 1–2 teeth per mm, occasionally smooth with scattered teeth, teeth terete to flattened, single, fused at base or laterally throughout length, gradually tapering toward apex, 1–6(–10) mm long × 1 mm wide at base, soft, brittle, with an overall glaucous and velutinous appearance from protruding cystidia, apices acuminate, entire or blunt and tufted, color variable, typically darker between and at base of teeth, brown [6(E–F)(4–6)], then becoming brownish orange (6C6), light brown (6D6), greyish brown (5D3), light orange (5A4), greyish orange (5B4), or yellowish brown [5D(4–5)] toward apex, at apex pale orange (5A3) to yellowish white (4A2), sometimes brownish orange (6C8) or brown [6(E–F)(4–7)] throughout; margins typically distinct, ropy, abrupt, closely appressed, adherent, 2–4 mm wide, sterile, lighter in color than hymenium, pale yellow (4A3) light yellow (4A4), pale orange (5A3), light orange (5A4) to greyish orange (5B4, 6B5), odontoid to warted or with ridges, edges deeply lacinate and incised or sometimes indistinct, thinning out. – Hyphal system monomitic. – Teeth consisting of a central core of vertically arranged, parallel, subicular hyphae that may be smooth or encrusted, and smooth or encrusted cystidia enclosed by subhymenium and hymenium, sometimes with elongate clusters of aceroses or flattened, hyaline crystals and resinous materials, often with cystidia protruding at apex and through hymenium. – Subiculum of smooth areas between teeth up to 900 µm thick, sometimes stratose, with a very thin, yellow-orange basal layer, up to 50 µm thick, of agglutinated hyphae arranged parallel to substrate and a thicker layer of non-agglutinated hyphae, first arranged more or less parallel to substrate in a loose, open *textura intricata* that develops into a dense vertical palisade

near subhymenial interface; hyphae 2.5–5.5  $\mu\text{m}$  diam, rarely orange, nodose septate, sparingly to moderately branched, often branching from clamps and forming H-connections, walls hyaline, thin to slightly thickened, smooth. – Subhymenium thickening, 25–80  $\mu\text{m}$  thick between teeth and near tooth apices, up to 300  $\mu\text{m}$  thick at base of teeth, hyphae oriented perpendicular to substrate or to long axis of teeth, dense, compact, agglutinated, often indistinct and collapsed; hyphae 2–3.5  $\mu\text{m}$  diam, nodose septate, frequently branched, conglutinate, short-celled, walls hyaline, thin, smooth. – Hymenium a dense palisade of basidia and cystidia, not agglutinated but difficult to separate individual elements, occasionally interspersed with clumps of reddish brown, resinous materials. – Cystidia of two types: (a) tramal cystidia fusiform, rarely cylindrical, with a long stalk, up to 180  $\mu\text{m}$  long, 3.5–8(–14)  $\mu\text{m}$  wide including crystals, tapering to 3.5–4  $\mu\text{m}$  diam at base, clamped at base, often with secondary septa, apex acute to rounded, walls hyaline to yellowish brown, thin throughout but sometimes slightly thickened at distal end, smooth or lightly to moderately encrusted at apex with hyaline, loosely adherent, coarse, crystalline materials, originating in subiculum or tooth trama, often curving into subhymenium and hymenium, becoming embedded or protruding up to 55  $\mu\text{m}$  beyond hymenium, also extending into tooth apex, numerous in tooth trama; (b) hymenial cystidia fusiform, 35–90  $\times$  5–7  $\mu\text{m}$ , tapering to 1.5–2.5  $\mu\text{m}$  diam at base, with a basal clamp, walls hyaline, slightly thickened, up to 1 mm thick, but often thinning at base, basal part smooth, distal part lightly to moderately encrusted with closely adherent, hyaline crystalline materials, embedded or protruding up to 45  $\mu\text{m}$ , arising from subhymenium, numerous in subhymenium and hymenium. – Basidia clavate, 20–32(–36)  $\times$  4–6  $\mu\text{m}$ , tapering to 2–2.5  $\mu\text{m}$  diam at base, clamped at base, 4-sterigmate, walls hyaline, thin, smooth. – Basidiospores ellipsoid, adaxial side straight or slightly concave, (4.5–)5–5.5(–6)  $\times$  2.2–2.5(–2.9)  $\mu\text{m}$ , walls hyaline, thin, distinct, smooth, negative in Melzer's reagent.

**Habitat.** – On bark and wood of angiosperms.

**Distribution.** – Canada, United States, Great Britain, France, Spain, Portugal (Melo, 1985), Germany, Czech Republic, Slovak Republic, Switzerland, Romania (Hallenberg & Toma, 1989), Russia, Georgia, Azerbaijan, Thailand (Hjortstam & Ryvarden, 1982; Pharnichapol, 1986), New Zealand, Australia.

**Type specimens examined.** – AUSTRALIA: Victoria, Tarra Valley Park, on fallen timber, 14. Sep. 1955, Mrs. K. Healey 5628 (HOLOTYPE of *Odontia nothofagi* var. *australiensis*: K). – MACEDONIA: Šar Planina, Crni Kamen, alt.



Figs. 21–22. – Microscopic elements of *Phlebia* species. – 21. *P. nothofagi* (HHB 4273): (a) tramal cystidia, (b) subicular hyphae, (c) hymenial cystidia, (d) basidia, (e) basidiospores. – 22. *P. uda* (KHL 4711): (a) basidia, (b) cystidia, (c) basidiospores.

1100 m, on *Fagus nerotica* L., Aug. 1937, A. Pilát & V. Lindtner, PRM 488941 (HOLOTYPE of *M. fuscoatrum* f. *carnicolor*: PRM). – NEW ZEALAND: Otago, Woodlaw State Forest, on (corticate) *Nothofagus menziesii* (Hook. f.) Oerst., Nov. 1948, G. B. Rawlings, PDD 7281 (HOLOTYPE of *O. nothofagi*: PDD).

Representative specimens examined. – AUSTRALIA: Melbourne, Tarra Valley Park, on *Prostanthera lasianthos* Labill., 4. Feb. 1957, Mrs. K. Healey 6395 (paratype: K). – AZERBAIJAN: Caucasici, distr. Leriki, on fallen deciduous branch in a Parrotia forest, 11. Oct. 1962, E. Parmasto, ut *Mycocacia odoratissima* (TAA 15956). – CANADA: British Columbia, Vancouver area, Lions Bay, on (decorticate) *Cornus* sp.(?), 18. Aug. 1994, H.H. Burdsall, Jr. 15422 (CFMR). – CZECH REPUBLIC: Bohemica, silva virginea Boubínský prales ap. Zátón, ad truncum iacentem (bark and wood of) *Fagi sylvaticae*, 4. Sep. 1970, J. Kuthan, ut *M. odoratissima* (PRM 803585). Moraviae meridionalis, Lanzhot prope Breclav, in silva virginea madida "Ranspurk" dicta apud locum Rozek, ad truncum putridum deiectum Fraxini angustifoliae, 3 Jul. 1964, B. Hluza, F. Kotlaba & Z. Pouzar, ut *M. odoratissima* (PRM 803587). – FRANCE: Massif de la Sainte-Baume (Bouches-du-Rhône), 11. Feb. 1967, A. David (LY 5781). – GEORGIA: Distr. Ahmeta, Reservatum Batsaro Babaneuri, Batsara, on *F. orientalis*, ad ramum (decorticate) deiectum putridum in carpetino, 17. Sep. 1983, E. Parmasto, ut *M. fuscoatra* (TAA 105579). – GERMANY: Hessen, Odenwald, near Wembach, on deciduous wood, 7. Oct. 1982, B. Streitz & H. GrosseBrauckmann 1715; Hessen, Rhine Valley, Nature Reserve Kühkopf, Karlswörth, under a lying trunk of *Ulmus minor* Miller, 17. Jan. 1992, H. Grosse-Brauckmann 4893. – GREAT BRITAIN: West Sussex, Petworth, 12. Oct. 1969, D. Reid (O). – NEW ZEALAND: North Canterbury, Arthur's Pass National Park, Klondyke Corner, on (corticate) *N. solandri* var. *cliffortioides* (Hook. f.) Oerst., 22. Apr. 1987, P. K. Buchanan 87/103 (PDD 55244). Wellington, Hutt Valley, Keith George Park, on rotten log, 19. Jun. 1980, G. Stevenson 80/107 (PDD 41134). Westland, Ahaura, on *N. fusca* (Hook. f.) Oerst., Apr. 1955, J. M. Dingley (PDD 17965). – RUSSIA: Regio Primorsk, distr. Hasan, Reservatum Kedrovaja Padi, ad caudicum prolapsum putridum in querceto, 24. Jul. 1985, E. Parmasto (TAA 106244). – SLOVAK REPUBLIC: Rusovec ap. Bratislava, insula supra portum, ad truncum iacentem (decayed wood of) *Populi nigrae*, 21. Oct. 1979, Z. Pouzar, ut *M. odoratissima* (PRM 756721); In monte Laurin ap. Badin prope Banská Bystrica, silva virginea "Badínsky prales", ad truncum iacentem *Fagi sylvaticae*, 20. Oct. 1972, Z. Pouzar, ut *M. odoratissima* (PRM 756722). – SPAIN: Santander prov., Puerto de Palamera-Saja, 840 m, on (decorticate) *Fagus* sp., 13. Nov. 1977, L. Ryvarden 15361 (O). Canary Islands, Gomera, Cabezo Alto, 5 km SW of Hermigua, (on wood), 16. Jan. 1974, L. Ryvarden 12534 (O). – SWITZERLAND: Ticino, Valle Bavona, Ritorto, on bark and wood of hanging dry trunk of *Tilia cordata* Miller, 1. Nov. 1990, E. Martini 2826. – UNITED STATES: California, Smith River, on (decorticate) hardwood, 1. Nov. 1958, J. L. Lowe 10611 (CFMR). District of Columbia, on (decayed, decorticate) *L. tulipifera*, Sep. 1921, J. R. Weir 20092, ut *O. fuscoatra* (BPI US0259267). Florida, Marion County, Okalawaha River, on (decorticate) *Acer rubrum* L., 3. Aug. 1972, H. H. Burdsall, Jr. 6906 (CFMR, ARIZ AN002102). Idaho, Coolin, on (decorticate) *P. trichocarpa*, Sep. 1919, J. R. Weir 10940, ut *H. fuscoatrum* (BPI US0259272). Louisiana, St. Tammany Parish, W Pear River and N Hwy 11, on (decorticate) *L. styraciflua*, 9. Nov. 1952, A. S. Rhoads, FP 103595 (CFMR). Montana, Libby, on (decorticate) *P. trichocarpa*, Oct. 1911, J. R. Weir 12761, ut *H. fuscoatrum* (BPI US0259270). New York, Jamesville, Clark Reservation, on (decorticate) wood of *A. saccharinum*, 17. Sep. 1964, R. L. Gilbertson 5088 (CFMR). North Carolina, Haywood Co., Great Smoky Mountains Nat. Park, above Big Creek Ranger Station, on (decorticate) hardwood log, 6. Jul. 1970, H. H. Burdsall, Jr. 4222 (CFMR). Tennessee, Sevier County, Great Smoky Mountains Nat. Park, along Roaring Fork, on hardwood log, 8. Jun. 1970, H. H. Burdsall, Jr. 4273 (CFMR). Washington, Olympic Peninsula, Quinalt, on hardwood log, 18. Oct. 1958, J. L. Lowe 10410 (CFMR; ut *O. fuscoatra*-NY, BPI US0265755, ARIZ AN002748); Hoh River, on (decorticate) *Populus* sp., 9. Sep. 1957, J. L. Lowe 8184 (CFMR). Wisconsin, Sauk Co., Leopold Reserve, behind Shack, on well decayed (decorticate) hardwood log, 10. Jun. 1987, H. H. Burdsall, Jr. 12067 (CFMR).

This is a variable species in form and color but shows little variation in microscopic characters. *Phlebia nothofagi* is distinguished by soft, brittle teeth and abundant, thick-walled, encrusted cystidia. Only the subhymenium and basal layer of the subiculum are agglutinated. A distinctive sharp but sweet odor is present in cultures as well as in fresh and recently dried specimens. Some specimens examined from New Zealand and Europe are particularly robust with long (up to 10 mm) and well-developed teeth whereas most of the specimens from North America have shorter teeth (2 mm long). Basidiospores are also variable in length. Reid (1963) recognized the variety *australiensis* on the basis of shorter and wider spores ( $3.8\text{--}4.3 \times 2.2\text{--}2.5 \mu\text{m}$ ); however, I observed basidiospores in the holotype and paratype specimens to be slightly larger ( $4.3\text{--}5.1 \times 2.2\text{--}2.9 \mu\text{m}$ ) and well within the limits of the species.

Surprisingly, *P. nothofagi*, a distinctive and widely distributed species, was not described before 1959 probably because of its morphological similarity to *P. fuscoatra*. Some mycologists, however, did recognize *P. nothofagi* as a distinct species but used a variety of names. The earliest confirmed name for *P. nothofagi* appears to be by Pilát & Lindtner who described *M. fuscoater* f. *carnicolor* in 1938. A review of the literature disclosed the name *Hydnum castaneum* Alb. & Schwein., which may be the earliest name for *P. nothofagi*. Although this species is usually interpreted to be a variety of *H. fuscoatra* (Fries, 1821; Cejp, 1930), many aspects of the original description of *H. castaneum* by Albertini & Schweinitz (1805) appear to refer to a taxon similar to *P. nothofagi*. Unfortunately, this theory cannot be tested because there are no specimens of *H. castaneum* at PH, UPS or L; *H. castaneum* is considered a *nomen dubium*. In addition, a number of collections of *P. nothofagi* at PRM are filed as *Mycoacia odoratissima*, a herbarium name used by A. Pilát that was never published. *Phlebia nothofagi* was reported from North America under the name *Phlebia queletii* (Bourdot & Galzin) M. P. Christ. (Nakasone, 1990).

For other descriptions and illustrations of *P. nothofagi*, see Reid (1963), Hjortstam & al. (1981), Boidin & David (1981), Grosse-Brauckmann (1987), and Martini (1988). Boidin & David (1981) and Nakasone (1990, as *Phlebia queletii*) described cultures of *P. nothofagi* and reported that it has a unifactorial incompatibility system. In addition, dikaryotic and monokaryotic cultures of *P. nothofagi* from France (LY 5781 and LY 6552–Mirande, Gers, on dead wood, 6. Oct. 1970, A. David) were obtained from Dr. P. Lanquetin. Monokaryons of LY 5781 and LY 6552 were completely intercompatible with monokaryons from North America (HHB 15422, British Columbia; HHB 4273, Tennessee).

**Phlebia uda** (Fr.) Nakasone, comb. nov. – Figs. 9, 10, 19, 20, 22.

- ≡ *Hydnium udum* Fr., Syst. mycol. 1, p. 422. 1821.
- ≡ *Acia uda* (Fr.) P. Karst., Medd. Soc. Fauna Fl. Fenn. 5: 42. 1879 (*nom. illegit.*).
- ≡ *Odontia uda* (Fr.) Bres., Atti Imp. Regia Accad. Rovereto, ser. 3, 3: 97. 1897.
- ≡ *Acia uda* (Fr.) Bourdot & Galzin, Bull. Trimest. Soc. Mycol. Fr. 30: 255. 1914 (*nom. illegit.*).
- ≡ *Mycocacia uda* (Fr.) Donk, Meded. Ned. Mycol. Ver. 18–20: 151. 1931.
- ≡ *Sarcodontia uda* (Fr.) Nikol., Flora pl. cryptog. URSS 6, Fungi (2), p. 182. 1961.
- ≡ *Sistotrema griseum* Pers., Mycol. eur. 2, p. 198. 1825.
- ≡ *Odontia grisea* (Pers.) Bres., Ann. mycol. 1: 85. 1903.
- ≡ *Acia uda* (Fr.) Bourdot & Galzin var. *grisea* (Pers.) Bourdot & Galzin, Hyméno-my. de France p. 414. 1928 (*nom. illegit.*).
- ≡ *Sarcodontia uda* (Fr.) Nikol. var. *grisea* (Pers.) Nikol., Flora pl. cryptog. URSS 6, Fungi (2), p. 183. 1961.

Basidiomata annual, resupinate, small circular patches coalescing into widely effused structures, up to 22 × 5 cm, thin to moderately thin, 100–400 µm thick between teeth, hydnaceous to verrucose, occasionally with smooth areas, generally subceraceous to ceraceous with a membranous context; turning dark purple, red to dark brown in KOH; cracks rare to frequent; context typically bilayered with a thin, ceraceous upper layer, up to 50 µm thick, concolorous with hymenium, ceraceous, and a thicker lower layer, up to 400 µm thick, soft, white to pale cream, fibrous; hymenial surface denticulate to spinose, 2–6 teeth per mm, up to 3 mm long × 0.5 mm diam, teeth conical to cylindrical, gradually or abruptly tapering toward apex, becoming smaller and more slender near margins, single or joined at the base, ceraceous, brittle when dried, with entire, acuminate or blunt, penicillate apices, color variable, dried hymenial surface between and at bases of teeth, pale yellow (4A3), light yellow [4A(4–5)], greyish yellow [3B4, 4(B–C)6], light orange (5A4), greyish orange [5B(4–5)], brownish orange (5C6), yellowish brown [5D(4–5)], or brown (6D8, 7D7), occasionally dark brown (6F8), becoming paler toward tooth apices, mature areas often darker than margins; margins of two types, on bark 1–3 mm wide, thin, closely appressed, adherent, silky, white, pale yellow, pale orange (5A3), light orange (5A4), occasionally translucent and yellowish brown [5D(4–5)], sterile, edges fimbriate, white; on wood often abrupt, sometimes thinning out then flocculose, rarely silky-cordonic, appressed, concolorous with or paler than hymenium, fertile, often with teeth or warts. – Hyphal system monomitic. – Teeth consisting of a central core of vertically arranged, parallel subicular hyphae, typically associated with loose acerose (up to 7.5 × 1 µm) or coarse (up to 10 × 10 µm) hyaline crystals, sometimes encrustations closely appressed, and undifferentiated hyphal tips encrusted with brownish yellow, resinous materials enclosed by subhymenium and hymenium; apices entire, sterile, composed of protruding subicular hyphae cov-



ered with hyaline, acerosc crystals. – Subiculum between teeth stratose, 45–120  $\mu\text{m}$  thick, composed of a very thin, basal layer, up to 10  $\mu\text{m}$  thick, of agglutinated hyphae next to substrate topped by a thicker layer, 25–70  $\mu\text{m}$  thick, of non-agglutinated hyphae, first arranged in a loose, open *textura intricata* that develops into a dense vertical palisade at subhymenial interface; hyphae 1.5–5  $\mu\text{m}$  diam, nodose septate, sparingly to frequently branched, walls hyaline, thin or up to 1.5  $\mu\text{m}$  thick, smooth or coated with brownish yellow, resinous materials. – Subhymenium in smooth areas between and in teeth slightly thickening, 15–30  $\mu\text{m}$  thick, hyphae oriented perpendicular to substrate and to long axis of teeth, dense and agglutinated; hyphae 1.5–2.2  $\mu\text{m}$  diam, nodose septate, frequently branched, conglutinate, short-celled, walls hyaline, thin, smooth. – Hymenium up to 25  $\mu\text{m}$  thick, a dense palisade of basidia, cystidia and resinous coated undifferentiated hyphal tips, not agglutinated but difficult to separate individual elements. – Cystidia abundant to scarce, fusiform, with acute to rounded apices, 12–25  $\times$  2–4  $\mu\text{m}$ , tapering to 2–3  $\mu\text{m}$  diam at base, clamped at base, enclosed in hymenium, walls hyaline, thin, smooth. – Undifferentiated hyphal tips cylindrical, up to 25  $\times$  8  $\mu\text{m}$ , covered with brownish yellow resinous materials, in hymenium or embedded in subiculum and subhymenium, dissolving in 2% KOH, easily destroyed in squash mounts. – Basidia clavate, (16–)20–28(–35)  $\times$  4–5  $\mu\text{m}$ , tapering to 2–2.5  $\mu\text{m}$  diam at base, clamped at base, 4-sterigmate, walls hyaline, thin, smooth. – Basidiospores cylindrical to ellipsoid, (4.5–)5–6 (–6.5)  $\times$  2.5–3  $\mu\text{m}$ , walls hyaline, distinct, slightly thickened, smooth, negative in Melzer's reagent.

*Habitat.* – On bark and wood of angiosperms, especially branches, rarely on gymnosperms; associated with a white rot decay.

*Distribution.* – United States, Canada, Sweden, Denmark, Netherlands, Germany, France, Portugal (Melo, 1994), Spain (Tellería, 1990), Italy, Czech Republic, Austria, Estonia, Russia, Georgia, Armenia, Azerbaijan, Turkmenistan, Turkey (Hallenberg, 1991), Iran (Hallenberg, 1981), Ethiopia (Hjortstam & Larsson, 1994), Morocco (Malençon, 1957).

*Type specimen examined.* – No country, no date, #910.270-471 (NEO-TYPE of *Sistotrema griseum*: L).

*Representative specimens examined.* – ARMENIA: Distr. Idzhevan, Getashen, on (decorticate) fallen branch of *C. avellana*, 26. Sep. 1962, E. Parmasto (TAA 15436). – AUSTRIA: Nieder-Österreich, Lainzer Tiergarten bei Wien, on (decorticate) *F. sylvatica*, 9. Jul. 1929, V. Litschauer 12 (GB); Tirol, Kranebittenklamm bei Innsbruck, on *Fraxinus excelsior* L., 29. Jul. 1930, V. Litschauer

(FH). – AZERBAIJAN: Distr. Lenkoran, Hyrcanian Reserve, on (corticate) fallen branch of *Pterocarya pterocarpa* (Michx.) Kunth, 15. Oct. 1962, E. Parmasto (TAA 15083). – CANADA: British Columbia, Victoria, Mt. Douglas Park, on (decorticate) *Acer macrophyllum* Pursh, 30. May 1946, A. McKinnon, V-2646 (DAOM 17849); Vancouver Island, Sidney, on (bark of) *Arbutus menziesii* Pursh, 5. Jul. 1948, W. G. Ziller, DAVFP 3074 (DAOM 52641). Manitoba, Winnipeg, Manitoba Agricultural College, on old (decorticate) *Populus* sp., 2. Oct. 1926, G. R. Bisby 4200 (DAOM F-5244). Ontario, Rondeau Government Park, on (decorticate) *Quercus rubra* L., 14. Aug. 1934, R. F. Cain 7625, TRTC 8582 (DAOM 164393). Quebec, Gatinaeu Park, Fortune Lake, on (decorticate) dead deciduous tree, 17. Sep. 1961, G. L. Hennebert 2598 (DAOM 73148). – CZECH REPUBLIC: Moravicae merid., Lanzhot pr. Breclav, in silva virginea madida “Lanzhotsky prales” dicta, ad (decorticate) truncum emortuum *Aceris campestris*, 15. Aug. 1967, F. Kotlaba & Z. Pouzar (PRM 658121). – DENMARK: Jutland, Skaersögård, N of Ebeiftoft, on branch of *Betula*, 19. Aug. 1987, N. Hallenberg (GB 10294). – ESTONIA: Distr. Pärnu, ins. Rahn, Austerenge, on (corticate branch of) frondose tree, 15. Aug. 1984, I. Parmasto (TAA 105832). Distr. Tartu, Kärevere, on (corticate twig of) *B. pubescens*, 8. Oct. 1967, E. Parmasto, ut *M. fuscoatra* (TAA 18916). – FRANCE: Allier, St. Priest, br. pouvie l’aune, 18. Sep. 1907, H. Bourdot 9928 (FH). Alsace, Haut-Setin, in forest between Burhaupt-le-Haut and Gildwiller, on decayed deciduous wood, 10. Sep. 1982, S. Rastetter (GB). – GEORGIA: Distr. Poti, Poti Nature Reserve, on (corticate) fallen branch of *P. pterocarya*, 11. Oct. 1963, E. Parmasto (TAA 16628). – GERMANY: Hessen, Hessische Oberrheinebene, Jägersburger Wald bei Langwaden, on (decorticate) *F. sylvatica*, 20. Oct. 1983, H. Grosse-Brauckmann, K.-H. Larsson & K. Hjortstam, HJM 14276 (GB). – ITALY: Latina prov., Circeo Nat. Park, Selva di Circeo, on (corticate) deciduous wood, 22–25. Oct. 1984, K. Hjortstam, K.-H. Larsson, & L. Ryvarden, HJM 14978 (GB). – NETHERLANDS: Haagsche Bosch im Haag, auf morschen Stämmen und abgefallenen Aesten, 14. Oct. 1933, M. A. Donk 172 (GB). – RUSSIA: Caucasic, Regio Krasnodar, Apsheronsk, Piatigorskoie, alt. 100–200 m, on (wood and bark of) *Pyrus caucasicae* Fed., 3. Oct. 1966, E. Parmasto (TAA 19908). Tatarica, reservatum Volga-Kama, Raifa, on (decayed, decorticate) *T. cordata*, 26. Aug. 1977, E. Parmasto (TAA 100909). – SPAIN: Huesca, silva de oza, on (decorticate) *Fagus* log, 7. Nov. 1986, N. Hallenberg 9757, ut *M. fuscoatra* (GB). – SWEDEN: Närke, Hallsberg par., Herrfallsäng nature preserve, on (corticate branch of) *Prunus padus*, 25. Aug. 1972, N. Hallenberg (GB 22597). Öland, Västerstads lund, on (well decayed wood of) *F. excelsior*, 19. Sep. 1964, Å. Strid 362 (GB 19278). – TURKMENISTAN: Turcomania, Montes Kopet-dagh, distr. Bacharden, Nuchur, Kara-Suv, alt. 1300 m, on (corticate) *Juglans regia* L., 21. Oct. 1971, E. Parmasto (TAA 55510). – UNITED STATES: Idaho, Bonner County, Coolin, on *Alnus tenuifolia* Nutt., Sep. 1919, J. R. Weir (BPI: US0260566). Illinois, Ogle County, Oregon, Sinnissippi Forest, on hardwood branch, 29. Sep. 1984, K. K. Nakason, FP 102010 (CFMR). Iowa, Dubuque County, Pine Hollow, 3. Oct. 1931, L. W. Miller 166 (ISC ISU386880). Montana, Flathead Nat. Forest, Mission Range, Crane Mountain, on *P. tremuloides*, 29. Jun. 1964, R. L. Gilbertson 4481 (ARIZ AN002815). New York, Essex County, Newcomb, on hardwood log, 24. Aug. 1960, R. L. Gilbertson 2590, ut *M. stenodon* (ARIZ AN002813). Oregon, Benton County, Aelsea Mountain, near Greasy Creek, on *Pseudotsuga taxifolia* (Lamb.) Britton, 12. Nov. 1937, W. B. Cooke 9759 (ISC ISU386848). South Dakota, James River woods, on *Salix* (?), 4. Nov. 1928, J. F. Brenckle 2213, (ISC ISU386858). Tennessee, Blount County, Cades Cove, near Cable Mill, on (decorticate) rotted deciduous log, 14. Aug. 1969, H. H. Burdsall, Jr 2993 (CFMR). Virginia, Bull Run, on *Betula* sp., 6. Oct. 1928, C. L. Shear 75694 (ISC ISU386846). Washington, Olympic Peninsula, Hoh River, elev. 550 ft, on *Alnus* sp., 27. Aug. 1957, J. L. Lowe, R. L. Gilbertson & D. Griffin, JLL 7911 (FH, GB, NYS). Wisconsin, Sauk County, Baraboo, Potter Tract, on wood of decayed *Ulmus* sp., 29. Sep. 1985, H. H. Burdsall, Jr 11828

(CFMR); Dane County, Madison, Picnic Point, on (corticate) hardwood branch, 31. Aug. 1987, E. Dorworth & L. A. Poule, FP 102252 (CFMR).

*Phlebia uda* is distinguished by basidiomata that turn purple, red or brown in KOH, resinous covered hyphal-end cells in the teeth, short, fusiform cystidia, and ellipsoid basidiospores. The cystidia are distinctive but often inconspicuous and difficult to observe. The variable color of the basidiomata results in different reactions to KOH. Yellow specimens typically turn bright red in KOH, while tan or brown specimens turn dark brown. Although sometimes confused with *P. fuscoatra*, *P. uda* can be distinguished by its lighter colored basidioma, resinous covered hyphal end-cells, shorter cystidia, and wider basidiospores.

Although Bresadola (1897) considered *S. griseum* to be conspecific with *H. fuscoatum*, Bourdot & Galzin (1928) and Nikolajeva (1964) reduced *S. griseum* to a variety of *H. uda*. Because *S. griseum* lacks a type specimen, a neotype is designated (L #910.270-471). This specimen is from Persoon's herbarium and is labeled in Persoon's hand. In addition, there is a label attached to the specimen sheet by M. A. Donk that has "original" on it. This neotype material is in fair condition. Although many of the teeth had broken off at the base, a few basidiospores ( $4.7-5.4 \times 2.5-2.7 \mu\text{m}$ ) and golden brown resinous masses capping undifferentiated hyphal tips in the teeth were observed. The hymenium is dark brown and did not change color as expected with KOH; nevertheless, I agree with Bourdot & Galzin and Nikolajeva that *S. griseum* is conspecific with *H. uda* and not with *H. fuscoatra*. A type specimen of *H. udum* apparently does not exist and a neotype needs to be designated.

For other descriptions, illustrations, and photographs, see Breitenbach & Kränzlin (1986), Brown (1935), Eriksson & Ryvarden (1976), and Welden (1960). The basidiospore width ( $2-2.5 \mu\text{m}$ ) reported by Eriksson & Ryvarden (1976) is in error, since the widths of the basidiospores in the accompanying drawing are  $2.5-3 \mu\text{m}$ . For culture information, see Boidin (1958), Nakasone (1990), and Stalpers (1978). Paired single-spore and polyspore cultures of *P. uda* from Canada, Norway, Sweden, Spain and Turkey were all inter-compatible (Hallenberg 1985; 1991).

## Discussion

*Phlebia aurea*, *P. fuscoatra*, and *P. uda* are widely distributed and well-known taxa. *Phlebia nothofagi* is also widely distributed but has been reported under a variety of names. *Phlebia aurea* is a cosmopolitan species reported from 29 countries. A total of 72 specimens, representing 24 countries, were examined. *Phlebia aurea*

appears to be rather common in Europe but quite rare in North America as only seven specimens have been seen. Although reported from only 16 countries, *P. fuscoatra* is the most common and abundant species of the taxa discussed herein. Approximately 210 specimens of *P. fuscoatra* were examined from thirteen countries. It is widely distributed throughout Europe and North America, with a few records from Asia. *Phlebia nothofagi* is known from 17 countries including New Zealand and Australia. Forty-four specimens, representing 14 countries, have been studied. Although not common, *P. nothofagi* is widely distributed in Europe and the United States. Similarly, *Phlebia uda* is common and widely distributed in Europe and North America. It is reported from 22 countries; 17 countries were represented among the 135 specimens examined.

*Phlebia albofibrillosa* and *P. gilbertsonii*, in contrast, are quite limited in distribution. *Phlebia albofibrillosa* is known only from Nepal and northern India. Represented by 14 specimens, this species appears to be locally abundant. *Phlebia gilbertsonii* is rare, with only four known specimens from Louisiana and Florida in the southeastern United States.

*Phlebia* was originally characterized by resupinate basidiomata with conspicuously veined or wrinkled hymenia (Fries, 1821). Donk (1931; 1957) greatly expanded the genus concept to include taxa with smooth and tuberculate hymenial configurations, waxy, gelatinous or mucous texture, and thickening hymenia. However, to accommodate species microscopically similar to *Phlebia* but with toothed hymenophores, Donk (1931) introduced the genus *Mycoacia*. Subsequent researchers (Boidin, 1964; Parmasto, 1968; Eriksson & Ryvarden, 1976; Kropp & Nakasone, 1985; Wu, 1990; Wu & Chen, 1992) also recognized the close relationship between *Phlebia* and *Mycoacia*.

The distinction between *Phlebia* and *Mycoacia* blurred when toothed phlebioid taxa were included in *Phlebia*: *P. queletii*, *P. hydnooides* (Christiansen, 1960), *P. albofibrillosa* (Hjortstam & Ryvarden, 1984), *P. concentrica* (Cooke & Ellis) Kropp & Nakasone (Kropp & Nakasone, 1985), *P. ryvardenii* Hallenb. & Hjortstam (Hallenberg & Hjortstam, 1988), *P. setulosa* (Nakasone, 1990), *P. heterocystidia* Sheng H. Wu, *P. odontoidea* Sheng H. Wu, *P. chiricahuaensis* (Gilb. & Budington) Sheng H. Wu, *P. lutea* (Jül.) Sheng H. Wu (Wu, 1990), *P. fascicularia*, and *P. floridensis* Nakasone & Burds. (Nakasone & Burdsall, 1995).

Besides morphological evidence, cultural, genetic and molecular data support a close relationship between *Phlebia* and *Mycoacia*. Boidin (1964) noted that *M. uda*, *M. setosa* (Pers.) Donk, and several *Phlebia* species display astatocoenocytic nuclear behavior and possess bipolar or unifactorial incompatibility systems. In addition, some species of *Phlebia* and *Mycoacia*, as well as *Merulius*, *Sarco-*

*dontia* and *Cystidiophorus*, produce simple septate hyphae in the margin and extracellular phenoloxidase enzymes (Stalpers, 1978). Nakasone (1990) recognized numerous cultural similarities between *M. uda* and *M. fuscoatra* and *Phlebia* species. Moreover, preliminary sequence data from the internal transcribed spacer region of the nuclear ribosomal RNA indicate that *Mycoacia* is a paraphyletic genus that is embedded in *Phlebia* (Nakasone, 1991).

The evidence is overwhelming that *Mycoacia* should be synonymized under *Phlebia*. Thus, three of the original taxa in *Mycoacia*, namely, *M. fuscoatra*, *M. stenodon* and *M. uda*, are transferred to *Phlebia* based on morphological, cultural, and molecular data. With the transfer of *M. fuscoatra*, the generic type, *Mycoacia* is effectively placed in synonymy under *Phlebia*. The final disposition of other taxa presently in *Mycoacia* must await further studies.

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