

Plate 20. a. *Podostroma alutaceum*, ascus with disarticulating ascospores. b. *Pseudohypocrea citrinella*, ascus, ascus apex, conidiophores, and conidia. a. Holotype of *P. leucopus* - H. b. Guyana 4727 - NY. Scale bars: a, b = 10 μ m.

cid dots against a dull background; ascomatal apex of small cells, not sharply differentiated from the surrounding stroma. Asci cylindrical, 62–95 \times 4–6 μ m, apex with ring. Ascospores 1-septate, dividing into dimorphic part-ascospores, distal part conical to subglobose or globose, 2.9–3.9 \times 2.5–3.2 μ m; proximal part oblong to wedge-shaped 3.1–4.9 \times 1.9–2.9 μ m, hyaline, spinulose.

TYPE.— FINLAND. Tavastia australis, Tammela, Syrja, in ?larvis, P.A. Karsten 3247, 30 Sep 1892 (H, holotype of *Podostroma leucopus*). This specimen consists of several fragments of a cylindrical stroma. The type specimen of *S. alutacea* was not located at L and apparently no longer exists.

ADDITIONAL SPECIMEN EXAMINED.— FINLAND: Mustiala, versus Sarkjarvi, J. Lindroth, 8 Sep 1897, P.A. Karsten 3248 (H).

ILLUSTRATIONS.— Breitenbach & Kränzlin (1981, Fig. 316); Dennis (1975, Pl. XXXIC); Müller & von Arx (1962, Fig. 254, based on the type of *P. leucopus*); Tulasne & Tulasne (1865, Tab. IV, Figs. 1–6).

NOTES.— The description presented here is based on an examination of the holotype of *Podostroma leucopus* and one other specimen from a similar locality. Although *P. leucopus* was recorded as occurring on insect larvae, no evidence of such a host is present on the type specimen. Later collections of *P. alutaceum* have been reported on old wood from both tropical and temperate regions, although it is likely that more than one taxonomic entity has been included under this name. Doi (1966) provided a detailed account of the *Trichoderma*

anamorph of *P. alutaceum* and Eckblad & Torkelsen (1974) suggested that *P. alutaceum* is confined to the ground and decaying stumps in coniferous woods.

PROTOCREA Petch, J. Bot. 75: 219, 1937.

Lectotype, designated by Moravec (1956): *P. farinosa* (Berk. & Broome) Petch (\equiv *Hypocrea farinosa* Berk. & Broome).

Subiculum thin, cottony, arachnoid, white to pink, KOH-. Ascumata partly to completely immersed in the subiculum with adjacent ascumata remaining discrete; ascumatal wall less than 25 μ m thick, KOH-. Asci cylindrical. Ascospores fusiform to ellipsoid, 1-septate, disarticulating while in the asci into two part-ascospores, often of unequal size, hyaline to pale yellow-green, smooth or spinulose. Anamorphs *Acremonium*-like or *Verticillium*-like. On bark, decaying woody substrata and effused basidiomycetes.

NOTES.— *Protocrea* and *Arachnocrea* are similar, differing primarily in ascospore morphology. Ascospores of *Protocrea* are fusiform with rounded ends, the septum is sub-median, and the part-ascospores are of unequal size, whereas in *Arachnocrea* the part-ascospores are conical or apiculate and equal in size. Petch (1937) established the genus *Protocrea* for species that have simple ascumata immersed in or seated upon a byssoid stroma and two-celled ascospores that disarticulate into part-ascospores. The three species originally included in *Protocrea* were *P. farinosa*, *P. delicatula* (Tul. & C. Tul.) Petch, and *P. stipata* (Lib.) Petch. Moravec (1956) designated *H. farinosa* as the lectotype of *Protocrea*, restricting the genus to those species having globose part-ascospores similar to *Hypocrea*. He removed *P. stipata* to another genus, *Arachnocrea* Z. Moravec, based on the fusiform ascospores that disarticulate into part-ascospores each with a pointed end. *Arachnocrea* is herein accepted as a distinct but related genus in the *Hypocreales*. In studying *Hypocrea*, Doi (1972) maintained the segregate genera *Arachnocrea*, *Protocrea*, and *Pseudohypocrea*. Although the ascospores of *Protocrea* and *Arachnocrea* disarticulate while in the asci, these genera are similar to *Hypomyces* and *Sphaerostilbella* in having thin, effused, prosenchymatous stromata. Within *Hypocrea*, there is a series of *Hypocrea* species, typified by *H. citrina*, that have indefinite, effused stromata, but the stromata of these species are pseudoparenchymatous rather than hyphal. Besides the type, two additional species are recognized in *Protocrea*.

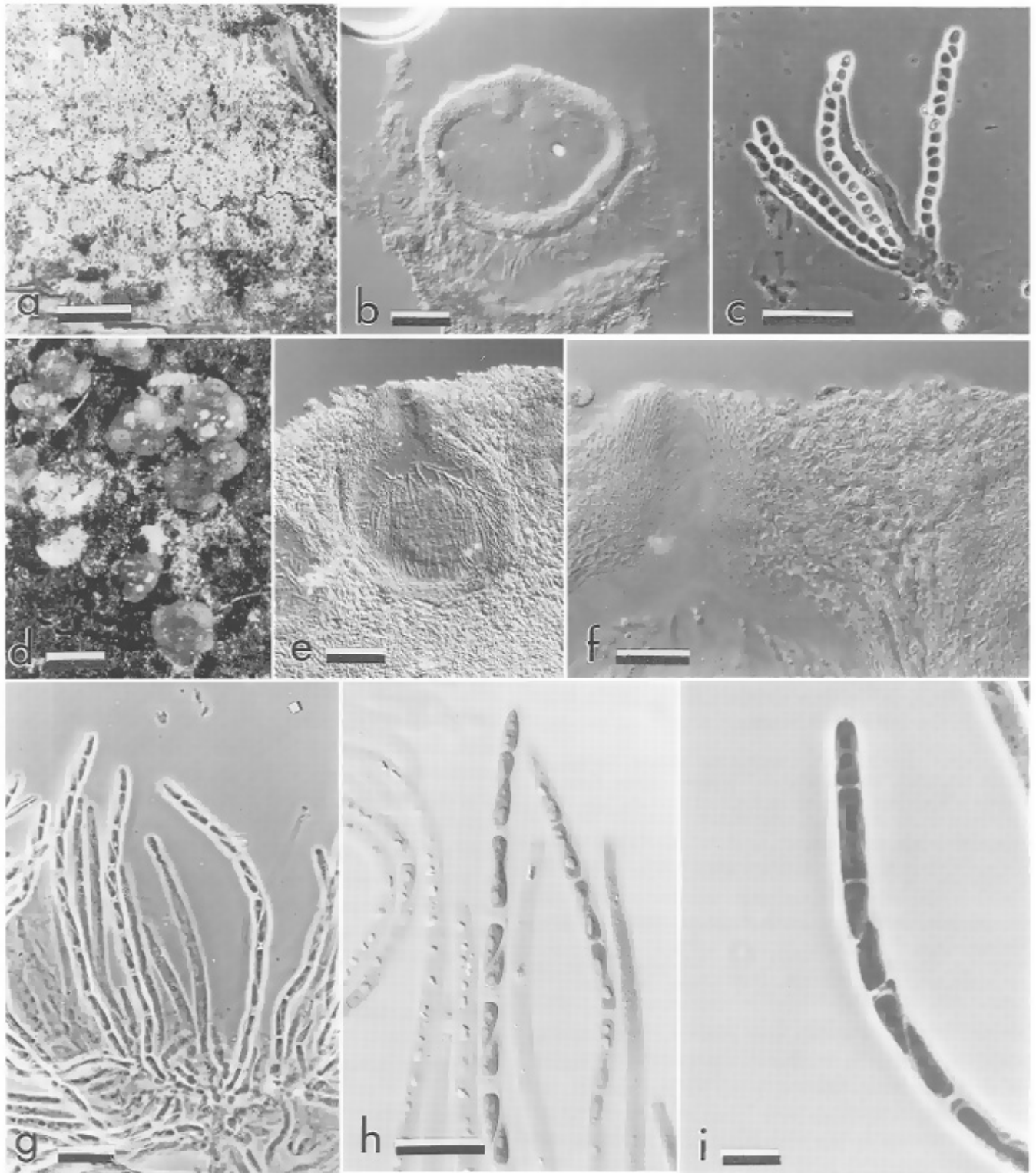


Plate 21. a–c. *Protocrea farinosa*. a. Subiculum with partially immersed ascomata. b. Median section of ascoma. c. Asci with disarticulating ascospores. d–i. *Pseudohypocrea citrinella*. d. Stroma with immersed ascomata. e. Median section of ascoma with surrounding stroma. f. Median section of apical portion of ascoma and surface of stroma. g. Asci with disarticulating ascospores in phase contrast. h. Asci with disarticulating ascospores. i. Apical portion of ascus with ascospores stained in cotton blue. a–c. Holotype – K. d. BPI 802549. e, f, h–i. BPI 744450. g. Holotype of *Hypocrea citrinella* – NY. Scale bars: a = 2 mm; b, f = 50 μ m; c, g, h = 25 μ m; d = 500 μ m; e = 100 μ m; i = 10 μ m.

Protocrea farinosa (Berk. & Broome) Petch, J. Bot. 75: 219. 1937. — Plate 4, m–n (see page 25); Plate 21, a–c.

≡ *Hypocrea farinosa* Berk. & Broome, Ann. Mag. Nat. Hist., Ser. 2, 7: 186. 1851.

Anamorph: *Acremonium*-like.

Subiculum thin, arachnoid, loosely cottony, spreading, white to cinereous, hyphae ca 4 µm wide, smooth, septate, branched, thin-walled, KOH–. Ascospores gregarious, seated on or immersed in subiculum, globose, 145–245 µm diam, pale yellow, KOH–, with a minute, free papilla, completely covered by densely compacted hyphae but remaining discrete. Ascospore wall 18–20 µm thick, of a single region of small, slightly thick-walled cells. Asci cylindrical, (47–)50–60(–68) × (3.5–)4–5.5 (–6.5) µm, apex slightly thickened, sessile, ascospores uniseriate. Ascospores 1-septate, disarticulating in the asci, part-ascospores dimorphic, distal part subglobose to somewhat conical, (3–)3.4–3.7(–4.6) × (2–)2.5–3(–3.3) µm; proximal part wedge-shaped to ellipsoid, (3.2–)3.5–4.5 × 2–2.7(–3) µm, hyaline, smooth to very finely spinulose.

HABITAT.— On an effused basidiomycete (*Aphyllorphorales*), possibly also on wood.

DISTRIBUTION.— England, Germany (Doll, 1975), Japan (Doi, 1972), and United States.

HOLOTYPE.— ENGLAND. King's Cliff, Milton, Norths., on fallen branches, Mr. Henderson; 'a more downy form occurred at Bach Hall, Chester, on decayed *Stereum*, July 1848' (K).

ADDITIONAL SPECIMEN EXAMINED. — UNITED STATES. New York, Vandercamp Lake, on decorticated wood, 17 Sep 1995, C. Catranis (BPI 737716).

ILLUSTRATIONS.— Breitenbach & Kränzlin (1981, Fig. 321); Dennis (1975, Pl. XXXIB); Doi (1972, Fig. 1).

SPECIMEN ILLUSTRATED.— FRANCE. Mongauzy (33), on *Skeletocutis nivea*, 4 Nov 1994, J.-F. Magni, A94131.

NOTES.— The type specimen of *Protocrea farinosa* was found on an effused basidiomycete. Doi (1972) reported an *Acremonium*-like anamorph for this species, but his Japanese collections were found on bark. To be absolutely certain of the anamorph of *P. farinosa*, the anamorph should be grown from a specimen more similar to the type in geographic location and host.

Protocrea delicatula Tul. & C. Tul., Ann. Sci. Nat. Bot., Sér. 4, 13: 18. 1860.

Anamorph: *Verticillium*-like.

Subiculum thin, arachnoid, loosely cottony, spreading, hyphae white, KOH–. Ascospores gregarious, immersed

in mycelium, remaining discrete, subglobose, 185–240 µm high, 140–200 µm diam, orange-amber, KOH–, with an emergent papilla. Ascospore surface of *textura epidermoidea*. Ascospore wall ca 15 µm thick, of a single region of non-descript cells. Papilla of narrow hyphal elements. Asci cylindrical, ca 50 × 5 µm, apex simple, apparently sessile, ascospores uniseriate. Ascospores disarticulating into part-ascospores, part-ascospores dimorphic, distal part globose to subglobose, 2.7–3.6 µm diam; proximal part oblong, 2.7–3 × ca 2.5 µm, hyaline, smooth.

HABITAT.— On decorticated wood, also on dematiaceous fungi.

DISTRIBUTION.— Belgium (Beeli, 1924); England (Petch, 1937), France, Japan (Doi, 1972).

TYPE.— FRANCE. Clamart, on dicotyledonous sticks, leaves and moss, 4 Jan 1860, L.-R. Tulasne (PC, lectotype, designated herein); Chaville, on dead wood, 21 Mar 1860, L.-R. Tulasne (PC, authentic).

ILLUSTRATIONS.— Doi (1972, Fig. 2); Malençon (1979, Fig. 1B–E); Tulasne & Tulasne (1865, Tab. IV, Figs. 7–13).

NOTES.— Two specimens are mentioned in the protologue and both were examined. The specimen collected at Clamart is in better condition and is designated as lectotype. Tulasne & Tulasne (1860) described a *Verticillium*-like anamorph of *P. delicatula*. Although the distinction between *P. farinosa* and *P. delicatula* is tenuous, they can be readily separated on the basis of their anamorphs, if the reported forms are accurate. Ascospores in the type specimen of *P. delicatula* have an orange color whereas ascospores in the type collection of *P. farinosa* are pale yellow. Ascospores of *P. farinosa* are clearly growing over an effused aphyllorphorean basidiomycete while ascospores in the type of *P. delicatula* are on decorticated wood. Doi (1972) and Petch (1937) accepted both species.

Protocrea latissima Mercuri & Ranalli, Physis (Buenos Aires) 35: 304. 1976.

Anamorph: *Acremonium*-like.

Subiculum thin, arachnoid, cottony, spreading, cream-colored to yellow, hyphae 3.5–6.5 µm wide, KOH reaction not known. Ascospores gregarious, partially to completely immersed in the subiculum, globose, 100–130 µm diam, color and KOH reaction not known, with an emergent papilla. Ascospore wall 12–20 µm thick, of a single region of flattened cells. Asci cylindrical, 60–75 × 3.2–5.2 µm, apex thickened, sessile, ascospores uniseriate. Ascospores disarticulating into part-ascospores: part-ascospores monomorphic, subglobose, 2.6–3.2 µm diam, pale yellow-green, spinulose.

ANAMORPH known only in culture: Conidiophores aris-

KEY TO THE SPECIES OF *PROTOCREA*

1. Proximal part of ascospores wedge-shaped to ellipsoid, $3.4\text{--}3.7 \times 2.5\text{--}3 \mu\text{m}$, hyaline, smooth to very finely spinulose *P. farinosa*
1. Proximal part of ascospores subglobose to oblong, less than $3.5 \mu\text{m}$ long, hyaline or yellow-green 2
2. Ascospores hyaline, smooth, proximal part oblong, $2.7\text{--}3 \times ca 2.5 \mu\text{m}$ *P. delicatula*
2. Ascospores pale yellow-green, spinulose, proximal part subglobose, $2.6\text{--}3.2 \mu\text{m}$ diam *P. latissima*

ing as lateral branches of hyphae, unbranched and *Acremonium*-like or producing 2–3 branches, each branch a single phialide, $15\text{--}30 \times 1.8\text{--}3 \mu\text{m}$. Conidia subglobose to oblong, $5\text{--}10 \times 1.5\text{--}3.8 \mu\text{m}$, smooth, hyaline. Chlamydospores rare, obovate, terminal or intercalary, $6.5\text{--}7.8 \times 4.5\text{--}5.2 \mu\text{m}$, verrucose.

HABITAT.— On bark of hardwood trees.

DISTRIBUTION.— Argentina.

TYPE.— ARGENTINA. Buenos Aires: La Plata, Punta Lara, Boca Cerrada, on trunk of *Ligustrum* sp. in the forest, Apr. 1975, C. E. Gómez (BAFC 24077, holotype – not examined).

ILLUSTRATIONS.— Mercuri & Ranalli (1976, Pl. 1–4).

NOTES.— The description given here is paraphrased from the protologue. The illustrations provided with the original description indicate that this is a species of *Protocrea*. The anamorph is strongly suggestive of the anamorphs of *Protocrea farinosa* (Doi, 1972) and *Hypocrea* species such as *H. lactea* (Fr.) Fr. that have effused stromata (Rifai & Webster, 1966b). Mercuri & Ranalli (1976) observed ascomata forming in cultures derived from single ascospores indicating that this species is homothallic.

PSEUDOHYPOCREA Doi, Bull. Natl. Sci. Mus. Tokyo 15: 655. 1972.

Type: *P. citrinella* (Ellis & Everh.) Doi (= *Hypocrea citrinella* Ellis & Everh.).

Stroma discrete, discoidal to pulvinate, of compact, intertwined hyphae. Asci cylindrical. Ascospores one-septate, disarticulating into two conical part-ascospores, hyaline, smooth. Anamorph *Acremonium*-like. On bark.

NOTES.— Doi (1972) established the unispecific genus *Pseudohypocrea* for a *Hypocrea*-like fungus with ascospores that disarticulate into smooth, distinctly conical part-ascospores. The hyphal nature of the stroma and the conical part-ascospores distinguishes *Pseudohypocrea* from *Hypocrea*. Because no 'true' *Hypocrea* has ascospores comparable to those of *P. citrinella*, it is

not necessary to detail stromal anatomy. The smooth, conical part-ascospores and the anatomy of the ascomatal apex are similar to *Hypomyces chrysostomus* and its relatives. In these fungi the ascomata are superficial on a thin subiculum on basidiomata of *Aphyllophorales*, most often members of the *Ganodermataceae*, and their anamorphs are *Acremonium*-like. Only one species of *Pseudohypocrea* is known.

Pseudohypocrea citrinella (Ellis & Everh.) Doi, Bull. Natl. Sci. Mus. Tokyo 15: 655. 1972.— Plate 20, b; Plate 21, d–i; Plate 22, a.

≡ *Hypocrea citrinella* Ellis & Everh., Bull. Torrey Bot. Club 6: 108. 1876.

≡ *Hypomyces citrinellus* (Ellis) Seaver, Mycologia 2: 79. 1910.

≡ *Arachnocrea citrinella* (Ellis) Z. Moravec, Bull. Trimestriel Soc. Mycol. France 72: 165. 1956.

Anamorph: *Acremonium*-like.

Stromata discrete, scattered, pulvinate or discoidal, broadly attached or with margins slightly raised, $0.5\text{--}1.5 \text{ mm}$ diam, surface smooth, outlines of ascomata not evident, ostiolar openings somewhat darker than the surrounding stromatal tissue, relatively few ascomata in each stroma with considerable sterile tissue separating the individual ascomata, pale yellow, KOH–. Stroma surface of intertwined, $5\text{--}6 \mu\text{m}$ wide hyphae, with $ca 1.5 \mu\text{m}$ thick walls. Internal stromatal tissue homogeneous, of intertwined, $6\text{--}7 \mu\text{m}$ wide hyphae, with $1.5\text{--}2 \mu\text{m}$ thick walls. Ascomata pyriform to subglobose, $380\text{--}410 \mu\text{m}$ high $\times 265\text{--}285 \mu\text{m}$ diam, apex of narrow, brick-like cells, $ca 3 \mu\text{m}$ wide, that merge with the periphyses. Asci cylindrical, $(90\text{--})100\text{--}160\text{--}(192) \times (2.5\text{--})5\text{--}6.5\text{--}(8.5) \mu\text{m}$, apex thickened, sessile, ascospores uniseriate. Part-ascospores monomorphic, conical, $(6\text{--})10\text{--}12\text{--}(15) \times (2.5\text{--})3.5\text{--}4.5\text{--}(6.5) \mu\text{m}$, hyaline, smooth.

ANAMORPH KNOWN only from culture. Conidiophores often arising from thick-walled hyphal elements, unbranched or irregularly branched, each branch a single phialide; phialides $15\text{--}40 \mu\text{m}$ long, $2\text{--}3 \mu\text{m}$ wide at the apex. Conidia ellipsoid to fusiform, $6\text{--}12 \times 2\text{--}2.5 \mu\text{m}$,