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THREE BROWN-ROT FUNGI IN THE CORTICIACEAE

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ABSTRACT

Crustoderma resinosum and two new species, *Crustoderma flavescens* and *C. opuntiae,* are described and illustrated. All are associated with brown rots. Cultural characters are included for all species. Cultures previously reported as Unknown A were found to be identical to polysporous cultures of *C. flavescens.*

Key Words: new taxa, culture descriptions, Corticiaceae.

Gilbertson recently reported **(1980, 1981)** that the majority of brown-rot fungi are members of the Polyporaceae. However, six species in the Corticiaceae, in the genera *Chaetoderma, Crustoderma, Dacryobolus,* and *Pseudomerulius,* cause brown rots. We have discovered two additional corticiaceous fungi that cause brown rots, *Crustoderma flavescens* and *C. opuntiae.* We propose these as new species. *Crustoderma resinosum* (Jacks. et Deard.) Gilbn. was recently reported also to be a brown-rot fungus (Gilbertson, **1981).**

METHODS AND MATERIALS

Microscopic examinations of basidiocarps were made from freehand sections mounted in 2% KOH and 1% aqueous phloxine or Melzer's reagent (Ainsworth, 1971). Sections mounted in 0.1% cotton blue (Poirrier's blue) in 60% lactic acid were also examined. Color names are from Ridgway **(1912).** Herbarium abbreviations are from Holmgren and Keuken **(1974).** Specimens are deposited at ARIZ and CFMR unless otherwise indicated.

All cultures are of polysporous origin unless otherwise indicated. Cultures were grown on 1.5% Difco malt extract agar (MEA), 0.5% gallic acid agar (GAA), and 0.5% tannic acid agar (TAA) in the dark at 25 C (Davidson *et al.,* **1938).** Cultures were checked at weekly intervals. Key patterns describing 2-wk-old cultures are based on the system of Davidson *et al.* **(1942).** The species codes, describing 6-wk-old cultures, are based on the system of Nobles **(1965).** Cultures are deposited at the Center for Forest Mycology Research (CFMR).

DESCRIPTION OF SPECIES

CRUSTODERMA RESINOSUM (Jacks. et Deard.) Gilbertson, Mycotaxon **12:** 377. 1981. FIG. 1

≡*Peniophora resinosa* Jacks. et Deard., Canad. J. Res., Sect. C, 27: 147. 1949.
≡*Hyphoderma resinosum* (Jacks. et Deard.) K. J. Martin et Gilbn., Mycotaxon 6: 22. 1977.

[1] **Maintained at Madison, Wisconsin, in cooperation with the University of Wisconsin.**

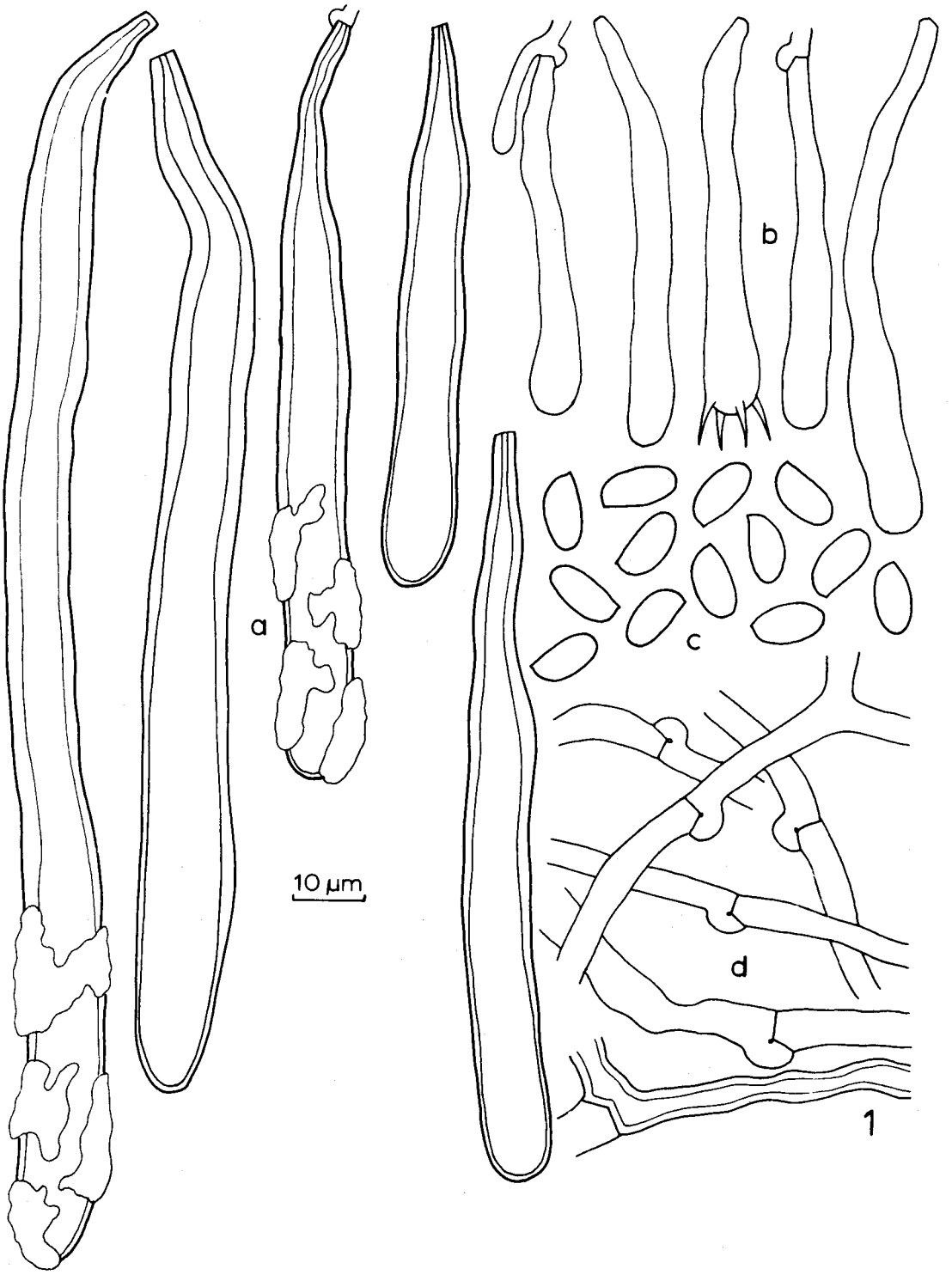

FIG. 1. *Crustoderma resinosum* (RLG 4893). a. Cystidia. b. Basidia. c. Basidiospores. d. Subicular hyphae.

Basidiocarps widely effused, adnate, membranous to ceraceous, 200-400 µm thick; hymenial surface Warm Buff to Cinnamon-Buff, sometimes Light Grayish Olive, smooth, but hispid under a 30× lens because of numerous, emergent cystidia; margin abrupt or thinning out, concolorous or lighter than hymenium; subiculum white; *hyphal system* monomitic; subicular hyphae 4–6 µm diam, thin- to moderately thick-walled, nodose septate, frequently branched; subhymenial hyphae 4-6 µm diam, thin-walled, nodose septate, arranged vertically, dense and compact; *cystidia* numerous, arising from various depths in subhymenium, clavate, 100–280 × 8–16 µm, thin-walled at first, later thick-walled at base then gradually thinning toward apex, with basal clamp, projecting to 80 µm, entirely or partially covered with a thin layer of hyaline, resinous or crystalline material; *basidia* clavate, 40-80 × 6.5-8 µm, thin-walled, with a basal clamp, 4-sterigmate, sterigmata up to 8 µm long; *basidiospores* broadly cylindrical, 8–12 × 4.5–6 µm, hyaline, smooth, thin-walled, negative in Melzer's reagent, acyanophilous.

Specimens examined: CANADA—ALBERTA:RLG 6428 and 6429, on *Picea glauca* (Moench.) Voss and RLG 6440, on *Pinus contorta* Dougl. ex Loud. Banff Nat. Park; BRITISH COLUMBIA: DAOM 16026 (HOLOTYPE), 16025, 16030, 16063, and 16068, on *Picea sitchensis* (Bong.) Carr. QUEEN CHARLOTTE ISLANDS (DAOM); DAOM 17618 on *Pseudotsuga menziesii* (Mirb.) Franco, Vancouver Island (DAOM). U.S.A.—MONTANA:RLG 4893, on *P. contorta.* Flathead County; OREGON: FP 133802, on conifer, Lincoln County; WASHINGTON: JLL 10631 on conifer, Snoqualmie Pass.

Cultural morphology: Growth on MEA moderately rapid, 50-60 mm diam at 1 wk; mats white, appressed and subfelty to felty or raised and woolly, denser near inoculum, thinning out toward margin at 2 and 6 wk; margin even, appressed; odor pungent, garlic-like; agar discoloration none; not fruiting by 6 wk. Oxidase reactions after 1 wk on GAA negative, mat 39–43 mm diam; on TAA negative or stain, no growth. Microscopic characters. Advancing zone hyphae 3—5 µm diam, thin-walled, later irregularly thick-walled, simple septate, much branched. Submerged hyphae (a) 2-6 µm diam, thin-walled or irregularly thick-walled, nodose septate, much branched; (b) 8–10 µm diam, evenly thick-walled, simple septate, moderately branched, scattered at 4 wk. Aerial hyphae 24 µm diam, thin-walled then becoming slightly thick-walled, nodose septate, moderately branched, covered with hyaline, resinous matter. Chlamydospores globose to limoniform, 13.5—20 × 11.5–20 µm, thin-walled at first then slightly thick-walled, hyaline, intercalary or terminal, numerous in submerged mycelium.

Cultures studied: FP 133802 and JLL 1063 I.
Key patterns: A-0-1-1-2-1-10, A-O-I-1-2-10–16. *Species code:* 1.5.9.21.34.36.38.43.53.55.

Crustoderma resinosum occurs in northwestern U.S.A. and western Canada on dead conifers. The diagnostic characters of this species are the large, thick-walled, encrusted cystidia and large, broadly cylindrical basidiospores.

Crustoderma flavescens Nakasone et Gilbertson, sp. nov. **FIG. 2**

Fructificatio effusa, pallido-bubalina; hyphae fibulatae, 3.5–7 µm diam; cystidia clavata, crassitunicata, incrustata, 100-175 x 10–14 µm diam; basidia 45–70 × 7–9 µm; basidiosporae ellipsoidae, hyalinae, laeves, nonamyloidae, 7–9(–10.5) × (6–)6.5–7(-8) µm.

Holotypus: in ligno *Castanea dentata* (Marsh.) Borkh., Glen Falls-Blue Valley Trail, Nantahala National Forest, Macon County, North Carolina; leg. H. H. Burdsall, No. 2173, 16 July 1969; in herb. CFMR, isotypes in herb. ARIZ.

Basidiocarps widely effused, adnate, membranous, up to 600 µm thick; hymenial surface Light Ochraceous Buff to Warm Buff or Cinnamon-Buff to Tawny Olive, smooth or with scattered warts, hispid under lens because of numerous, protruding cystidia; margin thinning out, narrow, white or concolorous with hy-

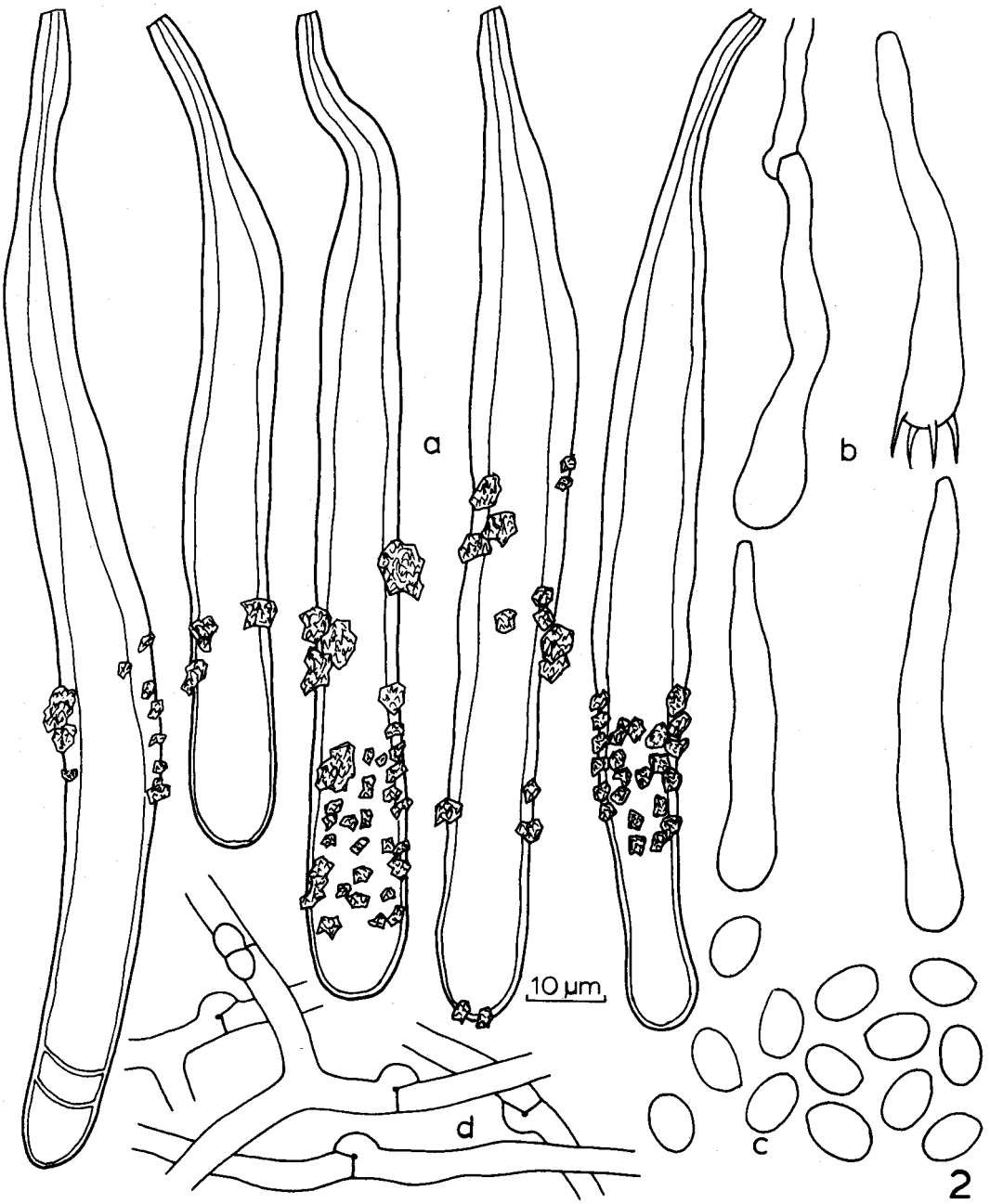

FIG. 2. *Crustoderma flavescens* (HHB 2173, holotype). a. Cystidia. b. Basidia. c. Basidiospores. d. Subicular hyphae.

menium; subiculum white; *hyphal system* monomitic; subicular hyphae 3.5–7 µm diam, thin- to moderately thick-walled, nodose septate, frequently branched; subhymenial hyphae similar to subicular hyphae except thin-walled; *cystidia* numerous, arising from hymenium or upper part of subhymenium, clavate or tapering

toward the apex, 100–175 × 10–14 µm, thick-walled at base then gradually thinning toward apex, sometimes with secondary simple septa, with basal clamp, projecting up to 80 µm, entirely or partially encrusted with hyaline, crystalline material; *basidia* clavate, 45–70 × 7-9 µm, thin-walled, with basal clamp, 4-sterigmate, sterigmata up to 8 µm long; *basidiospores* broadly ellipsoid, 7-9 (-10.5) × (6-)6.5-7(-8) µm, hyaline, smooth, thin-walled, negative in Melzer's reagent, acyanophilous.

Specimens examined: U.S.A.—MARYLAND:FP 90032 and 90132 on *Quercus* sp., Prince Georges County; NORTH CAROLINA: HHB 2173 (HOLOTYPE) and 2174 on *C. dentata,* Macon County; JLL 11385 on hardwood, Buncombe County; WISCONSIN: HHB 9359 on *Quercus* sp., Iowa County.

Cultural morphology: Growth on MEA moderately rapid, 75-85 mm diam at I wk; mats white, appressed, subfelty to felty, with an overlapping streaking pattern (best seen when plate is held up to light), restricted areas becoming raised and cottony, growing up along plate sides at 2 wk, by 4 wk developing large, scattered, cottony mycelial mounds, white to Naples Yellow; margins even, appressed; odor pungent; agar discoloration none; not fruiting by 6 wk. Oxidase reactions after I wk on GAA negative, mat 50-76 mm diam; on TAA negative or stain, mat 0-trace. *Microscopic characters.* Advancing zone hyphae 3-4 µm diam, thin-walled, nodose septate, moderately branched. Submerged hyphae (a) 2-6 µm diam, similar to advancing zone hyphae except larger hyphae often with irregularly thickened walls; (b) 8–10 µm diam, evenly or irregularly thick-walled, simple septate, sparingly branched, scattered at 4 wk. Aerial hyphae 2-6 µm diam, thin-walled, nodose septate, moderately branched, covered with hyaline, resinous material. Chlamydospores globose, 15-30 µm diam, thin-walled or walls up to 2 µm thick, hyaline, intercalary or terminal, numerous in submerged mycelium.

Cultures studied: PANAMA—MS14, 15, 16, 17, 18, 19, 20, and 21, rot isolates from pine ammunition boxes. U.S.A.—MISSOURI:ML 19, 23, Mad 5078-1, 5078-2, and 5078-3, rot isolates from redwood cooling towers; WISCONSIN: HHB 9359 on Quercus sp.

Key patterns: A-O-I-1-2-10, A-O-I-1-2-10-14, A-O-I-1-2-10-16, A-,O-I-1-2-10-14-16. *Species code:* 1.3.9.21.34.36.43.53.54.55.

Crustoderma flavescens is associated with a brown rot of hardwood and coniferous logs and slash. It differs from *C. resinosum* in having broadly ellipsoid basidiospores. Also *C. resinosum* is known to occur only in alpine habitats of northwestern U.S. and western Canada, while *C. flavescens* is apparently restricted to warmer habitats of midwestern and eastern North America.

Crustoderma flavescens is similar to *C. resinosum* in culture. However, *C. flavescens* grows faster on MEA and GAA, develops streaks in agar, has larger chlamydospores, and grows up along the plate sides. This is the same fungus that Duncan and Lombard **(1965)** reported as Unknown A. Polysporous isolates of *C. flavescens* have a tendency to degenerate in culture.

As of this writing, no basidiocarp specimens of *C. flavescens* have been seen from Panama. The pine boxes may have been infected with *C. flavescens* in the U.S.A. before they were placed in testing sites in Panama.

Crustoderma opuntiae Nakasone et Gilbertson, sp. nov. FIG. 3

Fructificatio effusa, grisea, ad marginum alba; subiculum alba; hyphae fibulatae, 3–5 µm diam; cystidia cylindrica vel capitata, tenuitunicata, non-incrustata, 60–145 × 6-10 µm; basidia 35-40 × 6-7 µm; basidiosporae ovoidae vel ellipsoidae, hyalinae, laeves, nonamyloideae, 7-8(–11) × 4–5 µm.

Holotypus. In ligno *Opuntia fulgida* Engelm., Park Link Drive, Pinal County, Arizona; leg. R. L. Gilbertson No. 12348, 19 Mar. 1980; in herb. CFMR, isotypes in herb. ARIZ.

Basidiocarps effused up to 15 cm, not readily separable; hymenial surface

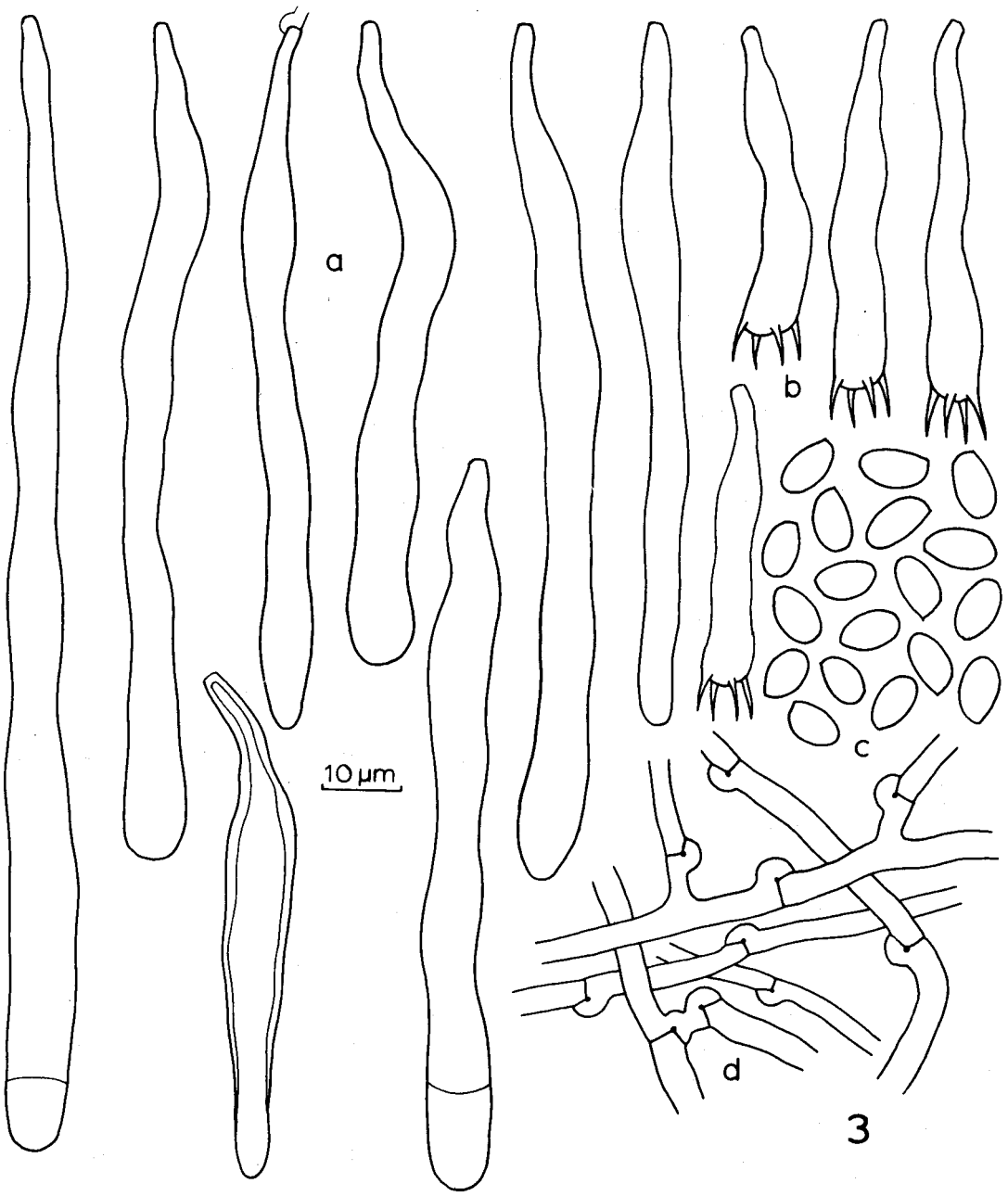

FIG. 3. *Crustoderma opuntiae* (RLG 12348, holotype). a. Cystidia. b. Basidiospores. d. Subicular hyphae.

gray, smooth, cystidiate under a 10× hand lens, cracking on drying to reveal the underlying white, floccose subiculum; margin fertile and concolorous with hymenial surface or narrowly sterile, white, floccose in some areas; *hyphal system* monomitic; subicular hyphae 3–5 µm diam, thin- to moderately thick-walled,

nodose septate, with frequent branching; *cystidia* abundant, cylindric or tapering toward the apex or occasionally capitate, some slightly swollen above the tapered base, 60–145 × 6–10 µm, thin-walled or occasionally thick-walled at the base, a few with secondary simple septa, with a basal clamp, projecting to 80 µm, lacking encrustations; *basidia* narrowly clavate, 35-40 × 6–7 µm, thin-walled, with a basal clamp, 4-sterigmate, sterigmata up to 7 µm long; *basidiospores* ovoid to ellipsoid or cylindric-ellipsoid, mostly 7–8(–11) × 4–5 µm, hyaline, smooth, thin-walled, negative in Melzer's reagent, acyanophilous.

Specimens examined: U.S.A.—ARIZONA RLG 12290, 12348, (HOLOTYPE), and 12563, all on *Opuntia fulgida* Engelm., Pinal County.

Cultural morphology: Growth on MEA moderately rapid, 44–52 mm diam at 1 wk; mats white, appressed and subfelty around inoculum, then slightly raised, downy to arachnoid at 2 and 6 wk; margins even, appressed; odor strong, unpleasant; agar discoloration none; not fruiting by 6 wk. Oxidase reactions after 1 wk on GAA negative, mat 40-43 mm diam; on TAA negative, mat 0-trace. *Microscopic characters.* Advancing zone hyphae 3–6 µm diam, thin-walled, nodose septate, occasionally branched. Submerged hyphae (a) 2–3 µm diam, thin-walled or slightly thick-walled, nodose septate, frequently branched; (b) 4–6 µm diam, irregularly thick-walled, nodose septate, frequently branched. Aerial hyphae 2–3 µm diam, thin-walled, nodose septate, moderately branched, covered with a hyaline, resinous matter.

Cultures studied: RLG 12348 and 12290.

Incompatibility system: Nineteen single-spored isolates of RLG I2348 that lacked clamp connections were paired in all combinations. Two weeks later the matings were examined. Two mating types were isolated: A_1 = 1, 2, 5, 6, 8, 9, 11, 13, 14, 16, 18; A_2 = 3, 4, 7, 12, 15, 17, 19, 20. Thus, *Crustoderma opuntiae* is bipolar.

Key patterns: A-O-I-1–10–14; A-O-I-1-10-14-16. *Species code:* 1.3.9.21.32.36.38.43.53.55.59.

Crustoderma opuntiae is distinctive because of the gray color of the hymenial surface, the large, nonencrusted cystidia, and the ovoid to ellipsoid spores. This species has been found only on dead jumping cholla in southern Arizona. It is similar microscopically to *Hyphoderma* sp. de Vries 488, illustrated and described by Ericksson and Ryvarden **(1975).**

Because *C. opuntiae* lacks chlamydospores, it can be distinguished easily from *C. flavescens* and *C. resinosum* in culture.

DISCUSSION

When *Crustoderma* was first described (Parmasto, **1968),** it consisted of the single species, *C. dryinum* (Berk. et Curt.) Parmasto. The description naturally reflects a narrow interpretation of the genus. We feel that *Crustoderma* is the best genus in which to place the three species just discussed. They agree well with the generic descriptions by Parmasto **(1968)** and Eriksson and Ryvarden **(1975)** except for a few points. First, *Eriksson* and Ryvarden mention that the basidiospores of *Crustoderma* stain strongly in cotton blue. We have used cotton blue on all three species but cannot confirm any staining reaction by the spores. Second, although we have observed slightly thick-walled basidia in *C. dryinum,* they were not observed in the other species of *Crustoderma.* Lastly, the distinctive gray color of *C. opuntiae* is not typical for most *Crustoderma* species.

Culturally, the three species of *Crustoderma* are similar. They grow rapidly on MEA and GAA, do not react on GAA and TAA, develop irregularly thick-walled hyphae, and have a strong, disagreeable odor. Cultural studies of *C. dryinum* have not been published, but the few cultures available at CFMR are similar.

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