

## **Studies in Ganodermataceae (Basidiomycota): the concept of *Ganoderma coffeatum* in the Neotropics and East Asia**

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**Abstract** – The circumscription of *Ganoderma coffeatum* has been revised, based on morphological data. It is evidenced that the commonly used concept of the species encompassed several taxa. In addition to *G. coffeatum* s.s., two additional species occur endemically in the Neotropics and are identified as *Ganoderma flaviporum* and *Amauroderma deviatum*. In tropical Asia, two other taxa were evidenced but are so far of uncertain status. The main features of *G. coffeatum*, *G. flaviporum*, and *A. deviatum* are emphasized. A preliminary key to the *Ganodermataceae* with a complex endosporic ornamentation pattern is presented.

**Morphology / polypores / South America / Tropical Asia / taxonomy**

**Résumé** – La définition de *Ganoderma coffeatum* est discutée, sur base d'études morphologiques de nombreux spécimens originaires de son aire présumée de distribution. Cette étude démontre que le concept largement utilisé de *G. coffeatum* est hétérogène et comprend plusieurs taxa : deux espèces additionnelles sont mises en évidence en Amérique tropicale, *Ganoderma flaviporum* et *Amauroderma deviatum*. Deux autres taxa sont présents en Asie tropicale, mais leur identification reste problématique et nécessite la révision des nombreux types de *Ganoderma* décrit de la région. Les caractéristiques principales de *G. coffeatum*, *G. flaviporum*, et *A. deviatum* sont brièvement décrites. Une clé d'identification préliminaire des *Ganodermataceae* dont les basidiospores possèdent une ornementation complexes est proposée.

**Morphologie / polypores / Amérique tropical / Asie tropicale / taxonomie**

### **INTRODUCTION**

*Ganoderma coffeatum* (Berk.) Furtado, also known as *Humphreya coffeatum* (Berk.) Steyaert, is a peculiar species characterized by a complex basidiospore ornamentation (Steyaert, 1972). The species, as reported in

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1. MUCL is a part of the Belgian Coordinated Collections of Microorganisms, BCCM<sup>tm</sup>.

literature, has a disjoint tropical distribution, with record on one side from tropical areas of America (Furtado, 1967; Ryvardeen, 2004) and on the other side, Southern subtropical China (Zhao, 1989; Xingliang & Dai, 2005; Xingliang *et al.*, 1997).

In the frame of a revision of some *Ganodermataceae* Donk (see Decock & Herrera, 2006), several collections identified as *G. coffeatum* and originating from its presumed distribution range were revised. From these studies, it soon became obvious that the commonly used concept of that species was heterogeneous, and encompassed several morphological types; in the Neotropics, specimens examined were sorted into three distinct groups. Two groups have “ganodermoid” basidiospores with the endosporic ornamentations in the form of coarse, non-reticulated ridges (cristae), having an orientation either predominantly longitudinal (group 1, Figs 1-3) or predominantly transversal (group 2, Figs 4-6). The third group, for which a single specimen was present in the examined collections, has “amaurodermoid” basidiospores with the endosporic ornamentations as coarse, reticulated ridges having a secondary, subjacent network of very low ridges (type 3, Figs 7-9). Basidiomes corresponding to these three types have dull pileus covered with an undetermined crust.

In southern (sub)tropical China, two additional distinct morphologies were identified, both with “ganodermoid” basidiospores but with much less conspicuous endosporic ornamentation patterns, in the form of isolated pilar or small cristae (group 4 & 5). Furthermore, the basidiomes corresponding to these two types have laccate pileus formed by a hymenoderm.

Consequently, and in order to ascertain the concept of *G. coffeatum* *s.s.*, its type and the type of its presumed taxonomic synonyms *viz.* *Polyporus augustus* Berkeley (1856), *Polyporus hemibaphus* Berkeley (1856) (Furtado, 1967; Ryvardeen, 1984), *Amauroderma flaviporum* Murrill (1908) (Ryvardeen, 1985), and *Polyporus infulgens* Lloyd (1917) (Ryvardeen, 1990) were all revised.

These studies allowed to restrict the concept of *G. coffeatum*, which was found to correspond to the group 1 (Figs 1-3), and confirm the status of *P. augustus* and *P. infulgens*, both accepted as taxonomic synonyms of the former. These studies also demonstrated that *A. flaviporum* represented a distinct species, and corresponded to the group 2 (Figs 4-6). The third group (Figs 7-9) did not correspond to any of these synonyms. However, on examining the literature, it was found to represent *Amauroderma deviatum* Ryvardeen, which until then was known from the type collection only (Ryvardeen, 2004). The status of *P. hemibaphus* remains uncertain. Likewise, the identity of the taxa represented under *G. coffeatum sensu* Chinese *auctores* is, for the time being, uncertain.

The main distinguishing features of *G. coffeatum*, *A. flaviporum*, and *A. deviatum* are emphasized and illustrated.

## MATERIALS AND METHODS

The study is based on types specimens from BPI, HAC, HMAS, K, LY, MUCL, NY, PRM, and PC (herbarium acronyms are from Holmgren *et al.*, 1990). Living strains are kept at BCCM/MUCL and, for some of them, at CRGF (La Havana, Cuba). Specimens were examined in Melzer’s reagent, KOH 4% and Lactic acid Cotton blue. Colors are described according to Kornerup & Wanscher

(1981). All microscopic measurements were done in Melzer's reagent. In presenting the size range of microscopic elements, 5 % of the measurements were excluded from each end and are given in parentheses. The arithmetic means of different measurements are also provided.

## TAXONOMY

***Ganoderma coffeatum*** (Berk.) J.S. Furtado, *Persoonia* 4: 383, 1967. Figs 1-3

≡ *Polyporus coffeatus* Berk., *Ann. Nat. Hist.* 3: 385, 1839 (basionym).

≡ *Fomes coffeatus* (Berk.) Sacc., *Syll. Fung.* 6: 163, 1888.

≡ *Scindalma coffeatum* (Berk.) O. Kuntze, *Rev. Gen. Pl.* 3: 518, 1898.

≡ *Amauroderma coffeatum* (Berk.) Murrill, *Bull. Torr. Bot. Club* 32: 367, 1905.

≡ *Humphreya coffeatum* (Berk.) Steyaert, *Persoonia* 7: 102, 1972.

= *Polyporus augustus* Berk., *Hook. J. Bot. & Kew Misc.* 8: 143, 1856.

≡ *Fomes augustus* (Berk.) Sacc., *Syll. Fung.* 6: 151, 1888.

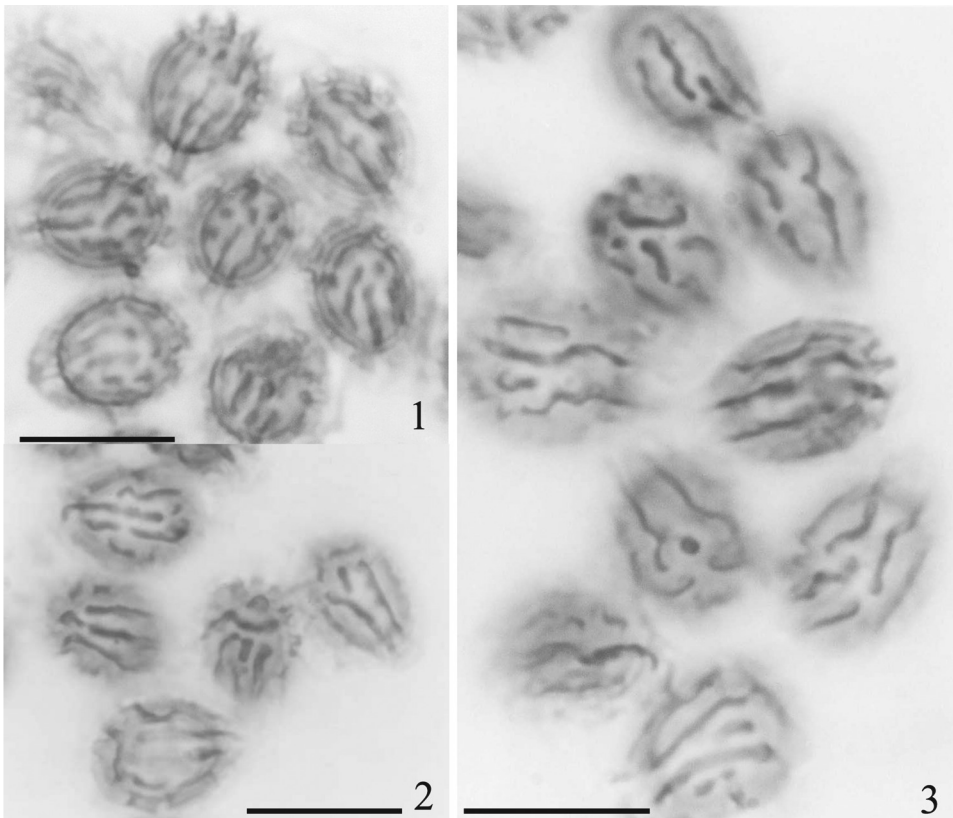
≡ *Amauroderma augustum* (Berk.) Torrend, *Broteria, Bot.* 18: 137, 1920.

= *Polyporus infulgens* Lloyd, *Mycol. Writ.* 5: 656, 1917.

≡ *Amauroderma infulgens* (Lloyd) Torrend, *Broteria, Bot.* 18: 134, 1920.

≡ *Ganoderma infulgens* (Lloyd) Sacc. & Trotter, *Syll. Fung.* 23: 408, 1925.

*Basidiome* seasonal, stipitate, pleuro- to mesopodal; *stipe* lateral, sub-lateral or central, straight, erect or occasionally with a short horizontal basal part then erected, cylindrical to (slightly) ob-clavate, then slightly wider at the base, the latter sometimes bulbous at the attachment point, circular to more commonly ellipsoid in section, sometimes irregular, 60-125 mm high, 6-31 × (3-)6-16 mm diam., uniformly covered with a hard, horny crust up to 100-300 μm thick., glabrous, dull, smooth, pale grayish brown (5D3), light brown (6D(4-6), camel, sunburn, cinnamon), brown, dark cinnamon brown to cocoa brown (6(D-E(-F))(5-6)) to dark brown, or blackish, grayish black; *pileus* solitary, circular to ellipsoid when centrally attached, and up to 220 × 185 mm diam., or dimidiate to reniform when laterally attached, commonly with the two back sides fused then pseudo-circular, occasionally with marginal, smaller outgrowth, applanate to applanate convex in section, occasionally applanate-campanulate, planed, slightly (to strongly) depressed at the center, with the margin commonly abruptly bent downward or occasionally horizontal, the all pileus up to 20-70 mm long, 27-110 mm wide, 9-30 mm thick at the base, down to 2-10 mm thick at the margin; *pileus surface* smooth to more commonly faintly to strongly, roughly concentrically sulcate, wavy, radially slightly wrinkled when dried, especially in the margin, the center sometimes irregular, tuberculoses, glabrous, dull, mainly brown, cocoa brown, grayish cocoa brown (6E(4-5-6), 7E(5-6)), with several concentric bands either lighter, grayish corky (5C3) or more commonly darker, dark brown (6F5), up to black, narrow near the margin, progressively larger and more distant toward the base or the center; *margin* plane to abruptly bent downward, or slightly enrolled below, narrow, up to 1-1.5 mm wide, sharp, even, probably white when fresh and actively growing, drying off-white, pale corky, or pale orange, pale brown, or even concolorous with the pileus; *pore surface* even, plane, free from the stipe from which it is occasionally separated by a narrow, light brown to cocoa brown sterile area (collarium) surrounding the stipe's attachment point, rarely slightly decurrent, probably white when fresh, drying off-white, pale creamy, grayish



Figs 1-3. *Ganoderma coffeatum*. Basidiospores. From basidiospores print, Lloyd Mycological Collections Cat. # 23406, BPI (US 0304433, type of *P. infulgens*). Scale bar = 10  $\mu$ m.

white to very pale corky (pale grayish orange) to corky (4B3); *pores* round, slightly angular on drying, even, (6-)7-8(-9)/mm, (100-)115-160(-175)  $\mu$ m diam. ( $\bar{X}$  = 137  $\mu$ m); *dissepiments* thin to moderately thick, entire, smooth, (25-)35-75(-100)  $\mu$ m thick ( $\bar{X}$  = 51  $\mu$ m); *context and trama of the stipe* 2.5-10 mm thick, probably white, whitish when fresh, drying off-white, pale creamy (5A2), pale corky (pale grayish orange) to corky, grayish orange, with a hard corky consistency and a fibrous texture; *tube layer* single, to 7 mm thick, probably white, whitish when fresh, drying pale corky to corky or up to light brown, pale cinnamon (6(C-D)4), with a hard corky consistency, fibrous texture; *crust* to 250  $\mu$ m thick, hard, horny; *hyphal system* dimitic in all parts; *generative hyphae* thin-walled, sparingly branched, with clamped septa; *vegetative hyphae* hyaline, non-dextrinoid, cyanophilous, variably branched, as mainly arboriform skeleto-binding hyphae, especially in the hymenophoral trama; *basidia* mature not seen; *basidiospores* ellipsoid to ovoid, apex round, truncate on drying (shrinking of the exospore), double-walled, endospore thick, pale yellowish, non- to faintly dextrinoid, cyanophilous, endosporic ornamentations cyanophilous, coarse as (tubercles) but more commonly as sinuous ridges having a mainly longitudinal (parallel to the

great axe) orientation, either free or irregularly, slightly anastomozed, exospore thin, hyaline, non-cyanophilous, endo-exospore space 1.2-1.5  $\mu\text{m}$  thick, (8.5-)10.0-12.5(-13.5)  $\times$  (6.0-)7.5-9.5(-10.0)  $\mu\text{m}$  ( $\bar{X}$  = 11.3  $\times$  8.5  $\mu\text{m}$ ), R = (1.2-)1.2-1.5(-1.7) ( $\bar{X}_R$  = 1.3); *basidiospores* print light brown, camel to cinnamon (6D(4-6)); *chlamydospores* absent; *substratum*: on soil and dead wood (buried wood, roots ?); *type of rot*: a white rot; *cultural features*: unknown; *sexuality*: unknown; *distribution*: Neotropics, up to eastern Cuba in the North.

HOLOTYPE: ST. VINCENT: on rotting tree, coll. Guilding, K (K(M): 41845).

*Other type material examined*: BRAZIL, AMAZONAS: Panure, on dead branch ("ramo emortuos") Spruce 211, K (K(M): 108627, holotype of *P. augustus*); BAHIA STATE: 1923, Rev. C. Torrend, Lloyd Mycological Collections Cat. # 23406, BPI (US 0304433, holotype of *Polyporus infulgens*); BAHIA STATE: 1923, Rev. C. Torrend, Lloyd Mycological Collections Cat. # 23405, BPI (Paratype of *Polyporus infulgens*, US 0304438).

*Other specimens examined*: COLOMBIA, DPTO BOYACA: on the Chocontá-Aguaclara Road, near the Pst 165, 1400 ft. asl, on undetermined roots, 1 Jun. 1976, K.P. Dumont, S.E. Carpenter, M.A. Sherwood, and A. Molina, # Dumont-CO 4762, NY; Intendencia Caqueta, ca 29 Miles from Florencia, on the Florencia-Altamira Road, ca. 4000 ft asl, 18 Jan. 1976, K.P. Dumont, P. Buritica, J. Luteyn, and L.A. Molina, Dumont-CO 3044, NY; CUBA, PROV. GUANTANAMO: Municipio Baracoa, Tetas de Santa Tereza, on dead trunk of an undetermined angiosperm, 31 Oct. 1968, F. Kotlaba, PRM 871127; ECUADOR, PROV. SUCUMBIO: tierra firme, on soil, Jul. 1994, C. Decock, MUCL 40279 and 40280 (cultures ex-: MUCL 40279 and 40280); FRENCH GUYANA: Cayenne area, Rorota trail, rainforest, 22 Jan. 1997, C. Decock, # FG 2175 (MUCL 40320, culture ex-: MUCL 40320); MARTINIQUE: Bois du Quartier La Charles, on soil, 09 Oct. 1976, A. David, LY-AD-2233; Anse d'Arlet/Anse Noire, on soil in a xero-mesophylic forest/ravine, 200 m. from the Caribbean sea, 30 Aug. 2005, C. Lécure, CL/Mart 05.185 (MUCL 49207); Le Prêchere, Anse Couleuvre, on soil in a hygrophilous secondary forest, 18 Aug. 2005, R. Courtecuisse, RC/MART 05.012 (MUCL 49208); MEXICO, ESTADO VERACRUZ: Uxpanapa region, about 6 miles south of Campamento Uxpanapa, 17 Jul. 1974, A.L. Welden # 3833, NY (ex-Herbario Universitae Tulane # 9250); PANAMA, PROV. SAN BLAS: trail from Puerto Obaldia to Armila Indian village, alt. ca. 500 ft., on unidentified wood, 21 Jun 1975, K.P. Dumont, S.E. Carpenter, S.M. Carpenter, and S.A. Mori, # Dumont-PA 871 and 876, NY; trail from Puerto Obaldia to Darien, ca. 300 ft. asl, on log unidentified angiosperm, 22 Jun. 1975, K.P. Dumont, S.E. Carpenter, S.M. Carpenter, and S.A. Mori, # Dumont-PA # 982, NY; TRINIDAD: 1912, J.B. Rorer, NY; VENEZUELA: Territorio Amazonas, Cerro Sipapo (Paráque), near the Base camp of the Kunhardt Venezuelan Expedition 1948-49, second growth woodland, alt. 125 m., 24 Nov. 1948, B. Maguire and L. Politi # 27424, NY.

*Remarks*. *Ganoderma coffeatum* is characterized by a stipitate, mainly pleuropodal basidiome, occasionally mesopodal, or pseudo-mesopodal (the result of the fusion of the back sides of a laterally attached, initially dimidiate pileus), a mainly brown to chocolate brown pileus, a white (whitish) pore surface when fresh, discoloring to whitish, pale creamy, creamy, cork-colored on drying, (6-)7-8 pores/mm, 115-160  $\mu\text{m}$  diam., a dimitic hyphal system with hyaline vegetative hyphae, arboriform skeletal hyphae in the hymenophoral trama, and broadly ellipsoid to ovoid basidiospores with free or rarely partially anastomozed, coarse, cyanophilous endospore ornamentations as predominantly longitudinally orientated ridges (Figs 1-3).

The type specimen of *G. coffeatum* is in very poor shape, almost completely destroyed, what made it impossible to figure out what the entire

basidiome looked like. However, although very few pieces of the tube layers are left, basidiospores are present, which allow us to define the species.

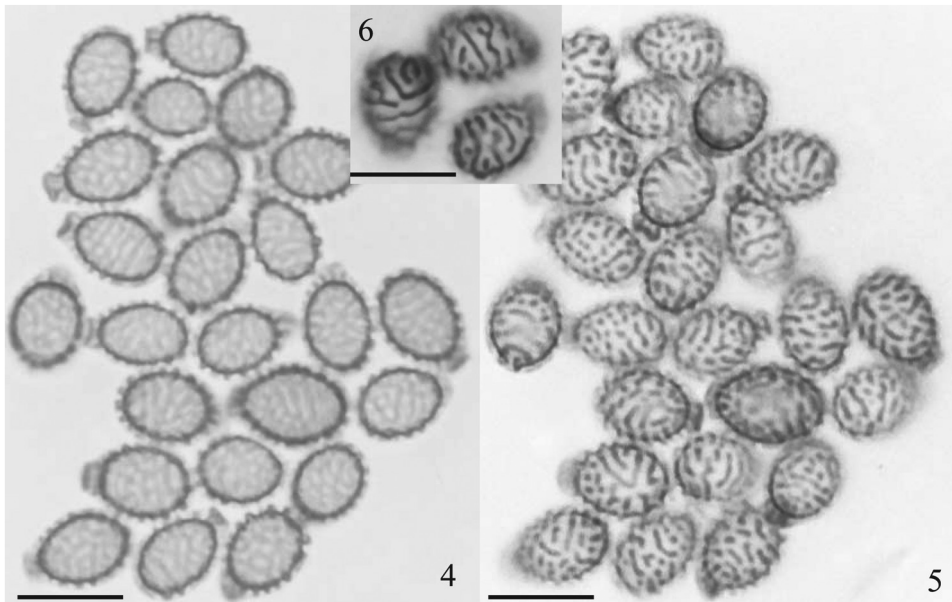
Two specimens of *P. infulgens* Lloyd are annotated “type”, viz. Lloyd catalogue # 23405 and # 23406, both collected by Torrend, and presumably originating from the same original collections. The specimen # 23406 is better preserved than # 23405 and, as mentioned by previous authors (Furtado 1967, Ryvarden 1990, Moncalvo & Ryvarden 1997), represents the lectotype.

Interestingly, the pileus of several specimens, of which both Lloyd’s specimens of *P. infulgens*, and collections from Cuba (PRM), Trinidad (NY), and Venezuela (NY) are almost uniformly covered with a basidiospores deposit, making the surface paler than usual (light brown, camel to cinnamon-colored). These basidiospores are in all respects identical to those seen in the tube layers and in the type of *G. coffeatum*, which gave a better idea of the basidiospores shape, ornamentation, and size.

*Ganoderma coffeatum* is so far known from South and Central America, and the Caribbean area, up to eastern Cuba, which is probably its northernmost limit of distribution. In addition to the countries cited in the list of specimens examined, the species is, in literature, reported from Argentina, Bolivia, Costa Rica, Haiti, Jamaica, Peru, and Puerto Rico (Furtado 1967, Steyaert 1972). However, voucher specimens related to these citations should be carefully re-examined, as some might have been confused with either *G. flaviporum* or *A. deviatum*.

***Ganoderma flaviporum*** (Murrill) Sacc. & Trot., Syll. Fung. 21: 304, 1912. Figs 4-6  
≡ *Amauroderma flaviporum* Murrill, North American Flora 9: 116, 1908 (basionym)

*Basidiocarp* seasonal, stipitate, pleuro- to mesopodal; *stipe* lateral to central, mainly solitary or occasionally two arising from a common base, clavate, cylindrical to obclavate, the base sometime slightly bulbous, circular to ellipsoid or irregular in section, 40-85 mm high, up to 35 × 25 mm wide at the base, down to 26 × 10 mm wide at the apex, almost uniformly brown, mainly cinnamon brown or slightly paler (sunburn, 6D(5-6)) up to chocolate brown or grayish chocolate brown (6E(5-6)), dull, glabrous, covered with a thin, horny crust, chocolate brown in section; *pileus* solitary, flabelliform, dimidiate to slightly reniform, circular to broadly ellipsoid, applanate to applanate-convex in section with the margin plane to abruptly bent, 20-45 mm long, 30-65 mm wide when pleuropodal, 115 × 95 mm when ellipsoid-circular and mesopodal, up to 5-15 mm thick at the center (base) down to 2-6 mm thick at the margin, with the surface faintly to roughly concentrically sulcate, radially slightly to distinctly wrinkled, glabrous to slightly velutinous, dull, concentrically zoned, mainly pale grayish brown, grayish coffee milk, pale brown (6D(4-5), camel to sunburn) with some darker brown (6E(5-6)), dark brown, up to black, narrow concentric bands, sometimes with a brighter grayish orange to brownish orange marginal zone; *margin* thin, even to irregular, undulating, white when fresh, whitish to pale grayish orange on drying, abruptly bent downward; *pore surface* even, (whitish to) more commonly pale yellow (4A3, cream), yellow, up to bright yellow when fresh, paler when dried ((3-4)A(2-4), yellowish white, pale yellow, pastel yellow. *Pores* round, even, (4-)5-6(-7)/mm, (116-)125-193(-225) μm diam ( $\bar{X}$  = 150 μm); *dissepiments* thin to moderately thick, entire, smooth to slightly pruinose, 40-100 μm ( $\bar{X}$  = 57 μm); *trama of the stipe* probably white, pale grayish orange when fresh, drying off-white, pale whitish cream, pale corky, with a corky to hard corky consistency, a fibrous texture, covered with a thin, up to 50 μm thick, chocolate brown, horny crust; *context* 5-12 mm thick, concolorous with the trama of the stipe, covered with a thin, up to 50 μm thick, brown crust; *tube layer* single, 1-6 mm thick, slightly darker than the context and the trama of the stipe, grayish yellow to pale grayish orange (4B(3-4), 5B3, champagne to pale corky) up to light brown (6C5, camel), with a corky consistency, a fibrous texture; *hyphal system* dimitic in all parts; *vegetative hyphae* hyaline, thin-walled, sparingly branched, clamped; *vegetative hyphae* as arboriform skeleto-binding hyphae in the trama of the stipe



Figs 4-6. *Ganoderma flaviporum*. Basidiospores. From basidiospores print, MUCL 45086. Scale bar = 10  $\mu$ m.

and the context, arboriform skeletal hyphae in the trama of the tubes, hyaline, non-dextrinoid, cyanophilous; *basidia* mature not seen; *basidiospores* ellipsoid to slightly ovoid, with the apex rounded or truncate (shrinking of the exospore), double-walled, the endospore thick, hyaline to pale yellowish, non-dextrinoid, cyanophilous, with well-marked, cyanophilous endosporic ornamentation as coarse tubercles or, more frequently, ridges, having mainly a transversal orientation, free or somewhat anastomozed, the exospore thin, hyaline, the endo-exosporic space 0.5-0.75  $\mu$ m thick, (8.0-)9.5-11.5(-11.5)  $\times$  (5.6-)6.6-8.0(-9.0)  $\mu$ m,  $\bar{X}$  = 10.3  $\times$  7.4  $\mu$ m, R = (1.1-)1.3-1.4(-1.6),  $\bar{X}_R$  = 1.4; *chlamydospores* absent; *substratum*: on soil, from buried wood or roots of angiosperm; *type of rot*: a white rot; *cultural features*: unknown; *sexuality*: unknown; *distribution*: Neotropics (specimens seen from Jamaica, Cuba, Mexico, Puerto Rico, Argentina).

HOLOTYPE: JAMAICA: Hope Mine, on *Melicocca bijuga*, 25 Oct. 1902, # 776, F.S. Earle 105 (NY).

*Other specimens examined*: ARGENTINA: Salta, Luis Burda, *sobre suelo, creciendo sobre raíces* [on soil, growing on roots], Apr. 1961, C.E. Gomez, BAFC 23664, NY; CUBA, PROV. SANTIAGO DE CUBA: Alto Cedro, on dead wood in low dense virgin forest, 19-20 Mar. 1905, Earle and W. Murrill # 521, NY; PROV. CIUDAD LA HABANA: Municipio Playa, "Fruti Cuba", garden, on soil near a dead stump, probably of *Roystonea regia*, 11 Sep. 1999, C. Decock, MUCL 41804 (culture ex-: MUCL 41804, CRGF 5); Municipio Miramar, esquina entre Calles 10 y 5<sup>a</sup>, on soil, garden, 17 Oct. 2002, S. Herrera Figueroa, HAC, MUCL 44309; Municipio Miramar, Jan. 2003, S. Herrera Figueroa, HAC, MUCL 44354; Municipio Miramar, on soil, near a dead stump of *Ficus sp.*, 12 Sep. 2003, S. Herrera Figueroa, MUCL 45086 (culture ex-: MUCL 45086, CRGF 6); Municipio Boyeros, Instituto de Ecología y Sistemática, Park, 21 Oct. 2003, L. Del Castillo Suarez and S. Herrera Figueroa, HAC, MUCL 45518; Instituto de Ecología y Sistemática, on soil, near a dead stump, probably of *Roystonea regia*, 07 Sep. 2004, S. Herrera Figueroa and C. Decock

CU-04-110, HAC, MUCL 45995 (culture ex-: MUCL 45995, CRGF 7) and 7 Sep. 2004, S. Herrera Figueroa and C. Decock CU-04-111, HAC, MUCL 45996 (culture ex-: MUCL 45996, CRGF 8). PUERTO RICO, SANTA ISABEL: 10 Jan 1912, J.R. Johnston # 156, NY; 24 Jan. to 05 Apr. 1923, F.J. Seaver and C.E. Chardon # 944, NY.

*Probable additional specimens, not examined:*

BOLIVIA: Santa Cruz de la Sierra, from buried roots round a dead tree, 17 Jan. 1948, E.J.H. Corner (E); MEXICO, ESTADO TAMAULIPAS: Occidental slope of the Sierra Chiquita, ca. del Municipio Gomez Farias, alt. 240-350 m., in tropical caducifoliate forest, Valenzuela and Chacón-Jiménez (voucher specimen in ENCB); ESTADO DE JALISCO: Municipio de Zapotlanejo, Corralillos, 26 Oct. 1980, Sánchez-Ochoa s.n., (IBUG, XAL); Municipio de Guadalajara, Barraca de Huentitán, Vásquez 293 (IBUG, XAL).

*Remarks.* *Ganoderma flaviporum* is characterized by a stipitate basidiome, with a brown stipe covered with a thin, hard crust, a mainly pale grayish brown to pale brown pileus, concentrically zonated with narrow, darker brown concentric bands, a commonly pale yellow, yellow, up to bright yellow pore surface when fresh, 5-6 pores per mm, and ellipsoid to ovoid, ganodermoid basidiospores with free or rarely partly anastomozed endosporic ridges having a predominantly transversal orientation (Fig. 4-6).

Corner (1984) used the name *H. coffeatum* to give a good description of a Bolivian collection that can reasonably be interpreted as *G. flaviporum*. He emphasized clearly the pattern of the endosporic ornamentation. Salvador Vásquez & Guzmán Daválos (1991) and Valenzuela & Chacón Jiménez (1991) also reported collections of *G. coffeatum* s.l. from Mexico, but, according to their basidiospores description and drawings, they were most probably dealing with *G. flaviporum* as presently conceived.

The pileus and pore surface color, and the basidiospore ornamentation differentiate *G. flaviporum* from *G. coffeatum*. It is also probable that the two species have different ecological requirements, *G. coffeatum* occurring preferably within the shade of closed, dense, humid rainforest while *G. flaviporum* would prefer a more open, sunny environment or drier forest. However, this should be ascertained by recording more detailed habitat and ecological data for further collections, which, in the case of polypores, are generally overlooked.

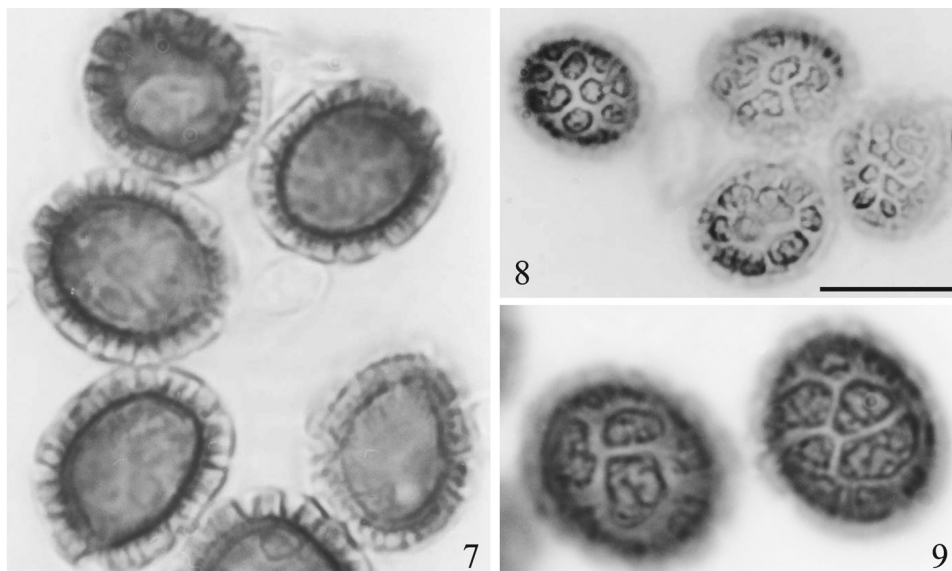
*Amauroderma deviatum* (see below) differs from both *G. coffeatum* and *G. flaviporum* by having amaurodermoid basidiospores and a reticulated pattern of endosporic ornamentations.

*Ganoderma coffeatum* and *G. flaviporum* are morphologically and phylogenetically (data not shown) closely related. *Ganoderma coffeatum* was placed in *Humphreya* Steyaert because of its complex endosporic ornamentation (Steyaert 1972), together with *H. lloydii* (Pat. & Har.) Steyaert and *H. endertii* Steyaert. However, the status of *Humphreya* and the placement of both *G. coffeatum* and *G. flaviporum* in the vicinity of *H. lloydii* are still uncertain, and consequently, we prefer to use existing combinations in *Ganoderma* rather than to make an uncertain new combination in *Humphreya* for *G. flaviporum*.

***Amauroderma deviatum*** Ryvar den, Synopsis Fungorum 19: 51, 2004      Figs 7-9  
For a complete description of the species, see Ryvar den 2004.

The specimen examined is seasonal, stipitate; *stipe* lateral, solitary, cylindrical, circular to ellipsoid or irregular in section, up to 30 mm high, up to 11 × 9 mm wide in section, almost uniformly grayish brown, (grayish cocoa brown, cocoa brown, or darker, teak brown, 6E(4-5)-F5), dull, glabrous, covered with a thin to thick, horny





Figs 7-9. *Amauroderma deviatum*. Basidiospores. From basidiospores print, # Dumont-CO 5683, NY. Scale bar = 10  $\mu$ m.

crust, chocolate brown in section; *pileus* pleuropodal, solitary, flabelliform to dimidiate, appanate in section with the margin plane to abruptly bent, the attachment point slightly depressed, up to 45 mm long, 70 mm wide, up to 10 mm thick at the center (base) down to 2-3 mm thick at the margin, with the surface slightly concentrically sulcate, irregular, glabrous, dull, concentrically zonated, mainly grayish chocolate brown (6E(4-5)F5) with some darker brown (6E(5-6)), rather narrow concentric bands; *margin* thin, even to irregular, undulating, abruptly bent, forming a narrow 1-1.5 mm wide sterile "bourrelet", concolorous with the pileus. *Pores surface* light brown (6D5, sunburn); *pores* round, even, (4-)5 mm, 140-180  $\mu$ m diam ( $\bar{X}$  = 151  $\mu$ m); *dissepiments* thick, entire, smooth, 90-240  $\mu$ m ( $\bar{X}$  = 127  $\mu$ m); *trama of the stipe* drying pale corky, with a hard corky consistency, a fibrous texture, covered with a thin, up to 100  $\mu$ m thick, chocolate brown, horny crust; *context* 2-3 mm thick, concolorous with the trama of the stipe, pale corky to corky colored, with a hard corky consistency, a fibrous texture; *tube layer* single, 3-7 mm thick, concolorous or slightly paler than the context and the trama of the stipe, (4B(3-4), 5B3, champagne to pale corky), with a corky consistency and a fibrous texture; *hyphal system* dimitic (trimitic) in all parts of the basidiome; *generative hyphae* hyaline, thin-walled, sparingly branched, clamped; *vegetative hyphae* hyaline to very faintly yellowish, slightly dextrinoid (better observed in mass, individual hyphae faintly brown), cyanophilous; *basidiospores*<sup>2</sup> broadly ellipsoid up to subglobose or slightly ovoid, with the apex rounded or

2. The pileus of the specimen examined is partially covered by a heavy basidiospores deposit, in all respects identical to those seen in the tube layers, and permitted to have a better idea of the basidiospores shape, ornamentation, and size.

slightly pointed, double-walled, the endospore thick, hyaline to pale yellowish, non- to dextrinoid, cyanophilous, with primary well-marked endosporic ridges, reticulated forming a “honey-comb” pattern and secondary, lower ridges forming an irregularly reticulate pattern, the exospore thin, hyaline, the inter-wall space 0.5-0.75  $\mu\text{m}$  thick, (12.5-)12.8-14.0(-14.0)  $\times$  (10.5-)10.5-12.0(-12.5)  $\mu\text{m}$ ,  $\bar{X}$  = 13.5  $\times$  11.2  $\mu\text{m}$ , R = 1.1-1.3,  $\bar{X}_R$  = 1.2; *substratum*: on soil (?); *distribution*: Neotropics, so far only known from the type locality (Ecuador) and Colombia.

*Specimen examined*: COLOMBIA, DPTO CHOCO: on the Quibdó-Istmina Road, ca. 30 km from Quibdó, alt. ca 200 ft, on duff, 08 Aug. 1976, K.P. Dumont, S.E. Carpenter and M.A. Sherwood, # Dumont-CO 5683, NY.

*Remarks*. *Amauroderma deviatum* is characterized by “amaurodermoid” basidiospores with an endosporic ornamentation in the form of a primary reticulated network of coarse ridges (“honeycomb-like” pattern, Figs 7-9) and a subjacent secondary, more irregular network made of much lower ridges, less marked although clearly visible under light microscopy. This feature is peculiar in the genus *Amauroderma*, most other species having a punctuate ornamentation with, however, the remarkable exception of *A. macrosporum* Furtado (Furtado 1981), a species known exclusively from the Neotropics. Basidiospores in *A. macrosporum* were described as having “conspicuous endosporic projections giving .....a sub-reticulate appearance to the spore wall” (*vide* Furtado 1981). *Amauroderma aurantium* Torrend in Bres. was described and illustrated also with seemingly related basidiospores “*ruguloso-subreticulatae* [rugulose-subreticulate]” (Bresadola 1932, Furtado 1981). This name is of uncertain status, the type specimen having being lost (Furtado 1981), but that could well be the correct name for *A. macrosporum*.

Superficially, the endosporic ornamentation pattern of *A. deviatum* reminds us the pattern present in the basidiospores of *Humphreya eminii* (P. Henn.) Ryvar den, as illustrated in Ryvar den & Johansen (1980), and of *H. lloydii*, *Humphreya* type species<sup>3</sup> (Steyaert 1972), although in the latter, there are no published indications of a secondary subjacent network. However, both *H. lloydii* and *H. eminii* have “ganodermoid” basidiospores, broadly ovoid with an apical umbo that commonly shrink on drying, giving the apex a truncate aspect.

*Amauroderma deviatum* was previously known only from its type specimen, originating from Ecuador (Ryvar den 2004). This seems to be the second collection of this apparently uncommon species.

#### **Name, species, or specimens of uncertain status.**

*Polyporus hemibaphus* Berk., Hook. J. Bot. & Kew Misc. 8: 194, 1856.

≡ *Fomes hemibaphus* (Berk.) Sacc., Syll. Fung. 6: 161, 1888.

≡ *Scindalma hemibaphum* (Berk.) O. Kuntze, Rev. Gen. Pl. 3: 518, 1898.

Furtado (1967), Steyaert (1972), and Ryvar den (1991) listed the name as a synonym of *H. coffeatum*. However, all that remains of the type specimen in K is the stipe, itself partly destroyed by insects. The pileus is absent and we have not observed basidiospores in the fragment of the basidiome, which impeded any secure identification.

3. Specimen examined: GABON, OGOUÉ-IVINDO: Parc National de l'Ivindo, Réserve Intégrale d'Ipassa, Koungou Falls, near the camp, below the main building, on soil near a dead stump, Apr. 2006, C. Decock GA-06-108, MUCL 47640 (culture ex-: MUCL 47640).

HOLOTYPE. BRAZIL, AMAZONAS: Panure, Spruce, K (K(M): 108629).

*Specimens of doubtful identity:*

COLOMBIA, MAGDALENA: Sierra Nevada de Sta Marta, Little 10028 (COL), see Henao 1997; DPTO. CHOCO: ca 30 km from Quibdo, on the Qibdo-Istmina Rd., 200 ft asl, on unidentified log, 08 Aug. 1976, K.P. Dumont, S.E. Carpenter, and M.A. Sherwood, # Dumont-CO 5680, NY.

*Remarks.* These specimens are apparently sterile but judging from the morphology of their vegetative hyphae in the hymenophoral trama, they represent most probably neither *G. coffeatum*, *G. flaviporum* nor *A. deviatum*.

*Ganoderma cf coffeatum sensu Chinese auctores.*

*Ganoderma coffeatum* has been reported from Southern China (Zhao 1989, Xingliang & Dai 2005, Xingliang *et al.* 1997). However, on the basis of descriptions and drawings provided by these authors, and critical examination of several collections held in HMAS, it can be concluded that *G. coffeatum sensu Chinese auctores* is not *G. coffeatum s.s.*, and neither *G. flaviporum* nor *A. deviatum*. These Chinese collections differ by having a laccate pileus, with a typical hymenoderm covering both the pileus and stipe surface, larger pores (3-4/mm), and basidiospores with a different pattern of endosporic ornamentation being mainly punctate, or with very small cristae.

Furthermore, in the three collections examined from HMAS, two species are represented. They differ in their pileus color and basidiospore ornamentation (either faintly punctate or slightly ridged). The identity of these two taxa is so far uncertain. Examination of the numerous type specimens originating from the area (southeast Asia) (Moncalvo and Ryvarden 1997) is required before concluding about their status. This will be discussed in a separate paper.

*Specimens examined:* CHINA, HAINAN: Zhan County, 14 Jan. 1935, *Xiang Kun Deng*, # 8366; Bawangling, 19°16'N – 109°03'E, 13 Aug. 1994, *Wu Xing-Liang* # 4886 (HMAS 77057); Bawangling, on root of *Castanopsis fabri* Hance, 06 Nov. 1969 (CAS).

**TENTATIVE KEY TO SOME SPECIES OF GANODERMATACEAE  
WITH A COMPLEX ORNAMENTATION PATTERN  
(RETICULATE OR DISJOINED CRISTAE)**

- 1a** Basidiospores “amaurodermoid”; endosporic ornamentations as disjoint cristae or reticulated . . . . . 2
- 1b** Basidiospores “ganodermoid”, ovoid, apically truncate; endosporic ornamentations as disjoint cristae or reticulated. . . . . 3
  - 2a** Endosporic ornamentations reticulated (“honeycomb pattern”); 12-14 × 10-12 µm; pores 5/mm, Neotropical species. . . . . *A. deviatum*
  - 2b** Endosporic ornamentations as disjoint ridges; 13-16 × 13-15 µm; pores 1-2/mm; Neotropical species. . . . . *A. macrosporum*
- 3a** Endosporic ornamentations reticulated (“honeycomb pattern”); African species. . . . . 4
- 3b** Endosporic ornamentations as disjoint ridges; Neotropical, Southeast Asian, African species. . . . . 5

- 4a** Basidiospores on average exceeding 20  $\mu\text{m}$ , and up to 35  $\mu\text{m}$  in length . . . .  
 . . . . . *H. eminii*
- 4b** Basidiospores on average less than 20  $\mu\text{m}$  12.5-20  $\times$  8-15  $\mu\text{m}$  . . . . *H. lloydii*
- 5a** Basidiospores on average exceeding 24  $\mu\text{m}$ , ranging 24-28  $\mu\text{m}$  in length . . . . .  
 . . . . . *G. reticulatosporum*
- 5b** Basidiospores on average less than or equal to 20  $\mu\text{m}$  in length . . . . . 6
- 6a** Basidiospores on average exceeding 15  $\mu\text{m}$ , . . . . . 7
- 6b** Basidiospores on average less than 15  $\mu\text{m}$  in length . . . . . 8
- 7a** Basidiospores 17-24  $\times$  10-14  $\mu\text{m}$  . . . . . *G. asperulatum*
- 7b** Basidiospores 16-20  $\times$  12-15  $\mu\text{m}$  . . . . . *H. endertii*
- 8a** Basidiome stipitate; basidiospores on average less than 12  $\mu\text{m}$  in length;  
 Neotropical species . . . . . 9
- 8b** Basidiome sessile; basidiospores on average longer than 12  $\mu\text{m}$ ; Asian  
 species . . . . . *G. trengganuense*
- 9a** Basidiospores with the endosporic ornamentations predominantly  
 longitudinal; 7.5-9.5  $\mu\text{m}$  wide, 8 = 11.3  $\times$  8.5  $\mu\text{m}$ ; pores surface whitish to pale  
 corky . . . . . *G. coffeatum*
- 9b** Basidiospores with the endosporic ornamentations predominantly transversal;  
 6.6-8.0  $\mu\text{m}$  wide, 8 = 10.3  $\times$  7.4  $\mu\text{m}$ ; pore surface yellow when fresh, drying  
 yellowish or paler . . . . . *G. flaviporum*

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