the loan of Thaxter's specimens of *Acompsomyces*. I thank Drs. Isabelle Tavares and David Thompson for critically reviewing the manuscript and offering many helpful suggestions for its improvement.

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FEBRUARY 1989 MEMOIRS OF THE NEW YORK BOTANICAL GARDEN **49:** 233–242

Hypocrea pallida and Its Allies (Hypocreaceae)

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Doi, Yoshimichi (Department of Botany, National Science Museum, Hyakunin-cho 3.23.1, Shinjuku-ku, Tokyo 160, Japan) and **Kaori Yamatoya** (Japan Women's University; present address: Institute of Applied Microbiology, University of Tokyo, Yayoi 1-1-1, Bunkyo-ku, Tokyo 113, Japan). *Hypocrea pallida* and its allies (Hypocreaceae). Mem. New York Bot. Gard. **49:** 233–242. 1989. *Hypocrea pallida* and its allies, *H. nebulosa* and the new species ***Hypocrea ampulliformis*** are described and illustrated. The anamorphs of these species are proven to be species of *Gliocladium* with colorless conidia.

Key Words: Hypocreaceae, *Hypocrea pallida, Hypocrea nebulosa, Hypocrea ampulliformis, Gliocladium,* taxonomy

Introduction

Hypocrea pallida Ellis & Everhart is characterized by having solitary, *Hypomyces*-like, perithecia that usually occur on basidiomata of *Tyromyces* species. The perithecial wall of *H. pallida* and its relatives comprises two layers. The inner layer is thin and formed of thin-walled cells that become roseous in 3% KOH; the outer layer is thicker and is formed of ± pseudoparenchymatous cells. The inner layer corresponds to the "true" perithecial wall while the outer layer corresponds to stromal tissue (Doi, 1972, 1973). This anatomy is in distinction to the perithecial wall anatomy seen in the morphologically similar species of the genus *Protocrea*. The perithecial wall of *Protocrea* spp. comprises only a single region, the "true" perithecial wall, and lacks stromal tissue. On the basis of the anatomy of the perithecial wall, Doi (1972, 1973) placed *H. pallida* into its own group within *Hypocrea*: *Hypocrea* subgen. *Hypocrea*, sect. *Homalocrea* (Sacc.) Doi, subsect. *Pulvinatae* Doi, series *Pallidae* Doi.

Hypocrea pallida has a *Gliocladium* anamorph that is closely similar to *G. penicilloides* Corda, the anamorph of *Sphaerostilbella aureonitens* (L.-R. & C. Tul.) Seifert, Samuels & W. Gams and to *G. viride* Matr., the anamorph of *H. lutea* (Tode: Fr.) Petch. Such close morphological similarity among the anamorphs of teleomorphs that are not thought to be closely related causes serious problems in the definition of natural genera of Fungi Imperfecti. If Samuels and Seifert's (1987) thesis that biologically homogeneous teleomorph genera should be linked to equally homogeneous anamorph genera is correct, then it should be possible to identify and use morphological characters to recognize those anamorph genera in the absence of a teleomorph. At this time, though, we do not see a hiatus separating the *Gliocladium* anamorphs of *Sphaerostilbella, H. lutea,* and *Hypocrea* ser. *Pallidae*. In the present paper, we investigate the *Gliocladium* anamorphs of *Hypocrea* ser. *Pallidae* in an effort to characterize them vis-à-vis other *Gliocladium* anamorphs and *Trichoderma*, the anamorph genus most characteristic of *Hypocrea*.

Hypocrea pallida was described from the U.S.A. by Ellis and Everhart (1886) and later redescribed by Canham (1966) on the basis of recent collections from the U.S.A. It has since

been collected in Japan (Doi, 1972, 1973), New Zealand, Gabon (Africa), and French Guiana. The species is thus apparently cosmopolitan. Until now it has been the sole member of *Hypocrea* ser. *Pallidae*. In the present work we add two additional species to that series, viz., *H. nebulosa* Massee and the new species *H. ampulliformis*. Each of these species has a *Gliocladium* anamorph similar to that of *H. pallida*. Cultures of *H. nebulosa* and *H. pallida* have been deposited at ATCC, CBS, IFO, and IAM.

Key to the Species of *Hypocrea* series *Pallidae*

1. Perithecia obpyriform-ampulliform, outlines of individual cells of the perithecial wall distinct when viewed in longitudinal section; mainly on *Hirschioporus*. *H. ampulliformis*.
1. Perithecia subglobose-urniform, outlines of individual cells of the perithecial wall indistinct when viewed in longitudinal section; mainly on *Tyromyces*.
   2. Perithecia 170–330 × 210–350 μm; part-spores 2.8–3.6 × 2.2–2.6 μm; conidia ellipsoidal, ovate, or slightly allantoid. *H. pallida*.
   2. Perithecia 230–440 × 240–390 μm; part-spores 2.7–4.8 × 2.2–3.3 μm; conidia generally allantoid. *H. nebulosa*.

1. *Hypocrea pallida* Ellis & Everhart, J. Mycol. **2**: 65. 1886. Figs. 1–3.

=*Hypocrea aurantiaca* Peck, Annual Rep. New York State Mus. **51**: 295. 1898, *non* Hennings *in* Warburg, Monsunia **1**: 163. 1899 (fide Barr et al., 1986).

Anamorph. *Gliocladium* sp. with colorless conidia (Canham, 1966; Doi, 1972).

Subiculum effuse, thin, whitish, pale yellow-ochre, or pale orange when fresh, becoming orange-brown when dry, dense around the perithecia and filling space between adjacent perithecia; hyphae of subiculum narrow, 1–4.5 μm wide, septate, branched, loosely interwoven or forming strands, wall thin or occasionally to 0.8 μm thick. Perithecia densely gregarious and forming an effuse, thin, dense, stroma-like layer, or solitary and seated within a loose subiculum, subglobose or urniform, 170–330 × 210–350 μm, with a minute papilla, pale yellow-ochre. Perithecial wall comprising two regions; inner region 9–17 μm thick, cells flattened, thin-walled, 8–14 × 3–8 μm, becoming roseous in 3% KOH, sometimes more intensely colored around the ostiolar area; outer, stromal, region 10–18 μm thick, composed of rounded to nearly polyhedral cells 3–10 × 2–7 μm diam. with walls 0.8–1.2 μm thick (see Doi, 1973, p. 67, fig. 2), not reacting to 3% KOH. Asci cylindrical, 55–62 × 2.6–3 μm, apex thick walled, with 16 part-spores. Part-spores minutely tuberculate, colorless, dimorphic with upper parts subglobose-obovate, flattened at the inner end, 2.8–3.1 × 2.2–2.6 μm, lower parts obovate-ellipsoidal, flattened at the inner end, 2.9–3.6 × 2.2–2.4 μm.

CHARACTERISTICS IN CULTURE. Ascospores germinating within 2 days on 1% malt agar in cotton-plugged, 18 mm diam. culture tubes and 9 cm Petri dishes at 24–28°C, diffuse daylight. Colonies advancing 0.5–1.5 cm/day in Petri dishes, at first smooth and translucent with aerial mycelium lacking; aerial hyphae arising from surface of colonies after 3 days, vegetative hyphae septate, smooth, colorless, 1.5–5 μm wide; sometimes with a yellow [Kornerup & Wanscher (1967) 3B6–2A4] pigment spreading in the medium. Chlamydospores not observed. Conidiophores formed after 3–5 days, occasionally forming in concentric rings on surface of colony, macronematous, mononematous, at first *Acremonium*-like, later primarily *Gliocladium*-like. *Acremonium*-like conidiophores to 0.8 mm long, 1.5–2.5 μm wide at base, unbranched or rarely branched. *Gliocladium* conidiophores 80–290 μm long, 2.5–7.5 μm wide at base, 40–220 μm from base to first branch, smooth, straight, bi- to quin- (rarely sex-)verticillate, with rami (1° side branches), ramuli (2° side branches), and metulae (side branches producing phialides), sometimes with 2° or 3° ramulae; rami oblong, 12–33 × 2–4.5 μm, smooth, each bearing 2–3 ramuli or metulae; ramuli cylindrical, 10–18 × 2–3 μm, smooth, each bearing 3–5 metulae; metuale cylindrical, 7–13 × 1.5–2.5 μm, smooth, each bearing 4–8 phialides. Phialides cylindrical or subulate, 8–17 × 1.5–2 μm, tip with visible periclinal thickening, collarette not flared. Conidia oblong, ellipsoidal, ovoid, or slightly allantoid, 2.2–5.5 × 1–1.8 μm in week old cultures and 1.8–3.7(–5.5) × 0.8–1.7 μm in 3 week old cultures, unicellular, colorless, smooth, formed in slimy masses. Perithecia formed in some isolates (*Doi 6371, 6372, 6373, 6536*).

HABITAT. On basidiomata of *Tyromyces* spp., rarely on other polypores.

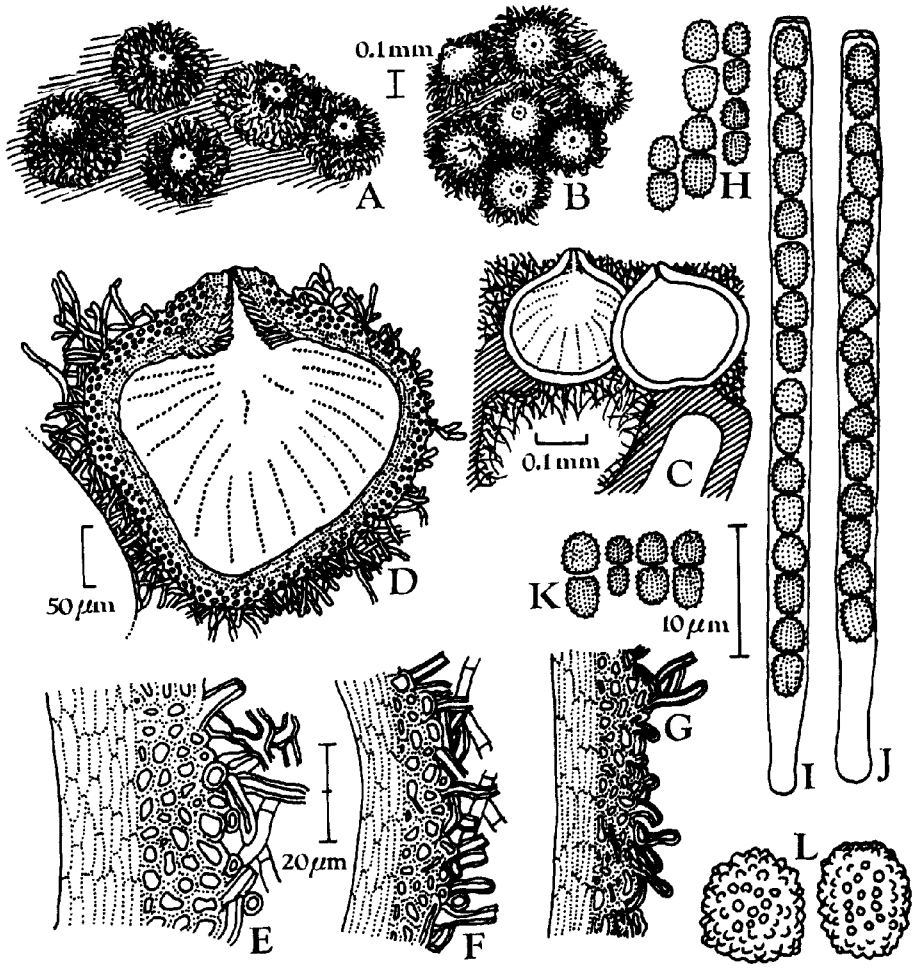

FIG. 1. *Hypocrea pallida*. **A, B.** Perithecia in surface view (A: *D-6123*, B: *CTR 67-51*). **C, D.** Longitudinal sections of perithecial wall showing true, inner perithecial wall and outer stromal tissue; filamentous hyphae of subiculum surrounding perithecia. (E: *CTR 67-51*, F: holotype of *Hypocrea aurantiaca*, G: *G-12*). **H–K.** Part-spores and asci (H: holotype, I: *CTR 67-51*, J: holotype of *H. aurantiaca*, K: *G-12*). **L.** Exospore ornamentation of part-spores drawn from an SEM photograph (*D-6123*).

KNOWN DISTRIBUTION. Canada, U.S.A., French Guiana, Gabon, Japan, New Zealand.

SPECIMENS EXAMINED. CANADA. ONTARIO: York Co., Nashville, on *Tyromyces chioneus*, 11 Sep 1955, *R. F. Cain* (TRTC 31327).

U.S.A. NEW JERSEY: Gloucester Co., Newfield, on *Tyromyces caesius*, Oct 1880 (holotype of *H. pallida*, FH). NEW YORK: Cortland Co., on *Tyromyces albellus*, *C. T. Rogerson 3249* (NY, TNS); Rockland Co., Harriman State Park, on *Tyromyces* sp., 4 Aug 1967, *C. T. Rogerson 67-51* (NY, TNS); Saratoga Co., Gansevoort, on *Tyromyces chioneus*, Jul 1897, *C. H. Peck* (holotype of *H. aurantiaca*, NYS). PENNSYLVANIA: Chester Co.,

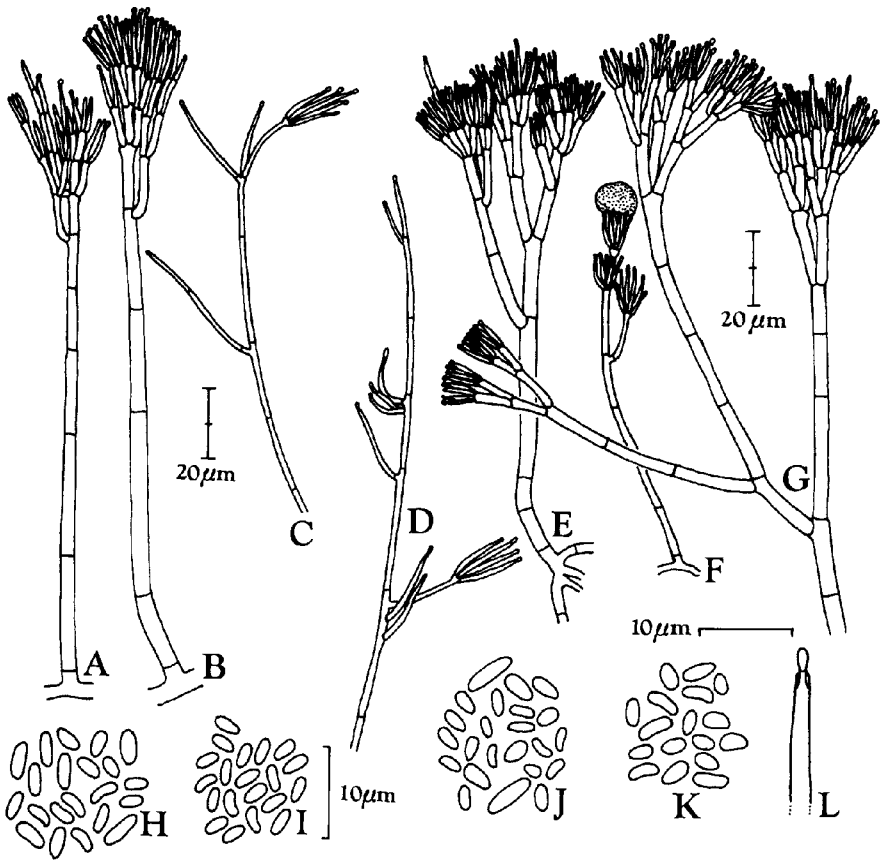

FIG. 2. Anamorphs of *Hypocrea pallida*. A–G. Conidiophores (A–C: *CTR 67-51*, D–G: *D-6123*). H–K. Conidia (H, I: *CTR 67-51*, J, K: *D-6123*). L. Tip of phialide with periclinal thickening (*D-6123*).

Newlin Township, on *Tyromyces* sp., *C. T. Rogerson 86-76* (NY, TNS).

FRENCH GUIANA. Trail between Saül and Mt. Galbao, ca. 7 km SW of Saül, 450 m elev., on ?*Tyromyces* sp., 11 Jan 1986, *Samuels 2803 & Boise* (Rogerson culture 86-2, NY, TNS).

GABON. 30 km from Libreville, Route Boboneau, "La Mondah," on ?*Tyromyces* sp., 3 Apr 1979, *G. Gilles 12* (TNS).

JAPAN. HOKKAIDO: Kamiiso-gun, Chirichiri-gawa R., on ?*Tyromyces semipileatus*, 8 Sep 1986, *Y. Doi 6371* (TNS); Matsumae-gun, foot of Mt. Daisengen-dake, on *Tyromyces* ? *caesius*, 10 Sep 1986, *Y. Doi 6372* (TNS). HONSHU: Aomori Pref., Mt. Ookuzure-yama, on *Tyromyces* sp., 14 Sep 1986, *Y. Doi 6373* (TNS). KYUSHU: Kagoshima Pref., Yakushima, at foot of Mt. Hanayama, on *Tyromyces* sp., 1 Sep 1975, *K. Tubaki 225-55* (IFO, TNS); Yakushima, Ono-aida, on *Heterochaete* sp., 26 Jan 1977, *Y. Doi 3004* (TNS); Mt. Yuwandake, Amami-Oushima, on ?*Tyromyces* sp., 22 Nov 1978, *Y. Doi 4118* (TNS); Amami-Oushima, Sumiyo-son, Kamiya, on *Tyromyces caesius*, 24 Nov 1978, *Y. Doi 4226* (TNS); Amami-Oushima, Nase City, Kinsakubaru, on *Tyromyces* ? *caesius*, *Y. Doi 4262* (TNS); Kagoshima Pref., Tokunoshima Isl., Mikyo, on ?*Tyromyces*, 30 Nov 1978, *Y. Doi 4381* (TNS), 1 Dec 1978, *Y. Doi 4425* (TNS); Tokunoshima Isl., Mt. Tanpatsu-san, on ?*Tyromyces*, 2 Dec 1978, *Y. Doi 4433* (TNS); Yamagata Pref., Asahi-Kousen, on *Tyromyces caesius*, 17 Sep 1978, *Y. Doi 4394* (TNS); Tottori Pref., Mt. Daisen, on *Tyromyces caesius*, 27–28 Oct 1984, *Y. Doi 5916* (TNS); Mt. Daisen, on *Tyromyces albellus*, 25 Sep 1986, *Y. Doi 6536* (TNS).

NEW ZEALAND. AUCKLAND: Dome Valley, N of Warkworth, on *Tyromyces* sp., 27 Apr 1976, *G. J. Samuels* (PDD 37124); Waitemata City, Waitakere Ranges, Piha Rd., Lucy Cranwell-Kauri Grove tracks, on *Tyromyces* sp., 11 May 1986, *Y. Doi 6123 & G. J. Samuels* (PDD, TNS). NELSON: West Haven Inlet, on ?*Fomes* sp., *J. M. Dingley*, 14 Nov 1970 (PDD 28739).

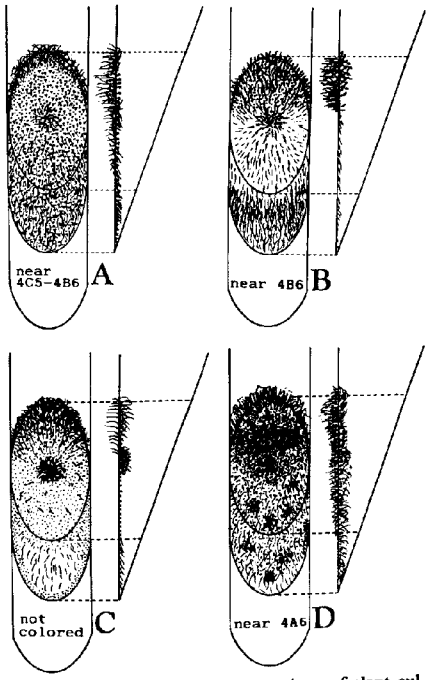

FIG. 3. Macroscopic representations of slant cultures of *Hypocrea pallida* (see Doi et al., 1984, for an explanation of this method of illustrating colonies). A. *Gliocladium*-type conidiophores (*CTR 67-51*). B. *Acremonium*-type conidiophores (*CTR 86-76*). C. A dense colony at the point of inoculation (*D-6123*). D. Perithecial formation at the middle-upper part of the colony (*D-6373*).

NOTES. *Hypocrea pallida* is generally found on *Tyromyces* spp. The specimen *Doi 3004* is unusual in occurring on what may be a species of *Heterochaete*.

Perithecia of the type specimen of *H. aurantiaca* are crowded and the subiculum is orange. The primary described difference between *H. pallida* and *H. aurantiaca* is the color of the subiculum, lighter in *H. pallida* than in *H. aurantiaca*. The subiculum in the collections *Doi 4381*, and *6536* is mottled white and orange. We follow Barr et al. (1986) in considering *H. aurantiaca* to be a synonym of *H. pallida*.

In a previous paper (Doi, 1972) the strain *Doi 14* was given as *H. pallida*. This collection is actually *H. ampulliformis*, which is described below.

Part-spores of *Hypocrea pallida* appear to be minutely tuberculate with the tubercles arranged without obvious order when viewed by light microscopy. With scanning electron microscopy, the tubercles appear to be arranged in straight lines.

According to Seifert (1985), the *Gliocladium* anamorph of *H. pallida* is almost identical with *G. penicilloides*. The chief difference between these two anamorphs is that the stipe of the conidiophore of *G. penicilloides* and its relatives is roughened (see Seifert, 1985) whereas the stipe of the conidiophore of *H. pallida* is smooth. The significance of this difference has yet to be assessed.

There was variation among the anamorphs obtained from isolations of *H. pallida*, especially in a New Zealand collection (*Doi 6123*). The optimum temperature of growth of most strains was 26–28°C but that of *Doi 6123* was only 20–22°C. *Rogerson 67-51* and *Doi 6123* produced *Acremonium*-like conidiophores rather than the expected *Gliocladium*-type. In general the *Gliocladium* conidiophores arise singly from the surface of the colony but conidiophores in *Doi 6123* were crowded along the axis of an aerial hypha. Although the New Zealand collection (*Doi 6123*) was culturally unusual, its teleomorph was indistinguishable from other, more culturally typical, collections of *H. pallida* and we retain the New Zealand collection in *H. pallida*.

Hypocrea nebulosa Massee, Bull. Misc. Inform. **1898**: 130. 1898. Figs. 4A, B; 5.

Subiculum effuse, dense, whitish, pale yellow or pale ochre, dense around the perithecia and filling space between adjacent perithecia; hyphae of subiculum narrow, 1–3 μm wide, septate, branched, loosely interwoven or forming strands, wall thin or occasionally to 0.7 μm thick. Perithecia densely gregarious and forming an effuse, thin, dense, stroma-like layer, or solitary and seated in a dense subiculum, subglobose or uniform, 230–440 × 240–390 μm, with a minute papilla, individual perithecia appearing as dark spots against the light-colored subiculum in dry

specimens, pale yellow-ochre. Perithecial wall comprising two regions; inner region 8–20 μm thick, cells flattened, thin-walled, 7–12 × 4–9 μm, becoming roseous in 3% KOH, usually more intensely colored around the ostiolar area; outer, stromal, region 11–20 μm thick, composed of rounded to nearly polyhedral cells 2–3.5 μm diam. with walls 0.7–0.9 μm thick, not reacting to 3% KOH. Asci cylindrical, 68–75 × 3.5–4 μm, apex thick-walled, with 16 part-spores. Part-spores minutely tuberculate, dimorphic with upper parts subglobose-ovate, flattened at the inner end, 2.7–3.8 × 2.7–3.3 μm; lower parts obovate-ellipsoidal, flattened at the inner end, 3–4.8 × 2.2–3.2 μm.

CHARACTERISTICS IN CULTURE. Ascospores germinating within 2 days on 1% malt agar. Colonies advancing 0.5–1.5 cm/day in Petri dishes, at first smooth and translucent with aerial mycelium lacking; aerial hyphae arising from surface of colonies after 3 days, vegetative hyphae septate, smooth, colorless, 2–6 μm wide; rarely with a yellow [Kornerup & Wanscher (1967) 1A4–2A5] pigment spreading in the medium. Chlamydospores infrequently observed, irregularly rounded, ca. 7 × 6 μm, colorless, smooth. Conidiophores formed after 3–5 days, occasionally forming in concentric rings on surface of colony, macronematous, mononematous, at first *Acremonium*-like and unbranched or infrequently branched with main branches to 0.8 mm long × 1.5–2.5 μm wide. *Gliocladium* conidiophores 90–240 μm long, 2.5–7.5 μm wide at base, 60–80 μm from base to first branch, smooth, straight, bi- to sexverticillate, with rami, ramuli, metulae, rarely with 2° or 3° ramulae; rami cylindrical, 14–25 μm long × 2–4.5 μm wide, smooth, often arising from one-half the length of the conidiophore, each bearing 2–3 ramuli or metulae; ramuli cylindrical, 7–27 μm long × 1.5–3.5 μm wide, smooth, each bearing 3–5 metulae or rarely a few 2° ramuli; 2° ramuli cylindrical, 11–24 × 2.5–3.5 μm, smooth, each bearing 3–5 metulae or rarely a few 3° ramuli. 3° ramuli cylindrical, 12–17 × 2–2.5 μm, smooth, each bearing 2–4 metulae; metulae cylindrical, 7–10 × 1.5–2 μm, smooth, each bearing 3–7 phialides; phialides cylindrical or subulate, 6–22 × 1.5–2 μm, tip with visible periclinal thickening, collarette not flared. Conidia allantoid, less frequently oblong, ellipsoidal or ellipsoid-ovate, 2.7–5 × (0.8–)1–1.5 μm in week old cultures and 2.6–4.1(–6) × 0.7–1.8 μm in 3 week old cultures, unicellular, colorless, smooth, formed in slimy masses. Perithecia not formed in culture.

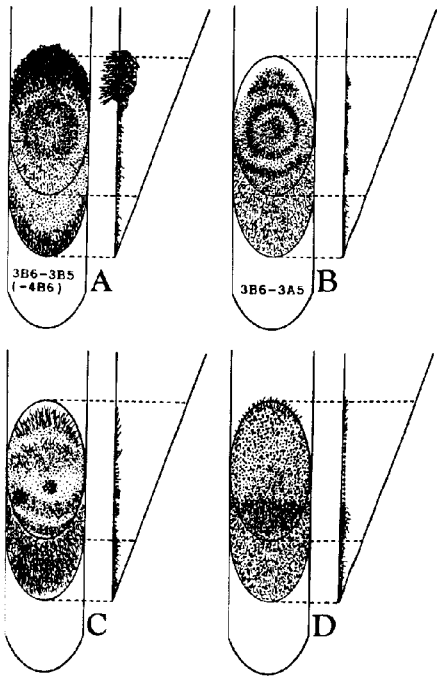

FIG. 4. Macroscopic appearance of cultures. **A, B.** *Hypocrea nebulosa* (*D-6801*). **C, D.** *H. ampulliformis* (holotype, drawn from dried culture).

HABITAT. On *Tyromyces* spp.

KNOWN DISTRIBUTION. Australia (Tasmania).

SPECIMENS EXAMINED. AUSTRALIA. TASMANIA (all on *Tyromyces* spp.): Hobart, Cascades, Aug 1918, *O. Rodway 494* (holotype in a paper bag from the Rodway herbarium 526 at HO; isotype K); track to Liffey Falls, N of the Great Lake, 14 May 1987, *Y. Doi 6801* (HO, TNS).

NOTES. The isotype of this species (K) is a small and largely immature portion of the type.

Cultural characteristics of *Hypocrea nebulosa* are described from the single collection, *Doi 6801*. Ascospore germination and growth characteristics at 24–28°C were similar to those of *H. pallida*.

Hypocrea nebulosa and *H. pallida* are obviously very closely related and in the future may be

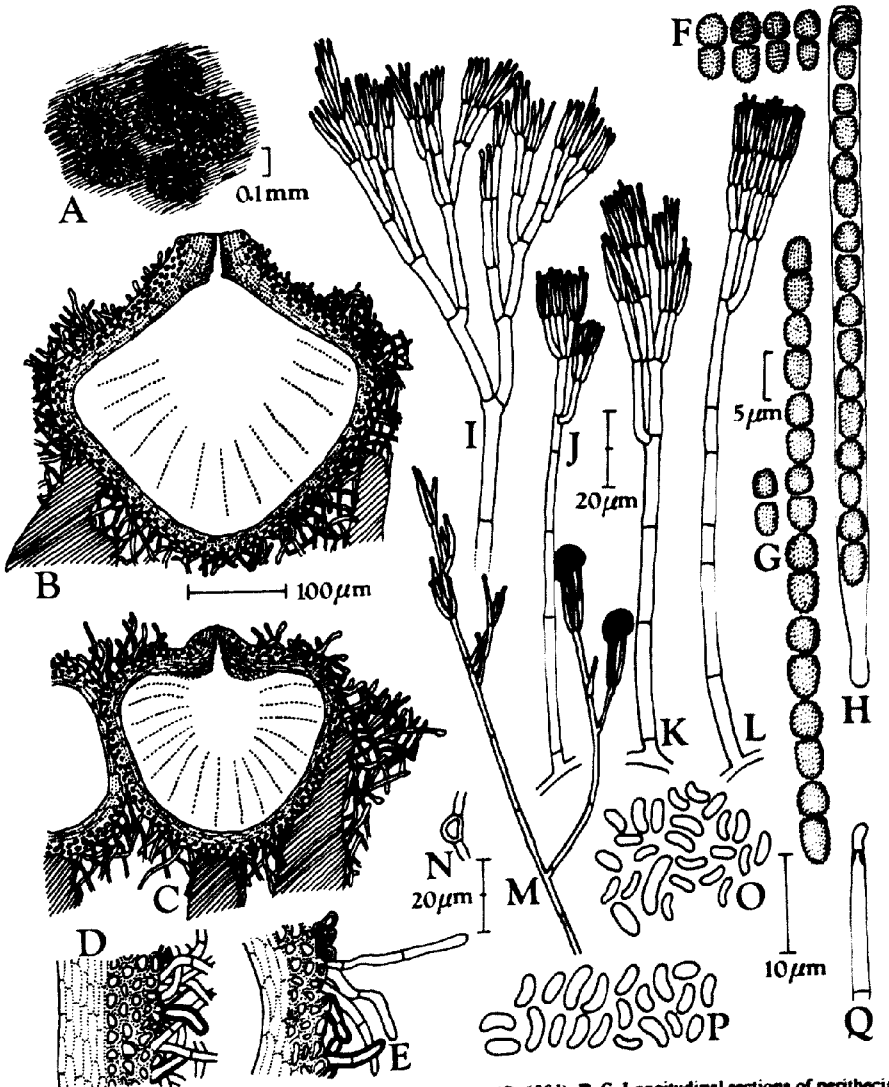

FIG. 5. *Hypocrea nebulosa*. **A.** Perithecia in surface view (*D-6801*). **B, C.** Longitudinal sections of perithecia (B: *Rodway 494*, C: *D-6801*). **D, E.** Longitudinal sections of perithecia showing true perithecial wall, outer stromal tissue, and hyphae of subiculum surrounding the perithecia (D: *Rodway 494*, E: *D-6801*). **F–H.** Asci and part-spores (F, H: *D-6801*, G: *Rodway 494*). **I–M.** Conidiophores (*D-6801*). **N.** Chlamydospore. **O, P.** Conidia (*D-6801*: O: 1 week old culture, P: 3 week old culture).

amalgamated. On the basis of very few observations, collections from Tasmania tend to have considerably larger perithecia and the conidia tend to be allantoid rather than oblong or ellipsoidal as in *H. pallida*.

Gliocladium conidiophores often developed as side branches from *Acremonium*-like conidiophores. This was also observed in a New Zealand strain (*Doi 6123*) of *H. pallida*.

Hypocrea ampulliformis Doi & Yamatoya, sp. nov. Figs. 4C, D; 6.

Perithecia ampulliformia vel obpyriformia, aggregata vel dispersa, textura stromate instructa et in subiculo immersa, 170–230 × 130–160 μm. Asci cylindrici, 73–82 × 3.2–3.8 μm, 16 partispori. Partispori hyalinae, minute tuberculatae; partisporis distalibus subgloboso-ovatis, 2.9–3.8 × 2.6–3.3 μm; partisporis proximalibus obovato-ellipsoidibus, 3.5–5 × 2.2–3 μm.

Status anamorphicus. *Gliocladium*-typus, conidiophoris macronematis, mononematis, penicillatis, quater vel quini verticillate ramificatis, 180–450 μm longis, 5–12 μm latis ad basim. Conidia unicellularia, hyalina, laevia, ellipsoidea vel ellipsoideo-obovata, 2–3.5 × 1.5–2.2 μm. Holotypus. *Y. Doi 14* (TNS; isotypi NY, K).

Subiculum effuse, thin, pale cream, pale ochre, ochre-brown, or often orange-brown in age, loosely disposed around the perithecia and filling space between adjacent perithecia; hyphae of subiculum narrow or often swollen, 2–4 μm wide, septate, branched, loosely interwoven or forming strands, wall thin or often ± thick-walled, verruculose at the surface of the subiculum. Perithecia densely gregarious and forming an effuse, thin, dense, stroma-like layer, or solitary and seated within the subiculum, ampulliform or obpyriform, 170–230 × 130–160 μm, with a minute papilla, pale ochre or ochre-brown. Perithecial wall comprising two regions; inner region 9–14 μm thick, cells flattened, thin-walled, 9–14 × 5–11 μm, becoming roseous in 3% KOH; outer, stromal, region formed around the perithecial apex and lacking or highly reduced around the sides of the perithecia, 12–18 μm thick, composed of globose to short obovoid cells 6–11 × 3.5–8 μm and forming *textura globulosa*, or often with hyphal elements 2.5–3.5 μm wide; not reacting to 3% KOH. Asci cylindrical, 73–82 × 3.2–3.8 μm, apex thick-walled, with 16 part-spores. Part-spores minutely tuberculate, colorless, dimorphic with upper parts subglobose-ovate, flattened at the inner end, 2.9–3.8 × 2.6–3.3 μm; lower parts obovate-ellipsoidal, flattened at the inner end, 3.5–5 × 2.2–3 μm.

CHARACTERISTICS IN CULTURE. Ascospores germinating within 1 week. Colonies slow-growing, aerial mycelium lacking after 1 week, forming later, vegetative hyphae septate, smooth, colorless, 2–9 μm wide; with a pale orange pigment spreading through the medium. Chlamydospores not observed. Conidiophores formed profusely, occasionally forming in concentric rings on surface of colony, macronematous, monomenatous, sometimes *Acremonium*-like conidiophores bearing ± penicillate clusters of phialides forming but most conidiophores *Gliocladium*. *Gliocladium* conidiophores 180–450 μm long, 5–12 μm wide at base, 120–370 μm from base to first branch, minutely verrucose above, straight, quater- to quinverticillate, with rami, ramuli, metulae, rarely with 2° ramulae; rami 4–6, cylindrical, 12–22 × 3–8 μm, minutely verruculose, each bearing 4–6 ramuli; ramuli cylindrical, 7–13 × 2–4 μm, minutely verruculose, each bearing 5–6 metulae or rarely 2° ramuli; 2° ramulae cylindrical, 4–9 × 2–3 μm, minutely verruculose to nearly smooth, each bearing 3–4 metulae; metulae cylindrical, 4–10 × 2–2.5 μm, minutely verruculose appearing almost smooth, each bearing 5–7 phialides; phialides elongated, lageniform or subulate, 6–15 × 1.5–2 μm, densely tufted and spreading like an unfolded fan, tip with visible periclinal thickening, collarette not flared. Conidia short ellipsoid or ellipsoid ovate, 2.4–3.8 × 1.4–2.3 μm (1-week cultures), 1.9–2.6 × 1.5–1.8 μm (3-week cultures), 1-celled, colorless, smooth, held in a slimy mass at the tip of each conidiophore. Perithecia not formed in culture.

HABITAT. On basidiomata of *Hirschioporus* sp.

KNOWN DISTRIBUTION. Japan, known only from the type.

TYPE. Japan. Honshu: Nara City, Mt. Kasuga-yama, on *Hirschioporus elongatus*,, 15 Oct 1966, *K. Aoshima (Doi 14)* (holotype TNS-F-19005; isotypes NY, K).

NOTES. The culture from the holotype collection of *H. ampulliformis* was made in 1966. Doi (1972) previously described the characteristics of this collection and culture as *H. pallida*. The culture is no longer viable; dried cultures and microscope slide preparations have been preserved at TNS.

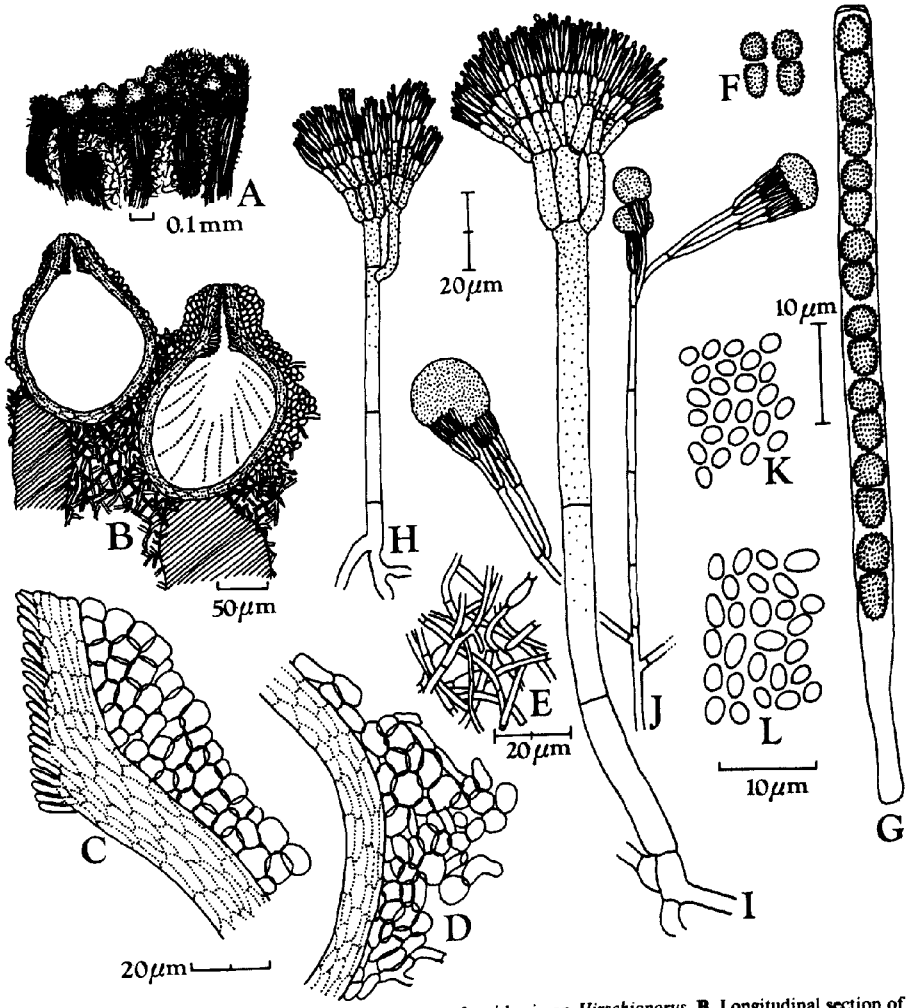

FIG. 6. *Hypocrea ampulliformis*. A. Surface view of perithecia on *Hirschioporus*. B. Longitudinal section of perithecia, diagonal lines are tissue of host basidiomata. C. Longitudinal section of perithecial papilla with stromatal tissue around the ostiolar opening. D. Longitudinal section of perithecium with stromal tissue outside true perithecial wall. E. Subiculum. F, G. Ascus and part-spores. H–J. Conidiophores. K, L. Conidia (K drawn from 3 week culture, L drawn from 1 week culture). All drawn from the holotype.

Hypocrea ampulliformis is characterized within *Hypocrea* ser. *Pallidae* by the relatively small perithecia that are seated in a loose subiculum, by the thick stromal component of the perithecial wall that surrounds the ostiolar area, by the very long *Gliocladium* conidiophores, and by the short, ellipsoid-ovate conidia that are not at all allantoid. The cells of the stromal component of the perithecial wall remain discrete and have much thinner walls than do the cells of the stromal component of the perithecial walls of *H. pallida* and *H. nebulosa*, which lack definite outlines.

An *Acremonium*-like morph is uncommon in *H. ampulliformis* whereas it is commonly produced by cultures of *H. pallida* and *H. nebulosa*. The presence or absence of an *Acremonium*-like morph, and the relationship of that *Acremonium*-like morph to the *Gliocladium* morph should be carefully considered in the taxonomy of the genus *Gliocladium* as a whole, but especially among the anamorphs of *Hypocrea* and its allies.

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Two New Species of *Nectriella* and an *Acremonium* Anamorph

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Lowen, Rosalind (The New York Botanical Garden, Bronx, NY 10458, U.S.A.). Two new species of *Nectriella* and an *Acremonium* anamorph. Mem. New York Bot. Gard. **49**: 243–252. 1989. Two new species of *Nectriella* (Hypocreaceae) with orange perithecia ornamented by hyaline hairs are described. **Nectriella guttulata** sp. nov. occurs on petioles of *Gunnera chilensis* in Chile; **Nectriella anisospora** sp. nov. is found in the lichen *Hypogymnia physodes* from Maine. Both were grown in culture from single ascospores. No anamorph developed in cultures of *Nectriella guttulata* but the formation of perithecia indicates that the species is homothallic. The new anamorph species **Acremonium pedatum** sp. nov. developed in cultures of *Nectriella anisospora* but perithecia did not form. The advantage of using low temperature scanning electron microscopy for taxonomy is discussed. A key to the lichenicolous species of *Nectriella* is provided.

Dos nuevas especies de *Nectriella* (Hypocreaceae) con peritecio naranja y ornamentadas con pubescencia hialina son descritas. **Nectriella guttulata** sp. nov. se encuentra sobre peciolos de *Gunnera chilensis* en Chile; **Nectriella anisospora** sp. nov. se encuentra en el liquen, *Hypogymnia physodes* en Maine. Ambos crecieron en cultivos a partir de ascosporas. *Nectriella guttulata* no desarrollo anamorfo en el cultivo pero la formación de peritecio indica que es una especia homotálica. El nuevo anamorfo de **Acremonium pedatum** sp. nov. se produjo en el cultivo de *Nectriella anisospora* pero los peritecios en este caso no se formaron. Se discute, la ventaja de usar microscopio electrónico de baja temperatura, aplicada a la sistemática. Una clave para especies liquenicolas de *Nectriella* es dada.

Key Words: *Acremonium*, anamorph, lichenicolous, *Nectriella*, SEM, taxonomy

Introduction

Nectriella Nitschke (Ascomycetes, Hypocreales, Hypocreaceae) is characterized by immersed-erumpent, light-colored, soft perithecia, and hyaline, two-celled ascospores. Species are found in the thalli of lichens and in the stems of herbaceous plants, as well as in a variety of other substrates. This is an account of two new species that, while superficially resembling each other because of their bright orange perithecia ornamented at the apex with hyaline hairs, differ in shape, anatomy, hosts, and geographic distribution. *Nectriella guttulata* does not form an anamorph but produces perithecia in cultures of single or multiple ascospores. The lichenicolous species, *N. anisospora*, produces an *Acremonium* anamorph from cultures of single ascospores. The two species represent two groups in the genus, one with members mostly in dead herbaceous stems, while perithecia of species of the other group are immersed in lichens.

Nectriella santessonii Lowen & Hawksworth (Lowen & Hawksworth, 1986), a lichenicolous species, and *N. muelleri* Samuels, Rogerson, Rossman & Smith, and an unnamed *Nectriella* species (Samuels et al., 1984) are also known to have *Acremonium* anamorphs. *Kutilakesopsis* has been reported to be the anamorph of *N. pironii* (Alfieri & Samuels, 1979). Additional life history