HYPOCREACEAE De Not., *in* Sacc., Syll. Fung. 2: 447. 1883

Type: *Hypocrea* Fr.

The *Hypocreaceae* are defined here in a more restricted sense than by Rogerson (1970) who considered the *Hypocreaceae* to be the only family in the *Hypocreales* and thus was equivalent to the order. In this work the *Hypocreaceae* includes 12 genera, with most species placed in the two major genera, *Hypocrea*, having ascospores generally one-septate, non-apiculate, disarticulating, and ascomata generally immersed in a well-developed stroma; and *Hypomyces*, having ascospores generally one-septate, apiculate, not disarticulating, and ascomata immersed in a subiculum. Members of the *Hypocreaceae* generally have discrete or effuse stromata, ranging from less than 1 mm to 5 cm wide or more. The stromata are often light- to bright colored in shades of white, pale yellow, orange or red, rarely black. Stromata of some members appear as disks or clubs up to 6 cm tall, as in *Podostroma*. The genus *Hypocrea* includes about 350 described species. The ascospores are typically hyaline or green, one-septate, and disarticulate at the septum to yield sixteen, non-septate part-ascospores in each ascus instead of the usual eight, one-septate ascospores. The earliest workers considered only gross characteristics of stromal shape and color along with ascospore morphology (Seaver, 1909 a, b; 1910 a, b). Using stromal anatomy and asexual states in his study of species of *Hypocrea* in Japan, Doi (1972) accepted a number of genera segregated from *Hypocrea*, namely *Arachnocrea*, *Podostroma*, and *Protocrea*. He described *Pseudohypocrea* for species that have discrete stromata and fusiform ascospores. One cleistothecial genus, *Aphysiostroma*, is allied with the *Hypocrea* in the *Hypocreaceae* (Rehner & Samuels, 1994; Spatafora & Blackwell, 1993). The other major genus in the *Hypocreaceae* is *Hypomyces*. Species of *Hypomyces* typically have warted, apiculate ascospores and occur on mushrooms (*Agaricales*, *Boletales*), bracket fungi (*Aphyllophorales*), and less frequently on discomycetes (*Helotiales*, *Pezizales*).

Key to the genera of the *Hypocreaceae*

1. Ascospores conspicuously transversely striate, aseptate ..... **Rogersonia**
1. Ascospores smooth, spinulose, longitudinally striate, or ornamented but not transversely striate, one-septate, rarely aseptate or multiseptate 2

2. Ascospores not disarticulating within the ascus 3
2. Ascospores disarticulating while in the ascus 4

3. Ascospores typically fusiform, apiculate, often coarsely warted, less frequently smooth or spinulose; ascomata typically partly or wholly immersed in a densely cottony or highly compacted subiculum; anamorphs *Acremonium*-like (on *Ganodermataceae*), *Cladobotryum* (on *Aphyllophorales*, less frequently on agarics), *Sepedonium* (on boletes), or *Verticillium*-like (on brown-spored agarics); conidia wet or dry ..... **Hypomyces**
3. Ascospores ellipsoid to naviculate, non-apiculate, spinulose; ascomata superficial on a subiculum; anamorphs *Gliocladium*, mononematous, rarely synnematous, conidia wet; fungicolous on *Aphyllophorales* ..... **Sphaerostilbella**

4. Ascomata cleistothecial; stromata less than 1 mm diam, yellow to orange; ascospores one-septate; coprophilous; anamorph *Verticillium*-like ..... **Aphysiostroma**
4. Ascomata perithecial; stromata generally more than 1 mm diam, yellow, orange, brown, or dark olivaceous to nearly black; fungicolous or lignicolous; anamorphs *Acremonium*-, *Gliocladium*-, *Stilbella*-, *Trichoderma*- or *Verticillium*-like 5

5. Stroma a thin, arachnoid to loose, cottony subiculum; white or in shades of yellow; ascospores hyaline; often fungicolous on *Aphyllophorales*, also corticolous or lignicolous, rarely on herbaceous debris; anamorphs, where known, *Acremonium*- or *Verticillium*-like 6
5. Stromata discrete to effused, globose, discoidal to clavate, translucent or yellow to rufous or nearly black; ascospores hyaline or green; usually lignicolous or corticolous, rarely on

persistent *Aphyllophorales* or coprophilous; anamorphs, where known, *Acremonium*-, *Gliocladium*-, *Stilbella*-, *Trichoderma*- or *Verticillium*-like 7

6. Part-ascospores conical or apiculate, septum median, resulting in monomorphic part-ascospores ..... **Arachnocrea**
6. Part-ascospores irregularly globose, septum sub-median, resulting in dimorphic part-ascospores ..... **Protocrea**

7. Stromata prosenchymatous, up to 1.5 mm diam, discrete, pulvinate to discoidal; part-ascospores monomorphic, conical to apiculate, hyaline, smooth; anamorph *Acremonium*-like ..... **Pseudohypocrea**
7. Stromata pseudoparenchymatous, up to several centimeters diam, discrete, pulvinate to discoidal or erect and clavate; part-ascospores generally dimorphic, also monomorphic, globose, subglobose to wedge-shaped, hyaline or green, with broad tubercles or otherwise warted; anamorphs *Acremonium*-, *Gliocladium*-, *Stilbella*-, *Trichoderma*- or *Verticillium*-like 8

8. Stromata small, up to 1 mm diam, each with 3–20 ascomata, yellow-orange; ascospores one-septate, disarticulating, dimorphic, hyaline, spinulose; anamorph unknown ..... **Dialhypocrea**
8. Stromata more than 1 mm diam, pulvinate to discoidal or erect and clavate; ascospores non-septate or one-septate, rarely three-septate, usually disarticulating, monomorphic or dimorphic, hyaline to green, smooth to spinulose or coarsely ornamented; anamorphs present (at least in culture) 9

9. Stroma erect and clavate ..... **Podostroma**
9. Stroma pulvinate to discoidal 10

10. Ascospores one-septate, usually disarticulating, rarely three-septate, and not disarticulating ..... **Hypocrea**
10. Ascospores non-septate ..... **Sarawakus**

THE GENERA OF THE *HYPOCREACEAE*

APHYSIOSTROMA Barrasa, A.T. Martínez & G. Moreno, Canad. J. Bot. 63: 2439. 1985.

Type: *A. stercorarium* Barrasa, A.T. Martínez & G. Moreno.

Ascomata immersed in pulvinate, prosenchymatous stromata, yellow to orange or ochraceous, cleistothecial, subglobose to globose, concolorous with the stroma, KOH–, walls thin, smooth. Asci cylindrical, evanescent, 8-spored, ascospores uniseriate. Ascospores one-septate, separating into monomorphic, globose part-ascospores, coarsely ornamented at maturity. Anamorph *Verticillium*-like. On cow dung.

NOTES.— Barrasa *et al.* (1985) recognized the relationship of the cleistothecial *Aphysiostroma* to species of *Hypocrea* having *Verticillium*-like anamorphs. In their work on the relationships among pyrenomycetous fungi using 18S rDNA sequence data, Spatafora & Blackwell (1993) noted that *Aphysiostroma* grouped with *Hypocrea schweinitzii* in the *Hypocreaceae*.

Aphysiostroma stercorarium Barrasa, A.T. Martínez & G. Moreno, Canad. J. Bot. 63: 2439. 1985.
Anamorph: *Verticillium*-like.

Ascomata immersed in a pulvinate, prosenchymatous stroma, yellow to orange or ochraceous, reminiscent of some *Hypocrea* spp., cleistothecial, subglobose to globose, 140–250 µm diam, bright orange, KOH–; ascomatal wall of thin-walled cells, 9–20 µm diam. Asci cylindrical, 45–55 × 3–4 µm, with obtuse apex, evanescent, 8-spored, ascospores uniseriate. Ascospores equally one-septate, disarticulating into monomorphic, globose part-ascospores, each 3–4 µm diam, hyaline, coarsely ornamented at maturity. Description modified from Barrasa *et al.* (1985).

TYPE.— SPAIN: Puerto de Somosierra, on cow dung, from pure culture JB-GM 3719 = IJFM A-121 (MA–Fungi 8059, holotype). The ex-type culture, ATCC 62321 = CBS 148.85, was used in molecular studies reported by Spatafora & Blackwell (1993).