

THE GENERA OF THE *BIONECTRIACEAE*

BATTARRINA (Sacc.) Clem., *in* Clem. & Shear, *Genera of Fungi* p. 279. 1931.

= *Hypocrea* subgenus *Battarrina* Sacc., *Syll. Fung.* 2: 533. 1883.

Type: *Battarrina inclusa* (Berk. & Broome) Clem. (= *Hypocrea inclusa* Berk. & Broome).

Ascomata immersed in host tissue, forming in discolored areas, non-ostiolate, hyaline to pale yellow, globose, about 250 μm diam, walls thin, membranous. Asci evanescent, scattered, without an organized hymenium. Ascospores globose to angular, non-septate, hyaline, sparsely echinulate. Anamorph unknown. On fruiting bodies of *Tuber*.

NOTES.— *Battarrina* was established as a subgenus of *Hypocrea* for species with globose ascospores. Although three species, *H. inclusa*, *H. cervina* Berk. & M.A. Curtis, and *H. cerebriformis* Berk., were included in the subgenus, the taxon was raised to generic rank with only *B. inclusa* and remains a unispecific genus. Benny & Kimbrough (1980) included *Battarrina* in the *Hypocreales* based on the literature.

Battarrina inclusa (Berk. & Broome) Clem., *in* Clem. & Shear, *Genera of Fungi* p. 279. 1931.

= *Hypocrea inclusa* Berk. & Broome, *Ann. Mag. Nat. Hist.*, Ser. 3, 7: 461. 1861.

Ascomata about 250 μm diam, cleistothecial, hyaline to pale yellow, membranous, thin-walled, wall structure of parallel hyphae up to 4 μm diam. Asci cylindrical, 30–33 \times 5–6 μm , clavate when young, evanescent at maturity, 8-spored, ascospores uniseriate. Ascospores globose to slightly angular, 4–6 μm diam, hyaline, thin-walled with sparse, slender echinulations about 1 μm tall.

HABITAT.— Parasitic in ascomata of *Tuber puberulum* Berk. & Broome.

DISTRIBUTION.— England.

HOLOTYPE.— ENGLAND. Bristol, Leigh Wood, Sept. 1859, C.E. Broome (K).

ADDITIONAL SPECIMENS EXAMINED.— ENGLAND. N. Bristol, Nov. 1869, C.E. Broome 2335 (K); Hanham near Bristol, Nov. 1871, C.E. Broome, Rabenhorst, *Fungi Europ.* 1610 (BPI, K, UPS).

ILLUSTRATIONS.— Berkeley & Broome (l.c., 1861, Fig. 23); Hawker (1955, Fig. 2); Petch (1938, Fig. 2).

NOTES.— The type specimen of *Battarrina inclusa* was

examined and found to be in poor condition apparently having been stored in liquid preservation and subsequently dried. The two sections of the host ascomata of *Tuber puberulum* contain indistinct ascomata of *B. inclusa*, appearing on the cut surface as glazed, pale-yellow areas. These areas are packed with asci and ascospores. The specimens of *Fungi Europaei* 1610 were also in poor condition. Petch (1938) included *B. inclusa* in his account of the British *Hypocreales*, based on the type description. Hawker (1955) discussed the species based on a fresh collection from Great Britain that was not located. Due to the poor condition of the type specimen and lack of additional specimens, many characteristics of *B. inclusa* remain obscure. The description given here includes details from Hawker (1955) and Petch (1938).

BIONECTRIA Speg., *Bol. Acad. Nac. Ci.* 23: 563. 1919.

Type: *B. tonduzii* Speg.

Ascomata solitary to gregarious, superficial to slightly immersed in an erumpent stroma, often occurring on other fungi. Ascomata white, yellow, pale orange, tan or brown. KOH–, wall smooth to warted or with scales, thin-walled hairs or flexuous setae, subglobose or globose to ovoid, when dried not collapsing or collapsing irregularly, ostiolate. Asci narrowly clavate to clavate. Ascospores 1-septate, rarely multiseptate, hyaline, smooth to spinulose or slightly warted. Anamorph *Clonostachys*. On leaves and decaying woody substrata.

NOTES.— At present *Bionectria* includes species formerly placed in the *Nectria ochroleuca*-group (Samuels, 1976a; Rossman, 1983; Schroers & Samuels, 1997), but it may also include species placed in the *N. ralfsii*-group (Samuels, 1976a), the *N. muscivora*-group (Rossman, 1983; Samuels, 1988), and species of *Nectria* having *Sesquicillium* anamorphs (Samuels, 1989a). Apart from having pallid perithecia, these species are similar in gross morphology and wall anatomy of the perithecium (Schroers & Samuels, 1997; Schroers *et al.*, 1999). Most species occur on woody substrata and are readily grown on agar. Anamorphs of species of *Bionectria* are useful in distinguishing species (Schroers *et al.*, 1999) and are classified primarily in *Clonostachys* (syn. *Dendrodochium*) or *Myrothecium*-like, the groups differing from each other by conidial color, viz. salmon in *Clonostachys*, and dark

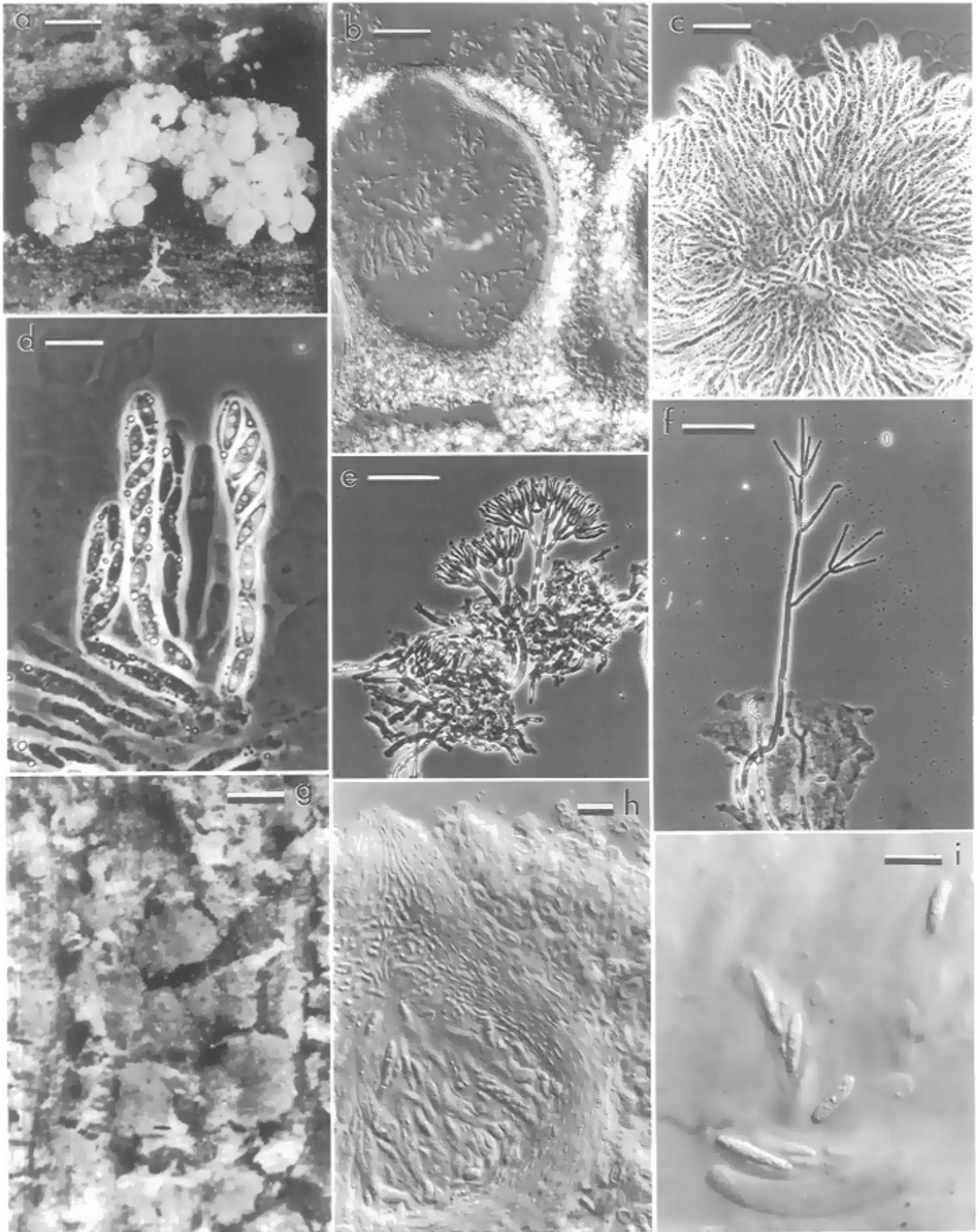


Plate 1. a–f. *Bionectria ochroleuca* and anamorph, *Clonostachys rosea*. a. Ascomata. b. Median section of ascoma. c. Asci with ascospores and inflated cells of apical paraphyses. d. Asci with ascospores. e. Penicillate conidiophores of anamorph. f. Verticillate conidiophore of anamorph. g–i. *Clibanites paradoxa*. g. Stroma with ascomata. h. Median section of ascoma. i. Ascospores. a–d. BPI 749158. e–f. Anamorph grown from BPI 737784. g–i. Holotype of *Clibanites paradoxa* – H. Scale bars: a = 500 μ m; b, e, f = 50 μ m; c = 25 μ m; d, h, i = 10 μ m; g = 250 μ m.

green in *Myrothecium*-like anamorphs. *Bionectria ochroleuca*, particularly as its anamorph *Clonostachys rosea*, is one of the most commonly encountered soil fungi and is often cited in the biological control literature as a destructive mycoparasite (Schroers *et al.*, 1999).

Bionectria tonduzii Speg., Bol. Acad. Nac. Ci. 23: 563. 1919 [as '*tonduzi*'].

≡ *Nectria tonduzii* (Speg.) Samuels, Mem. New York Bot. Garden 48: 22. 1988 [as '*tonduzi*'].

Mycelium tan, spreading. Ascomata seated in mycelium, solitary to caespitose in groups of up to 15, partially immersed in an erumpent, granular stroma, globose, 250–280 µm diam, non-papillate, wall warted, pale orange, KOH–, warts lighter, ascomata collapsing by lateral pinching. Surface of ascomatal wall of nearly circular cells in outline, 12–25 µm diam, walls slightly thickened, 2–4 µm. Ascomatal wall about 50 µm thick, of two regions: outer region about 25 µm thick, of cells circular to slightly elongate, 12–25 µm diam, forming warts up to 50 µm high; inner region about 25 µm thick, of cells flattened to fusiform, 10–15 × 2–3.5 µm. Ascomatal apex of narrow, about 1 µm wide hyphal elements arising from the inner ascomatal wall. Asci clavate, (62–)64–81(–85) × (11–)12.5 × 15 µm, apex broad, simple, 8-spored, ascospores entirely or partially biseriolate. Ascospores fusiform, (16–)19.5–24.5(–27) × (5–)5.5–6.5(–7) µm, 1-septate, hyaline, smooth to spinulose.

ANAMORPH.— None known.

HABITAT AND DISTRIBUTION.— Known only from the type collection.

HOLOTYPE.— COSTA RICA. San José: on leaves of *Byttneria carthagenensis*, possibly parasitizing ascomata of *Puiggarina costaricensis* Syd. (LPS).

ILLUSTRATIONS.— Samuels (1988, Figs. 5 a, b, as *N. 'tonduzi'*); Schroers & Samuels (1997, Fig. 6).

NOTES.— *Bionectria* was established for species that are like *Nectria* but occur on living plant parts. The type species of *Bionectria*, *B. tonduzii*, occurs on living leaves of *Byttneria carthagenensis* Jacq. (*Sterculiaceae*), possibly parasitizing ascomata of *Puiggarina costaricensis* Syd. Samuels (1988) redescribed and illustrated this species based on an examination of the type specimen. *Bionectria tonduzii* has never been cultured or linked to an anamorph.

The four species of *Bionectria* listed below in addition to the type were recently treated by Schroers & Samuels (1997) including color illustrations and references to recent descriptions.

Bionectria apocyni (Peck) Schroers & Samuels, Z. Mykol. 63: 153. 1997.

≡ *Nectria apocyni* Peck, Bull. Buffalo Soc. Nat. Sci. 1: 71. 1873.

Bionectria aureofulva (Cooke & Ellis) Schroers & Samuels, Z. Mykol. 63: 153. 1997.

≡ *Nectria aureofulva* Cooke & Ellis, Grevillea 7: 8. 1878.

Bionectria byssicola (Berk. & Broome) Schroers & Samuels, Z. Mykol. 63: 152. 1997.

≡ *Nectria byssicola* Berk. & Broome, J. Linn. Soc. Bot. 14: 116. 1873.

Bionectria ochroleuca (Schwein.) Schroers & Samuels, Z. Mykol. 63: 151. 1997. — Plate 1, a–f.

≡ *Sphaeria ochroleuca* Schwein., Trans. Amer. Philos. Soc., N.S. 4: 204. 1834.

≡ *Nectria ochroleuca* (Schwein.) Berk., Grevillea 4: 16. 1875.

Anamorph: *Clonostachys rosea* (Link : Fr.) Schroers *et al.*, Mycologia 91: 369. 1999.

A detailed account of *B. ochroleuca* and its *Clonostachys rosea* anamorph is given by Schroers *et al.* (1999).

SPECIMENS EXAMINED.— MEXICO. Veracruz: Laguna Verde, on dead leaves of *Yucca* sp., 2 Oct 1994, G. Bills, G.J.S. 94-122 (BPI 737784); PUERTO RICO. Caribbean National Forest: Luquillo Mts., Bisley Experimental Watershed, on dead bark of *Mangifera indica*, elev. 300 m, 21 Feb 1996, G.J. Samuels, H.J. Schroers (H.J.S. 82), D.J. Lodge, det. H.J. Schroers (BPI 749158).

KEY TO THE SPECIES OF *BIONECTRIA*

1. Ascospores more than 15 μm long, warted 2
1. Ascospores generally less than 15 μm long, smooth, warted or spinulose 3
2. On living leaves, possibly associated with stromatic fungi; ascomata with warts up to 50 μm high; ascospores 19.5–24.5 \times 5.5–6.5 μm *B. tonduzii*
2. On decaying bark or wood; ascomata smooth; ascospores 16–33 \times 4.5–9.5 μm *B. apocyni*
3. Ascomata orange with conspicuous white warts; ascospores ellipsoid, (10–)11–14(–16) \times 4–5(–6) μm , smooth or spinulose *B. byssicola*
3. Ascomata orange to brown, smooth to slightly scaly or covered with a thin layer of hyphae 4
4. Ascomata smooth; ascospores 8.5–15 \times 2.5–5 μm , spinulose or warted *B. aureofulva*
4. Ascomata slightly scaly or covered with a thin layer of hyphae; ascospores 7.5–14.5 \times 2.5–4.5 μm , slightly spinulose *B. ochroleuca*

BRYONECTRIA Döbberler, Nova Hedwigia 66: 334. 1998.

Type: *B. hylocomii* (Döbberler) Döbberler (\equiv *Nectria hylocomii* Döbberler, Mitt. Bot. Staatssamml. München 14: 78. 1978).

Ascomata superficial, with hyphae penetrating the host cells, solitary or rarely aggregated, non-stromatic, globose to obpyriform, 80–200 μm diam, hyaline to white, not changing color in KOH or lactic acid or rarely reacting. Smooth or with short setae. Ascomatal wall of thick-walled cells. Asci ellipsoid to cylindrical, with or without an apical ring. Ascospores ellipsoid, 1- or 2-septate, hyaline, often with a guttule in each cell. Anamorph unknown. Parasitic on liverworts and mosses.

NOTES.—*Bryonectria* was described to accommodate six species of hypocrealean fungi that occur on foliose liverworts and mosses.

CLIBANITES P. Karst., Bidrag Kännedom Finlands Natur Folk 19: 14. 1871.

\equiv *Peziza* sect. *Clibanites* P. Karst., Monogr. Peziz. Fenn. p. 155. 1869. — Type: *C. paradoxa* (P. Karst.) P. Karst. (\equiv *Peziza paradoxa* P. Karst.).

Stroma of intertwined hyphae in the middle and at the base, with highly compacted hyphae near the surface, ascomata immersed in a stroma, loosely united in groups up to ten. Ascomata globose, dark yellow, non-papillate, apex not differentiated, ostiolar canal periphysate, not collapsed upon drying. Ascomatal wall ca 10 μm thick, of several layers of small, flattened cells. Asci subcylindrical, apex broad, blunt, with a ring, as-

cospores biseriate. Ascospores narrowly cylindrical, equally 2-celled, not constricted, hyaline, smooth. Anamorph unknown. On well-rotted wood of *Quercus*. NOTES.—*Clibanites* is a unispecific genus originally described by Karsten as a discomycete. An examination of the type specimen reveals that, based on the small, thin-walled, pallid ascomata and non-disarticulating ascospores, *C. paradoxa* is similar to *Nectriopsis* in the *Bionectriaceae*. It differs from *Nectriopsis* in having relatively thick-walled ascomata loosely united in a common stroma and in the non-fungicolous habit.

Clibanites paradoxa P. Karst., Bidrag Kännedom Finlands Natur Folk 19: 14. 1871. — Plate 1, g–i, Plate 2, a.

\equiv *Peziza paradoxa* P. Karst., Monogr. Peziz. Fenn. p. 155. 1869.

Stroma superficial on decorticated wood, evident as pallid scurf, dissected and squamose (possibly as an artifact of drying), entire stromal aggregate easy to remove; ascomata loosely united into groups of up to 10, immersed in a stroma, adjacent ascomata evident as slightly tuberculate, ostiolate areas, ascomata joined by a subiculum of smooth-walled, 2–3 μm wide, branched, septate hyphae with few free ends, thin-walled, hyaline in transmitted light. Stroma 25–30 μm thick, surface consisting of highly compacted, ca 3 μm wide hyphae; internally hyphae more loosely disposed. Ostioles visible as viscid dots against the dull background of the ascomatal wall. Ascomata globose, ca 100–160 μm diam, pale yellow, KOH–, non-papillate, not collapsed on drying, ostiolar canal periphysate. Ascomatal wall ca 10 μm thick, of one region of small,