Key to the species of *Hypocreopsis*

1. Ascospores 22–30 × 7–9.5 µm, ellipsoid to short-fusiform, 1-septate, minutely warted; primarily from northern Europe including England, northern United States, and Canada ..... *H. lichenoides*
1. Ascospores 12–17 × 12–13.5 µm, globose with one to several spores cemented together, 1–3-septate, thick-walled, irregularly coarsely warted; southern Europe, but also England and southern United States ..... *H. rhododendri*

specimen of *S. riccioidea* at K is in poor condition and was not examined for this study.
Specimen illustrated.— FRANCE. Barèges (65), on *Betula*, 28 Aug 1989, J.-F. Magni A8907.

Illustrations.— Brandt (1992, Fig. 2); Candoussau (1990 Fig. 1D, 2A-B); Dennis (1975, Fig. 8B; 1978, Pl. 31A); Ellis & Ellis (1985, Fig. 1132); Ellis & Everhart (1892, Pl. 11, Figs. 1–3); Laessøe (1989); Marson (1987, Fig. 14-22); Müller & von Arx (1962, Fig. 255, as *H. riccioidea*); Niemelä & Nordin (1985, Figs. 1-3); Nordin (1969, Figs. 1–2); Strid (1967, Figs. 1–5).

Notes.— Cauchon & Ouellette (1964) demonstrated that *Hypocreopsis lichenoides* is fungicolous on *Hymenochaete* spp. Cooke (1952) described a fungus that appears macroscopically identical to *H. lichenoides* as *Stromatocrea cerebriformis* W.B. Cooke, the presumed anamorph of *H. lichenoides*. Cooke's specimen of *S. cerebriformis* from the United States (Idaho) does not contain the teleomorph. Repeated attempts to germinate ascospores or conidia have failed (Candoussau, 1990; W. Gams, pers. comm.), although Candy & Webster (1988) were successful in obtaining cultures from stromatal explants. These cultures produced pigments similar to those of the stroma but failed to sporulate. Niemelä & Nordin (1985) presented a description and illustrations of *H. lichenoides*, and Brandt (1992) discussed the ecology of this species.

A second species of *Hypocreopsis*, *H. rhododendri* Thaxter, is macroscopically similar to *H. lichenoides* and also occurs on *Hymenochaete* spp. but can be differentiated by smaller, globose, warted ascospores (12–17 × 12–13.5 µm) as illustrated by Candoussau (1990) and Marson (1987). *Hypocreopsis rhododendri* was originally described from Tennessee and is reported from England (Dennis, 1975; Henderson & Watling, 1978), southern France (Candoussau, 1990), and the United States (Maryland *fide* Cauchon & Ouellette, 1964; North Carolina, Tennessee and West Virginia, Fayette Co., on *Kalmia latifolia*, alt. 670 m, 24 Aug 1893, L. W. Nuttall 567, BPI 631883). Candy & Webster (1988) and Candoussau (1990) provided good descriptions and illustrations of both *H. lichenoides* and *H. rhododendri*. An unidentified species of *Hypocreopsis* was reported from Australia (May & Eichler, 1993).

HYPOMYCES (Fr.) Tul., Ann. Sci. Nat. Bot., Sér. 4, 13: 11. 1860

(≡ *Hypocrea* subgenus *Hypomyces* Fr., Syst. Orb. Veg. p. 105. 1825).
Lectotype, designated by Seaver (1910a): *H. lactifluorum* (Schwein. : Fr.) Tul. (≡ *Sphaeria lactifluorum* Schwein. : Fr.). — Plate 4, j (page 25); Plate 18, a–d.

= *Bonordenia* Schulzer, Verh. K. Zool. Bot. Ges. Wien 16: 58. 1866. — Type: *B. aurantia* (Pers. : Fr.) Schulzer, recognized as *Hypomyces aurantius* (Pers. : Fr.) Tul. & C. Tul.
= *Peckiella* (Sacc.) Sacc., Syll. Fung. 9: 944. 1891 (≡ *Hypomyces* subgenus *Peckiella* Sacc., Syll. Fung. 2: 472. 1883). — Lectotype, designated by Seaver (1910a): *P. viridis* (Alb. & Schwein. : Fr.) Sacc. (≡ *Sphaeria viridis* Alb. & Schwein. : Fr. ≡ *Hypomyces viridis* (Alb. & Schwein. : Fr.) P. Karst.), a synonym of *Hypomyces luteovirens* (Fr. : Fr.) Tul., as discussed by Rogerson & Samuels (1994).
= *Clintoniella* (Sacc.) Rehm, Hedwigia 39: 223. 1900 ≡ *Hypocrea* subgenus *Clintoniella* Sacc., Syll. Fung. 2: 532. 1883. — Lectotype, designated by Clements & Shear (1931): *C. apiculata* (Cooke & Peck) Sacc. (≡ *Hypocrea apiculata* Cooke & Peck ≡ *Hypomyces apiculatus* (Cooke & Peck) Seaver), a synonym of *Hypomyces armeniacus* Tul., according to Rogerson & Samuels (1994).
= *Apiocrea* Syd. & P. Syd., Ann. Mycol. 18: 186. 1920 [1921]. — Type: *A. chrysosperma* (Tul. & C. Tul.) Syd. & P. Syd., recognized as *Hypomyces chrysospermus* Tul. & C. Tul.
= *Chiajaea* Höhn., Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, 129: 151. 1920. — Lectotype, designated by Clements & Shear (1931): *C. rhodomela* (Fr.) Höhn. (≡ *Sphaeria rhodomela* Fr.), a synonym of *Hypomyces roselllus* (Alb. & Schwein. : Fr.) Tul.

Subiculum of loosely intertwined or compacted hyphae, sometimes forming thin, separable sheets upon which ascomata are seated, or a firm stroma-like tissue within which ascomata are completely immersed, light- to bright-colored, reacting or not to KOH. Ascomata solitary to densely gregarious or caespitose, superficial on or immersed in the subiculum to a greater or lesser extent, pyriform, papillate, ascomatal wall smooth, thin, generally less than 25 µm, nearly hyaline or in shades of yellow, orange, tan or green, part or all of each ascoma becoming red or purple in KOH or not reacting to KOH. Asci cylindrical, apex thickened to a greater or lesser extent, with a pore, 8-spored. Ascospores ellipsoid, lanceolate with rounded ends, or fusiform with a blunt or acute apiculus at each end, apiculus obscure to conspicuous, non- or 1-septate with

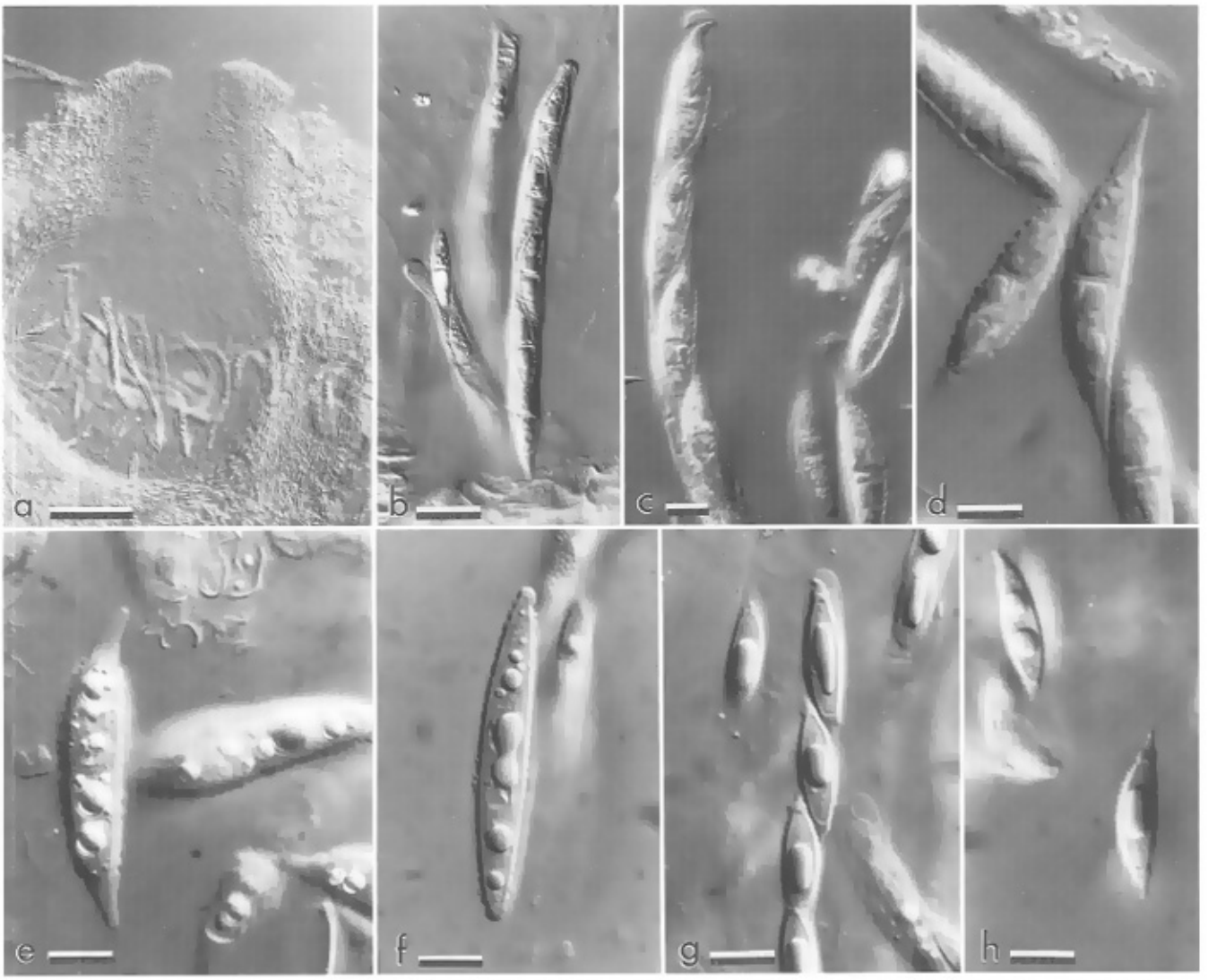

Plate 18. a–d. *Hypomyces lactifluorum*. a. Median section of ascoma. b. Asci with ascospores. c. Apical portion of ascus. d. Ascospores. **e.** *Hypomyces armeniacus*. Ascospores. **f.** *Hypomyces banningiae*. Ascospores. **g–h.** *Hypomyces lateritius*. g. Ascospores in median focus. h. Ascospores focussed on outer wall to show finely spinulose ornamentation. a. C.T. Rogerson, 31 July 1964 – NY. b–d. R.L. Shaffer, 25 July 1964 – NY. e. C.T. Rogerson 90-32 – NY. f. C.T. Rogerson 80-101 – NY. g–h. C.T. Rogerson 84-11 – NY. Scale bars: a = 100 µm; b = 25 µm; c–h = 10 µm.

a median or submedian septum, rarely 3-septate, hyaline, smooth, spinulose to tuberculate.

ANAMORPHS.— *Acremonium*-like, *Cladobotryum*, *Mycogone*, *Papulaspora*-like, *Stephanoma*, *Sepedonium*, or *Verticillium*-like.

HABITAT.— On other fungi, most commonly on mushrooms (*Agaricales*, *Boletales*), bracket fungi (*Poriales*), and discomycetes (*Helotiales*, *Pezizales*).

NOTES.— *Hypomyces* includes about 150 described taxa that typically have warted, apiculate ascospores. Ascomatal ontogeny has been described for a few species of *Hypomyces* and is typical of the *Hypocreales* (Hanlin, 1963b, 1964; Samuels, 1973c). Rogerson & Samuels (1985, 1989, 1993, 1994) described and illustrated the sexual and asexual forms of 48 species of *Hypomyces* contributing to a monographic account of the genus. Host preferences and correlated morphological characteristics of sexual and asexual forms suggest that within *Hypomyces* exist groups of species that may represent distinct genera or infrageneric taxa. Species that occur on boletes, agarics and discomycetes appear to occur only on these generalized hosts; however, there is a limited specificity to host species or group of host species. The agaricicolous species are most commonly found on species of the *Russulaceae*. Some species of *Hypomyces* transform the hymenium of the host completely into the ascomycete with the host gills visible only as shallow ridges. Often it is no longer possible to determine the specific host of boleticolous species of *Hypomyces*.

The species on *Aphyllophorales* show some host specificity in that their teleomorphs occur on specific families within the order, e.g. *H. chrysostomus* is found only on members of the *Ganodermataceae*, while *H. aurantius* occurs on members of the *Coriolaceae* and *Polyporaceae*. In species of *Hypomyces* that occur on polypores, the anamorphs have a wider host range, even known on agarics. The relationship between the host and parasite in the agaricicolous and polyporicolous species of *Hypomyces* appears to be highly developed because the host continues to produce some basidiospores even when the hymenium is covered by the parasite. The groups of *Hypomyces* that correlate with their hosts are further defined by their anamorphs. The type species of *Hypomyces*, *H. lactifluorum*, parasitizes *Russulaceae*. Unusual *Cladobotryum* anamorphs have been reported for *H. lateritius*, see Plate 4 k, and *H. lithuanicus* (Helfer, 1991), both of which are closely related to *H. lactifluorum*. Despite many attempts, ascospores have never been observed to germinate in this or any other species related to it, nor has *H. lactifluorum* been consistently associated with an anamorph.

Bonordenia is typified by *Sphaeria aurantia* Pers., recognized as a species of *Hypomyces* by Rogerson & Samuels (1993). *Bonordenia* could serve as the generic name for the species of *Hypomyces* with *Cladobotryum* anamorphs that occur on members of the *Aphyllophorales* as monographed by Rogerson & Samuels (1993).

Peckiella was originally described as a subgenus of *Hypomyces* for species that have non-septate ascospores. Nine species were included although none was designated type. When the name was raised to generic rank, four more species were added along with the previous nine species. Seaver (1910a) designated *P. viridis* as the lectotype. Based on the comments in Rogerson & Samuels (1994), *Sphaeria viridis* is considered a synonym of *H. luteovirens* and, thus, *Peckiella* is a synonym of *Hypomyces*. Rogerson & Samuels (1985, 1989, 1993, 1994) did not place significance on ascospore septation because in some species variability in these features occurs, occasionally even in a single perithecium (Rogerson & Samuels, 1989). All species previously placed in *Peckiella* are considered members of the genus *Hypomyces*.

Saccardo (1883) recognized *Hypocrea* subgenus *Clintoniella* for species of *Hypocrea* having fusiform ascospores that do not separate into part-ascospores. Rehm (1900) was the first to use the name *Clintoniella* at the generic level. The lectotype, *C. apiculata*, is a synonym of *Hypomyces armeniacus* Tul. according to Rogerson & Samuels (1994), see Plate 18, e.

Apiocrea was established as a segregate of *Hypomyces* for species with unequally, one-septate ascospores; however, as mentioned above, Rogerson & Samuels (1989, 1993, 1994) observed variability in ascospore septation, and thus do not place importance on ascospore septation. The type species of *Apiocrea* is recognized in *Hypomyces* as *H. chrysospermus* by Rogerson & Samuels (1989) who provided a detailed description, illustrations, and discussion. If recognized at the generic level as a segregate from *Hypomyces*, *Apiocrea* as the generic name could serve for those species of *Hypomyces* that occur on boletes and have a *Sepedonium* anamorph.

When von Höhnel (1920) recognized the name *Chiajaea* as a new genus, he included two species, *C. rhodomela* (Fr.) Höhn. and *C. hendersoniae* (Fuckel) Höhn. Von Höhnel did not include *Calonectria hippocastani* (Otth) Sacc. in *Chiajaea*, the only name included in *Calonectria* section *Chiajaea* Sacc. 1896, because he recognized that the type specimen of *Calonectria hippocastani* was a mixed collection as discussed by Nannfeldt (1975). The origin of the generic name *Chiajaea* therefore dates from von Höhnel (1920), rather than *Calonectria* section *Chiajaea* Sacc. as listed by Rogerson (1970). Von Höhnel (1920) did not designate a type for the genus *Chiajaea*, but later Clements & Shear (1931) designated *C. rhodomela* as lectotype. Holm (1957) examined type material of *Sphaeria rhodomela* from the Fries herbarium and concluded that *Chiajaea rhodomela* is a synonym of *Hypomyces rosellus*, thus the genus *Chiajaea* is a synonym of *Hypomyces*.

Genera similar to *Hypomyces* in their hosts and general aspect include *Arachnocrea*, *Protocrea* and *Sphaerostilbella*. *Hypomyces* is similar to *Arachnocrea* in having one-septate ascospores with acute ends but the ascospores of *Arachnocrea* disarticulate as in *Hypocrea*. *Hypomyces* resembles *Sphaerostilbella* in having one-septate, non-disarticulating ascospores and a fungicolous habit; however, the anamorph of *Sphaerostilbella* is *Gliocladium sensu stricto*. Using 28S DNA sequence analysis Rehner & Samuels (1994) demonstrated that *Sphaerostilbella* and *Hypomyces* are distinct monophyletic groups within the *Hypocreaceae*.

Specimens illustrated:

H. armeniacus: UNITED STATES. Connecticut: Tolland County, Hebron, Hemlocks Education Center, on rotten wood, 15 Sep 1990, C.T. Rogerson 90-32 (NY): Plate 18 e.

H. banningiae: UNITED STATES. North Carolina: Henderson County, Green Cove Camp, S of Tuxedo, on *Lactarius* sp., 20 Sep 1980, C.T. Rogerson 80-101 (NY): Plate 18 f.

H. lactifluorum: UNITED STATES. Michigan: Che-

boygan County, woods near Topinabee, on *Russula brevipes* Peck, 25 Jul 1964, R.L. Shaffer (NY): Plate 18, b–d. — Cheboygan County, University of Michigan Biological Station, pine woods, 31 Jul 1964, C.T. Rogerson (NY): Plate 5j (page 25), 18 a-d.
H. lateritius: UNITED STATES. New Jersey: Gloucester County, vic. Glassboro, on *Lactarius* sp., 17–18 Aug 1984, S. Stein, C.T. Rogerson 84-11 (NY): Plate 4 k (page 25), 18, g–h.

PODOSTROMA P. Karst., Hedwigia 31: 294. 1892.

Type: *P. leucopus* P. Karst., a synonym of *Podostroma alutaceum* (Pers. : Fr.) G.F. Atk.

= *Podocrea* Lindau, *in* Engler & Prantl, Natürl. Pflanzenfam. 1(1): 364. 1897. — Type: *P. alutacea* (Pers. : Fr.) Lindau (≡ *Sphaeria alutacea* Pers. : Fr.), recognized as *Podostroma alutaceum*.

Stroma well-developed, light-colored, fleshy, upright, stipitate. Ascomata immersed in the stroma. Asci cylindrical. Ascospores 1-septate, disarticulating early in the development into two globose, subglobose, ovoidal, oblong or wedge-shaped part-ascospores, hyaline or green, typically spinulose or warted, also smooth. Anamorph, where known, *Trichoderma*. On decaying woody substrata.

Notes.— Karsten (1892) described the genus *Podostroma* in the *Hypocreaceae* for fungi characterized by 'stroma stipitate, clavate, erect, entomogenous, fleshy, bright-colored. Ascomata immersed in the stroma. Asci cylindrical, 16-spored. Spores globose, hyaline. Paraphyses lacking.' Lindau (1897) recognized the genus *Podocrea* for *Hypocrea*-like species that have an upright, often branched stroma. He attributed the name to Saccardo (1883) who had previously established *Hypocrea* subgenus *Podocrea* with three species, namely *H. larvata* (Mont.) Sacc., *H. petersii* Berk. & M.A. Curtis, and *H. brevipes* (Mont.) Sacc.; however, Lindau did not include any of these three species in the genus. Thus the generic name is ascribed to Lindau (1897). Three species were included by Lindau in *Podocrea*, namely *P. alutacea*, *P. solmsii* (E. Fisch.) Lindau and *P. cornu-damae* (Pat.) Lindau. The type species of *Podocrea*, *P. alutacea*, was considered by Atkinson (1905) to be a synonym of the type species of *Podostroma*, *P. leucopus*; thus *Podocrea* is a synonym of *Podostroma*.

Partial accounts of the genus *Podostroma* have been provided by Boedijn (1934; 1938), Doi (1966, 1967b, 1973a, 1987), Imai (1932), and Seaver & Chardon (1926), all of whom noted the strong similarity of *Podostroma* to members of the genus *Hypocrea* in both teleomorph and anamorph characteristics. *Podostroma* is similar to *Hypocrea* differing only in the presence of a stalked stroma. In all other characters such as habitat, anamorph, stromal and centrum morphology, *Podostroma* and *Hypocrea* are indistinguishable. In several species of *Hypocrea* the stromata become raised, narrowed at the base, and could be considered stalked (Samuels & Lodge, 1996a). At present, *Podostroma* is retained with only the type species until a more detailed study has been completed of the stipitate species of *Hypocrea*-like fungi.

Podostroma alutaceum (Pers. : Fr.) G.F. Atk., Bot. Gaz. 40: 401. 1905. — Plate 4, l (see page 25); Plate 19, a, b; Plate 20, a.

≡ *Sphaeria alutacea* Pers. : Fr., Persoon, Observ. Mycol. 2: 66. 1797 : Fries, Syst. Mycol. 2: 325. 1822.
≡ *Podocrea alutacea* (Pers. : Fr.) Lindau, Engler & Prantl's Natürl. Pflanzenfam. 1(1): 364. 1897.
= *Podostroma leucopus* P. Karst., Hedwigia 31: 294. 1892.

Anamorph: *Trichoderma* sp.

Stroma pale yellow to yellow-buff, spathulate-flattened, divided into fertile and sterile parts: stipe or sterile part cylindrical, about 0.5–1.5 cm long × 1.5–2 mm diam, longitudinally wrinkled; fertile part broad, cylindrical, sometimes flattened, 0.5 × 1–1.5 mm × 15 mm tall; surface of fertile part unwrinkled, with low tuberculations formed by individual ascomatal apices, KOH–. Cells at stromatal surface ellipsoid to globose, 5–10 µm diam, with walls less than 0.5 µm thick, appearing moniliform. Stromal surface layer 30–50 µm thick, of uniformly small pseudoparenchyma, cells ellipsoid 5–7 µm diam, wall 0.5 µm thick. Ascomata completely immersed, visible as tuberculations beneath the stromal surface, ostiolar openings appearing as vis-

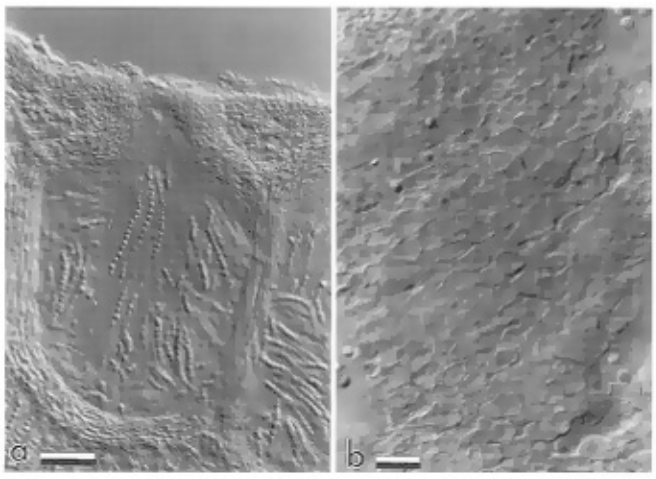

Plate 19. a, b. *Podostroma alutaceum*. a. Median section of stroma and immersed ascoma. b. Close-up of section of stroma. a, b. Holotype of *P. leucopus* – H. Scale bars: a = 50 µm; b = 10 µm.