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# *Cheiromyces lignicola*, a new chirosporous anamorphic species from Hong Kong

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***Abstract:*** *Cheiromyces lignicola* sp. nov. is described and illustrated from a freshwater stream in Hong Kong. The species is characterized by chiroid, yellowish brown, distoseptate conidia that are composed of 3–5 arms, each terminating apically in an inflated cell. The developmental stages of the inflated apical cell are illustrated. *Cheiromyces lignicola* is compared with other *Cheiromyces* species, and other taxa that produce chiroid conidia with inflated apical cells. The taxonomic disposition of *C. cubensis* and *C. wrightii* in *Cheiromyces* is also discussed. Keys to species of *Cheiromyces* and to 26 anamorphic genera that produce chiroid conidia are provided.

***Key Words:*** aquatic fungi, chiroconidia, freshwater fungi, hyphomycetes, lignicolous fungi, systematics, taxonomy

## INTRODUCTION

In a continuing study of freshwater mycota in the tropics (Ho et al 1997, 1999a, b, c, Goh et al 1998b, Hyde et al 1999), an undescribed dematiaceous hyphomycete was found on wood baits of *Machilus velutina* Champ. and *Pinus massoniana* Lamb. and wood naturally submerged in a small stream in Hong Kong. This fungus produced chiroid conidia in sporodochia. Morphological characters indicate that it is an undescribed species of *Cheiromyces* Berk. & M. A. Curtis.

*Cheiromyces* was described by Berkeley (1875) with *C. stellatus* Berk. & M. A. Curtis as the only species. Two specimens were cited in the protologue, viz. No. 4883, on culms of *Scirpus eriophorus,* and No. 5087, on "a *Sphaeropsis.*" Berkeley described *C. stellatus* as having nonseptate conidia. However, based on an examination of specimen No. 5087, Martin (1944) and Damon (1950) established that the genus has septate conidia, and characterized it as such. Subsequently, Sutton (1985) designated specimen No. 4883 as lectotype, and restricted the genus to species having distoseptate conidia. Nine species producing euseptate conidia were excluded by Sutton (1985), leaving the genus monospecific.

Three additional species have been described: *C. cubensis* Matsush., from decaying leaf rachis of royal palm, *Roystonea regia* (Kunth) Cook, in Cuba, *C. recurvus* V. G. Rao & De Hoog from rotten wood in India and *C. wrightii* Aramb. et al on wood and bark from the Santiago River in Argentina. The conidia of *C. cubensis* and *C. wrightii* are apparently euseptate (Arambarri et al 1987, Matsushima 1987) and possibly these species should not be included in *Cheiromyces*. No *Cheiromyces* species has been linked to a teleomorph.

The lectotype specimen of *C. stellatus* is characterized by the presence of punctiform, sporodochial conidiomata that lack obvious conidiophores, discrete, monoblastic conidiogenous cells that do not proliferate; holoblastic, pale brown conidia that are composed of a truncate basal cell upon which 3–5 straight, vertical, appressed or slightly divergent, cylindrical, distoseptate arms are formed in different planes; and schizolytic secession (Sutton 1985). The conidia of *C. recurvus* possess 5–6 arms that are 10–14-distoseptate, with a marked ring of pigmentation around the septal pores (Rao and De Hoog 1986). In *C. cubensis,* conidia have 1–5 (mostly 4) arms that are 5–15-septate and constricted at the septa (Matsushima 1987), while in *C. wrightii,* conidia possess 3–5 arms that are 3–5-septate and constricted at the septa (Arambarri et al 1987).

## TAXONOMY

**Cheiromyces lignicola** W. H. Ho, K. D. Hyde et I. J. Hodgkiss, sp. nov. FIGS. 1–12

Conidiomata sporodochia, sparsa, punctiformia, pulvinata, atrobrunnea vel atra, 150–350 μm diam. Mycelium in substrato immersum, ex hyphis pallide brunneis, laevibus, tenuitunicatis, septatis, ramosis compositum. Conidiophora absens. Cellulae conidiogene monoblasticae, integratae, terminales, determinatae, hyalinae vel pallide brunneae, oblongae, 5–7.5 × 3.5–5 μm, laeve, tenuitunicatae, maturere insimul, non proliferatinibus. Conidia acrogenosa, holo-

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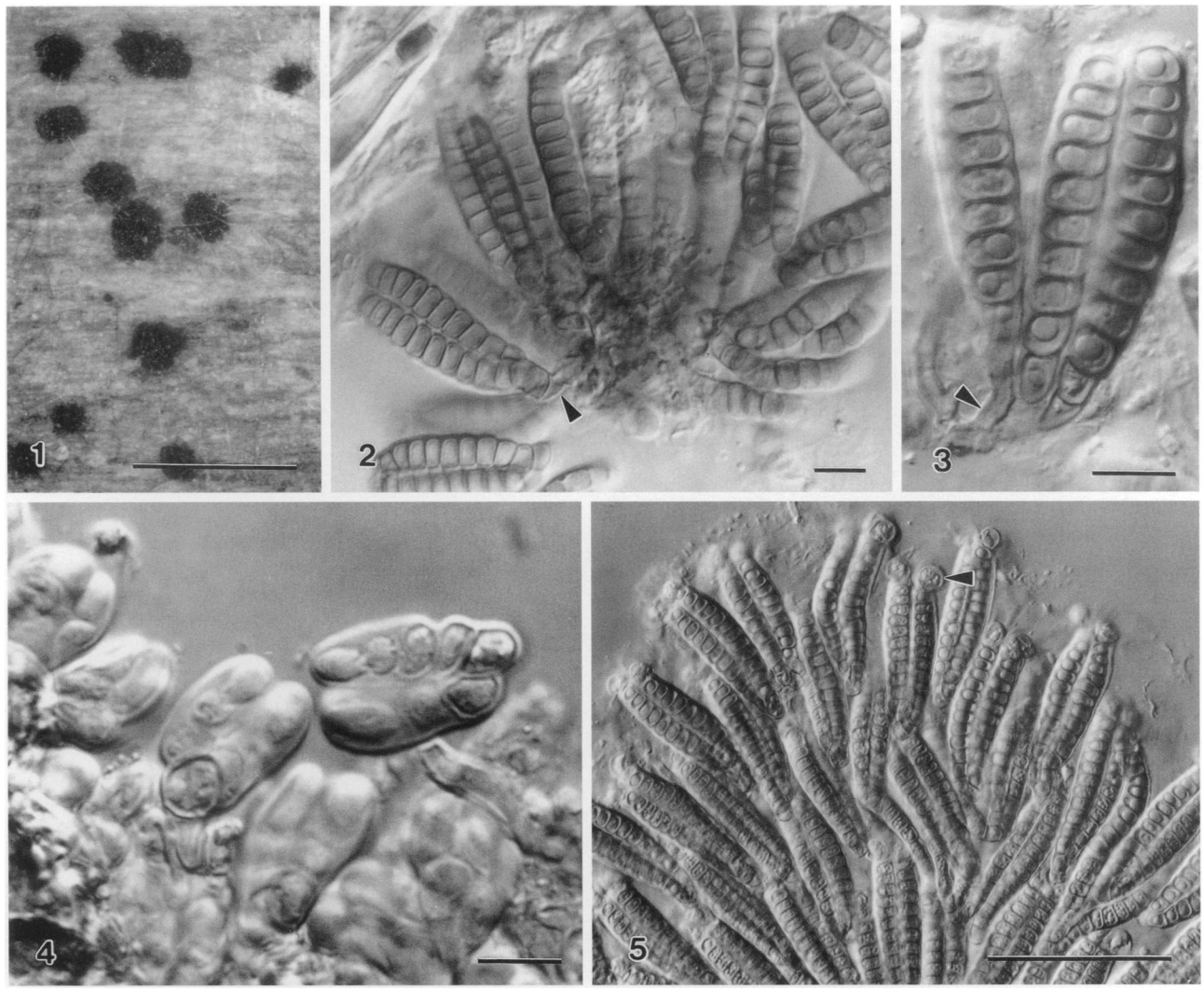
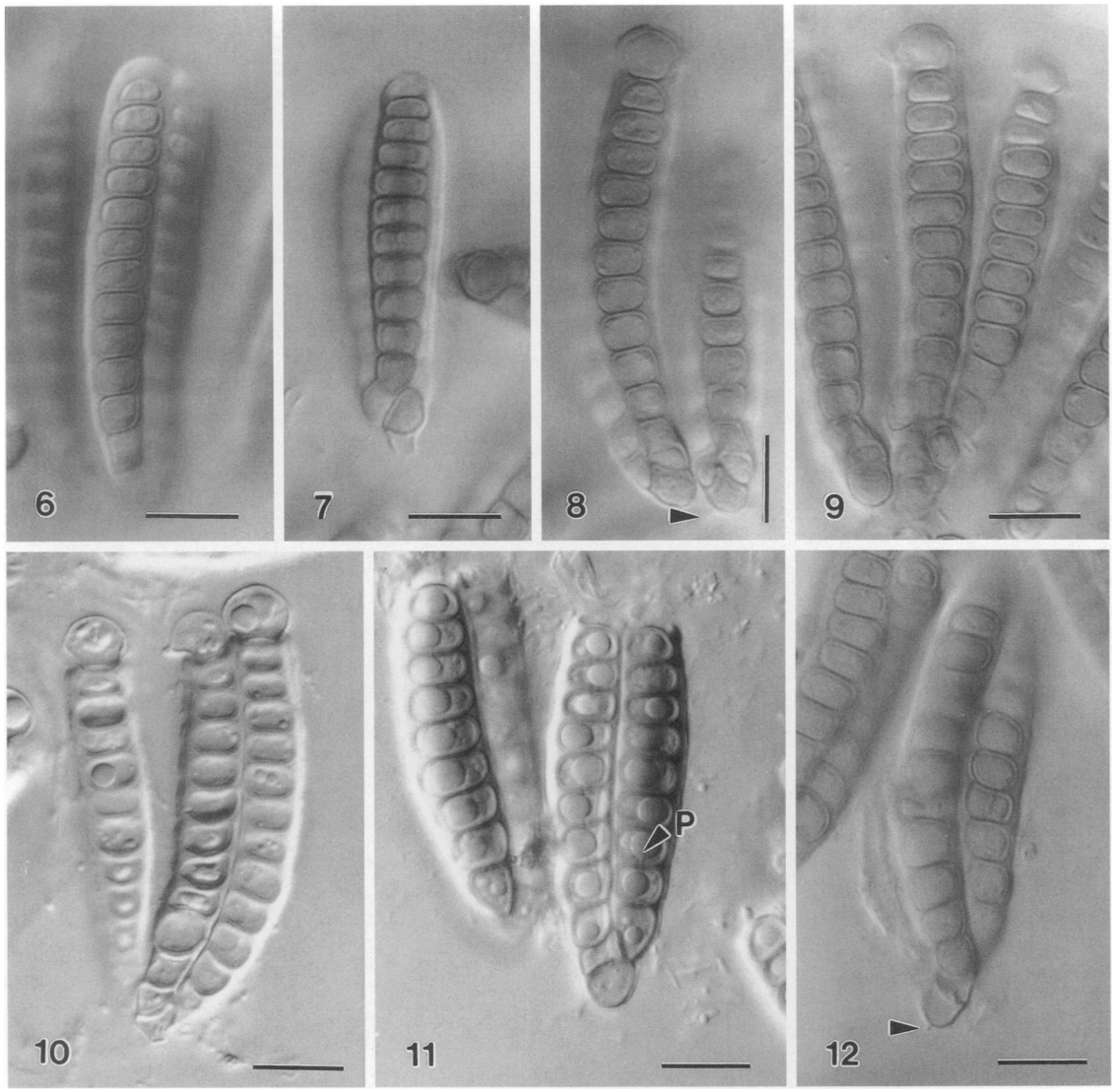



FIGS. 1–5. *Cheiromyces lignicola* (from HOLOTYPE). 1. Sporodochia on wood substratum. 2, 3. Conidia in sporodochia, illustrating the conidiogenous cells (arrowheads). 4. Immature hyaline conidia. 5. Mass of mature conidia. Note the inflated apical cells (arrowhead). 1. Stereo micrograph. 2–5. Interference light micrographs. 2. In lacto-phenol. 3–5. In water. Bars: 1 = 1 mm; 2–4 = 10 μm; 5 = 50 μm.

blastica, solitaria, hyaline cum immatura, pallide fulva ad maturita, chiroidea, 30–60 × 10–14 μm, distoseptata, cum 3–4(–5) rami praedita, verticalia; cellula basilaris pallide brunnea, truncata, 3–5.5 × 3.5–4.5 μm, laevia, tenuitunicata; rami discreti, non ramosi, dense appressi vel modice divergenti, cylindrici, 28–55 × 6–8 μm, 5–12-distoseptati, ad septa haud constricti, omne brachi cum celluli apicalis turgidi; *cellula apicalis turgidus* hyalina, globosa vel subglobosa, 5–7.5 μm diam, laevia, crassitunicata, tum tenuitunicata, postremo fastiscens. *Conidiorum secessio* rhexolytica.

Conidiomata sporodochial, scattered, punctiform, pulvinate, dark brown to black, 150–350 μm diam (FIG. 1). Mycelium immersed in the substratum, composed of pale brown, smooth, thin-walled, septate, branched hyphae. Conidiophores absent. Conidiogenous cells monoblastic, integrated, terminal, determinate, hyaline or pale brown, oblong, 5–7.5 × 3.5–5 μm, smooth, thin-walled, giving rise to a single crop of conidia that mature synchronously, not proliferating (FIGS. 2, 3). Conidia acrogenous, holoblastic, solitary, hyaline when immature, pale yellowish brown at maturity, chiroid, 30–60 × 10–14 μm ($\bar{x}$ = 47 × 11.8 μm, n = 30), distoseptate, with 3–4(–5) arms vertically inserted, in different planes, on basal cells (FIGS. 4–12); basal cells pale brown, truncate, 3–5.5 × 3.5–4.5 μm, smooth, thin-walled (FIGS. 4, 7, 11, 12); arms discrete, unbranched, closely appressed to each other or slightly divergent, cylindrical, 28–55 × 6–8 μm, 5–12-distoseptate, not constricted at the septa, each arm with an inflated apical cell (FIGS. 5–12); inflated apical cells hyaline, globose to subglobose, 5–7.5 μm diam, smooth, with wall that is initially thick (FIGS. 6–9), but thin at later stages (FIG. 10),




FIGS. 6–12. *Cheiromyces lignicola* (from HOLOTYPE). 6–10. Conidia with developmental sequence of apical cells. 11. Conidia with disintegrated apical cells. Note the septal pores (P). 12. Conidia with a frill of remnants of conidiogenous cells after secession. 6–12. Interference light micrographs. 6–9, 12. In lacto-phenol. 10, 11. In water. Bars = 10 μm.

and may eventually disintegrate (FIG. 11). Conidial secession rhexolytic (FIG. 12).

*Materials examined.* HONG KONG. Tai Po Kau Forest Stream, on submerged decaying wood, 29 Dec 1996, *W. H. Ho & S. Y. Ho* WH316 [HOLOTYPE HKU(M) 5937]; on submerged wood, 29 Mar 1997, *W. H. Ho* [HKU(M) 5982]; on *Machilus velutina* wood bait, 29 Mar 1997, *W. H. Ho* [HKU(M) 6039]; on *Pinus massoniana* wood bait, 28 Jun 1997, *W. H. Ho* [HKU(M) 6146].

*Etymology.* In reference to the woody substratum.

*Known distribution.* Hong Kong.

*Habitat.* Saprobic on decaying wood in streams.

*Teleomorph.* Unknown.

*Commentary. Cheiromyces lignicola* differs from the type species, *C. stellatus,* and from *C. recurvus,* both of which also produce distoseptate conidia. Conidia in *C. lignicola* are pale yellowish brown with 3–5 apically inflated conidial arms. Conidia in *C. stellatus* are brown with 3–5 conidial arms that have longer apical cells (Sutton 1985), while conidia in *C. recurvus* are pale brown with 5–6 apically recurved conidial arms (Rao and De Hoog 1986). In *C. recurvus,* marked rings of pigmentation, visible in lateral view as a dark brown disc, are present in all conidium delimiting and conidial septa (Rao and De Hoog 1986). Similar rings are not found in *C. stellatus* (Sutton 1985) or in *C. lignicola.* A pigmented ring surrounding septal pores has been recorded in euseptate conidia in other fungi, such as *Digitodesmium recurvum* W. H. Ho et al (Ho et al 1999a); in distoseptate conidia, as found in *Pyricularia peruamazonica* Matsush. (Mat-

sushima 1993); or in conidia with both distosepta and eusepta, as found in *Janetia curviapicis* Goh & K. D. Hyde (Goh and Hyde 1996). A pigmented septal ring is recognized as a generic character in *Canalisporium* Marvanová (Goh et al 1998a). *Bactrodesmium* Cooke (Ellis 1971) includes species with and without the pigmented ring.

*Cheiromyces lignicola* is distinguished by its conidial arms with inflated apical cells. Developmental stages of the apical cells are illustrated in FIGS. 6–10. It is evident that the apical cells are initially thick-walled; this development is followed by an increase in size, and subsequently the outer wall disintegrates leaving the thin inner wall. The apical cells disintegrate at maturity (FIG. 2, 3, 11). Conidia failed to germinate on water agar and potato dextrose agar at 24 C.

Several fungi with euseptate conidia produce conidia with inflated apical cells. *Cheiromyces inflatus* Matsush. produces such conidia (Matsushima 1983). Sutton (1985) considered this fungus better placed in *Cheiromycella* Höhn. because of its euseptate conidia. *Cheiromyces lignicola* can be compared to *Cheiromycella moniliphora* Matsush. (Matsushima 1981), *Dictyosporium alatum* Van Emden (1975), *D. bulbosum* Tzean & Chen (Tzean and Chen 1989) and *D. digitatum* Chen et al (1991), all of which produce chiroid conidia with inflated apical cells. All of these latter species produce euseptate conidia, however, clearly distinguishing them from *C. lignicola.*

Placement of *C. cubensis* and *C. wrightii* in *Cheiromyces* appears to be inappropriate. As mentioned earlier, the initial concept of *Cheiromyces* was confused because the syntypes had, respectively, euseptate and distoseptate conidia. Sutton (1985) restricted the genus to species that produce distoseptate conidia. The line drawings that accompany the descriptions of *C. cubensis* and *C. wrightii* suggest that these species are euseptate (Matsushima 1987, Arambarri et al 1987); if this is the case, they must be redisposed. Examination of the original material is necessary before such disposition can be made.

Conidial secession in *C. lignicola* is rhexolytic. Following secession, some conidia retain a basal frill that consists of wall remnants of the conidiogenous cell. Conidial secession in *C. stellatus* was described as schizolytic (Sutton 1985), while the illustrations of *C. recurvus* indicated no remnants of conidiogenous cell at the base of the detached conidia (Rao and DeHoog 1986). It is possible that conidia with a basal frill were overlooked, as was the case in *Canalisporium.* In *Canalisporium,* conidia were described as seceding schizolytically (Nawawi and Kuthubutheen 1989), but secession in the latter was shown to be rhexolytic (Goh et al 1998a).

### KEY TO SPECIES OF *CHEIROMYCES*

A key to species of *Cheiromyces,* including the doubtful species *C. cubensis* and *C. wrightii,* is based on literature.

1. Conidia with inflated apical cells ..... 2
1. Conidia without inflated apical cells ..... 3
   2. Conidia with 3–5 conidial arms; conidial arms 28–55 × 6–8 µm, unbranched, 5–12 septate, without constriction at the septa ..... *C. lignicola*
   2. Conidia with 1–5 conidial arms; conidial arms 20–60 × 3–5 µm, branched near the basal cells, 5–15 septate, with slight constriction at the septa ... ..... *C. cubensis*
3. Conidia with recurved apical cells ..... *C. recurvus*
3. Conidia without recurved apical cells ..... 4
   4. Conidial arms 23–30 × 4–6 µm, without constriction at the septa ..... *C. stellatus*
   4. Conidial arms 13–22 × 4–5 µm, with slight constriction at the septa ..... *C. wrightii*

### KEY TO CHIROSPOROUS GENERA

In addition to *Cheiromyces,* 26 genera of anamorphic fungi produce chiroid conidia. Of these, 2 produce distoseptate conidia and 24 produce euseptate conidia. A key to these genera, based on literature, is provided.

1. Conidia distoseptate ..... 2
1. Conidia euseptate ..... 3
   2. Conidial arms arising from single basal cells, conidia formed at one level, nonlichenized ..... *Cheiromyces*
   2. Conidial arms formed from a series of dichotomous branches, conidia formed at many levels, lichenized ..... ..... *Cheiromycina* B. Sutton (Sutton and Muhr 1986, Hawksworth and Poelt 1990)
3. Conidia recurved, forming arms pointing downwards ..... 4
3. Conidia not forming arms pointing downwards ..... 7
   4. Conidiomata sporodochial ..... *Cryptocoryneum* Fuckel (Ellis 1971)
   4. Conidiomata not sporodochial ..... 5
5. Conidiophores micronematous ..... *Digitosarcinella* S. Hughes (Hughes 1984)
5. Conidiophores macronematous ..... 6
   6. Conidiogenous cells enteroblastic, proliferating percurrently ..... *Eversia* J. L. Crane & Schokn. (Schoknecht and Crane, 1977, Holubová-Jechová 1987)
   6. Conidiogenous cells holoblastic, not proliferating ..... *Cryptocoryneopsis* B. Sutton (Sutton 1980a)

7. Conidial arms not appressed laterally ..... 8
7. Conidial arms appressed laterally at least at the lower portion ..... 20
8. Conidiomata sporodochial ..... 9
8. Conidiomata not sporodochial ..... 14
9. Conidiogenous cells proliferating ..... 10
9. Conidiogenous cells not proliferating ..... 12
10. Conidiogenous cells enteroblastic, proliferating percurrently .. *Ramoconidiifera* B. Sutton et al (Sutton et al. 1996)
10. Conidiogenous cells holoblastic, proliferating sympodially ..... 11
11. Conidiophores constricted strongly at the septa, composed mainly of swollen conidiogenous cells that are sometimes connected to one another by narrow isthmi ..... *Cheiromycella* Höhn (Sutton 1985)
11. Conidiophores cylindrical, cells not constricted at the septa .. *Dicranidion* Harkn. (Peek and Solheim 1958, Ando and Tubaki 1984)
12. Conidial arms seceding at the basal cell .. *Petrakiopsis* Subram. & K. R. C. Reddy (Subramanian and Reddy 1968)
12. Conidial arms remaining intact ..... 13
13. Conidial arms not branching ..... *Digitodesmium* P. M. Kirk (Kirk 1981b, Ho et al. 1999a)
13. Conidial arms branch, with all arms parallel with and connected to each other at intermediate length of the conidia ..... *Amallospora* Penz. (Penzig 1897, Carmichael et al 1980)
14. Conidiomata acervular ..... *Sirothecium* P. Karst. (Sutton 1980b, 1985)
14. Conidiomata not acervular ..... 15
15. Conidiogenous cells enteroblastic, with proliferation ..... 16
15. Conidiogenous cells holoblastic, not proliferating ..... 17
16. Conidiogenous cells proliferating percurrently .. *Ceratosporella* Höhn. (Kuthubutheen and Nawawi 1991, Castañeda-Ruiz et al. 1996)
16. Conidiogenous cells proliferating sympodially ..... *Dendryphion* Wallr. (Carmichael et al 1980)
17. Conidial arms branch from the basal cells in whorl-shape .... *Nidulispora* Nawawi & Kuthub. (Nawawi and Kuthubutheen 1990)
17. Conidial arms branch at different level ..... 18
18. Conidia branch dichotomously ..... *Cladoconidium* Bandoni & Tubaki (Bandoni and Tubaki 1985)
18. Conidia branched irregularly ..... 19
19. Conidiophores micronematous ..... *Taeniolina* M. B. Ellis (Ellis 1976, Kirk 1981a, Crane and Schoknecht 1981)
19. Conidiophores macronematous ..... *Goosiomyces* N. K. Rao & Manohar. (Rao and Manoharachary 1989)
20. Conidial arms appressed laterally from the base to the apex ..... 21
20. Conidial arms appressed laterally at the lower portion, with separating arms at the apex ..... 24
21. Conidiomata sporodochial, conidiogenous cells not proliferating ..... *Dictyosporium* Corda (Goh et al. 1999)
21. Conidiomata not sporodochial, conidiogenous cells proliferating ..... 22
22. Conidiogenous cells holoblastic, proliferating sympodially .... *Cheiromoniliophora* Tzean & J. L. Chen (Tzean and Chen 1990, Castañeda-Ruiz et al. 1997a, b)
22. Conidiogenous cells enteroblastic, proliferating percurrently ..... 23
23. Conidiophores macronematous, with oval basal cells on tubular conidiophores ... *Pseudodictyosporium* Matsush. (Matsushima 1971)
23. Conidiophores semi-macronematous, conidiogenous cells composed of spherical, verruculose, catenulate cells *Cheiropolyschema* Matsush. (Matsushima 1980, Bhat and Kendrick 1993)
24. Conidiogenous cells holoblastic, not proliferating .. *Tetraploa* Berk. & Broome (Ellis 1971, Arambarri et al. 1987, Rifai et al. 1988)
24. Conidiogenous cells enteroblastic, with or without proliferation ..... 25
25. Conidiogenous cells not proliferating ..... *Tretospeira* Piroz. (Ellis 1976)
25. Conidiogenous cells proliferating percurrently ..... 26
26. Conidial arms in different planes ..... *Hughesinia* J. C. Lindq. & Gamundí (Lindquist and Gamundí 1970)
26. Conidial arms in one plane .... *Piricaudiopsis* J. Mena & Mercado (Mena-Portales and Mercado-Sierra 1987, Bhat and Kendrick 1993)

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