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A revision of the genus *Dictyosporium*, with descriptions of three new species

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The genus *Dictyosporium* is reviewed, based on examination of type specimens as well as new collections from various localities. Three new species, *D. giganticum*, *D. nigroapice* and *D. tetraseriale*, are described. Twenty two species are accepted in the genus, and their conidial morphology is illustrated. The characters of the accepted species are tabulated and a taxonomic key is provided. Short comments are given to 16 *Dictyosporium* names which are considered unacceptable or doubtful.

Key words: freshwater fungi, Hyphomycetes, lignicolous fungi, mitosporic fungi, palm fungi, systematics, taxonomy.

Introduction

One of the earliest treatments of the hyphomycete genus *Dictyosporium* Corda (1836), with related taxonomic history, was published by Damon (1952), who suggested a generic synonymy which included *Speira* Corda and *Cattanea* Garov. He accepted seven species in *Dictyosporium* and his concept of the genus was reasonably homogeneous. An account of *Dictyosporium* was given by Ellis (1971) who briefly described and illustrated four species, including *D. elegans* Corda, the type species. There are presently 35 binomials in *Dictyosporium* (Petch, 1917; Batista, 1951; Damon, 1952; Hughes, 1958; Batista and Farr, 1960; Batista *et al.*, 1960; Jones, 1963; Subramanian, 1971; Matsushima, 1975, 1980, 1981; van Emden, 1975; Sharma, Munjal and Jandaik, 1982; Kirk and Spooner, 1984; Bhat and Sutton, 1985; Sutton, 1985; Rao and de Hoog, 1986; Tzean and Chen, 1989; Mehrotra, 1990; Chen, Hwang and Tzean, 1991). The most recent account of the genus was by Sutton (1985) who briefly discussed 27 species, along with other mitosporic genera having cheiroid or digitate conidia.

Dictyosporium species have been recorded worldwide from dead wood, decaying leaves, and palm material (e.g., Ellis, 1971; Matsushima 1975, 1993). As presently conceived the genus *Dictyosporium* is characterised by colonies which are usually in the form of compact sporodochia, or rarely effuse, with mostly immersed mycelium. Conidiophores are micronematous or absent, but conidiogenous cells, which arise directly from hyphae and cells constituting the conidiomata, are discrete, and doliiform or subspherical. Conidia are holoblastic, solitary, dematiaceous, multiseptate, cheiroid with multiple columns of cells, closely branched from the base, without the arms separating, in most species flattened in one plane, and they secede rhexolytically (Damon, 1952; Ellis, 1971; Sutton, 1985). A few *Dictyosporium* species have conidia provided with appendages which are generally thin-walled, hyaline, and may be clavate, cylindrical, filiform or globose in shape (van Emden, 1975; Bhat and Sutton, 1985; Tzean and Chen, 1989; Chen *et al.*, 1991). A recent key to mitosporic genera with cheiroid or digitate, dematiaceous conidia provided by Sutton, Carmarán and Romero (1996) included *Dictyosporium*. We believe that the generic concept of *Dictyosporium* is clear, and it is separated from similar genera in having smooth-walled, euseptate conidia that are produced from determinate conidiogenous cells (Sutton *et al.*, 1996). *Dictyosporium* species have been grown *in vitro* and they can sporulate in culture (von Arx, 1981; Matsushima, 1975 1980, 1981, 1993; Chen *et al.*, 1991; Tzean and Chen, 1989). The teleomorphic state of *Dictyosporium* is unknown.

During our investigation of microfungi on plant litter in the tropics (e.g., Hyde and Goh, 1997, 1998; Hyde, Goh and Steinke, 1998), we have collected several *Dictyosporium* species, three of which are undescribed. In this paper we carried out a bibliographic review of *Dictyosporium* species throughout the twentieth century. When available, type specimens were re-examined in order to check their identity and to facilitate identification of freshly collected material. We now accept 22 species in *Dictyosporium*, including the three new species. The characteristics of these accepted species are compared in Table 1, and a taxonomic key is given. The remaining 16 published species are considered to be doubtful, or have already been removed from *Dictyosporium* by previous workers.

Taxonomy

Accepted species of Dictyosporium

Key to accepted species of *Dictyosporium*

1. Conidia complanate 2
1. Conidia not complanate 14

Table 1. Synopsis of accepted species of *Dictyosporium*.

Species	Colonies	Conidia					Substrata
		Size (µm)	Shape	No. of arms	Apex of central arms	Appendages	
D. alatum	s	26-32 × 15-24	n	5	straight	+	palm (*Livistona*), soil under a palm (*Elaeis*)
D. australiense	s	36-43 × 11-12	y	3	straight	-	dead wood
D. brahmaswaroopii	s	18-24 × 13-19	n	4	straight	-	dead twigs
D. bulbosum	s	27-46 × 11-30	n	5(-6)	straight	+	dead stems, dead *Pandanus* leaves
D. campaniforme	e	22-40 × 20-30	p	12-16	straight	-	dead *Quercus* leaves, palm (*Daemenorops*)
D. cocophilum	s	53-76 × 19-22	y	7	straight	-	palm leaves (*Cocos*)
D. digitatum	s	46-88 × 26-46	n	6-8	straight	+	palm (*Archontophoenix*), submerged wood
D. elegans	e	40-80 × 24-36	n	5(-6)	swollen	-	palm (*Livistona*), submerged wood
D. foliicola	e	34-56 × 20-38	n	5-7	curved	-	dead *Ilex* leaves
D. gauntii	s	40-50 × 18-25	y	4-6	incurved	+	dead wood
D. giganticum	s	105-121 × 25-32	y	7	incurved	-	submerged wood
D. heptasporum	s	50-80 × 20-30	y	7	incurved	-	palm (*Archontophoenix*), submerged wood
D. micronesicum	s	20-30 × 10-12	y	3(-4)	straight	-	palm (*Cocos*), dead leaves
D. nigroapice	s	28-41 × 15-20	n	4	blackened	+	submerged wood
D. oblongum	e	30-50 × 12-30	y	(3-)4-6	straight	-	dead wood
D. polystichum	s	26-34 × 23-34	n	(5-)7-9	curved	-	dead *Senecio* stems
D. schizostachyfolium	s	15-17 × 11-12	n	4	straight	-	dead leaves
D. subramanianii	s	33-42 × 16-20	y	7	incurved	-	palm (*Trachycarpus*), dead wood
D. tetraseriale	s	24-40 × 14-20	n	4	swollen	+	palm (*Livistona*), submerged wood
D. toruloides	e	38-56 × 25-32	n	(5-)6-8	straight	-	dead wood and leaves, dead herbaceous stems
D. triseriale	s	26-32 × 16-18	n	3	straight	-	dead bamboo culms (*Phyllostachys*)
D. zeylanicum	s	26-40 × 13-25	n	5	straight	-	dead wood

s = sporodochial; - = absent; y = cylindrical; p = campaniform.
e = effuse; + = present; n = complanate;

2. Conidia curved, with 5-7 arms each curving in the same direction, lacking conidial appendages, 34-56 × 20-38 µm; colonies effuse, occurring on dead leaves ..... *D. foliicola*
2. Conidia not curved or combination of characters not as above 3

3. Conidia 46-88 × 26-46, comprising mostly 6-8 rows of cells, bearing hyaline, curled appendages at the apex; occurring on fallen/submerged wood ..... *D. digitatum*
3. Conidia smaller, comprising mostly less than 6 rows of cells, or combination of characters not as above 4

4. Conidia bearing appendages at the apex 5
4. Conidia lacking appendages 8

5. Conidial appendages globose or obovoid ..... *D. bulbosum*
5. Conidial appendages cylindrical or clavate 6

6. Conidia regularly comprising 4 rows of cells, central rows of which are darker than the outer rows 7
6. Conidia mostly comprising 5 rows of cells, all of even colouration, apical cells of the outer rows each bearing a broadly clavate appendage containing crystalline material ..... *D. alatum*

7. Conidia with apical cells of the inner rows distinctly blackened to opaque, apical cells of the outer rows each bearing a cylindrical appendage; occurring on submerged wood ..... *D. nigroapice*
7. Conidia with apical cells of the inner rows not distinctly blackened, conidial appendages clavate; occurring on dead frond of *Livistona* palm ..... *D. tetraseriale*

8. Conidia borne in sporodochia or sporodochioid clumps 9
8. Conidia borne on effuse conidiophores, not in sporodochial form 13

9. Conidia less than 25 µm long 10
9. Conidia at least 26 µm long 11

10. Conidia 18-24 × 13-19 µm ..... *D. brahmaswaroopii*
10. Conidia 15-17 × 11-12 µm ..... *D. schizostachyfolium*

11. Conidia 16-18 µm wide, regularly comprising 3 rows of cells.. *D. triseriale*
11. Conidia wider (up to 25 µm or more), comprising 5-9 rows of cells 12

12. Conidia 23-34 µm wide, comprising mostly 7-9 rows of cells, all more or less the same length and colouration, distinctly constricted at the septa ..... *D. polystichum*
12. Conidia 13-25 µm wide, comprising mostly 5 rows of cells, central rows longer and distinctly darker than outer rows, not distinctly constricted at the septa..... *D. zeylanicum*

13. Conidia 38-56 × 25-32 µm, distinctly constricted at septa, comprising mostly 6-8 rows of cells, apical cells of the rows not swollen.. *D. toruloides*
13. Conidia 40-80 × 24-36 µm, slightly constricted at septa, comprising mostly 5 rows of cells, apical cells of the central rows usually swollen..... *D. elegans*

14. Conidia campaniform, with a darker base, comprising 12-16 rows of cells, 22-40 × 20-30 µm; colonies effuse ..... *D. campaniforme*
14. Conidia more or less cylindrical, even in colouration, comprising 3-7 rows of cells 15

15. Conidia 10-12 µm wide, regularly comprising 3 rows of cells..... 16
15. Conidia 18-32 µm wide, comprising mostly 4-7 rows of cells..... 17

16. Conidia 36-43 µm long; sporodochia usually covered in a gelatinous matrix ..... *D. australiense*
16. Conidia 20-30 µm long; sporodochia not as above ..... *D. micronesicum*

17. Conidia 40-50 × 18-25, comprising 4-6 rows of cells and appearing muriform, always seceding with the hyaline, subglobose conidiogenous cell at the base as an appendage..... *D. gauntii*
17. Conidia morphology not as above 18

18. Conidia with rows of cells which are distincly incurved or hook-like at the apex 19
18. Conidia with more or less straight rows of cells or apex not as above 21

19. Conidia 105-121 × 25-32 µm..... *D. giganticum*
19. Conidia smaller, up to 80 µm long 20

20. Conidia 50-80 × 20-30 µm..... *D. heptasporum*
20. Conidia 33-42 × 16-20 µm..... *D. subramanianii*

21. Colonies effuse, not sporodochial; conidia irregularly cylindrical or oblong, strongly constricted at the septa, 30-50 × 12-30 µm.... *D. oblongum*
21. Colonies in sporodochioid form; conidia more or less cylindrical, slightly constricted at the septa, 53-76 × 19-22 µm..... *D. cocophilum*

1. ***Dictyosporium alatum*** van Emden, Acta Botanica Neerlandica 24: 193 (1975). (Figs. 1-5, 88 A)

Colonies on natural substratum in the form of sporodochia, greenish to black. *Conidia* (22-)26-35 × 15-24 µm, uniformly pale brown, borne mainly on short conidiogenous cells in sporodochia but also along creeping hyphae, complanate, cheiroid in ventral view, cylindrical in lateral view, consisting of 26-32(-37) cells arranged mostly in 5 rows. The apical cells of the outer rows are provided with an appendage which is hyaline, thin-walled, allantoid to clavate, measuring 20-25 × 5 µm, and contains crystalline material.

Materials examined: SURINAM, Brokobaka, isolated from soil under *Elaeis guineensis* (Arecaceae), 6 Nov. 1974, J.H. van Emden Bbb 488 (CBS 578.73, holotype); HONG KONG, The University of Hong Kong campus, on decaying leaves of *Livistona chinensis* (Arecaceae), 14 Apr. 1998, S.R. Whitton (HKU(M) 10424).

Known distribution: Hong Kong, Surinam.

This species may be compared with *D. bulbosum* which also has conidia bearing appendages. These two species differ in the size of their conidia and shape of their appendages.

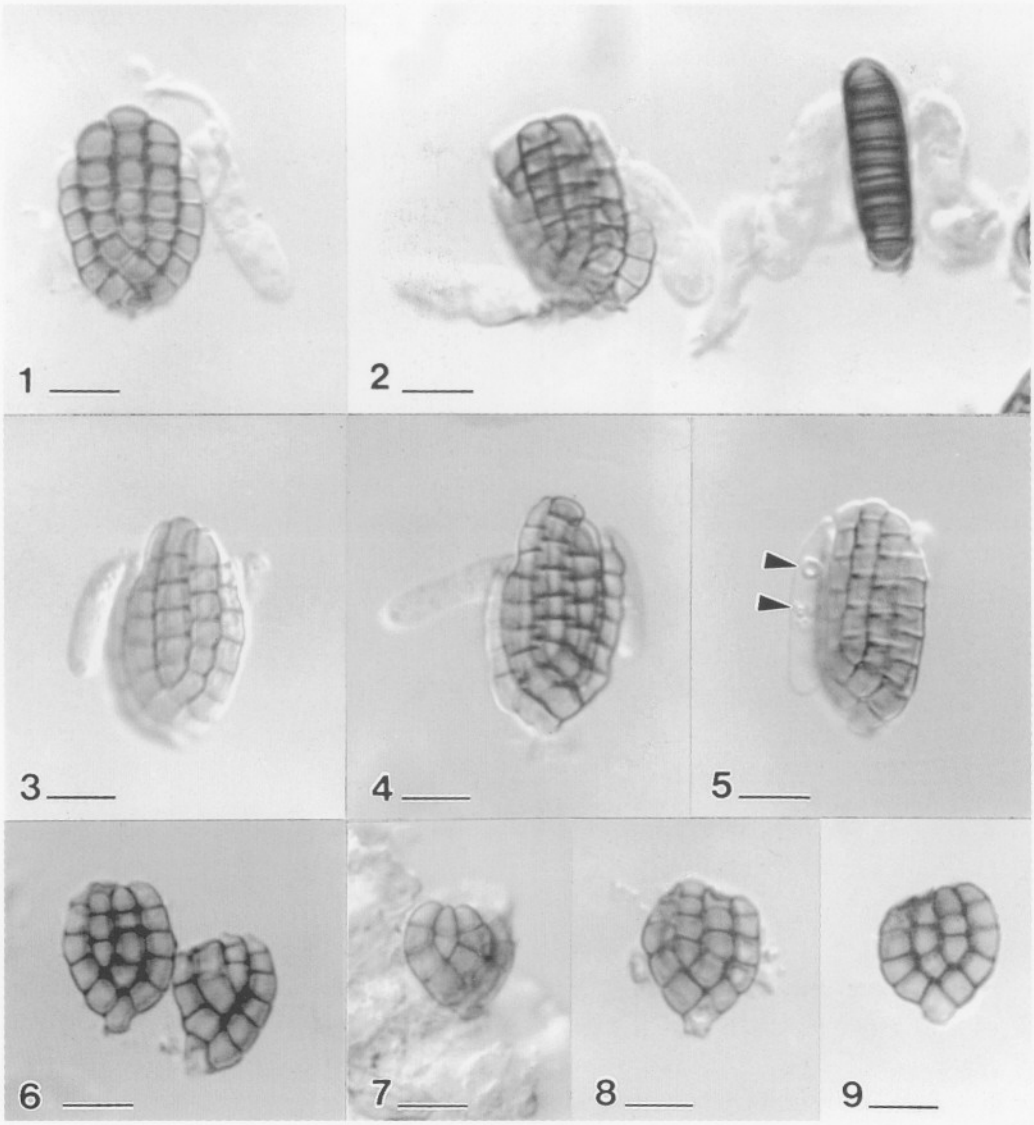
2. ***Dictyosporium australiense*** B. Sutton, Proceedings of the Indian Academy of Science (Plant Science) 94: 237 (1985). (Figs. 10-13, 88 B)

Colonies on natural substratum in the form of sporodochia, usually covered with a mass of mucilage. *Conidiophores* short, bearing doliiform to cylindrical conidiogenous cells. *Conidia* 36-43 × 11-12 µm, uniformly pale brown, closely appressed, consisting of a truncate basal cell on which 3 vertical, straight or slightly curved arms are inserted in a triangular plane (Fig. 13). The three arms are euseptate, markly constricted at the septa, and more or less of similar length.

Material examined: AUSTRALIA, Queensland, Mt. Glorious State Forest, on wood of *Eucalyptus* sp. (Myrtaceae), 27 Aug. 1981, B.C. Sutton and J.L. Alcorn (IMI 263318a, holotype).

Known distribution: Australia.

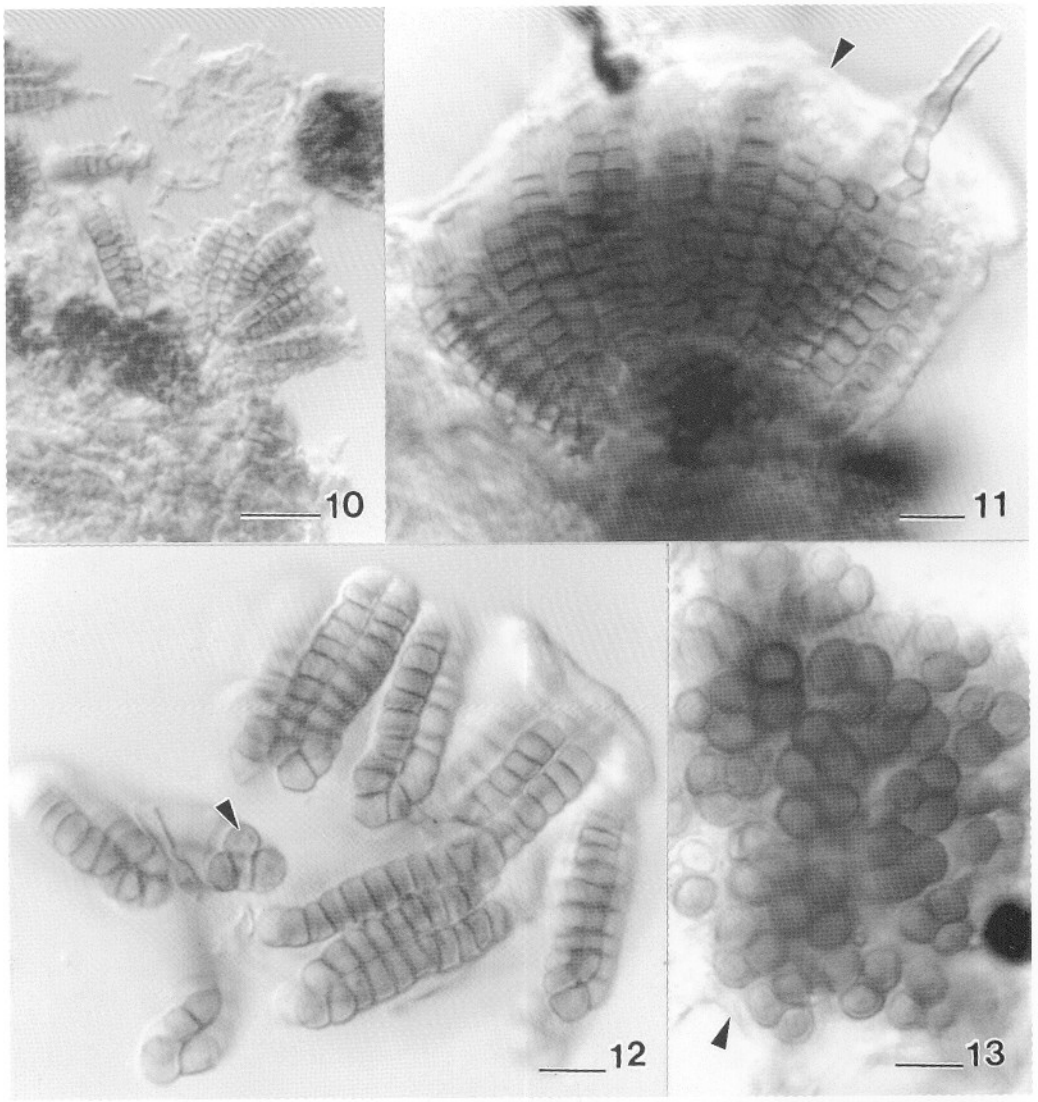
This species is distinct as the whole sporodochium of conidia is embedded in a gelatinous matrix, and the conidia consistently have three arms.



Figs. 1-5. Conidia of *Dictyosporium alatum*, with clavate conidial appendages at the apex. **1, 2.** from holotype (CBS 578.73). **3-5.** from Hong Kong collection (HKU(M) 10424). Note crystalline material (arrowed in 5) in the conidial appendage. **Figs. 6-9.** Conidia of *Dictyosporium brahmaswaroopii*, from holotype (IMI 297161). Bars = 10 µm.

3. ***Dictyosporium brahmaswaroopii*** M.D. Mehrotra, Mycological Research 94: 1149 (1990). (Figs. 6-9, 88 C)

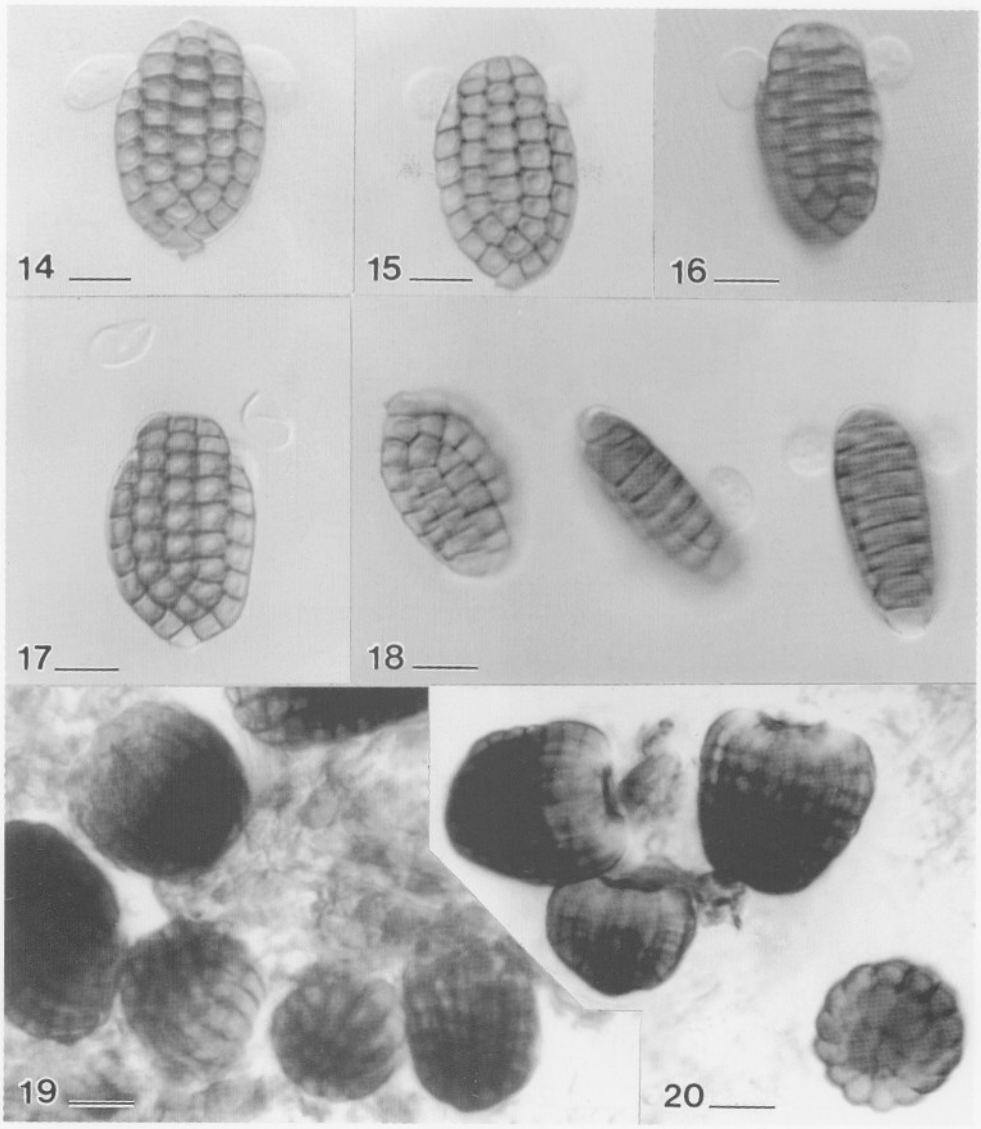
Colonies on natural substratum in the form of sporodochia. *Conidia* 17.5-24 × 12.5-19 µm, uniformly pale brown, complanate, cheiroid, consisting of 15-19



Figs. 10-13. *Dictyosporium australiense*, from holotype (IMI 263318a). **10.** Squash mount of a sporodochium. **11.** Section through a sporodochium, at higher magnification. Note the gelatinous matrix (arrowed) covering the conidia. **12.** Conidia, one showing a transverse sectional view (arrowed). **13.** Transverse section of conidia showing the three arms closely appressed together as a cylinder. Note gelatinous matrix (arrowed) surrounding the conidia. Bars: 10 = 20 µm, 11-13 = 10 µm.

cells arranged mostly in 4 rows on a basal cell. The outer 2 rows are longer and usually curved inwards. Conidial appendages absent.

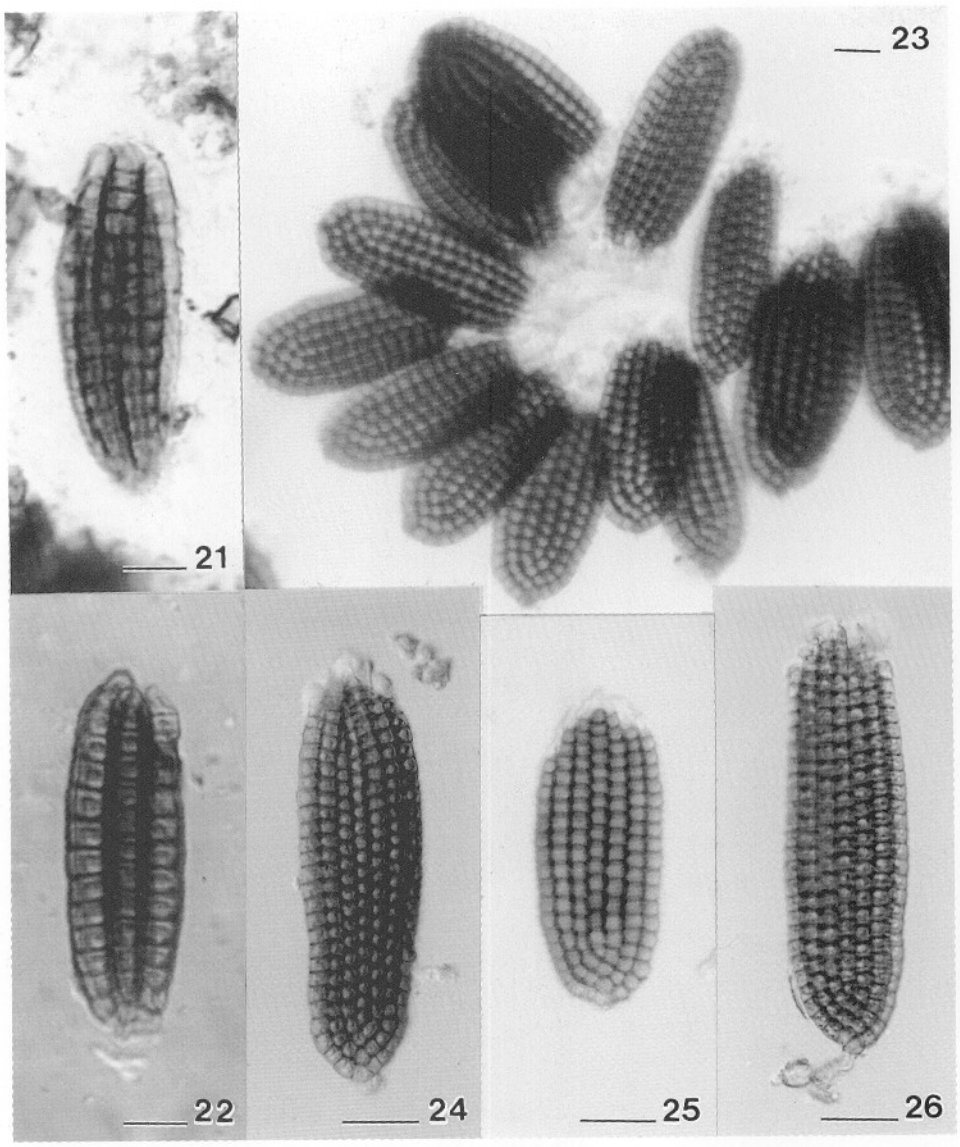
Materials examined: INDIA, Assam, Burnihat, on dead twigs of *Leucaena leucocephala* (Mimosaceae), Apr. 1985, M.D. Mehrotra (IMI 297161, holotype); HONG KONG, New



Figs. 14-18. Conidia of *Dictyosporium bulbosum*, with bulbose conidial appendages at the apex; from Hong Kong collection (HKU(M) 7435). Note detached conidial appendages in 17. **Figs. 19, 20.** Conidia of *Dictyosporium campaniforme*; from Brunei Darussalam collection (HKU(M) 6582). Bars = 10 µm.

Territories, Tai Po, Lam Tsuen River, on submerged wood, Apr. 1997, K.M. Tsui KM156 (HKU(M) 5371).

Known distribution: Hong Kong, India.



Figs. 21, 22. Conidia of *Dictyosporium cocophilum*, from holotype (IMI 44792). **Figs. 23-26.** Conidia of *Dictyosporium digitatum*, 23 and 25 from Thailand collection (SS0283), 24 and 26 from Hong Kong collection (HKU(M) 4857). Bars: 21, 22 = 10 µm, 23-26 = 20 µm.

Dictyosporium schizostachyfolium also has complanate, cheiroid conidia with 4 rows of cells (Fig. 88 Q), but they are smaller (15-17 × 11-12 µm) than those of *D. brahmaswaroopii*.

4. ***Dictyosporium bulbosum*** Tzean and J.L Chen, Mycological Research 92: 500 (1989). (Figs. 14-18, 88 D)

Colonies on natural substratum in the form of sporodochia. *Conidia* 27-46 × (11-)24-30 µm, uniformly pale brown, complanate, cheiroid in ventral view, cylindrical in lateral view, consisting of 30-48 cells arranged mostly in 5 rows. The apical cells of the outer rows are provided with an appendage which is hyaline, thin-walled, spherical to obovoid, measuring 11-28 × 10-19 µm, and containing crystalline material.

Materials examined: TAIWAN, Taipei, Wulai, on fallen decayed stem, 4 Mar. 1987, S.S. Tzean and J.L. Chen (PPH2E 798, isotype); HONG KONG, The University of Hong Kong campus, on decaying leaves of *Pandanus* sp. (Pandanaceae), 1 Mar. 1998, S.R. Whitton (HKU(M) 7435).

Known distribution: Hong Kong, Spain (Castañeda-Ruíz *et al.*, 1997b), Taiwan.

This species is comparable to *D. alatum* in having conidial appendages, but these appendages differ in shape. The conidia of *D. bulbosum* are also larger than those of *D. alatum*.

5. ***Dictyosporium campaniforme*** Matsush., Icones Microfungorum a Matsushima Lectorum p. 59 (1975). (Figs. 19, 20, 88 E)

Colonies on natural substratum dispersed, not in the form of compact sporodochia. *Conidia* 22.5-40 × 20-30 µm, medium brown to dark brown, darker at the base and paler at the apex, campaniform, not complanate, circular in cross section, consisting of 12-16 or more rows of cells arranged in a cylinder, slightly constricted at the septa. Conidial appendages absent.

Materials examined: JAPAN, Izu-Oshima, Tokyo, culture originally isolated from decaying leaves of *Quercus myrsinifolia* (Fagaceae), Apr. 1968, T. Matsushima (Matsushima Fungal Collection, ex-type culture of #2340); BRUNEI DARUSSALAM, Temburong, Batu Apoi Forest Reserve, Sungai Belalong, Kuala Belalong Field Studies Centre, on decaying petiole of *Daemenorops* sp. (Arecaceae), 30 Aug. 1997, K.D. Hyde and T.K. Goh (HKU(M) 10425).

Known distribution: Brunei Darussalam, Japan.

This species is distinct in having the unique campaniform conidia. We have obtained an ex-type culture of this species (Matsushima Fungal Collection #2340) but it did not sporulate.

6. ***Dictyosporium cocophilum*** Bat., Boletim Da Secretaria de Agricultura, Indústria e Comércio 18: 5 (1951). (Figs. 21, 22, 88 F)

Colonies on natural substratum in the form of sporodochia. *Conidia* 53-76 × 19-22 µm, medium brown to dark brown, cylindrical, not complanate, consisting mostly of 7 rows of cells arranged in a compact cylinder. Conidial appendages absent.

Material examined: BRAZIL, Leg. Agro. Sebastião da Paixã, Alagoinha, Paraiba, on leaves of *Cocos nucifera* (Arecaceae), 28 Aug. 1950, A.C. Bastita (IMI 44792, paratype).

Known distribution: Brazil.

This species was orginally reported from living petiole of coconut and in association with lesions. The conidia of this species somewhat resemble those of *D. heptosporum*, but the tips of the arms remain straight, i.e. not curved inwards as seen in the conidia of the latter species.

7. ***Dictyosporium digitatum*** J.L. Chen, C.H. Hwang and S.S. Tzean, Mycological Research 95: 1146 (1991). (Figs. 23-26, 88 G)

Colonies on natural substratum in the form of sporodochia. *Conidia* 46.5-74(-88) × 26-46 µm, uniformly pale to medium reddish brown, complanate, cheiroid, maize-like, consisting of 6-8 parallel, tightly appressed arms which are flattened in one plane, terminal cells of each arm are provided with a hyaline, thin-walled, straight or curled appendage.

Materials examined: AUSTRALIA, Pine Creek, northen Queensland, on dead petiole of *Archontophoenix alexandrae* (Arecaceae), 17 Apr. 1995, J.E. Taylor and K.D. Hyde JP2217 (HKU(M) 3759); *ibid.,* Atherton Tablelands, Lake Barrine, on submerged wood, Apr. 1996, K.D. Hyde and C.A. Pearce LB11 (HKU(M) 3204); *ibid.*, (HKU(M) 3236); BRUNEI DARUSSALAM, Temburong, Batu Apoi Forest Reserve, Sungai Belalong, Kuala Belalong Field Studies Centre, on submerged wood, 29 Aug. 1997, K.D. Hyde BRU48 (HKU(M) 6593); HONG KONG, Tai Po Kau Forest Stream, on submerged wood, 21 Sep. 1996, W.H. Ho and K.M. Tsui (HKU(M) 4835); *ibid.*, 29 Dec. 1996, W.H. Ho (HKU(M) 5912, 5913, 5937); *ibid.*, 27 Dec. 1997, W.H. Ho (HKU(M) 8694, 8716); *ibid.*, on submerged wood baits of *Machilus velutina* (Lauraceae), 21 Sep. 1996, W.H. Ho and K.M. Tsui (HKU(M) 4851, 4854, 4855, 4856, 4857, 4859, 4861, 4862, 4865, 4868); *ibid.*, 29 Mar. 1997, W.H. Ho (HKU(M) 6032, 6033, 6037, 6038, 6039, 6040, 6041, 6042, 6043, 6044, 6049, 6050); *ibid.*, 28 June 1997 (HKU(M) 6135, 6136, 6137); *ibid.*, on submerged wood baits of *Pinus massoniana* (Pinaceae), 21 Sep. 1996, W.H. Ho and K.M. Tsui (HKU(M) 4881); *ibid.*, 29 Dec. 1996, W.H. Ho and S.Y. Ho (HKU(M) 5965, 5971); *ibid.*, 29 Mar. 1997, W.H. Ho (HKU(M) 6051); *ibid.*, 28 June 1997 (HKU(M) 6141, 6153, 6154, 6155, 6157, 6158, 6159); *ibid.*, 28 Sep. 1997 (HKU(M) 8673, 8676, 8677, 8679, 8680, 8681, 8682, 8687); *ibid.*, 27 Dec. 1997 (HKU(M) 8766, 8768, 8772, 8774, 8777, 8778, 8779, 8780); New Territories, Tai Po, Lam Tsuen River, on submerged wood, Apr. 1997, K.M. Tsui KM178 (HKU(M) 5424); Plover Cove Reservoir, on submerged wood, 15 Nov. 1996, K.D. Hyde (HKU(M) 4729); *ibid.*, 18 Nov. 1996, K.D. Hyde and M. Wong (HKU(M) 4734, 4739, 4748); *ibid.*, 15 Feb. 1997, V.R. Mala (HKU(M) 5241); THE SEYCHELLES, Mahé, L'Eniol, Riviére Sainte Marie Louise, on submerged wood, 15 Aug. 1996, K.D. Hyde $20 (HKU(M) 3294); THAILAND, Nakorn Ratchasima Province, Khao Yai National Park, Tad Ta Phu, on submerged test block of *Anisoptera oblonga* (Annonaceae), 14 Mar. 1997, Somsak Sivichai (SS0257); *ibid.*, 25 Mar. 1997 (SS0283).

Known distribution: Australia, Brunei Darussalam, Hong Kong, Taiwan, The Seychelles, Thailand.

This is a species commonly found on submerged wood. It is distinct in having relatively large conidia with 6-8 parallel arms, the terminal cells of

which each bear a hyaline appendage. Cultures of this species are deposited at HKUCC (Nos. 1354, 1355, 1368, 1369, 1370, 1371, 1825, 1826, 1973, 1974).

8. ***Dictyosporium elegans*** Corda, Weitenweber's Beiträge zur gesammten Natur-und Heilwissenschaften 1: 87 (1836). (Figs. 27-31, 88 H)

Colonies on natural substratum effuse, not in the form of sporodochia. *Conidia* (44-)50-80 × 24-31(-36) µm, uniformly golden or reddish brown, complanate, cheiroid, consisting of 51-96 cells arranged mostly in 5 rows. The outer rows are usually shorter. The terminal cells of the the 3 inner rows are usually larger than other cells in the conidium. Conidial appendages absent.

Materials examined: On wood, ex Herb. Corda Nat. Mus. Prague, 515136 (DAOM 49939); HONG KONG, The University of Hong Kong campus, Lung Fu Shan, on dead fronds of *Livistona chinensis* (Arecaceae), 10 June 1997, Yanna (HKU(M) 5329, 5333, 5334, 5336, 5337, 5338, 5339, 5340, 5341, 5344); *ibid.*, Tai Po Kau Forest Stream, on submerged wood baits of *Machilus velutina* (Lauraceae), 23 June 1997, W.H. Ho (HKU(M) 4559; there are 71 additional records on submerged wood, *Machilus velutina* wood baits and *Pinus massoniana* wood baits from the same site); THAILAND, Nakorn Ratchasima Province, Khao Yai National Park, Tad Ta Phu, on submerged test block of *Anisoptera oblonga* (Annonaceae), 11 June 1997, Somsak Sivichai (SS0348).

Known distribution: Africa (Crous, 1993), Argentina (Arambarri, Cabello and Mengascini, 1987), Australia (Matsushima, 1989), Cuba (Mercado-Sierra and Mena-Portales, 1986), Hungary (Révay, 1985), Hong Kong, Japan (Matsushima, 1975), Peru (Matsushima, 1993), Portugal (Sousa-Dias, Lucas and Lopes, 1987), Taiwan (Matsuhima, 1980), Thailand, USA (Ellis, 1971).

This is the type species of the genus. This species is easy to identify because of its digitate or heart-shaped, 5-armed conidia, with the terminal cells of the inner arms distinctly swollen. Cultures of this species are deposited at HKUCC (Nos. 1173, 1174, 1318, 1835, 1836, 2214, 2215, 2322).

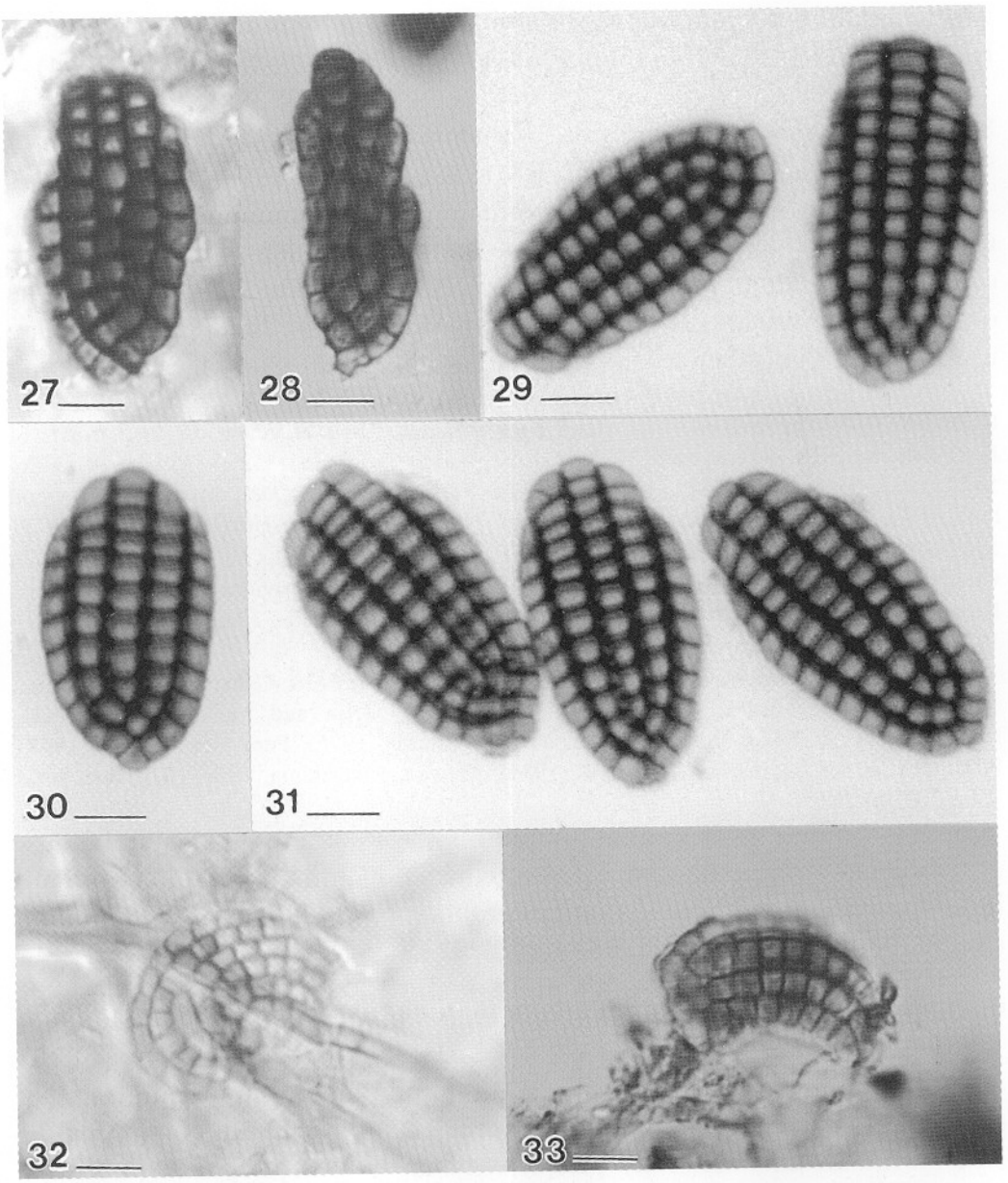
9. ***Dictyosporium foliicola*** P.M. Kirk, Kew Bulletin 38: 583 (1984). (Figs. 32, 33, 88 I)

Colonies on natural substratum effuse, inconspicuous, not in the form of sporodochia. *Conidiophores* indistinct, borne on superficial mycelium. *Conidia* 34-56 × 20-38 µm, uniformly pale to medium brown, complanate, cheiroid, curved, consisting of 35-42(-62) cells arranged in 5-7 rows. Conidial appendages absent.

Material examined: UNITED KINGDOM, Arran, Brodick Castle, on dead leaves of *Ilex pernyi* (Aquifoliaceae), 8 Sep. 1980, P.M. Kirk (IMI 252161, holotype).

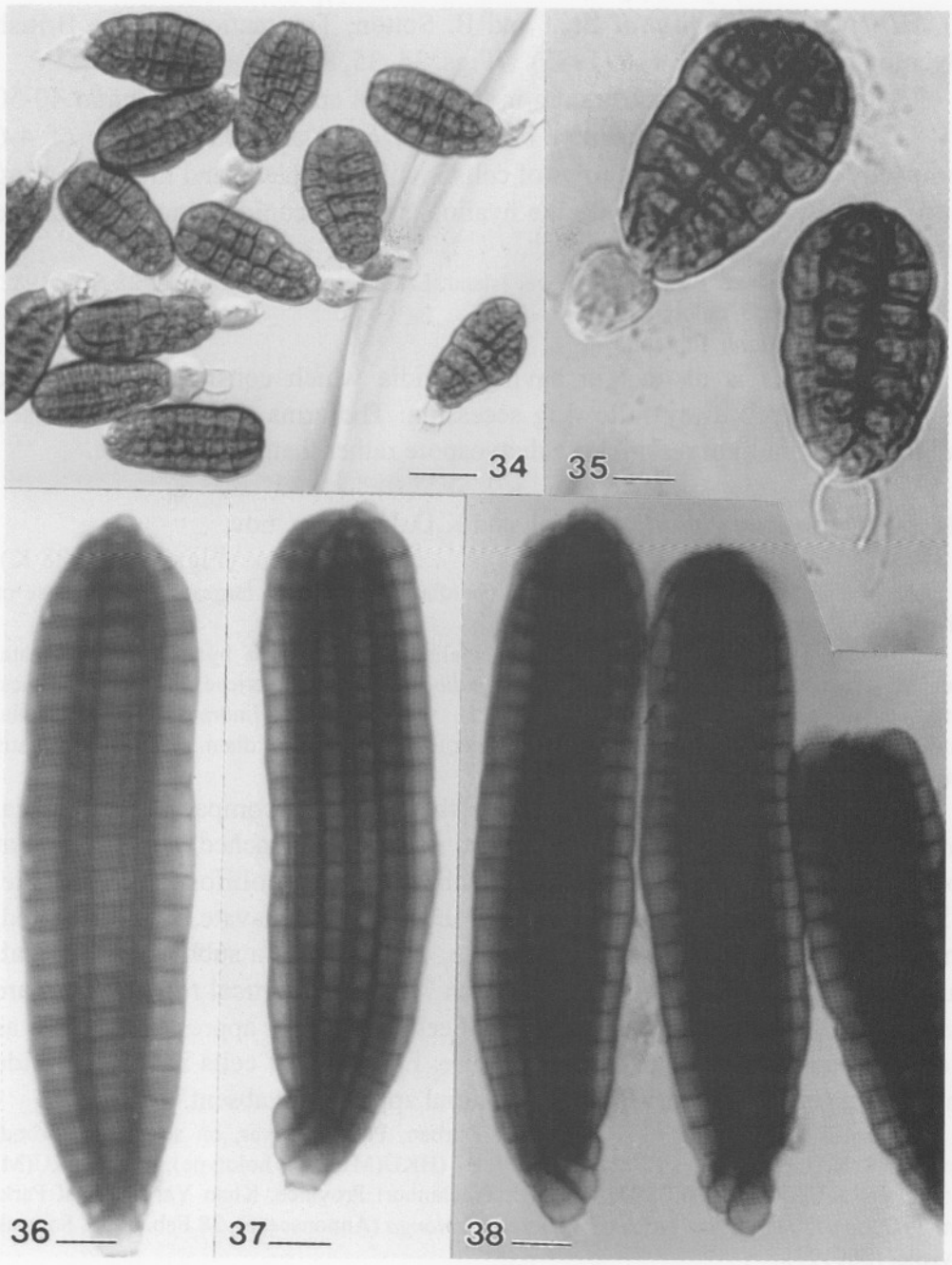
Known distribution: United Kingdom.

Kirk and Spooner (1984) commented that this species resembles species of *Xenosporium* because of the curved conidia. However, Sutton (1985) regarded



Figs. 27-31. Conidia of *Dictyosporium elegans*, 27 and 28 from holotype (DAOM 49939), 29-31 from Thailand collection (SS0348). **Figs. 32, 33.** Conidia of *Dictyosporium foliicola*, from holotype (IMI 252161). Bars = 10 µm.

D. foliicola to be an acceptable species. It is not a *Xenosporium* because the conidia lack a "secondary conidium" which is characteristic of that genus (Ellis, 1976).



Figs. 34, 35. Conidia of *Dictyosporium gauntii*, with hyaline, bulbose conidiogenous cells attached as an appendage at the base after conidial secession; from holotype (IMI 289653). **Figs. 36-38.** Conidia of *Dictyosporium giganticum*, from Thailand collection (SS0180), stained with lactophenol-cotton blue. Bars: 34 = 20 μm, 35-38 = 10 μm.

10. ***Dictyosporium gauntii*** Bhat and B. Sutton, Transactions of the British Mycological Society 85: 116 (1985). (Figs. 34, 35, 88 J)

Colonies on natural substratum in the form of sporodochia. *Conidia* 40-50 × 18-25 μm, uniformly medium brown, not complanate, consisting of 4-6 compactly arranged incurved rows of cells in different plane and thus appearing muriform, always seceding with the hyaline, swollen conidiogenous cell at the base.

Material examined: ETHIOPIA, Zegai Island, Lake Tana, on dead wood, 28 Sep. 1982, D.J. Bhat (IMI 289653, holotype).

Known distribution: Ethiopia.

This species is distinct in having conidia which consistently carry the conidiogenous cell away following secession. The arms are tightly appressed and thus the conidium resembles a dictyospore rather than a cheirospore.

11. ***Dictyosporium giganticum*** Goh and K.D. Hyde, sp. nov.

(Figs. 36-38, 88 K)

Etymology: *giganticum*, referring to the conidia, which are the largest amongst those of other *Dictyosporium* species.

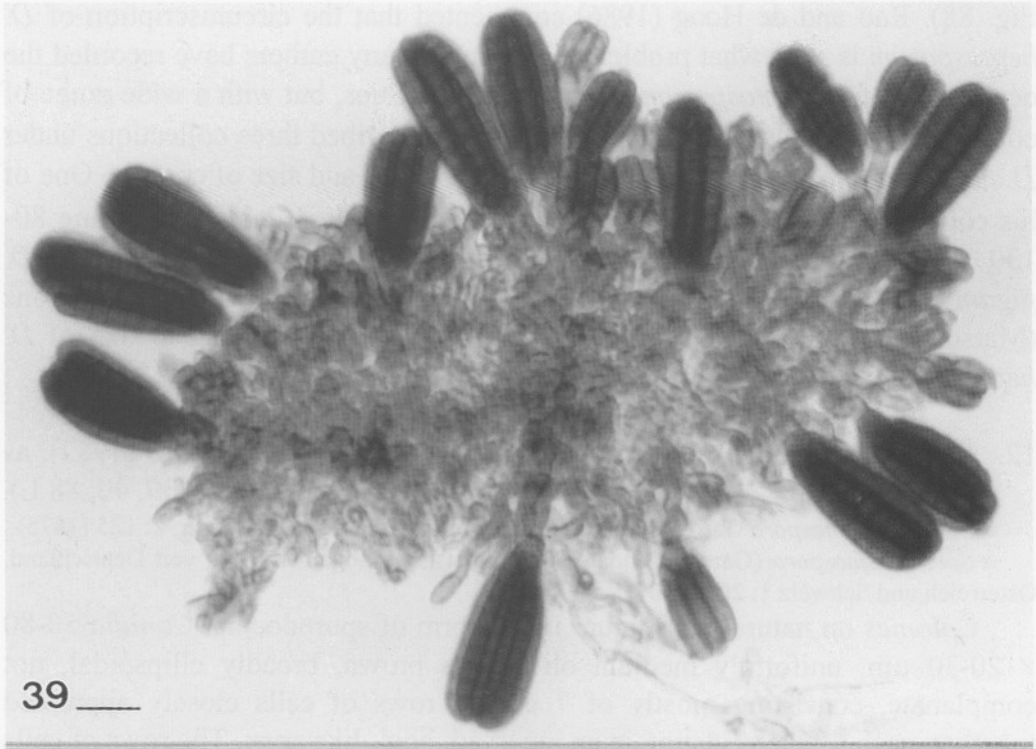
Coloniae in substrato naturali sporodochialiae. *Conidiophora* hyalina, tenuitunicata, brevia, irregulariter ramosa. *Cellulae conidiogenae* subsphaericae vel doliiformes, determinatae, 5.5-7 μm latae. *Conidia* 105-121 × 25-32 μm, cylindraceo-clavata, laevia, modice brunnea, non complanata, in 7-serietibus, quisque 7-8 μm diam., apicem incurvatis composita, non appendiculata.

Colonies on natural substratum in the form of compact sporodochia. *Conidiophores* hyaline, thin-walled, short, irregularly branched, deteriorating at conidial maturity. *Conidiogenous cells* subspherical or doliiform, determinate, 5.5-7 μm wide. *Conidia* 105-121 × 25-32 μm, cylindric-clavate, smooth-walled, uniformly medium brown, not complanate, consisting of a subhyaline, cubical, truncate basal cell 5-7 μm diam., on which 7 discrete, vertical rows of cells are inserted in different planes. These rows of cells are tightly appressed together as a cylinder and separate only under presure. Each row of cells is 7-8 μm wide and terminates in an incurved hook. Conidial appendages absent.

Materials examined: SOUTH AFRICA, Durban, Palmiet River, on submerged wood, Nov. 1994, K.D. Hyde and T.D. Steinke SAPR 37 (HKU(M) 2184, holotype); *ibid.*, (HKU(M) 2156); *ibid.*, (HKU(M) 2200); THAILAND, Prachinburi Province, Khao Yai National Park, Km 29.2, on submerged test block of *Anisoptera oblonga* (Annonaceae), 28 Feb. 1997, Somsak Sivichai (SS0199).

Known distribution: Solomon Island (Matsushima, 1971), South Africa, Thailand.

Dictyosporium giganticum resembles *D. heptasporum* in having conidia with arms which are somewhat recurved or hooked at the apex. The large size of the conidia, however, makes *D. giganticum* distinct in the genus (see Table 1 and



Figs. 39, 40. *Dictyosporium heptasporum*, from Thailand collection (SS0063), stained with lactophenol-cotton blue. **39.** Squash mount of a sporodochium with conidia. **40.** Conidia. Bars: 39 = 20 µm, 40 = 10 µm.

Fig. 88). Rao and de Hoog (1986) commented that the circumscription of *D. heptasporum* is somewhat problematic because many authors have recorded the occurrence of *D. heptasporum* from various localities, but with a wide range of conidial size. Matsushima (1971, 1980, 1993) described three collections under *D. heptasporum*, which greatly differed in the shape and size of conidia. One of his collections from the Solomon Islands, however, has conidia measuring 80-130 × 20-30 μm (Matsushima, 1971). This is obviously a collection of *D. giganticum*, which differs distinctly from his two other collections (Matsushima, 1980, 1993) in conidial size (which is pertaining to that of *D. heptasporum*, i.e. 50-75 × 18-25 μm).

12. ***Dictyosporium heptasporum*** (Garov.) Damon, Lloydia 15: 118 (1952), as "*hepatasporum*". (Figs. 39, 40, 88 L)

≡ *Cattanea heptaspora* Garov., Rendic. Real. Ist. Lombardi, 2 ser. 8: 125 (1875).

≡ *Speira heptaspora* (Garov.) Lindau, Rabenhorst's Kryptogamen-Flora von Deutschland, Osterreich und Schweiz 1: 201 (1907).

Colonies on natural substratum in the form of sporodochia. *Conidia* 50-80 × 20-30 μm, uniformly medium olivaceous brown, broadly ellipsoidal, not complanate, consisting mostly of 7 curved rows of cells closely appressed together, each row terminating in an incurved, hook-like apex. The rows of cells separate only under pressure. Conidial appendages absent.

Materials examined: On wood, Oct. 1913, ex Herb. Saccardo Inst. Bot. Padova (DAOM 51212, as *Speira hepatospora*); AUSTRALIA, Daintree, northern Queensland, on a dead rachis of *Archontophoenix alexandrae* (Arecaceae), 14 Apr. 1995, J.E. Taylor and K.D. Hyde JP2101 (HKU(M) 3595); *ibid.*, Crystal Cascades, on submerged wood, 28 Apr. 1996, T.M. and K.D. Hyde CC5 (HKU(M) 2788); BRUNEI DARUSSALAM, Temburong, Batu Apoi Forest Reserve, Sungai Belalong, Kuala Belalong Field Studies Centre, on submerged wood, 29 Aug. 1997, K.D. Hyde BRU69 (HKU(M) 4719); HONG KONG, New Territories, Tai Po, Lam Tsuen River, on submerged wood, Apr. 1997, K.M. Tsui KM118 (HKU(M) 5403); THAILAND, Chaing Mai Province, Doi Inthanon National Park, Royal Project, on submerged bamboo, 15 Nov. 1996, Somsak Sivichai (SS0063); *ibid.*, Saraburi Province, Jed Saun Noi Waterfall, on submerged wood, 15 Feb. 1997, Somsak Sivichai (SS0180).

Known distribution: Australia, Belize (Morris, 1978), Brunei Darussalam, Cuba (Mercado-Sierra, 1981), Europe (Ellis, 1971), Hong Kong, India (Rao and de Hoog, 1986), Ecuador (Matsushima, 1993), Mexico (Heredia, Mercado-Sierra and Portales, 1995), Peru (Matsushima, 1993), Taiwan (Matsushima, 1980), Tanzania (Pirozynski, 1972), Thailand, USA.

The species epithet of this fungus was incorrectly spelled as "*hepatosporum*" by Damon (1952), and was so cited in the Index of Fungi (2: 100; 1953). The correct name, *Dictyosporium heptasporum*, was cited later (see Index of Fungi 3: 381; 1967). This is a common species and has been recorded worldwide. It is probable, however, that it has often been confused with *D.*

giganticum and *D. subramanianii*, two similar species which differ in conidial size. Cultures of *D. heptasporum* are deposited at HKUCC (Nos. 753, 754, 1056, 1057, 1319, 1570, 1571).

13. ***Dictyosporium micronesicum*** Matsush., Matsushima Mycological Memoirs 2: 8 (1981). (Fig. 88 M)

Colonies on natural substratum in the form of sporodochia. *Conidia* 20-30 × 10-12 µm, uniformly medium brown, cylindric-ellipsoidal, not complanate, consisting of 3-4 rows of cells closely appressed together, each row measuring16-26 × 4.5-6.5 µm. Conidial appendages absent.

Known distribution: Cuba (Castañeda-Ruíz, Guarro and Cano, 1997a), Micronesia.

We have obtained an ex-type culture of this species (Matsushima Fungal Collection #10535), but unfortunately the culture did not sporulate. The description and illustration of this species given in this paper are taken from Matsushima (1981). This species is distinct in having conidia with three arms, and the arms are straight and clavate. It differs in conidial size from *D. australiense*, which also has conidia comprising three arms.

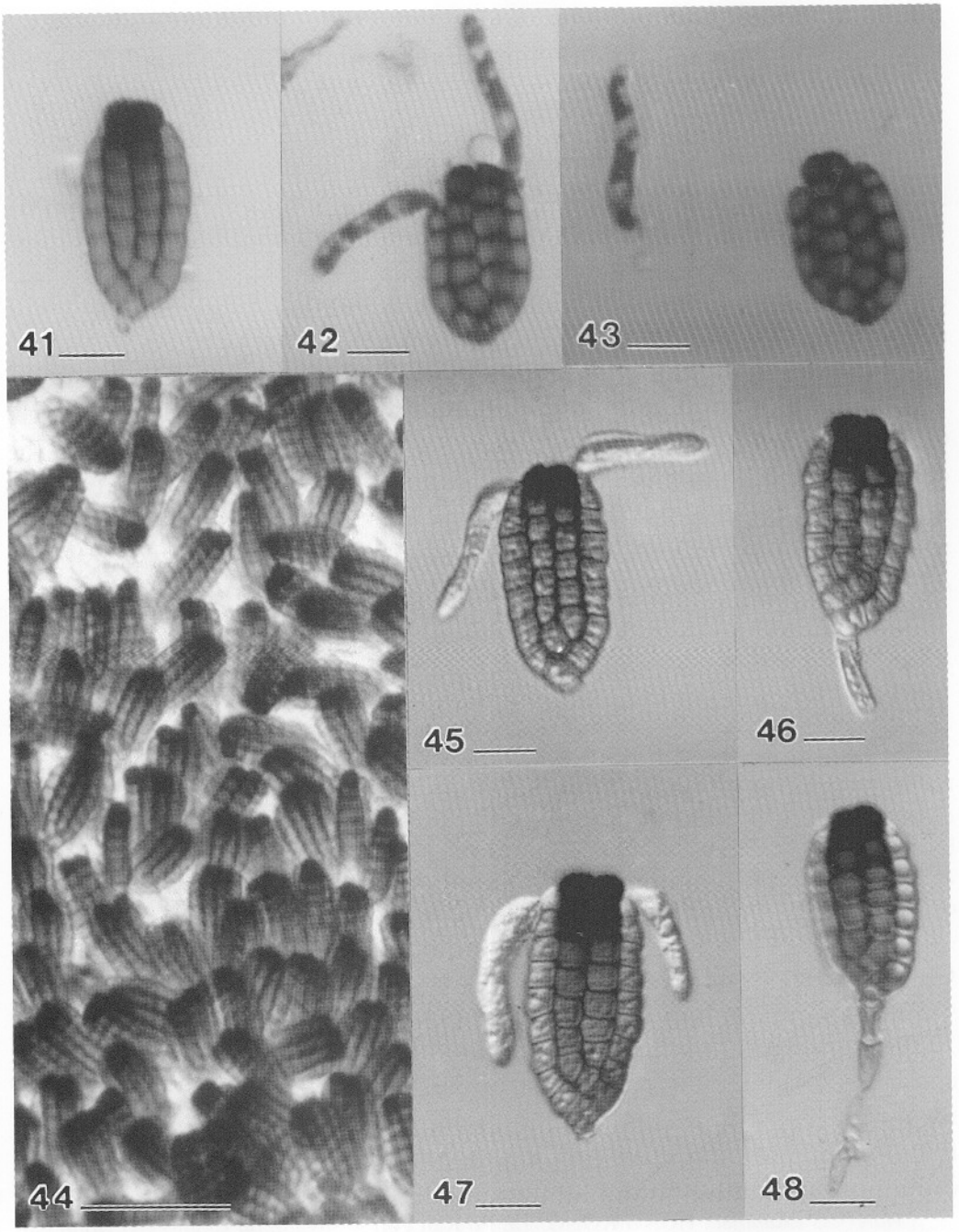
14. ***Dictyosporium nigroapice*** Goh, W.H. Ho and K.D. Hyde, sp. nov. (Figs. 41-48, 88 N)

Etymology: *nigroapice*, referring to the blackened apical portion of the conidia.

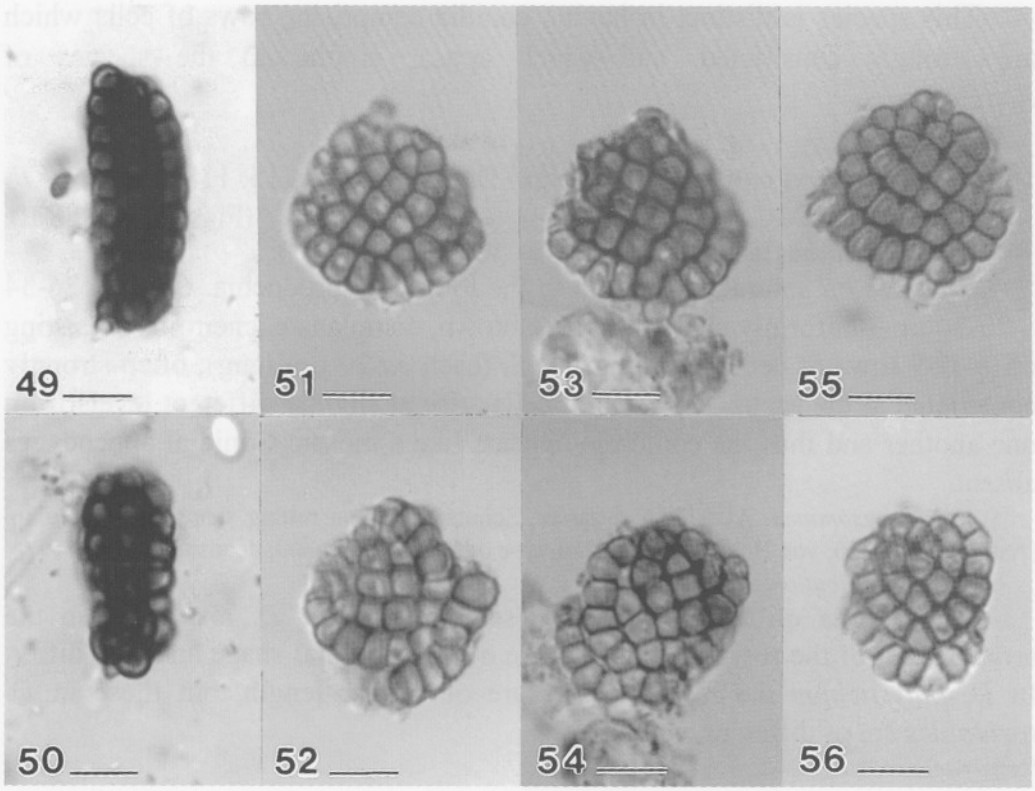
Coloniae in substrato naturali sporodochialiae. *Conidiophora* hyalina vel pallide brunnea, tenuitunicata, brevia, irregulariter ramosa. *Cellulae conidiogenae* cylindricae, determinatae. *Conidia* 28-41 × 15-20 µm ($\bar{x}$ = 33.9 × 17.1 µm, n = 30), complanata, cheiroidea, laevia, brunnea, in 20-32 cellulis 4-serietibus composita, cellula apicalis mediorum serietum atrobrunnea vel atra. Cellula apicalis exteriorum serietum cum appendicibus tenuitunicatis, cylindricis, 22-34 × 4-5 µm, hyalinis, praedita.

Colonies on natural substratum in the form of compact sporodochia. *Conidiophores* hyaline to pale brown, thin-walled, short, irregularly branched. *Conidiogenous cells* cylindrical, determinate. *Conidia* 28-41 × 15-20 µm ($\bar{x}$ = 33.9 × 17.1 µm, n = 30), complanate, cheiroid, smooth-walled, brown, consisting of 20-32 cells, arranged in 4 rows, with the apical cells of the 2 inner rows dark brown to almost black in colour, and the apical cells of the outer rows being provided with an appendage which is hyaline, thin-walled, cylindrical, measuring 22-34 × 4-5 µm.

Materials examined: HONG KONG, Tai Po Kau Forest Stream, on submerged wood bait of *Machilus velutina* (Lauraceae), 27 Sep. 1996, W.H. Ho and K.M. Tsui (HKU(M) 4856, holotype); *ibid.*, (HKU(M) 4867, 4868); *ibid.*, on submerged wood, 29 Dec. 1996, W.H. Ho and S.Y. Ho (HKU(M) 5922); *ibid.*, 28 Sep. 1997 (HKU(M) 8647); THAILAND, Nakorn Ratchasima Province, Khao Yai National Park, Tad Ta Phu, on submerged test block of *Anisoptera oblonga* (Annonaceae), 11 June 1997, Somsak Sivichai (SS0349).



Figs. 41-48. Conidia of *Dictyosporium nigroapice*, with cylindrical conidial appendages at the apex. **41-43.** From Thailand collection (SS0349), stained with lactophenol-cotton blue. **44-48.** From Hong Kong collection (HKU(M) 4856, holotype), mounted in water. Bars: 41-43, 45-48 = 10 μm, 44 = 50 μm.



Figs. 49, 50. Conidia of *Dictyosporium oblongum*, from holotype (DAOM 43272). **Figs. 51-56.** Conidia of *Dictyosporium polystichum*, from holotype (H2462, FH). Bars = 10 µm.

Known distribution: Hong Kong, Thailand.

The conidia in this species are unique in having conidial arms with darkly pigmented apical cells. Cultures of this species are deposited at HKUCC (Nos. 1436, 1437).

15. ***Dictyosporium oblongum*** (Fuckel) S. Hughes, Canadian Journal of Botany 36: 762 (1958). (Figs. 49, 50, 88 O)

≡ *Speira oblonga* Fuckel, Jb. nassau. Ver. Naturk. 23-24: 349 (1870).

Colonies on natural substratum effuse, not in the form of sporodochia. *Conidia* 30-50 × 12-30 µm, uniformly medium to dark brown, oblong or irregular, not complanate, consisting of 3-6 rows of cells of either the same length or different lengths, often strongly constricted at the septa. Conidial appendages absent.

Material examined: SWITZERLAND, Münchau, on dead wood, Fuckel (DAOM 43272, holotype of *Speira oblonga*).

Known distribution: Canada (Sutton, 1973), Europe, USA (Ellis, 1971).

This species is distinct in having conidia comprising rows of cells which are strongly constricted, and which appear similar to the species of *Papulaspora*.

16. ***Dictyosporium polystichum*** (Höhn.) Damon, Lloydia 15: 118 (1952). (Figs. 51-56, 88 P)

≡ *Speira polysticha* Höhn., Sber. Akad. Wiss. Wien 122: 49 (1913).

Colonies on natural substratum in the form of sporodochia. *Conidia* 26-34 × 23-34 µm, uniformly medium to dark brown, complanate, cheiroid, consisting of (5-)7-9 rows of cells of similar length (each *ca* 20 µm long), often strongly constricted at the septa. The rows of cells arise at slightly different levels from one another and thus the conidium appears like a mosaic Conidial appendages absent.

Material examined: AUSTRIA, Strasser, Sonntagsberg, on rotting stems of *Senecio* sp. (Asteraceae), 1910, von Höhnel (H2462, holotype of *Speira polysticha*, deposited in FH).

Known distribution: Austria.

The conidia of *D. polystichum* resemble those of *D. toruloides* in the arrangement of the rows of cells, but the overall conidial shape and size differ. In *D. polystichum* the rows of cells are of similar length, but those in *D. toruloides* are of different length.

17. ***Dictyosporium schizostachyfolium*** Bat. and Farr, Saccardoa 1: 103 (1960). (Fig. 88 Q)

Colonies on natural substratum in the form of sporodochia. *Conidia* 15-17 × 11-12 µm, uniformly brown, complanate, cheiroid, regularly consisting of 4 rows of cells, slightly constricted at the septa. Conidial appendages absent.

Known distribution: Italy.

We have been unable to obtain the type material of this species. The description and illustration of this species given in this paper are taken from Batista and Farr (1960). This species resembles *D. brahmaswaroopii* in having complanate conidia which comprise 4 rows of cells, however, they differ in size.

18. ***Dictyosporium subramanianii*** B. Sutton, Proceedings of the Indian Academy of Science (Plant Science) 94: 239 (1985). (Figs. 66, 67, 88 R)

= *Dictyosporium intermedium* Subram., Hyphomycetes: 478 (1971).

Colonies on natural substratum in the form of sporodochia. *Conidia* 33-42 × 16-20 µm, uniformly pale to medium brown, ellipsoidal, not complanate, consisting of 6-7 rows of cells with incurved, hook-like apex. Conidial appendages absent.

Materials examined: INDIA, Jabalpur, on wood of *Eucalyptus globulus* (Myrtaceae), 20 Sep. 1978, N.D. Sharma (IMI 232361, holotype); MAINLAND CHINA, southwest Hubei, Enshi, on a dead petiole of *Trachycarpus fortunei* (Arecaceae), 6 July 1995, J.E. Taylor JP5137 (HKU(M) 3994); THAILAND, Prachinburi Province, Khao Yai National Park, Km 29.2, on submerged test block of *Anisoptera oblonga* (Annonaceae), 13 Mar. 1997, Somsak Sivichai (SS0235).

Known distribution: Costa Rica (Mercado-Sierra, Gene and Guarro, 1997), Cuba (Mercado-Sierra, 1984), India (Subramanian, 1971; Sutton, 1985), Mainland China, Mexico (Mercado-Sierra and Heredia, 1994), Peru (Matsushima, 1993), Thailand.

This species is similar to *D. heptasporum* except for the smaller size of the conidia, and has been often interpreted as a small-spored version of the latter species.

19. ***Dictyosporium tetraseriale*** Goh, Yanna and K.D. Hyde, sp. nov.

(Figs. 57-65, 88 S)

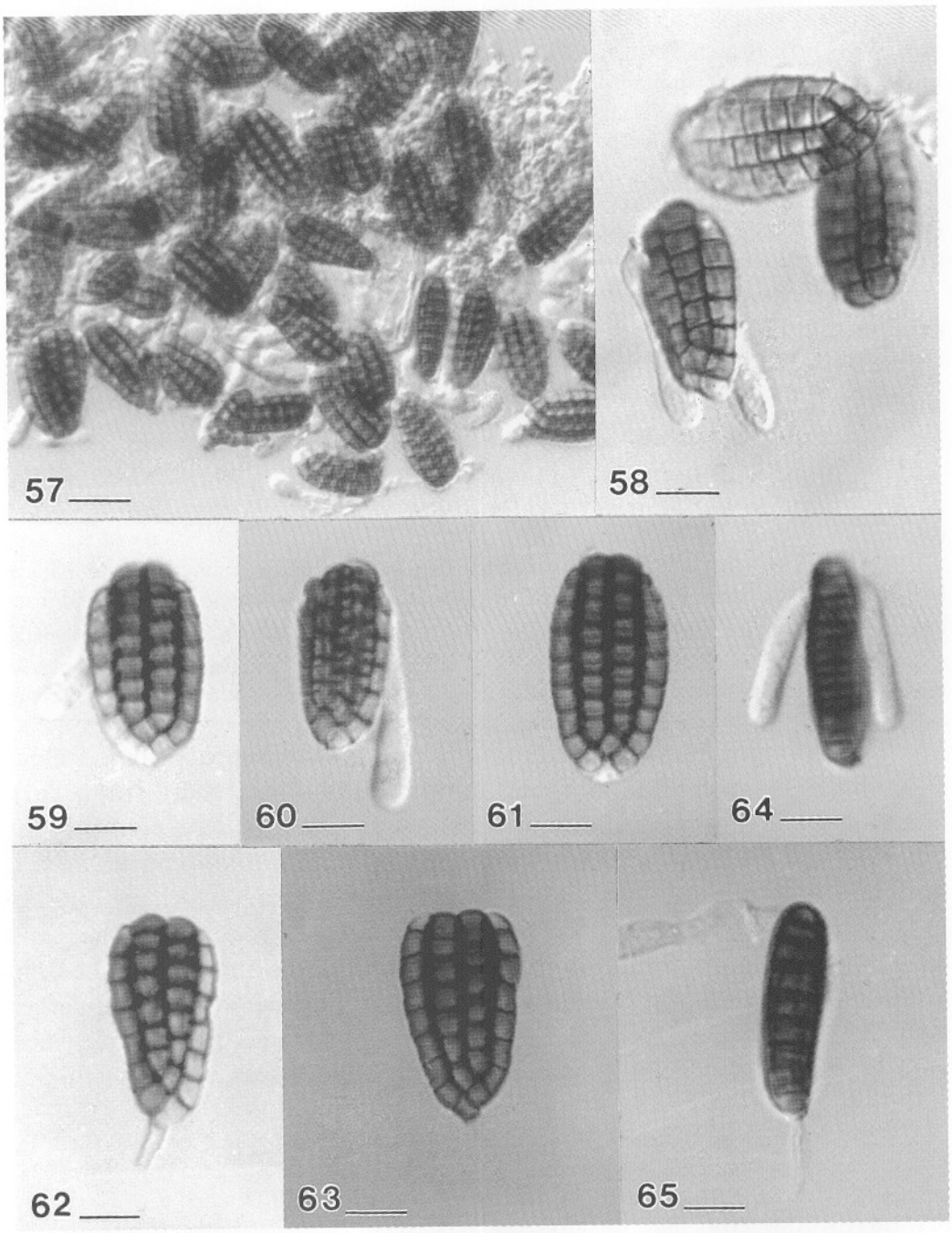
Etymology: *tetraseriale*, referring to the conidia which usually consisting of 4 rows of cells.

Coloniae in substrato naturali sporodochialiae. *Conidiophora* subhyalina vel pallide brunnea, tenuitunicata, brevia, irregulariter ramosa. *Cellulae conidiogenae* cylindricae, determinatae. *Conidia* 24-40 × 14-20 µm ($\bar{x}$ = 30.7 × 16.8 µm, n = 30), complanata, cheiroidea, laevia, modice brunnea, in 24-38 cellulis, 4-serietibus composita. Cellula apicalis mediorum serietum leniter inflata, cellula apicalis exteriorum serietum cum appendicibus tenuitunicatis, cylindricis, 24-35 × 3-8 µm, hyalinis, praedita.

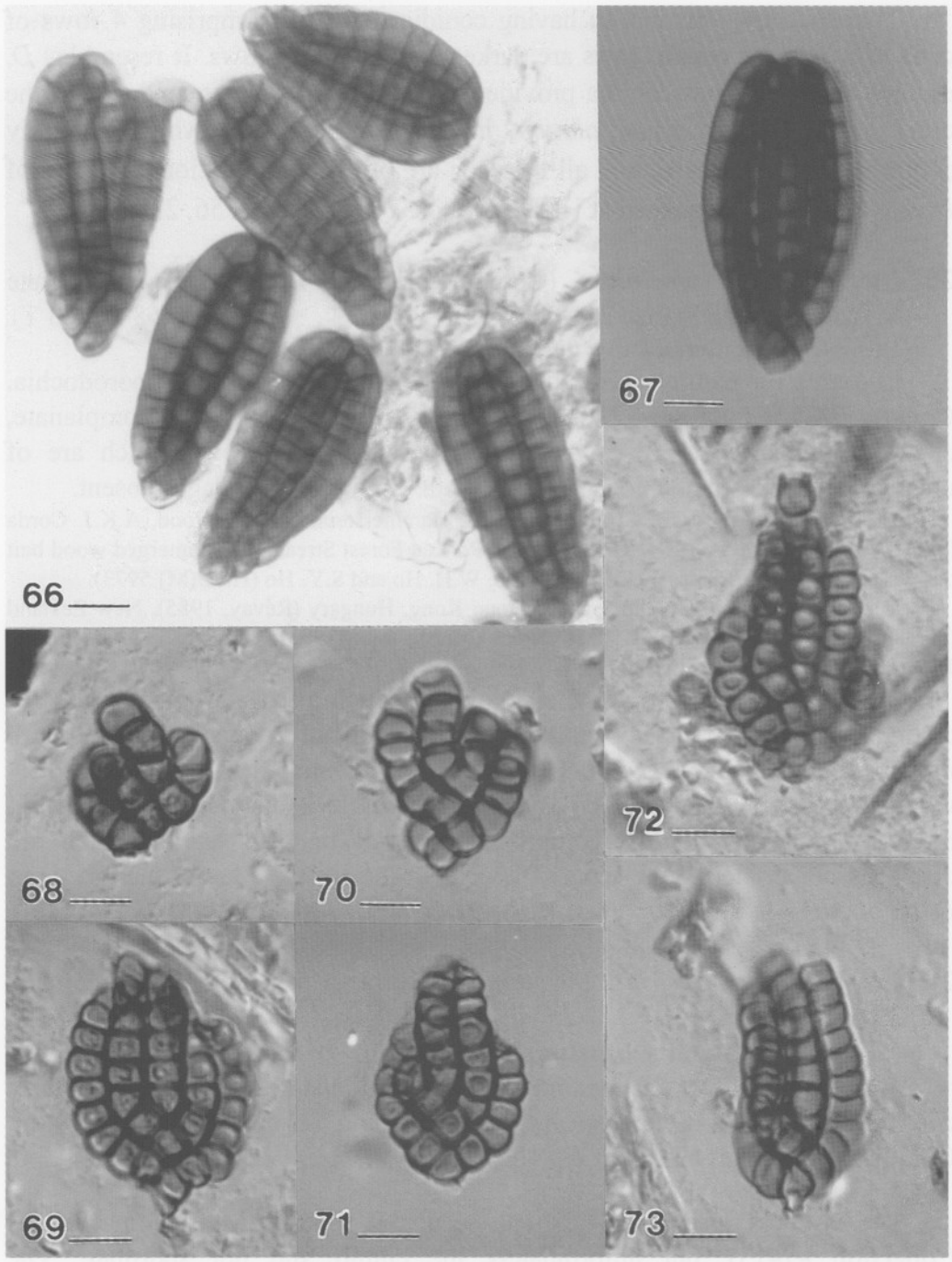
Colonies on natural substratum in the form of compact sporodochia. *Conidiophores* subhyaline to pale brown, thin-walled, short, irregularly branched. *Conidiogenous cells* cylindrical, determinate. *Conidia* 24-40 × 14-20 µm ($\bar{x}$ = 30.7 × 16.8 µm, n = 30), complanate, cheiroid, smooth-walled, medium brown, consisting of 24-38 cells, arranged in 4 rows which are inserted in a pale brown to brown, 2-3 µm diam., truncate basal cell. The cells comprising the central 2 rows are darker than those of the outer rows. The cells at the apical portion of the 2 central rows are slightly swollen and are darker than other cells of the conidium. The apical cells of the outer rows are provided with an appendage which is hyaline, thin-walled, cylindrical, measuring 24-35 × 3-8 µm.

Materials examined: HONG KONG, The University of Hong Kong campus, Lung Fu Shan, on dead fronds of *Livistona chinensis* (Arecaceae), 19 Oct. 1996, Yanna (HKU(M) 5327, holotype); *ibid.*, Tai Po Kau Forest Stream, on submerged wood, 29 Dec. 1996, W.H. Ho and S.Y. Ho (HKU(M) 5914); *ibid.*, on submerged wood bait of *Machilus velutina* (Lauraceae), 28 June 1997, W.H. Ho (HKU(M) 6121); *ibid.*, on submerged wood baits of *Pinus massonaina* (Pinaceae), 27 June 1996 (HKU(M) 4585, 4586, 4587); BRUNEI DARUSSALAM, Temburong, Batu Apoi Forest Reserve, Sungai Belalong, Kuala Belalong Field Studies Centre, Sungai Sitam, on submerged wood, 24 Oct. 1996, W.H. Ho and K.D. Hyde (HKU(M) 2930).

Known distribution: Brunei Darussalam, Hong Kong.



Figs. 57-65. *Dictyosporium tetraseriale*, from holotype (HKU(M) 5327). **57.** Squash mount of sporodochium with conidia. **58-63.** Conidia, with hyaline, clavate appendages at the apex. Note the darker colouration of the central rows of cells. **64, 65.** Conidia in side view. Bars: 57 = 20 µm, 58-65 = 10 µm.



Figs. 66, 67. Conidia of *Dictyosporium subramanianii*, from Thailand collection (SS0235). **Figs. 68-73.** Conidia of *Dictyosporium toruloides*, from holotype (DAOM 49420). Bars = 10 μm.

This species is distinct in having conidia regularly comprising 4 rows of cells in which the central rows are darker than the outer rows. It resembles *D. alatum* which also has conidia provided with apical clavate appendages in the outer arms. *Dictyosporium alatum*, however, has conidia which regularly comprise 5 rows of cells, and all the cells are of even colouration. Cultures of *D. tetraseriale* are deposited at HKUCC (Nos. 2152, 2153, 2756, 2757).

20. ***Dictyosporium toruloides*** (Corda) Gueguen, Bulletin de la Société Mycologique de France 21: 98 (1905). (Figs. 68-73, 88 T)

≡ *Speira toruloides* Corda, Icones fungorum 1: 9 (1837).

Colonies on natural substratum effuse, not in the form of sporodochia. *Conidia* 38-56 × 25-24(-32) µm, uniformly olivaceous brown, complanate, cheiroid, consisting of 36-51 cells arranged in (5-)6-8 rows which are of unequal length, distinctly constricted at septa. Conidial appendages absent.

Materials examined: CZECHOSLOVAKIA, Hammerstein, on dead wood, A.K.J. Corda (DAOM 49420, holotype); HONG KONG, Tai Po Kau Forest Stream, on submerged wood bait of *Pinus massoniana* (Pinaceae), 29 Dec. 1996, W.H. Ho and S.Y. Ho (HKU(M) 5973).

Known distribution: Czechoslovakia, Hong Kong, Hungary (Révay, 1985), New Zealand (Hughes, 1978), Pakistan (Ellis, 1971), Peru (Matsushima, 1993), United Kingdom (Jones, 1963; Kirk, 1981), USA (Ellis, 1971).

Dictyosporium oblongum, the conidia of which also have arms which are distinctly constricted at the septa, has been considered to be synonymous with *D. toruloides* (Damon, 1952). However, *D. oblongum* has smaller conidia, which are not complanate. *Dictyosporium toruloides* is distinct in the genus in having complanate conidia comprising arms of unequal length which are distinctly constricted at the septa. The cells in the arms are larger than those in *D. oblongum*.

21. ***Dictyosporium triseriale*** Matsush., Matsushima Mycological Memoirs 1: 32 (1980). (Fig. 88 U)

Colonies on natural substratum in the form of sporodochia. *Conidia* 26-32 × 16-18 µm, uniformly medium brown, complanate, cheiroid, regularly consisting of 3 rows of cells, each rows comprising 5-7 cells of width 5-7 µm. Conidial appendages absent.

Known distribution: Taiwan.

We have obtained an ex-type culture of this species (Matsushima Fungal Collection #7413), but unfortunately the culture did not sporulate. The description and illustration of this species given in this paper are taken from Matsushima (1980). This species is distinct in having complanate conidia which are regularly comprised of 3 rows of cells. *Dictyosporium australiense* and *D.*

micronesicum also have conidia comprising 3 rows of cells, but they are not complanate.

22. ***Dictyosporium zeylanicum*** Petch, Annals of the Royal Botanic Gardens, Peradeniya 6: 252 (1917). (Figs. 74-78, 88 V)

Colonies on natural substratum in the form of sporodochia. *Conidia* 26-40 × 13-25 µm, complanate, cheiroid, consisting mostly 5 rows of cells, the central rows dark brown and the outer 2 rows lighter brown, constricted at the septa. Conidial appendages absent.

Material examined: SRI LANKA, Peradeniya, on dead wood, Dec. 1914, Petch (IMI 723, holotype).

Known distribution: Belize (Morris, 1978), Sri Lanka.

This species resembles *D. bulbosum* in having conidia of similar shape and size, and comprising mostly 5 rows of cells. The conidia of *D. bulbosum*, however, differ in having bulbose conidial appendages, and the cells are all of the same colouration. *Dictyosporium tetraseriale* also has conidia in which the middle rows of cells are darker than the outer rows, but they are consistently comprised of 4 rows of cells with clavate conidial appendages.

Rejected, unacceptable, or uncertain species

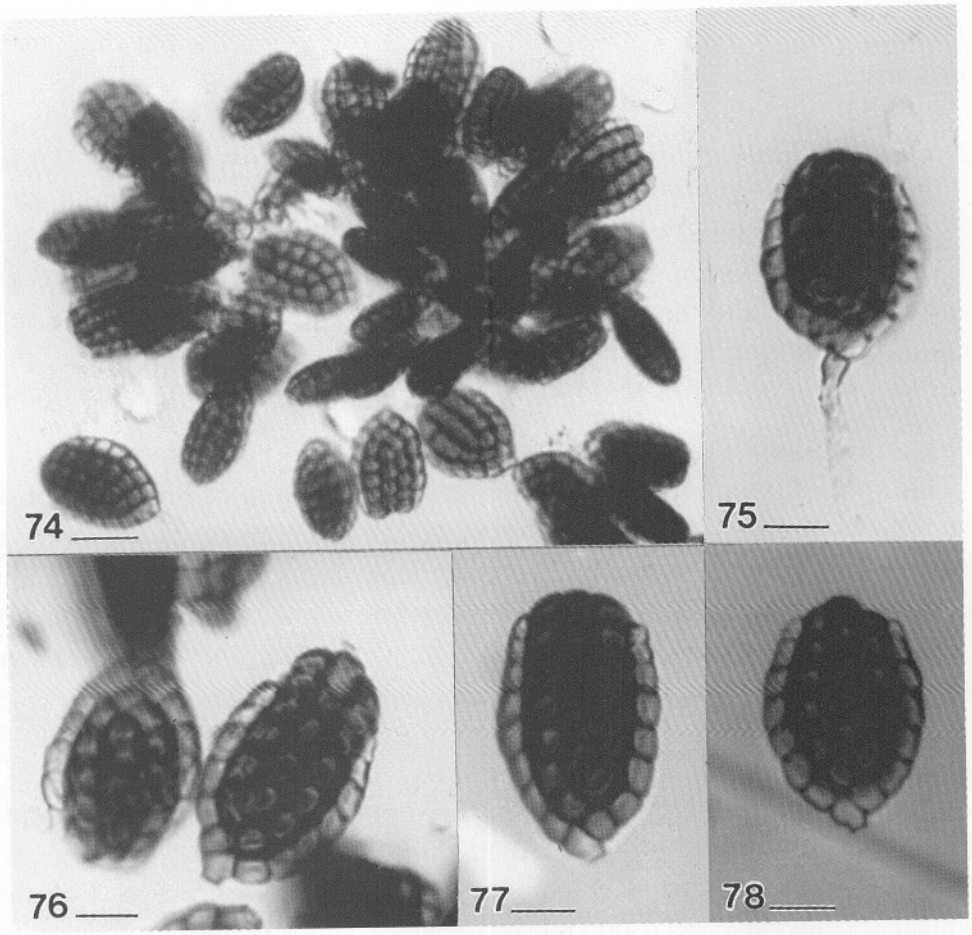
All of the accepted species of *Dictyosporium* have smooth, euseptate conidia with 3-7 rows of cells. There are several species, however, with verrucose or pseudoseptate conidia, atypical of the genus. Some of these atypical species have been previously transferred to other appropriate genera, and three further species are transferred here. A few species, for which we have not obtained the type specimens, are treated here as doubtful because of insufficient information or of atypical generic characters.

1. ***Dictyosporium binatum*** (Sacc.) S. Hughes, Canadian Journal of Botany 36: 762 (1958). (Figs.79, 80)

≡ *Speira binata* Sacc., Bulletino dell' Orto Botanico della regia Universitá di Napoli 6: 72 (1921).

Material examined: On decaying wood of *Corylus avellana*, Jan. 1918, Avellino, DAOM 51053 (holotype of *Speira binata*).

This fungus produces solitary, bifurcate, multiseptate, yellowish conidia which measure 25-42 × 10-13 µm. It appears that these conidia are not produced from cup-shaped or doliiform conidiogenous cells typical of *Dictyosporium*, but are borne on macronematous, mononematous, solitary, unbranched, septate, *ca* 20-35 × 3.5 µm, pale olivaceous brown, smooth conidiophores. Unfortunately details of conidiogenesis and conidial secession



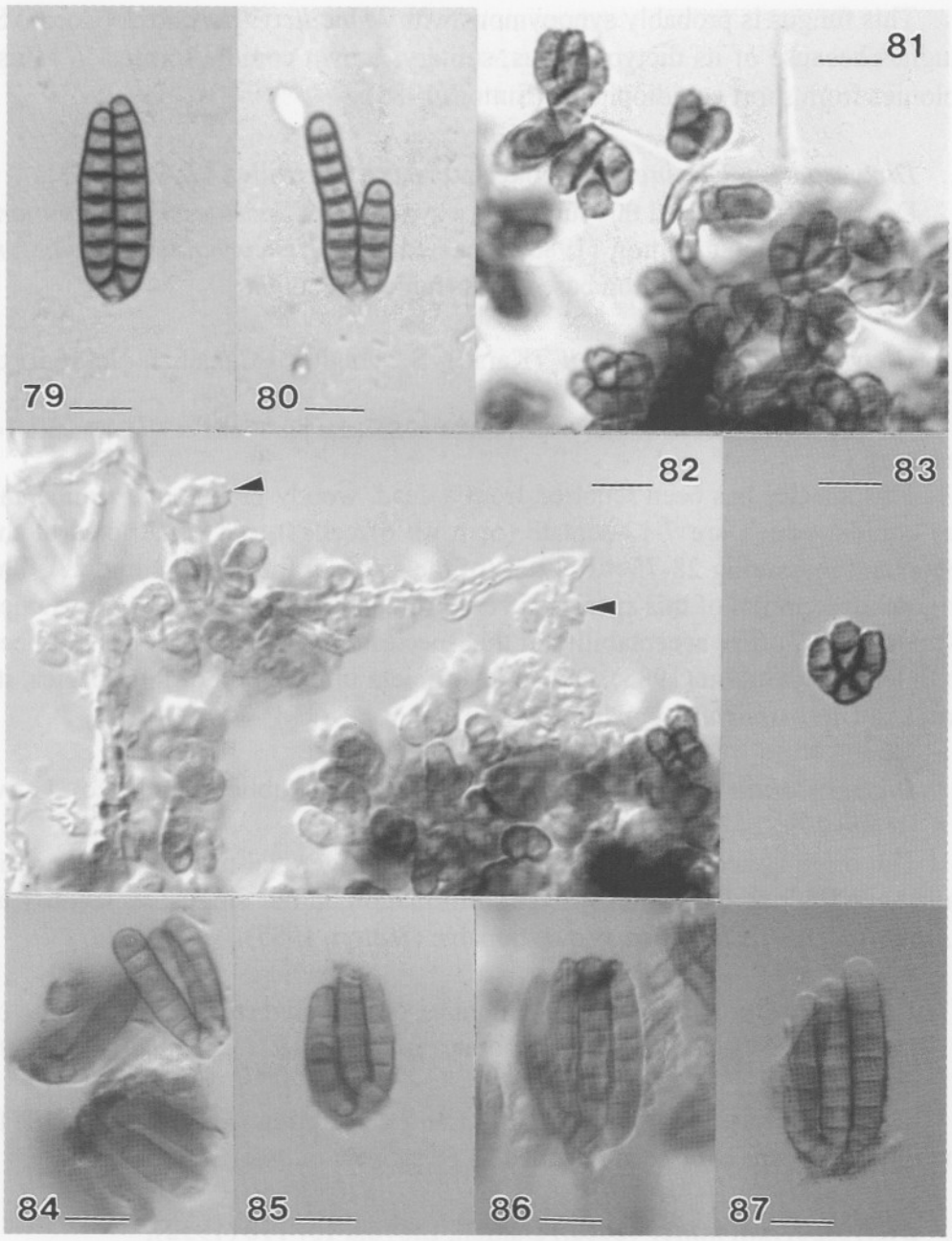
Figs. 74-78. Conidia of *Dictyosporium zeylanicum*, from holotype (IMI 723). Note the darker coloration of the central rows of cells. Bars: 74 = 20 µm, 75-78 = 10 µm.

could not be observed from this material. It may be an undescribed species of *Ceratosporella* Höhn.

2. ***Dictyosporium boydii*** A. L. Smith and Ramsb., Transactions of the British Mycological Society 5: 168 (1915).

This fungus is considered to be synonymous with *D. toruloides* (Corda) Gueguen (Damon, 1952).

3. ***Dictyosporium castaneum*** G. Frag., Boletim da Sociedade Broteriana ser. 2, 2: 46 (1924).



Figs. 79-87. Species excluded from *Dictyosporium*. **79, 80.** Conidia of *Dictyosporium binatum*, from holotype (DAOM 51053). **81-83.** Conidia of *Ramoconidiifera verrucosa* (syn. *Dictyosporium prolificum*), from ex-culture (PPH1E, isotype). Note developing conidia (arrowed) from conidiogenous hyphae in 82. **84-87.** Conidia of *Dictyosporium prolificum*, with distosepta; from holotype (No. 2396, NY Bot. Gard.). Bars = 10 µm.

This fungus is probably synonymous with *Monodictys paradoxa* (Corda) S. Hughes because of its dictyosporous, solitary, brown conidia formed in effuse colonies from short conidiophores (Sutton, 1985).

4. ***Dictyosporium circinatum*** Cooke and Harkn., Grevillea 12: 95 (1883).

Damon (1952) placed this fungus as a synonym of *Sporidesmium inquinans* Ellis and Everh., but Sutton (1985) renamed it as *Helicorhoidion circinatum* (Cooke and Harkn.) B. Sutton based on its helicoid conidia.

5. ***Dictyosporium crustaceum*** (Karst.) S. Hughes, Canadian Journal of Botany 36: 762 (1958).

≡ *Hormiscium crustaceum* Karst., Meddelanden af Societas pro Fauna et Flora Fennica 14: 90 (1887).

This species has been reported from a dead, woody branch of *Prunus*, and has conidia which are 7-12-septate (or rows of cells?), not constricted at the septa, and measuring 28-75 × 6-8 μm (of the arms, or the whole conidia?). The original description of this species is very brief and no illustration was provided (Karsten, 1887). The acceptability of this species in *Dictyosporium* has not been commented by Sutton (1985). Due to insufficient information of this species, its status in *Dictyosporium* remains doubtful.

6. ***Dictyosporium hymenaearum*** Bat. and Bezerra, Public. Inst. Micol. Univ. Recife 299: 24 (1960).

The original account of this fungus is too meager and no detached conidia have been figured. Due to insufficient information on the fungus, its identity as a *Dictyosporium* is regarded as questionable (Sutton, 1985).

7. ***Dictyosporium intermedium*** Subram., Hyphomycetes, an account of Indian species, except Cercosporae, p. 478 (1971), *nomem non rite publicatum*.

This name was not provided with a Latin description (Subramanian, 1971) and the fungus has later been renamed as *D. subramanianii* (Sutton, 1985).

8. ***Dictyosporium minor*** (Sacc.) Damon, Lloydia 15: 118 (1952).

This species has been regarded as synonymous with *Cryptocoryneum bigeminum* (Cooke and Ellis) S. Hughes (1958), and with *Eversia subopaca* (Cooke and Ellis) J. L. Crane and Schokn. (Schoknecht and Crane, 1977).

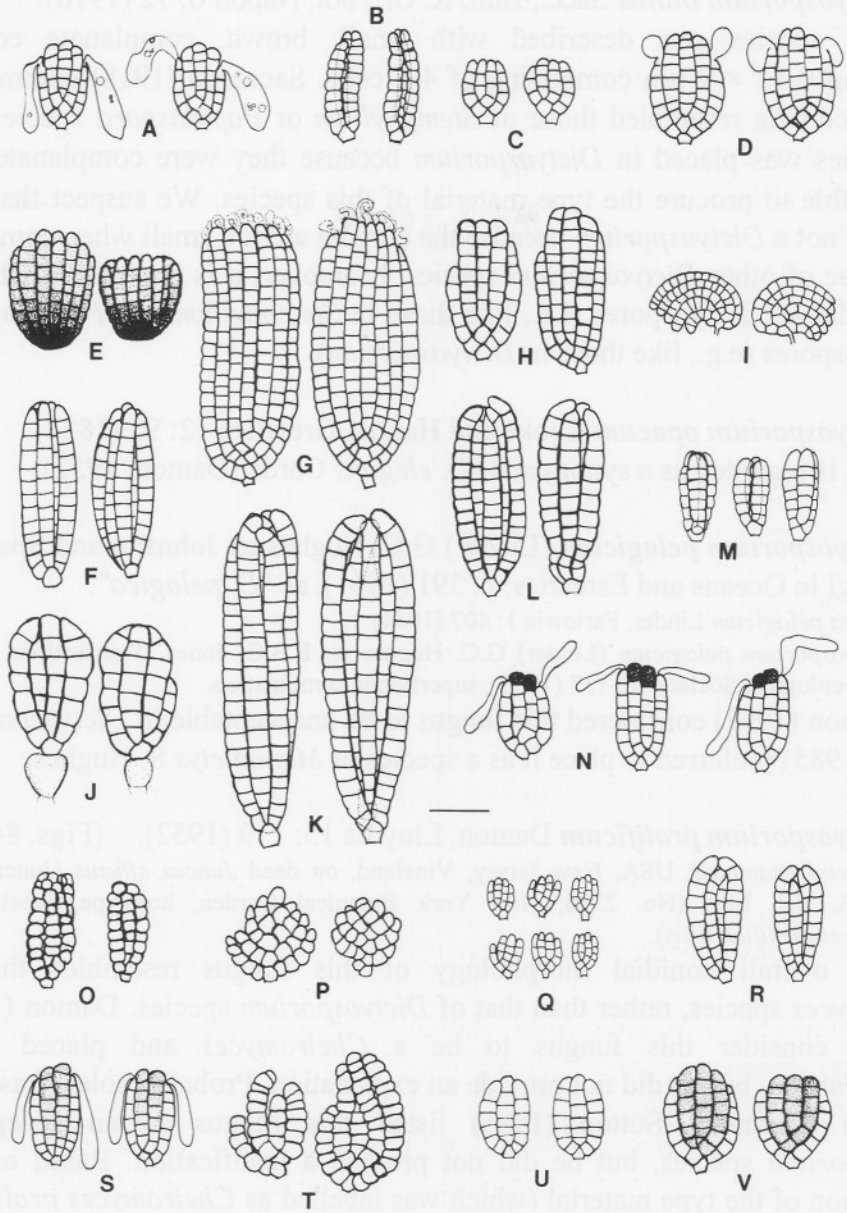


Fig. 88. Diagrammatic representation of conidia of *Dictyosporium* species drawn to the same scale for comparison (stippling omitted). **A.** *D. alatum.* **B.** *D. australiense.* **C.** *D. brahmaswaroopii.* **D.** *D. bulbosum.* **E.** *D. campaniforme.* **F.** *D. cocophilum.* **G.** *D. digitatum.* **H.** *D. elegans.* **I.** *D. foliicola.* **J.** *D. gauntii.* **K.** *D. giganticum.* **L.** *D. heptasporum.* **M.** *D. micronesicum.* **N.** *D. nigroapice.* **O.** *D. oblongum.* **P.** *D. polystichum.* **Q.** *D. schizostachyfolium.* **R.** *D. subramanianii.* **S.** *D. tetraseriale.* **T.** *D. toruloides.* **U.** *D. triseriale.* **V.** *D. zeylanicum.* Bar = 20 µm.

9. ***Dictyosporium minus*** Sacc., Bull. R. Ort. bot. Napoli 6: 72 (1918).

This species was described with small, brown, complanate conidia measuring 9-12 × 9 µm comprising of 4-8 cells. Saccardo (1918) commented that the conidia resembled those of *Stemphylium* or *Papulaspora* species, but the species was placed in *Dictyosporium* because they were complanate. We were unable to procure the type material of this species. We suspect that it is probably not a *Dictyosporium* because the conidia are too small when compared with those of other *Dictyosporium* species. Moreover, it is not known whether the conidia are dictyospores (i.e., like those in *Stemphylium* and *Papulaspora*) or cheirospores (e.g., like those in *Dictyosporium*).

10. ***Dictyosporium opacum*** Cooke and Harkn., Grevillea 12: 95 (1884).

This is regarded as a synonym of *D. elegans* Corda (Damon, 1952).

11. ***Dictyosporium pelagicum*** (Linder) G.C. Hughes ex Johnson and Sparrow, Fungi in Oceans and Estuaries, p. 391 (1961), as "*D. pelagica*".

≡ *Speira pelagicum* Linder, Farlowia 1: 407 (1944).

≡ *Dictyosporium pelagicum* (Linder) G.C. Hughes ex E.B.G. Jones, Transactions of the British Mycological Society 46: 137 (1963), superfluous combination.

Damon (1952) considered this fungus to be unacceptable in *Dictyosporium*. Sutton (1985) preferred to place it as a species of *Monodictys* S. Hughes.

12. ***Dictyosporium prolificum*** Damon, Lloydia 15: 119 (1952). (Figs. 84-87)

Material examined: USA, New Jersey, Vineland, on dead *Juncus effusus* (Juncaceae), Apr. 1883, N.J. Ellis (No. 2396, New York Botanical Garden, holotype, labelled as *Cheiromyces prolifica* Ellis).

The overall conidial morphology of this fungus resembles that of *Cheiromyces* species, rather than that of *Dictyosporium* species. Damon (1952) did not consider this fungus to be a *Cheiromyces* and placed it in *Dictyosporium*, but he did not provide an explanation. Probably solely based on Damon's treatment, Sutton (1985) listed this fungus as an acceptable *Dictyosporium* species, but he did not provide a justification. Based on our observation of the type material (which was labelled as *Cheiromyces prolifica*), we would consider this fungus to be a *Cheiromyces* because its conidia are distoseptate.

13. ***Dictyosporium secalinum*** Delacr., Bulletin de la Société Mycologique de France 7: 109 (1891).

This species is considered to be synonymous with *D. elegans* (Damon, 1952).

14. ***Dictyosporium solani*** A.D. Sharma, R.L. Munjal and C.L. Jandaik, Indian Journal of Mycology and Plant Pathology 12: 214 (1982).

We have been unable to obtain the type material of this species (type locality: HCIO, New Delhi, India). From the original description and illustration by Sharma *et al.* (1982), it appears to be identical to *D. subramanianii*, also originally reported from India (see Subramanian, 1971; Sutton, 1985).

15. ***Dictyosporium verrucosum*** S.S. Tzean and J.L. Chen, Mycological Research 92: 500 (1989). (Figs. 81-83)

Material examined: TAIWAN, Taitung, dried culture of *D. verrucosum* originally isolated from a fallen stem in Tsubeu forestry recreation area, 30 Mar. 1987, S.S. Tzean and J.L. Chen (PPH1E 770, isotype).

This species has conidia which are verrucose. Sutton *et al.* (1996) provided a key to some mitosporic genera with cheiroid or digitate conidia, and confined *Dictyosporium* species to those with smooth-walled conidia. Based on an examination of the type material, we consider *D. verrucosum* to be synonymous with *Ramoconidiifera verrucosa* B. Sutton, Carmarán and A. I. Romero (Sutton *et al.*, 1996).

16. ***Dictyosporium yerbae*** Speg., Anales del Museo Nacional de Historia Natural de Buenos Aires 12: 138 (1909).

This is considered to be synonymous with *Monodictys paradoxum* (Corda) S. Hughes (Damon, 1952; Hughes, 1958; Sutton, 1985).

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