

Studies on the Amphisphaeriales I. The Clypeosphaeriaceae

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The Clypeosphaeriaceae is retained to include sixteen genera. *Apioclypea*, *Ceratostomella*, *Clypeophysalospora*, *Clypeosphaeria*, *Crassoascus*, *Jobellisia*, *Oxydothis* and *Urosporella* are described and illustrated, while *Apiorhynchostoma*, *Brunneiapiospora*, *Capsulospora*, *Duradens*, *Frondispora*, *Leiosphaerella*, *Pseudovalsaria* and *Stereosphaeria* are discussed. Genera in the Clypeosphaeriaceae are distinguished from those in the Amphisphaeriaceae (sensu stricto). Their ascomata are immersed and typically clypeate. Asci are 8-spored, unitunicate, cylindrical, with a J+ or J–, apical ring. Ascospores are usually ellipsoidal or cylindrical, brown or hyaline, unicellular, pseudoseptate or septate, at times with appendages or germ pores. The Clypeosphaeriaceae is considered a member of the Amphisphaeriales and the differences between the Clypeosphaeriaceae and Amphisphaeriaceae are discussed. We are unsure if the Clypeosphaeriaceae as we define it is monophyletic.

Key Words—Amphisphaeriaceae; Clypeosphaeriaceae; molecular studies; morphological features.

The paper is part of a series of papers on the Amphisphaeriaceae G. Winter (sensu lato) (Hawksworth et al., 1995). In previous papers we have 1) presented results of molecular studies on the Amphisphaeriaceae and shown the Amphisphaeriaceae (sensu stricto) to comprise species with *Pestalotia*-like anamorphs and 2) illustrated members of the Amphisphaeriaceae (sensu stricto) with a description of genera and representative species. In this paper we discuss the Clypeosphaeriaceae G. Winter and include 14 genera which have many morphological features in common, although we are unsure if the family is monophyletic.

The Clypeosphaeriaceae was originally introduced by Winter (1887) to include *Clypeosphaeria* Fuckel, *Anthostomella* Sacc., *Hypospila* Sacc., *Linospora* Fuckel and *Trabutia* Sacc. & Roum. It was later included in the family Gnomoniacei as the subfamily Clypeosphaeriei by Schröter (1897). Thereafter, the type genus *Clypeosphaeria* was placed either in the Xylariaceae Tul. & C. Tul. (Miller, 1949; Munk, 1957) or in the Amphisphaeriaceae (Dennis, 1978; Hawksworth et al., 1983). Petrak (1923) recognized the close relationship between *Clypeosphaeria* and *Apiorhynchostoma curreyi* (Rabenh.) Müller, while Eriksson and Hawksworth (1987) included *Clypeosphaeria* in the Amphisphaeriaceae.

Barr (1989) revived the Clypeosphaeriaceae with the type genus *Clypeosphaeria*, but excluded the other distantly related genera (i.e., *Anthostomella* Sacc., *Hypospila* Fr., *Linospora* Fuckel and *Trabutia* Sacc. & Roum.). *Apiorhynchostoma* Petr., *Melomastia* Nitschke & Sacc., *Saccardoella* Speg., *Endoxyla* Fuckel, *Urosporella* G. F. Atk. and *Pseudovalsaria* Spooner, which used to be considered somewhat related to the broadly defined Amphi-

sphaeriaceae (Eriksson and Hawksworth, 1987) were also transferred to the Clypeosphaeriaceae (Barr, 1990). Later, Barr (1994) added *Jobellisia* (Höhn.) M. E. Barr to the Clypeosphaeriaceae, and removed *Melomastia* and *Saccardoella* to the revived Pleurotremataceae Walt. Watson. Hawksworth et al. (1995) accepted nine genera in the Clypeosphaeriaceae which comprised *Apiorhynchostoma*, *Ceratostomella* Sacc., *Clypeosphaeria*, *Crassoascus* Checa, Barrasa & A. T. Martínez, *Duradens* Samuels & Rogerson, *Frondicola* K. D. Hyde, *Jobellisia*, *Melomastia* and *Pseudovalsaria*.

Molecular studies (Kang et al., 1998a) have indicated that *Apioclypea livistonae* K. D. Hyde, *Capsulospora* sp., *Clypeosphaeria mamillana* (Fr.) Lamb., and *Oxydothis frondicola* K. D. Hyde are not the members of the Amphisphaeriaceae (sensu stricto) (Kang et al., 1998b). They are, however, more closely related to the Amphisphaeriaceae than to the Xylariaceae which appear to be from another phylogenetic lineage. The existing family Clypeosphaeriaceae should therefore be retained to include these and other genera which were originally placed in the Amphisphaeriaceae (sensu lato) (Hawksworth et al., 1995). Their ascomata are immersed and typically clypeate. Asci are 8-spored, unitunicate, cylindrical, with a J+ or J–, apical ring, and ascospores are usually ellipsoidal or cylindrical, brown or hyaline, unicellular, pseudoseptate or septate, straight to slightly curved, and at times with appendages or germ pores. Most of these genera have not been linked to their anamorphs, while *Oxydothis* Penz. & Sacc. was reported to have *Selenosporella* anamorph (Samuels and Rossmann, 1987). In this study, the type species of *Clypeosphaeria* and the type or representative species of *Apioclypea*

K. D. Hyde, *Ceratostomella*, *Crassoascus*, *Clypeophysalospora* H. J. Swart, *Jobellisia*, *Oxydothis*, and *Urosporella* are described and illustrated, while *Apiorhynchostoma*, *Brunneiapiospora* K. D. Hyde, J. Fröhl & J. E. Taylor, *Capsulospora* K. D. Hyde, *Duradens*, *Frondispora* K. D. Hyde, *Leiosphaerella* Höhn., *Pseudovalsaria* and *Stereosphaeria* Kirschst. are discussed. A key to the genera included in the Clypeosphaeriaceae is provided.

Materials and Methods

Herbarium specimens were loaned from the herbaria BRIP, NY, PAD, MA and FH. Fresh material of *C. mamillana* was provided by M. E. Barr. The fungal structures were rehydrated and mounted in water. Sectioning of fungal ascomata was carried out on a cryotome and mounted in lactophenol.

Taxonomy

Clypeosphaeriaceae G. Winter, Rabenh. Krypt. -Fl.

Deutschl., Oesterr. Schweiz, 2 Aufl., 1 (2): 554. 1887.
Type: *Clypeosphaeria* Fuckel.

Unitunicate ascomycetes often with stromatic tissues consisting of host cells and fungal hyphae which may form blackened clypei. Ascomata immersed to erumpent, rarely superficial, globose or subglobose, ostiolate, papillate, singly or in small groups; peridium comprising layers of pigmented compressed cells; paraphyses hypha-like, septate, flexuose, numerous and embedded in a gelatinous matrix. Asci cylindrical or broadly cylindrical, pedicellate, persistent, apical ring usually present, usually wedge-shaped, amyloid or non-amyloid. Ascospores uniseriate to biseriate, brown or hyaline, ellipsoidal or fusiform, rarely rounded, straight or slightly curved, unicellular, apiosporous or septate, wall smooth or ornamented, at times with a mucilaginous sheath, apical appendages, or longitudinal striations, rarely with germ slits or germ pores.

Anamorphs: Unknown.

Mode of life: Saprobic or hemibiotrophic in wood or herbaceous stems.

Key to Accepted Genera of Clypeosphaeriaceae

- | | |
|--|---------------------------|
| 1. Ascospores aseptate | 2 |
| 1. Ascospores 1-3-septate | 6 |
| 2. Ascospores with appendages | 3 |
| 2. Ascospores with gelatinous sheath | 5 |
| 3. Ascospores filiform | <i>Duradens</i> |
| 3. Ascospores fusiform, with linear outgrowths at both ends | 4 |
| 4. Ascomata form under a diffuse stromata | <i>Frondispora</i> |
| 4. Ascomata immersed in the host | <i>Urosporella</i> |
| 5. Ascospores ovoid, with thin gelatinous sheath | <i>Clypeophysalospora</i> |
| 5. Ascospores broadly fusiform to ellipsoidal, with thick layered gelatinous sheath | <i>Capsulospora</i> |
| 6. Ascospores 1-septate | 7 |
| 6. Ascospores 2-3-septate | 13 |
| 7. Ascospores apiosporous | 8 |
| 7. Ascospores, equally bicelled | 10 |
| 8. Ascospores hyaline | <i>Apioclypea</i> |
| 8. Ascospores brown | 9 |
| 9. Ascospores with a germ pore at one end | <i>Apiorhynchostoma</i> |
| 9. Ascospores with a large brown cell and a small basal hyaline to light brown cell | <i>Brunneiapiospora</i> |
| 10. Ascospores brown, lunate or oblong ellipsoidal | 11 |
| 10. Ascospores hyaline, cylindrical | 12 |
| 11. Ascospores lunate, inequilateral, concave on one side, with a germ pore at one or both ends | <i>Jobellisia</i> |
| 11. Ascospores, oblong ellipsoidal, with a germ pore at one end | <i>Pseudovalsaria</i> |
| 12. Ascomata clypeate, perpendicular to the surface of the host, ascus ring discoid | <i>Leiosphaerella</i> |
| 12. Ascomata surrounded by stromatic tissue, perpendicular or parallel to the surface of the host, ascus ring wedge-shaped or discoid, with a faint canal leading to the apex of ascus | <i>Oxydothis</i> |

13. Ascospores hyaline, fusiform, ascal ring J- *Ceratostomella*
 13. Ascospores brown, ellipsoidal, ascal ring J+ 14
14. Ascospores 3-5-septate, with bipolar germ pores and cap-like appendages, ascal ring wedge-shaped
 *Crassoascus*
14. Ascospores apiosporous, with cap-like appendages on hyaline apical cell, or pseudoseptate, with germ pores at one end 15
15. Ascomata typically clypeate, ascal ring wedge-shaped, with a faint apical canal leading to the apex of ascus, ascospores pseudoseptate, smooth-walled *Clypeosphaeria*
15. Ascospores apiosporous, with apical hyaline cells and basal radiating germ slits or X- or Y-shaped germ pore in end opposite small cell, or in septum *Stereosphaeria*

Notes on genera studied in detail

Clypeosphaeria Fuckel, Jahrb. Nass.Ver. Naturk. **23/24**: 117. 1870.

Type species: *Clypeosphaeria mamillana* (Fr.) Lamb.
 Recent accounts: Barr, 1994; Hyde et al., 1998.

Ascomata visible as black dots on the host surface; in section globose, immersed, or ovoid, singly or in small groups, under well developed blackened clypeus; papilla black, erumpent; with a central, periphysate ostiolar canal. Peridium composed of several layers of compressed cells, outwardly dark brown, and inwardly light brown. Paraphyses hypha-like, flexuose, numerous, septate, and embedded in a gelatinous matrix. Asci 8-spored, broadly cylindrical, unitunicate, pedicellate, with a J+, wedge-shaped, subapical ring and a faint canal leading to the rounded apex. Ascospores overlapping uniseriate, ellipsoidal, brown, pseudoseptate, not constricted at the septum, smooth-walled.

Anamorph: Unknown.

Mode of life: Saprobic in wood.

Distribution: North America and Europe.

Clypeosphaeria mamillana (Fr.) Lamb., Mem. Soc. R. Sci. Liège, sér. 2, **14**: 128. 1887. Figs. 1-9
 For synonyms see Barr (1989).

Ascomata visible as black dots on the host surface; in section 400-500 μm in diam, immersed, globose, singly or in small groups, under well developed blackened clypeus; papilla black, erumpent; with a central periphysate ostiolar canal (Fig. 3). Peridium 20-25 μm wide, composed of layers of compressed cells, outwardly dark brown, inwardly light brown (Fig. 3). Paraphyses up to 2 μm wide, hypha-like, flexuose, numerous, and embedded in a gelatinous matrix. Asci 120-150 \times 8-12 μm (mean = 138 \times 10 μm , n = 5), 8-spored, cylindrical to cylindric-clavate, pedicellate, with a J+, wedge-shaped, subapical ring and a faint canal leading to the rounded apex (Figs. 1, 2, 8, 9). Ascospores 18-26 \times 6-8 μm (mean = 21 \times 7 μm , n = 5), overlapping uniseriate, ellipsoidal, brown, straight to slightly curved, 0-(1-3)-pseudoseptate, not constricted at the septum, smooth-walled (Figs. 4-7).

Material examined: Canada, British Columbia, Sidney, on *Quercus garryana*, 28 August 1994, M. E. Barr (HKUCC 3264).

Clypeosphaeria is based on the type species *C.*

mamillana which also typifies the family Clypeosphaeriaceae (Barr, 1989, 1990). *Clypeosphaeria* includes two other species, *C. perfidiosa* (De Not.) M. E. Barr and *C. americana* M. E. Barr & Samuels (Barr, 1989). However, if *Clypeosphaeria* is retained for 3-pseudoseptate, non apiosporous, non porate species, these other taxa should probably be excluded (Hyde et al., 1998).

Apioclypea K. D. Hyde, Bot. J. Linn. Soc. **116**: 316. 1994.

Type species: *Apioclypea livistonae* K. D. Hyde.

Recent accounts: Hyde, 1994a; Hyde et al., 1998.

Ascomata visible as blackened dots or weakly darkened regions; in vertical section globose or subglobose, immersed, with a central protruding periphysate ostiolar canal, clypeus poorly developed. Peridium comprising several layers of flattened and angular cells. Paraphyses hypha-like, flexuose, septate, numerous, and embedded in a gelatinous matrix. Asci 8-spored, cylindrical, unitunicate, apically rounded, with a J+ or J-, discoid, subapical ring. Ascospores overlapping uniseriate, apiosporous, hyaline, surrounded by a mucilaginous sheath, basal cell small.

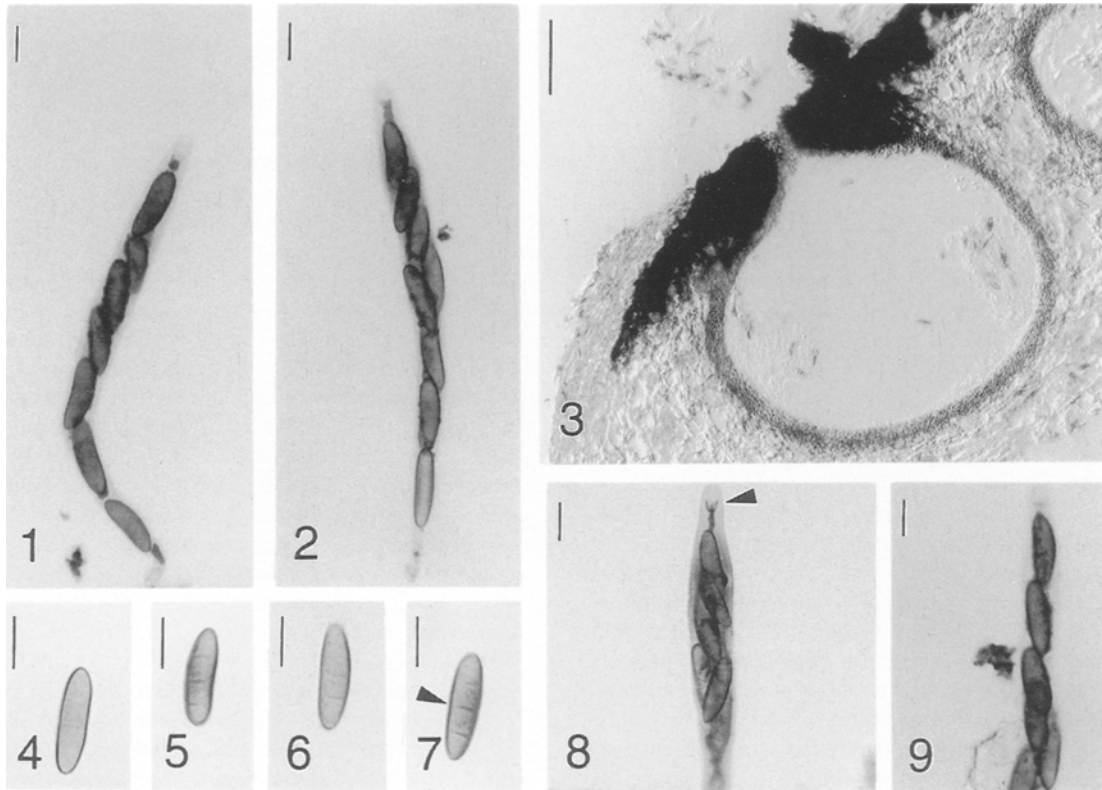
Anamorph: Unknown.

Mode of life: Saprophytic on palms.

Distribution: Mainly tropical.

Apioclypea livistonae K. D. Hyde, Bot. J. Linn. Soc. **116**: 317. 1994. Figs. 10-18

Ascomata visible as blackened dots in a bleached area on the host surface; in vertical section 224 μm high, 384 μm in diam, immersed, subglobose, with a central protruding ostiolar canal, 96 μm wide, internally lined by hyaline, paraphyses (Fig. 10). Peridium 22-35 μm wide, comprising several layers of flattened and angular cells, dark brown outwardly, and inwardly hyaline (Fig. 12). Paraphyses up to 3.2 μm in diam, hypha-like, flexuose, septate, numerous, and embedded in a gelatinous matrix (Fig. 13). Asci 115-136 \times 8-11 μm (mean = 124 \times 9.2 μm , n = 10), 8-spored, cylindrical, unitunicate, apically rounded, with a J-, subapical ring, 0.8-1.6 μm high, 1.6-2.4 μm in diam, and a faint canal leading to the apex (Figs. 11, 14, 15). Ascospores 13-18 \times 5-6 μm (mean = 15.8 \times 6.1 μm , n = 10), overlapping uniseriate, apiosporous, hyaline, with a septum near the base and a cap-like apical small cell, constricted at the septum and surrounded by a thick layered mucilaginous sheath (Figs.



Figs. 1–9. Interference light micrographs of *Clypeosphaeria mamillana* (HKUCC 3264).

1, 2, 8, 9. Asci. Note the J+, wedge-shaped, subapical ring (arrowed). 3. Vertical section through ascoma, which are immersed under a relatively large clypeus. 4–7. Ascospores. Note the pseudoseptata (arrowed). Scale bars: 3=100 μm ; 1, 2, 4–9=10 μm .

16–18).

Material examined: Papua New Guinea, Western Province, Bensbach, on dead rachis of *Livistona* sp., May 1992, K. D. Hyde 1365a (BRIP 22263, holotype).

The monotypic genus *Apioclypea* was erected by Hyde (1994a) to accommodate *A. livistonae*. Subsequently four species were added by Hyde et al. (1998). The hyaline unequally bicelled ascospores with a cap-like small apical cell of *Apioclypea* is quite distinctive, but resemble those of *Apiospora* Sacc. and *Pseudomassaria* Jacz. in the Hyponectriaceae (Eriksson and Hawksworth, 1993). However, both *Apiospora* and *Pseudomassaria* have clavate asci and ascospores without a mucilaginous sheath, and *Apiospora* species have an *Arthrinium* Kunze or *Cordella* Speg. anamorph. The blackened clypeus and immersed subglobose ascomata of *Apioclypea* indicate that it appears to have an affinity with *Clypeosphaeria* which however differs in having brown ascospores. At present it is considered best to include this genus in the Clypeosphaeriaceae until further research into the morphology and molecular phylogeny can be carried out.

***Ceratostomella* Sacc.,** *Michelia* 1: 370. 1878.

Type species: *Ceratostomella rostrata* (Fuckel) Sacc.

Recent accounts: Barr, 1993.

Ascomata visible as raised blackened areas on the

host surface; in vertical section globose, immersed, with a central periphysate beaked ostiolar canal. Peridium comprising several layers of compressed, blackened cells. Paraphyses hypha-like, flexuose, septate and embedded in a gelatinous matrix. Asci 8-spored, cylindrical to cylindric-clavate, apically rounded, with a J–, subapical ring. Ascospores overlapping uniseriate or biseriate, ellipsoidal-fusiform, hyaline, 1–3-septate, smooth-walled.

Anamorph: Unknown.

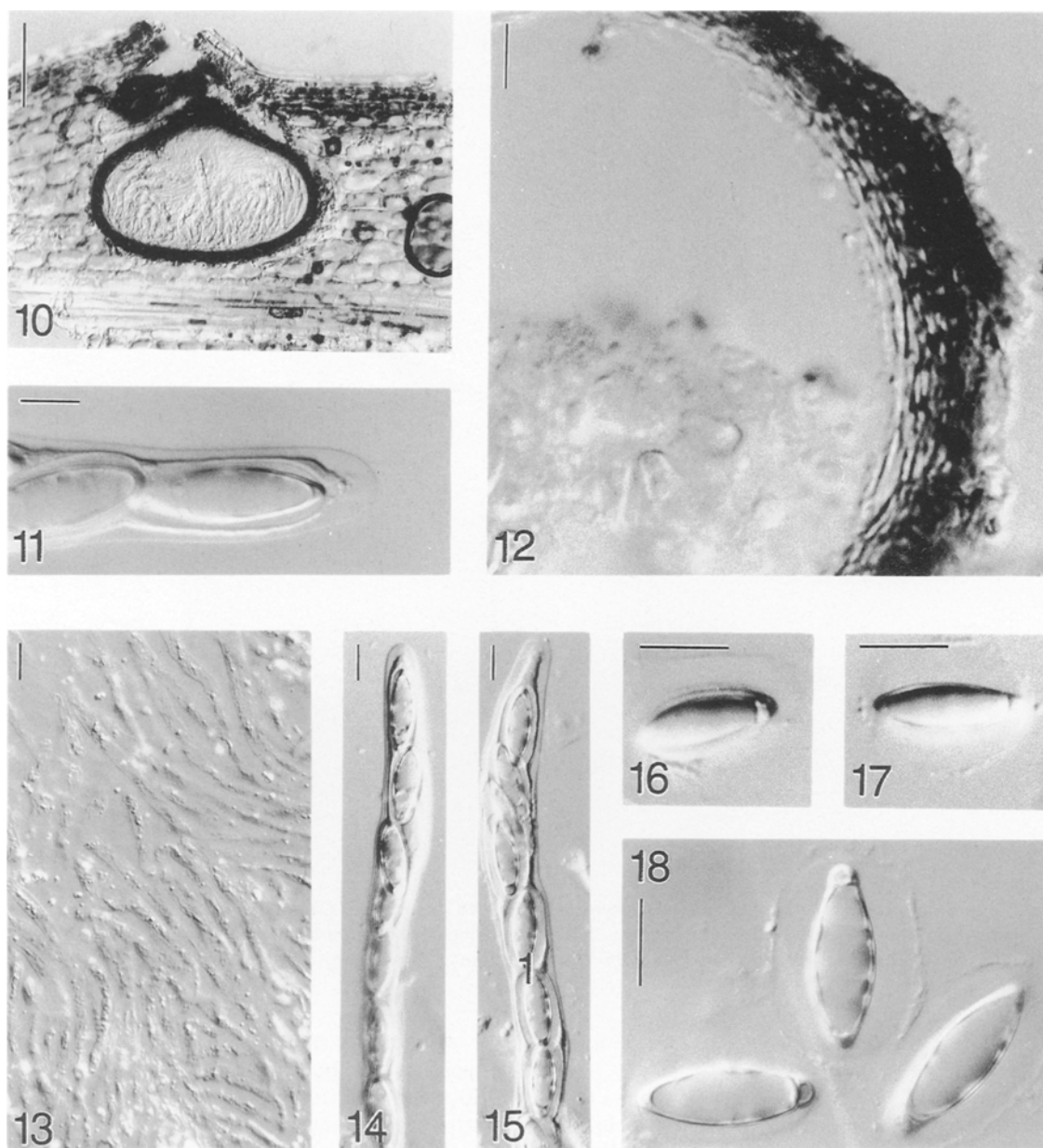
Mode of life: Saprophytic in old wood.

Distribution: World wide.

***Ceratostomella conica* (Ellis & Everh.) M. E. Barr,** *Mycotaxon* 46: 60. 1993. Figs. 19–28

\equiv *Ceratostoma conicum* Ellis & Everh., *Proc. Acad. Nat. Sci. Philadelphia* 42: 226. 1890.

Ascomata visible as raised blackened areas on the host surface (Fig. 21); in vertical section 300–500 μm in diam, immersed, globose, with a central periphysate protruding ostiolar canal 115 μm long, 70 μm wide (Fig. 20). Peridium 22–38 μm wide, comprising several layers of compressed, blackened cells (Fig. 19). Paraphyses up to 3.2 μm in diam, hypha-like, flexuose, septate and embedded in a gelatinous matrix. Asci 67–96 \times 8–10 μm (mean = 82 \times 9 μm , n = 10), 8-spored, cylindrical, apically rounded, with a J–, apical ring (Figs. 22–24). Asco-



Figs. 10–18. Interference light micrographs of *Apioclypea livistonae* (BRIP 22263, holotype).

10. Vertical section through ascoma. 11. Ascus apex, with J—, subapical ring and a faint canal leading to the apex. 12. Peridium. 13. Paraphyses embedded in a gelatinous matrix. 14, 15. Asci. 16–18. Ascospores. Note the small basel cell and a surrounding gelatinous sheath. Scale bars: 10=100 μm ; 11–18=10 μm .

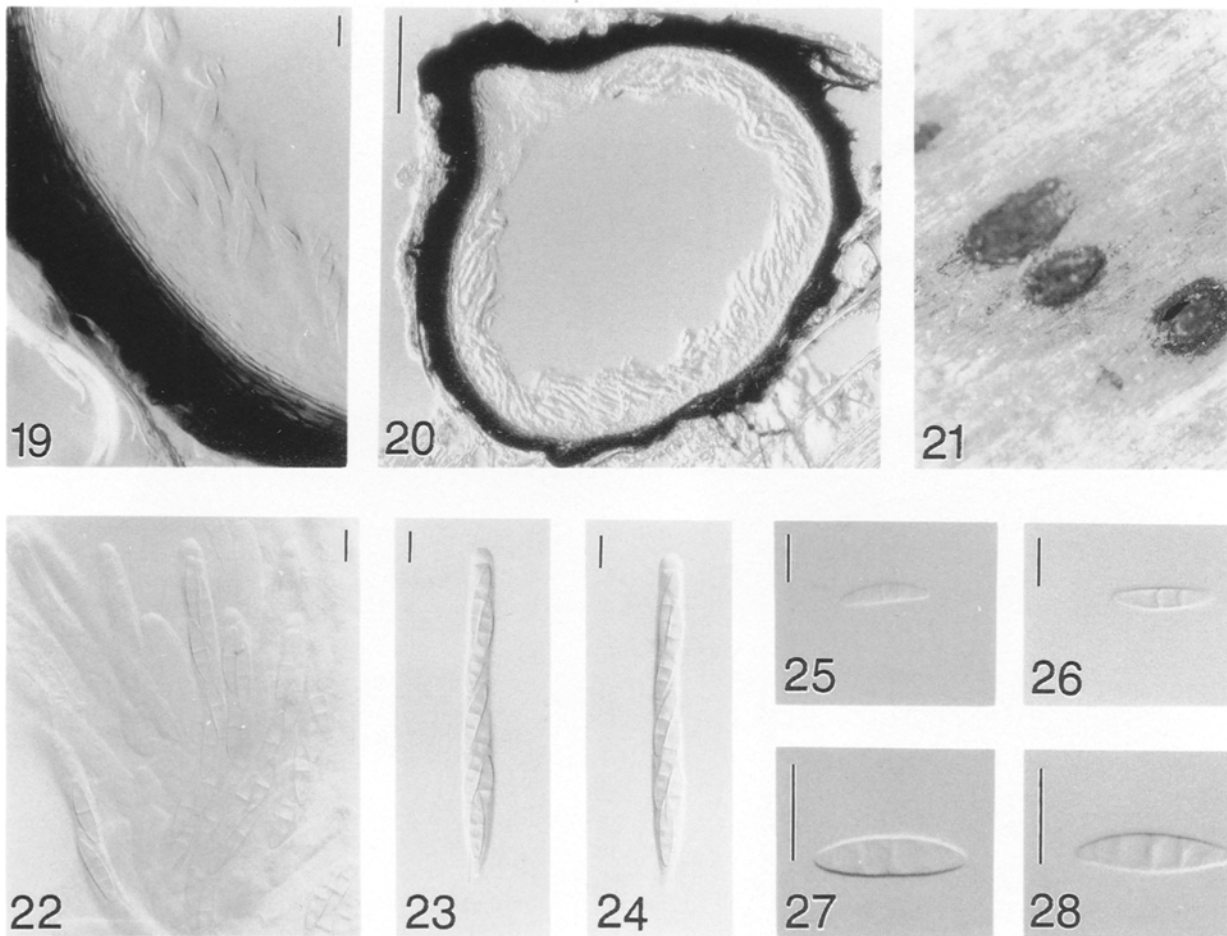
spores 16–19 \times 3.2–4.8 μm (mean=17 \times 3.9 μm , n=10), overlapping uniseriate or biseriata, fusiform, hyaline, (1)3–(4–5)-septate, smooth-walled (Figs. 25–28).

Material examined: U.S.A., New Jersey, Newfield, on rotten pine logs, July 1889, J. B. Ellis (NY, holotype of *C. conicum*).

Clements and Shear (1931) chose *C. rostrata* as the type species and there are more than 50 names in the genus. We were unable to locate type material of *C. rostrata* and therefore examined the more readily avail-

able *C. conica* (*Ceratostoma conicum*) which was re-described by Barr (1993) and is chosen to illustrate the genus in this study. There are no recent monographs of this genus which is in need of revision. *Ceratostomella* is presently included in the Clypeosphaeriaceae by Barr (1993). The phylogenetic lineage remains uncertain and morphological and molecular studies are needed to establish its affinities.

Clypeophysalospora H. J. Swart, Trans. Br. Mycol. Soc. 76: 93. 1981.



Figs. 19–28. Interference light micrographs of *Ceratostomella conica* (NY, holotype of *Ceratostoma conicum*).

19. Peridium. 20. Vertical section through ascoma. 21. Appearance of ascomata on host surface. 22–24. Asci, with a J–, subapical ring. Note the rounded thickened apex. 25–28. Ascospores. Scale bars: 20 = 100 μm ; 19, 22–28 = 10 μm .

Type species: *Clypeophysalospora latitans* (Sacc.) H. J. Swart.

Recent accounts: Swart, 1981.

Ascomata visible as erumpent, hemispherical, black regions on the host surface; in vertical section globose, immersed, clypeate, with a central periphysate ostiolar canal. Peridium comprising several layers of brown, compressed cells. Clypeus composed of dark brown compressed host cells and fungal hyphae. Paraphyses hypha-like, flexuose, septate, numerous, hyaline, and embedded in a gelatinous matrix. Asci 8-spored, cylindrical, unitunicate, pedicellate, apically rounded, with a J+, discoid, subapical ring. Ascospores overlapping uniseriate, ovoid, hyaline, unicellular, surrounded by a thin mucilaginous sheath.

Anamorph: Unknown.

Mode of life: Saprophytic in leaves.

Distribution: Only known from Australia.

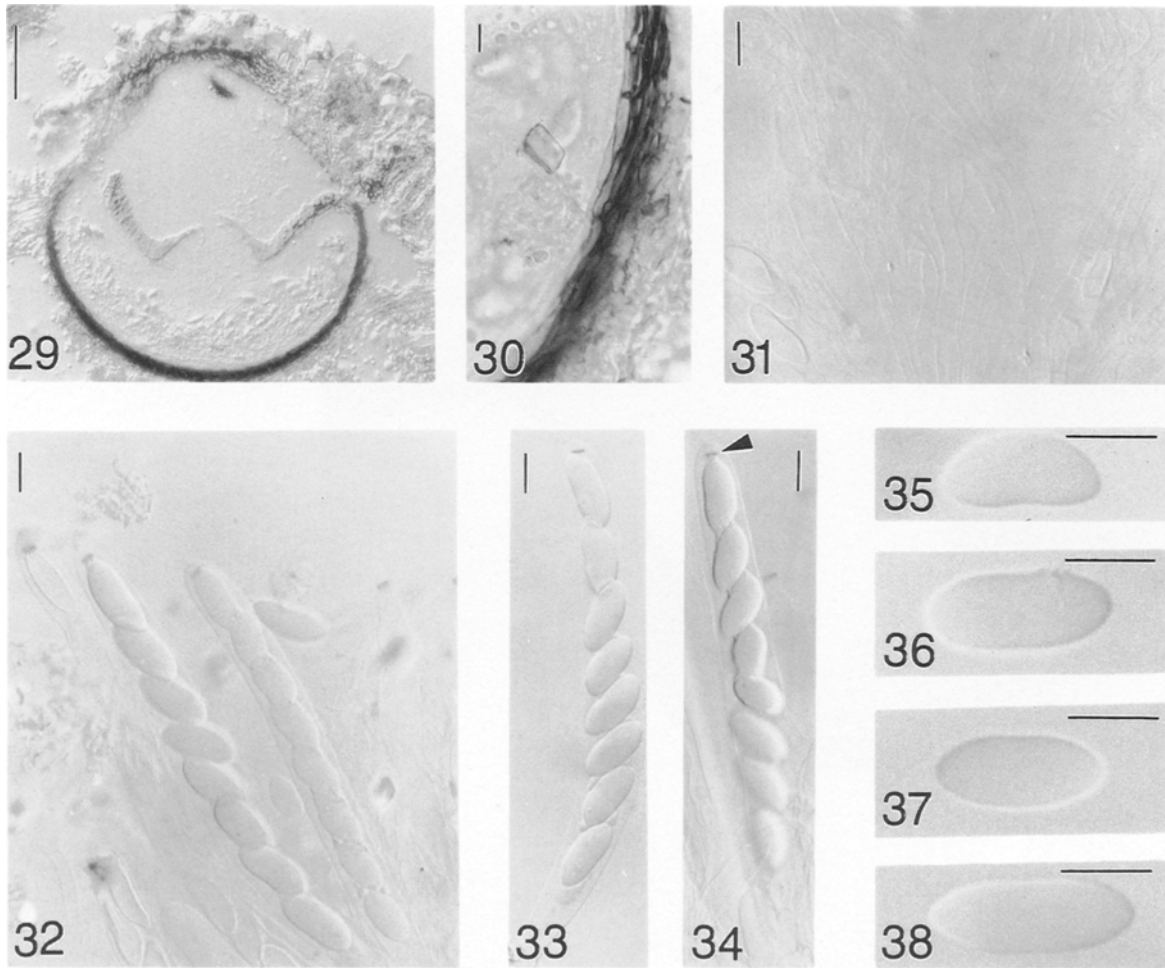
Clypeophysalospora latitans (Sacc.) H. J. Swart, Trans. Br. Mycol. Soc. **76**: 95. 1981. Figs. 29–38

For synonyms see Swart (1981).

Ascomata visible as erumpent, hemispherical, black region on the host surface; in vertical section 320–450 μm in diam, immersed, globose, clypeate, with a central periphysate ostiolar canal (Fig. 29). Peridium 13–16 μm wide, comprising several layers of brown compressed cells (Fig. 30). Clypeus composed of dark brown compressed host cells and fungal hyphae (Fig. 29). Paraphyses up to 6.4 μm in diam, hypha-like, flexuose, septate, numerous, hyaline, and embedded in a gelatinous matrix (Fig. 31). Asci 115–141 \times 11–16 μm (mean = 125.3 \times 14.2 μm , $n=10$), 8-spored, cylindrical, pedicellate, apically rounded, with a J+, discoid, subapical ring, 0.8 μm high (Figs. 32–34). Ascospores 13–22 \times 6–9 μm (mean = 17.6 \times 7.8 μm , $n=10$), overlapping uniseriate, ovoid, hyaline, unicellular, slightly curved, surrounded by a thin mucilaginous sheath (Figs. 35–38).

Material examined: Australia, Meningie, on dead leaves of *Eucalyptus* sp., no date given, L. D. Williams (PAD, lectotype of *Physalospora latitans* Sacc.).

Clypeophysalospora was introduced to accommodate a single species *C. latitans*, which is a combination



Figs. 29–38. Interference light micrographs of *Clypeophysalospora latitans* (PAD, lectotype of *Physalospora latitans*).
 29. Vertical section through ascoma. 30. Peridium. 31. Paraphyses. 32–34. Asci with J+, discoid, subapical ring (arrowed).
 35–38. Ascospores. Scale bars: 29 = 100 μm ; 30–38 = 10 μm .

based on the original *P. latitans* (Swart, 1981). It was disposed into the broadly defined Amphisphaeriaceae (Hawksworth et al., 1995). The blackened clypeus of *Clypeophysalospora* is similar to that of *Clypeosphaeria*. Its ascospores are hyaline and unicellular which resemble those of *Iodosphaeria* Samuels, *Urosporella*, *Xylochora* Arx & E. Müll. and *Capsulospora*. *Clypeophysalospora* is best placed in the Clypeosphaeriaceae until further studies can be carried out.

Crassoascus Checa, Barrasa & A. T. Martínez, Mycotaxon 46: 300. 1993.

Type species: *Crassoascus fusisporus* Checa, Barrasa & A. T. Martínez.

Recent accounts: Barrasa et al., 1993; Barr, 1994.

Ascomata visible as erumpent black dots, separate or gregarious, on the host surface; in vertical section, subglobose, immersed, with an eccentric periphysate ostiolar neck. Peridium comprising several layers of brown-walled textura globulosa. Paraphyses hypha-like, flexuose, numerous, hyaline, and embedded in a

gelatinous matrix. Asci 8-spored, cylindrical, unitunicate, pedicellate, apically rounded, with a J+, wedge-shaped, subapical ring. Ascospores biseriolate, fusiform, 3–5-septate, brown, apiculate at both ends with a conspicuous terminal pore and hyaline refractive cap-like appendages.

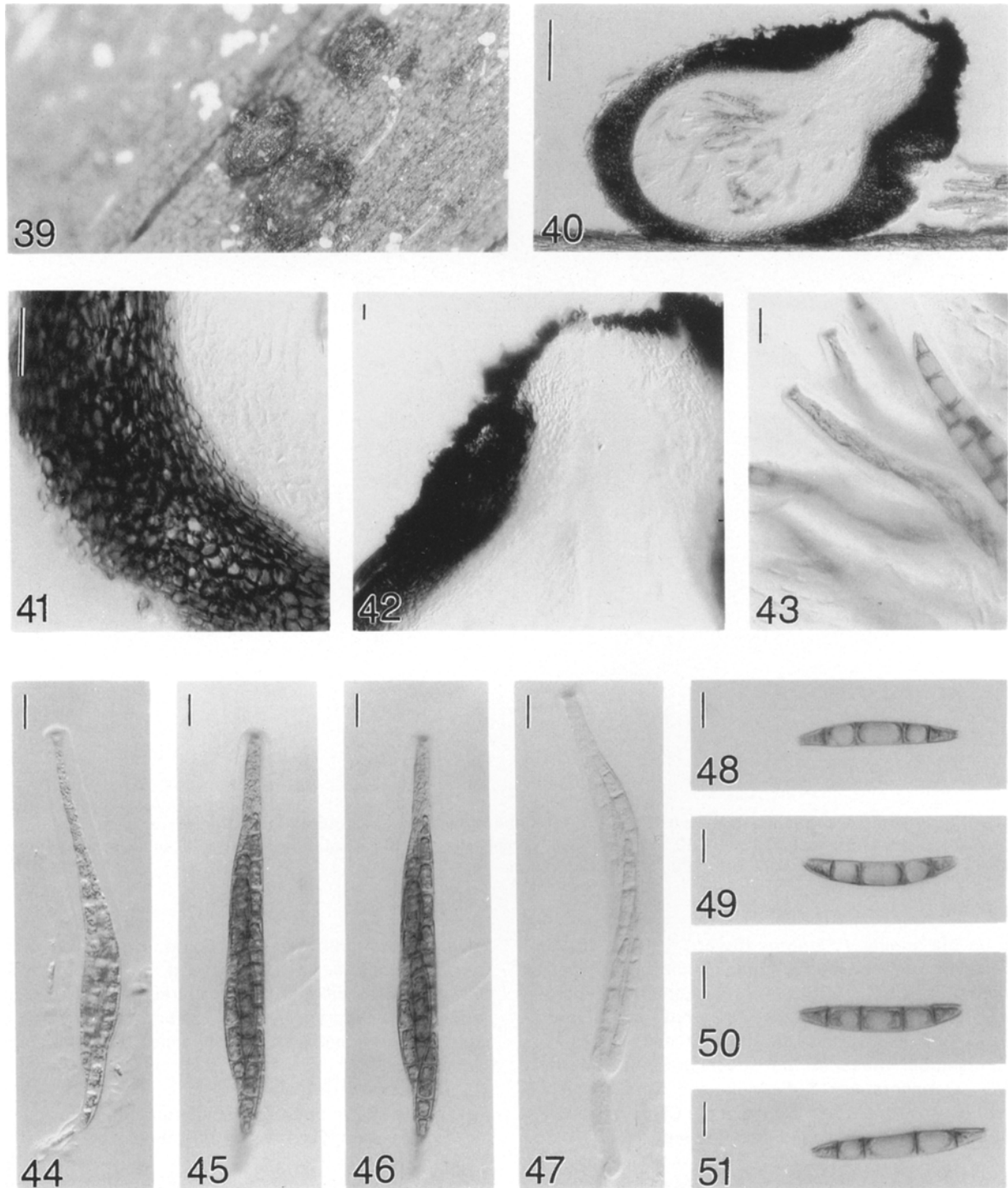
Anamorph: Unknown.

Mode of life: Saprophytic in wood.

Distribution: Europe, North America.

Crassoascus fusisporus Checa, Barrasa & A. T. Martínez, Mycotaxon 46: 302. 1993. Figs. 39–51

Ascomata visible as erumpent black areas, separate or gregarious, on the host surface (Fig. 39); in vertical section 256 μm high, 384 μm in diam, immersed, subglobose, with an eccentric neck, 147 μm long, 160 μm wide, internally lined by hyaline, periphyses (Figs. 40, 42). Peridium 19–28 μm wide comprising outer layers of brown-walled textura globulosa and inner layers of compressed cells (Figs. 41, 42). Paraphyses up to 2 μm diam, hypha-like, flexuose, septate, numerous, hyaline,



Figs. 39–51. Interference light micrographs of *Crassoascus fusisporus* (MA, holotype).

39. Appearance of ascomata on host surface. 40. Vertical section through ascoma. 41. Peridium. 42. Ostiolar canal internally lined by hyaline periphyses. 43–47. Asci. Note the wedge-shaped, J+, subapical rings. 48–51. Ascospores. Note the conspicuous terminal pore or the hyaline refractive cap-like appendages. Scale bars: 40=100 μm ; 41–51=10 μm .

and embedded in a gelatinous matrix. Asci 112–166 \times 13–16 μm (mean=134.7 \times 14.1 μm , n=10), 8-spored, cylindric-clavate, pedicellate, apically rounded, with a J+, wedge-shaped, subapical ring, 2.4 μm high, 4.8 μm

in diam (Figs. 43–47). Ascospores 37–43 \times 6–8 μm (mean=40.5 \times 7 μm , n=10), biseriata, fusiform, 3–5-septate, not constricted at the septa, brown, apiculate at both ends, with a conspicuous terminal pore and

hyaline refractive cap-like appendages (Figs. 48–51).

Material examined: Spain, Cáceres, Puerto de la Cañadilla, Natural Park of Monfragüe, on dead branches of *Erica arborea* L., 21 June 1989, J. Checa, J. M. Barrasa and M. N. Blanco FUNGI 26331 (MA, holotype).

Crassoascus was established by Barrasa et al. (1993) based on the type species *C. fusisporus* and was included in the Clypeosphaeriaceae. Barr (1994) added the second species *C. canadensis* M. E. Barr and transferred *Crassoascus* to the Amphisphaeriaceae. At present it would be appropriate to include *Crassoascus* in the Clypeosphaeriaceae. However, the peridium of textura globulosa and arrangement of ascospores are atypical.

Jobellisia M. E. Barr, Mycotaxon **46**: 60. 1993.

Type species: *Jobellisia luteola* (Ellis & Everh.) M. E. Barr.

Recent accounts: Barr, 1994.

Ascomata visible as raised, blackened areas on the host surface; in vertical section globose, erumpent or superficial, with a central periphysate ostiolar canal. Peridium comprising several layers of light brown angular cells. Paraphyses hypha-like, flexuose, septate, numerous, hyaline, and embedded in a gelatinous matrix. Asci 8-spored, cylindrical, unitunicate, apically rounded, with a J-, subapical ring. Ascospores uniseriate, lunate, inequilateral, with one side concave, curved, unicellular or bicelled, not constricted at the septum, brown, with a terminal germ pores at one or both ends.

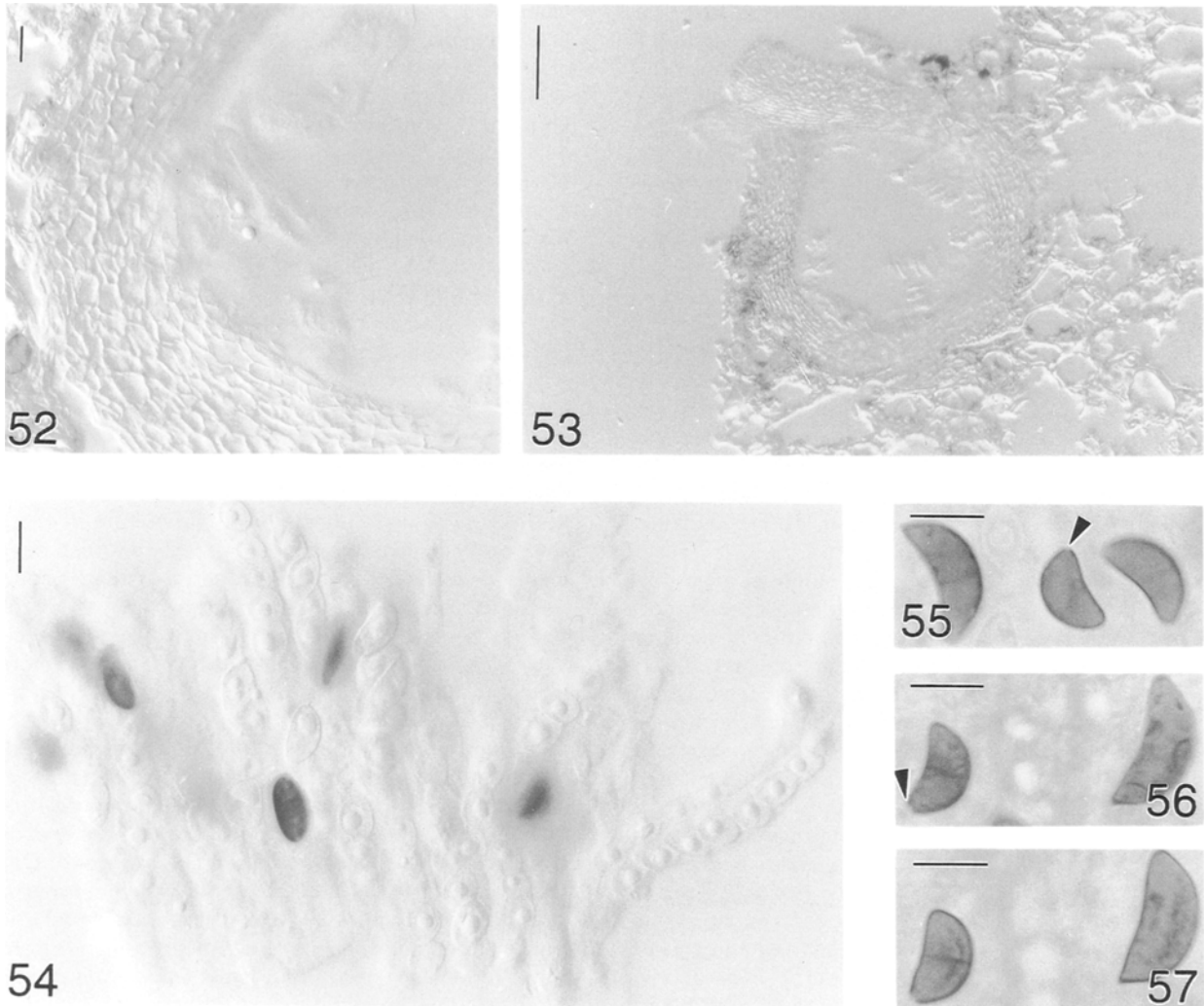
Anamorph: Unknown.

Mode of life: Saprophytic in wood.

Distribution: Austria, North America and Nicaragua.

Jobellisia rhynchostoma (Höhn.) M. E. Barr, Mycotaxon **51**: 208. 1994. Figs. 52–57

≡ *Letendraea rhynchostoma* Höhn., Sitzungsber. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl. Abt.



Figs. 52–57. Interference light micrographs of *Jobellisia rhynchostoma* (FH, holotype of *Letendraea rhynchostoma*).

52. Peridium. 53. Vertical section through ascoma. 54. Asci. 55–57. Ascospores, with one or two terminal germ pores (arrowed). Scale bars: 53=100 μ m; 52, 54–57=10 μ m.

1, 116: 108. 1907.

Ascomata visible as raised, blackened areas on the host surface; in vertical section 350–420 μm in diam, erumpent or superficial, globose, with a central periphysate ostiolar canal (Fig. 53). Peridium 45–64 μm wide, comprising several layers of light brown angular cells (Fig. 52). Paraphyses up to 3 μm in diam, hypha-like, flexuose, septate, numerous, hyaline, and embedded in a gelatinous matrix. Asci 65–90 \times 6–11 μm (Barr, 1994), 8-spored, cylindrical, apically rounded, with a J–, subapical ring (Fig. 54). Ascospores 14–24 \times 6–8 μm (mean = 17 \times 7 μm , n = 10), uniseriate, lunate, inequilateral, with one side concave, curved, bicelled, not constricted at the septum, brown, with a terminal germ pores at one or both ends (Figs. 55–57).

Material examined: Austria, near Vienna, Prater (Donau), on pericarps of *Juglans regia* L., 19 Aug. 1906, F. V. Höhnelt 2845 (FH, holotype of *L. rhynchostoma*).

Jobellisia was introduced with *J. luteola* as the type species, which was formerly known as *Letendreaea luteola* Ellis & Everh. (Hypocreales). A second species *J. nicaraguensis* (Ellis & Everh.) M. E. Barr was also described and later Barr (1994) transferred *L. rhynchostoma* to *J. rhynchostoma*. The type material of *J. luteola* was unavailable at the time of study and therefore *J. rhynchostoma* was loaned and studied to illustrate the genus. Its unilocular asci with J– subapical ring and the unicellular or bicelled brown ascospores with terminal germ pores are quite distinctive. It is presently placed in the Clypeosphaeriaceae, but its phylogenetic lineage requires further investigation.

Oxydothis Penz. & Sacc., *Malpighia* 11: 505. 1897.

= *Merrilliopeltis* Henn., *Hedwigia* 47: 261. 1908.

= *Plagiothecium* Schrantz, *Bull. Soc. Mycol. Fr.* 76: 335. 1960.

= *Plagiolagnion* Schantz, *Bull. Soc. Mycol. Fr.* 78: 218. 1962.

Type species: *Oxydothis grisea* Penz. & Sacc.

Recent accounts: Hyde, 1993a, b, 1994b; Fröhlich and Hyde, 1994.

Ascomata visible as black areas, singly or aggregated in small groups, in slightly raised, dome-shaped, darkened areas; in vertical section immersed, cylindrical or subglobose, clypeate, long axis parallel, oblique or perpendicular to the host surface, with central or eccentric periphysate ostiolar canal. Stromata variable, a clypeus or well-developed tissue surrounding the ascomata, composed of brown, thick-walled host cells and darkened fungal hyphae. Peridium comprising a few layers of compressed brown cells, at times integrated with stromatic tissue. Paraphyses hypha-like, flexuose, septate, hyaline, and embedded in a gelatinous matrix. Asci 8-spored, cylindrical or cylindrical-clavate, pedicellate, with a J+, wedge-shaped or discoid subapical ring and a faint canal leading to the apex. Ascospores overlapping uniseriate to multiseriate, long-fusiform to filiform, tapering from the broad centre to acute or rounded ends, hyaline, bicelled, with a central septum, not constricted at the septum.

Anamorph: Unknown for most species. A *Selenosporella* anamorph was reported for *Oxydothis selenosporellae* Samuels & Rossman (Samuels and Rossman, 1987).

Mode of life: Saprobic, endophytic or parasitic on petioles or leaves of palms, rarely on bamboo and Pandanaceae.

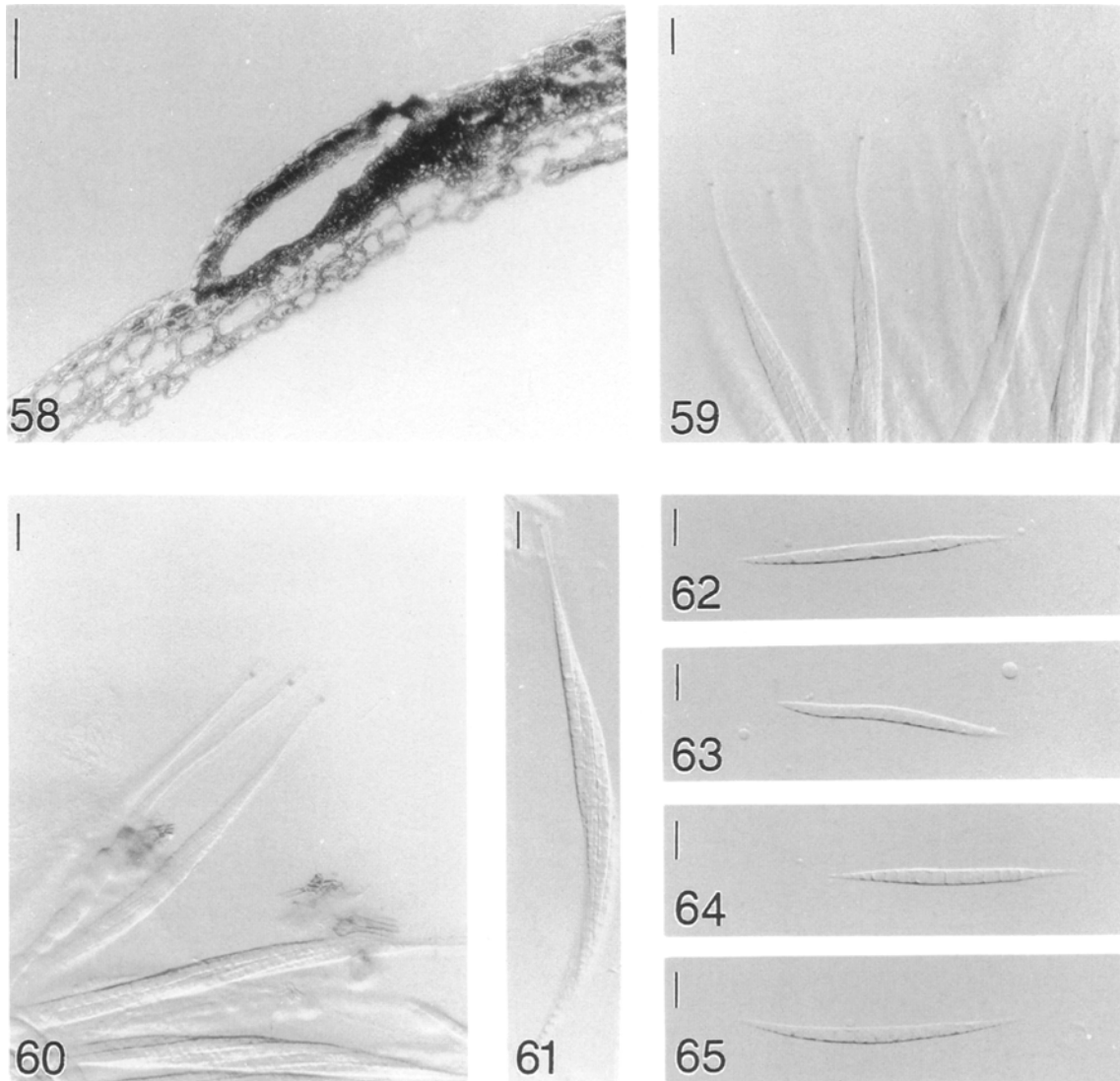
Distribution: Tropical and subtropical.

Oxydothis frondicola K. D. Hyde, *Sydowia* 45: 234. 1993. Figs. 58–65

Ascomata visible as black areas, singly or aggregated in small groups, in slightly raised, dome-shaped, darkened areas; in vertical section 420–480 μm in diam, 55–75 μm high, immersed, cylindrical or subglobose, clypeate, long axis parallel to the host surface, with a periphysate ostiolar canal curving upwards (Fig. 58). Stromatic tissue surrounding the ascomata, composed of brown, thick-walled host cells and blackened fungal hypha. Peridium 11–15 μm wide, comprising a few layers of compressed brown cells, integrated with stromatic tissue (Fig. 58). Paraphyses up to 2 μm in diam, hypha-like, flexuose, septate, hyaline and embedded in a gelatinous matrix. Asci 150–204 \times 8–10 μm (mean = 186 \times 9 μm , n = 10), 8-spored, cylindrical, pedicellate, with a J+, wedge-shaped subapical ring, 2 μm in diam, 2–3 μm high, and a faint canal leading to the apex (Figs. 59–61). Ascospores 74–90 \times 3–5 μm (mean = 81 \times 4 μm , n = 10), multiseriate, hyaline, long-fusiform to filiform, tapering from the broad centre to acute or rounded ends, bicelled, with a central septum, not constricted at the septum (Figs. 62–65).

Material examined: Philippines, Mindarao, Bukidon, on palm petiole, Dec. 1993, K. D. Hyde (HKUCC 3173).

Oxydothis was established by Penzig and Saccardo (1897) with the type species *O. grisea* Penz. & Sacc. and two other species *O. nigricans* Penz. & Sacc. and *O. maculosa* Penz. & Sacc. Currently forty one species have been accepted in the genus (Hyde, 1993a, b, 1994b). We were unable to obtain culture of the type species for molecular studies, but isolated fresh cultures for *O. frondicola* which we collected in the Philippines. As this is a representative species it is also described and illustrated. It is distinguished by long cylindrical asci and hyaline, bicelled, long-fusiform ascospores. Its morphological features specifically resemble that of *Leiosphaerella*. Samuels and Rossman (1987) have found that the asci in *Oxydothis*, *Leiosphaerella*, *Leptotypha* Petr. and some other amphispheariaceous taxa have anatomical similarities. They also reported that a *Selenosporella* anamorph was linked to *O. selenosporellae*. In spite of success in culturing a number of *Oxydothis* species (Hyde, 1994b), non of them formed anamorphs. Most species in *Oxydothis* are saprophytic on leaves or petioles of palms or leaves of *Pandanus* species. However one species in this genus *O. parasitica* J. Fröhl. & K. D. Hyde was found to be a pathogen on *Licuala ramsayi* (Fröhlich and Hyde, 1994) and several are thought to be endophytes (Hyde et al., 1996). The results of molecular studies have shown that *Oxydothis* does not



Figs. 58–65. Interference light contrast micrographs of *Oxydothis frondicola* (HKUCC 3173).

58. Vertical section through ascoma. 59–61. Asci with a J+, subapical ring and a faint canal leading to the apex. 62–65. Ascospores. Bars: 58=100 μm ; 59–65=10 μm .

have phylogenetic relationships with either Amphisphaeriaceae (sensu stricto) or Xylariaceae (Kang et al., 1998a). This genus is presently placed in the Clypeosphaeriaceae pending further phylogenetic study.

Urosporella G. F. Atk., Bull. Cornell Univ. (Sci.) 3: 9. 1897.

Type species: *Urosporella americana* G. F. Atk.

Recent accounts: Barr, 1966.

Ascomata visible as blackened, raised, oval regions on the host surface; in vertical section subglobose or globose, immersed to erumpent, with a central protruding periphysate ostiolar canal. Peridium comprising several layers of brown, compressed cells. Paraphyses hypha-like, flexuose, septate, numerous and embedded in a gelatinous matrix. Asci 8-spored, cylindrical, pedicellate, apically rounded, with a J–, discoid, apical ring.

Ascospores overlapping uniseriate, fusiform, hyaline, unicellular, tapering towards the acute ends, with linear outgrowths at both ends.

Anamorph: Unknown.

Mode of life: Saprophytic in wood or herbaceous stalks.

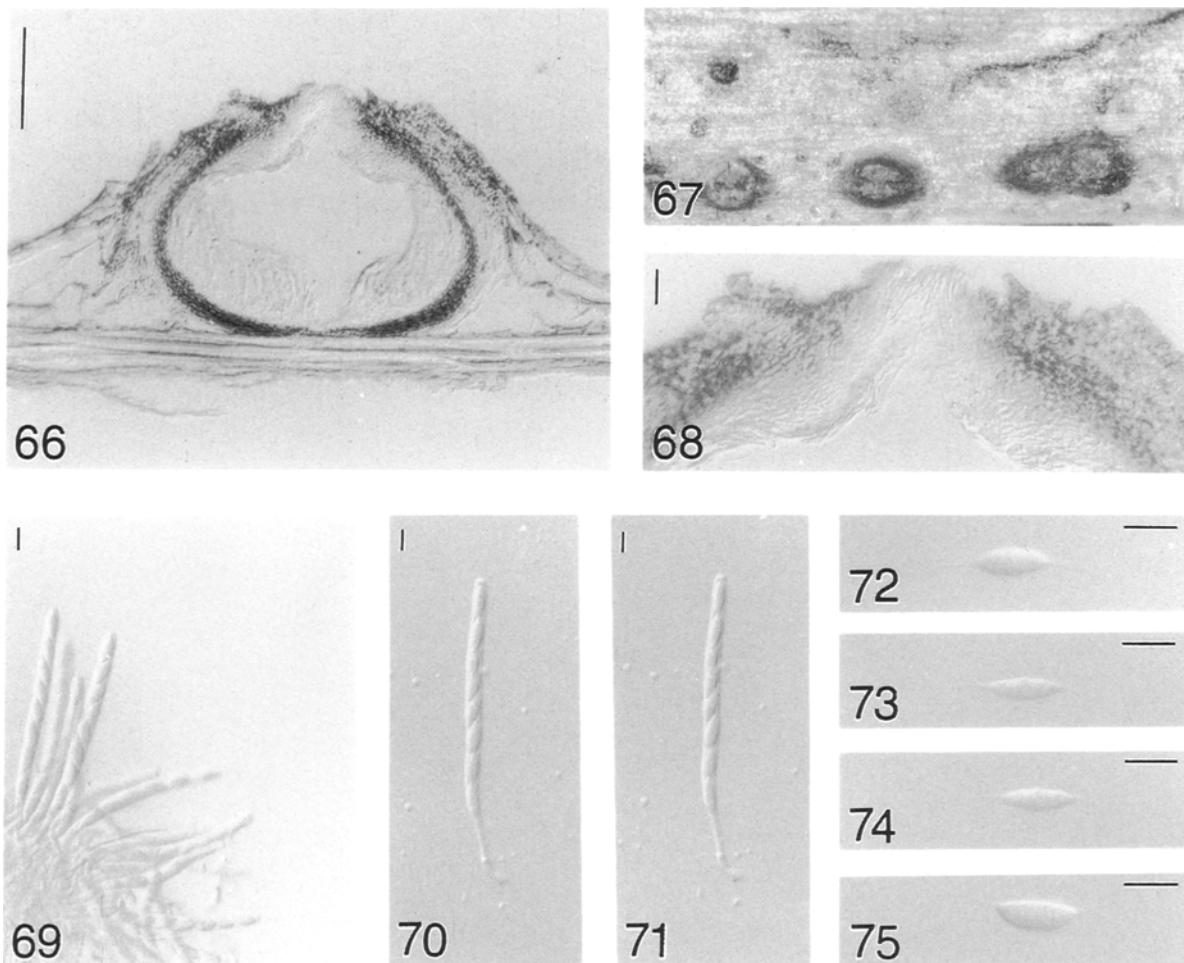
Distribution: North and South America.

Urosporella alabamensis (Ellis & Everh.) M. E. Barr, Mycologia 58: 690. 1966. Figs. 66–75

\equiv *Ceriospora alabamensis* Ellis & Everh., North American Pyrenomycetes: 391. 1892.

\equiv *Urosporella americana* G. F. Atk., Bull. Cornell Univ. (Sci.) 3: 9. 1897.

Ascomata visible as blackened, raised, circular regions on the host surface (Fig. 67); in vertical section 272 μm high, 320 μm in diam, subglobose or globose, im-



Figs. 66–75. Interference light micrographs of *Urosporella alabamensis* (NY 1770, holotype of *Ceriospora alabamensis*). 66. Vertical section through ascoma. 67. Appearance of ascomata on host surface. 68. Ostiolar canal internally lined with hyaline periphyses. 69–71. Asci with a J–, subapical ring. 72–75. Ascospores with linear appendages. Scale bars: 66 = 100 μm ; 68–75 = 10 μm .

mersed to erumpent, with a central protruding periphysate ostiolar canal, 48 μm wide, internally lined by hyaline periphyses (Figs. 66, 68). Peridium 10–22 μm wide, comprising several layers of brown, compressed cells (Figs. 66, 68). Paraphyses up to 4.8 μm in diam, hypha-like, flexuose, septate, numerous, and embedded in a gelatinous matrix. Asci 96–120 \times 6.4–8 μm (mean = 111.5 \times 7 μm , $n=10$), 8-spored, cylindrical, pedicellate, apically rounded, with a J–, apical ring, 2.4 μm diam (Figs. 69–71). Ascospores 14.4–16 \times 4–6.4 μm (mean = 15.3 \times 4.9 μm , $n=10$), overlapping uniseriate, fusiform, hyaline, unicellular, tapering towards the acute ends, with linear appendages at both ends, 12–16 μm long at both ends (Figs. 72–75).

Material examined: U.S.A., Alabama, Auburn, on dead herbaceous stalks, July 1890, G.K. Atkinson, MT61 (NY 1770, holotype of *C. alabamensis*).

Urosporella was introduced by Atkinson (1897) with the type species *U. americana*. *Urospora* Fabre was combined with *Urosporella* by Arx and Müller (1954). Barr (1966) found that *U. americana* and *C. alabamensis*

were based on the same holotype specimen and therefore combined them under *U. alabamensis*. This genus includes four species, i.e., *U. alabamensis*, *U. argentinensis* Speg., *U. magnoliae* (Ell. & Everh.) M. E. Barr and *U. cocciferae* (Fabre) Arx & E. Müller. The saprophytic habit and immersed globose ascomata of *Urosporella* are reminiscent of those in the *Amphisphaeria*. Its hyaline unicellular ascospores resemble species of *Ceriospora* Niessl (Barr, 1966). This genus is doubtfully placed in the Clypeosphaeriaceae. It may, however, have affinities with the Hyponectriaceae sensu Barr (Barr, 1990).

Notes on other related genera

Apiorhynchostoma Petr., Ann. Mycol. 21: 185. 1923.

Type species: *Apiorhynchostoma curreyi* (Rabenh.) E. Müll.

Apiorhynchostoma includes the type *A. curreyi*, *A. tumulatum* (M.C. Cooke) Sivan. and *A. altipetum* (Peck) F. Rappaz and is distinct in having the brown apiosporous ascospores with a germ pore at one end (Hyde et al.,

1998). It is presently placed in the Clypeosphaeriaceae (Hawksworth et al., 1995), which is confirmed by Hyde et al. (1998).

Brunneiapiospora K. D. Hyde, J. Fröhl. & J. E. Taylor, *Sydowia* **50**: 40. 1998.

Type species: *Brunneiapiospora javensis* K. D. Hyde, J. Fröhl. & J. E. Taylor.

Brunneiapiospora was introduced by Hyde et al. (1998) to accommodate *Apioclypea*-like species having apiospores, with a large brown cell and a small basal hyaline to light brown cell. Asci have a J+ or J- subapical ring and are cylindrical. Six species were included by Hyde et al. (1998).

Capsulospora K. D. Hyde, *Sydowia* **48**: 112. 1996.

Type species: *Capsulospora frondicola* K. D. Hyde.

Capsulospora was introduced to accommodate three new species on palms and was placed in the broadly defined Amphisphaeriaceae (Hyde, 1996). However, recent molecular studies (Kang et al., 1998) have found that *Capsulospora* is more closely related to *Clypeosphaeria* than to *Amphisphaeria*. It also morphologically resembles *Clypeosphaeria* in having darkened clypeus, cylindrical asci with J+ subapical ring and unicellular ascospores (Hyde, 1996). *Capsulospora* is therefore best included in the Clypeosphaeriaceae.

Duradens Samuels & Rogerson, *Mem. N. Y. Bot. Gard.* **64**: 170. 1990.

Type species: *Duradens lignicola* Samuels & Rogerson.

The genus *Duradens* resembles *Melomastia* Nitschke ex Sacc. in having blackened stromatic tissue around the ostiole. Its filiform ascospores are similar to those of *Lasiosphaeria* Ces. & De Not. (Samuels and Rogerson, 1990). The blackened peridium and the large, J- ascus ring are quite similar to those of clypeosphaeriaceous taxa, which indicates that *Duradens* should be placed in the Clypeosphaeriaceae.

Frondispora K. D. Hyde, *Sydowia* **45**: 208. 1993.

Type species: *Frondispora bicalcarata* (Ces.) K. D. Hyde.

This monotypic genus was introduced to accommodate *Sphaerella bicalcarata* Cesati by Hyde (1993a). In this species ascomata form under a diffuse stromata, asci are cylindrical with a J- apical ring and ascospores are unicellular with spine-like appendages. The anamorph is unknown. It is unlikely that this species can be accommodated in the Amphisphaeriaceae and it is therefore tentatively included in the Clypeosphaeriaceae, based on the shape of the asci and the well developed stromata. The ascospores in this species are similar to those of *Urosporella*. However, these genera differ, as in *Urosporella* ascomata are immersed in the host.

Leiosphaerella Höhn., *Sitzungsber. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Abt. 1*, **128**: 579. 1919.

Type species: *Leiosphaerella praeclara* (Rehm) Höhn.

Leiosphaerella contains the type *L. praeclara* and four other species (Samuels and Rossman, 1987; Barr, 1993). In this genus the unitunicate, cylindrical asci with a J+, subapical ring and bicellular cylindrical ascospores are apparently very similar to those of *Oxydothis*. These genera only differ in the orientation of their ascomata, always perpendicular to the surface of the host in *Leiosphaerella*, and mostly parallel to the surface of the host in *Oxydothis*. The asci of both genera have also been found to be anatomically similar to those of *Lepteutypa* (Samuels and Rossman, 1987). Based on its close relationship with *Oxydothis*, *Leiosphaerella* should also be included in the Clypeosphaeriaceae.

Pseudovalsaria Spooner, *Trans. Br. Mycol. Soc.* **86**: 405. 1986.

Type species: *Pseudovalsaria foedans* (P. Karst.) Spooner.

Pseudovalsaria is similar to *Clypeosphaeria* in having prosenchymatous stromatic tissues around neck (Barr, 1994). The ascospores are dark brown, medially 1-septate, with a pore at one end of the spores (Andersson et al., 1995). It was placed in the Trichosphaeriaceae (Spooner, 1986) and in the Boliniaceae (Rappaz, 1987). We suggest it is included in the Clypeosphaeriaceae based on its morphological similarities with *Clypeosphaeria*.

Stereosphaeria Kirschst., *Ann. Mycol.* **37**: 96. 1939.

Type species: *Stereosphaeria perfidiosa* (De Not.) O. Erikss.

Stereosphaeria is considered the most acceptable name for *Entosordaria* Höhn. and is used to accommodate two species. In *Stereosphaeria* ascospores have distinct basal radiating germ slits and an apical hyaline cell (Hyde et al., 1998).

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Literature cited

- Andersson, K., Eriksson, O. E. and Landvik, S. 1995. Boliniaceae transferred to Sordariales (Ascomycota). *Syst. Ascomycet.* **14**: 1–16.
- Arx, J. A. von and Müller, E. 1954. Die Gattungen der amersporen Pyrenomyceten. *Beitr. Kryptogamenfl. Schweiz* **11** (1): 1–434.
- Atkinson, G. F. 1897. Some fungi from Alabama. *Bull. Cornell Univ. (Sci.)* **3**: 1–50.
- Barr, M. E. 1966. Observations on *Urosporella*. *Mycologia* **58**: 690–693.
- Barr, M. E. 1989. *Clypeosphaeria* and the Clypeosphaeriaceae. *Syst. Ascomycet.* **8**: 1–8.

- Barr, M. E. 1990. Prodrum to nonlichenized, pyrenomycetous members of class Hymenoascmycetes. *Mycotaxon* **39**: 43–184.
- Barr, M. E. 1993. Redisposition of some taxa described by J. B. Ellis. *Mycotaxon* **46**: 45–76.
- Barr, M. E. 1994. Notes on the Amphisphaeriaceae and related families. *Mycotaxon* **51**: 191–224.
- Barrasa, J. M., Checa, J. and Martínez, A. T. 1993. *Crassoascus*, a new nonstromatic genus in the Clypeosphaeriaceae. *Mycotaxon* **46**: 299–305.
- Clements, F. E and Shear, C. L. 1931. The genera of fungi. H. W. Wilson, New York.
- Dennis, R. W. G. 1978. British Ascomycetes. J. Cramer, Vaduz.
- Eriksson, O. E and Hawksworth, D. L. 1987. Outline of the ascomycetes. *Syst. Ascomycet.* **6**: 259–337.
- Eriksson, O. E. and Hawksworth, D. L. 1993. Outline of the ascomycetes. *Syst. Ascomycet.* **12**: 51–257.
- Fröhlich, J. and Hyde, K. D. 1994. New *Oxydothis* species associated with palm leaf spots in north Queensland, Australia. *Mycol. Res.* **98**: 213–218.
- Fuckel, L. 1870. *Symbolae mycologicae*. Jahrb. Nass. Ver. Naturk. **23–24**: 1–459.
- Hawksworth, D. L., Sutton, B. C. and Ainsworth, G. C. 1983. Ainsworth & Bisby's Dictionary of the fungi, 7th ed. Commonw. Mycol. Inst., Kew.
- Hawksworth, D. L., Kirk, P. M., Sutton, B. C. and Pegler, D. N. 1995. Ainsworth & Bisby's Dictionary of the fungi, 8th ed. CAB International, Wallingford.
- Höhnelt, F. von. 1919. Fragmente zur Mykologie XXIII. Sitzungsber. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Abt. 1, **128**: 535–625.
- Hyde, K. D. 1993a. Fungi from palms. VI. Reflections on *Oxydothis* and related genera. *Sydowia* **45**: 204–225.
- Hyde, K. D. 1993b. Fungi from palms. VII. The genus *Oxydothis* from rachides of palms in north Queensland, including five new species. *Sydowia* **45**: 226–240.
- Hyde, K. D. 1994a. Fungi from rachides of *Livistona* in the Western Province of Papua New Guinea. *Bot. J. Linn. Soc.* **116**: 315–324.
- Hyde, K. D. 1994b. Fungi from palms. XIII. The genus *Oxydothis*, a revision. *Sydowia* **46**: 265–314.
- Hyde, K. D. 1996. Fungi from palms. XXVII. *Capsulospora* gen. nov., with three new species. *Sydowia* **48**: 111–121.
- Hyde, K. D., Fröhlich, J. and Taylor, J. E. 1996. Diversity of Ascomycetes on palms in the Tropics. In: Biodiversity of tropical microfungi, (ed. by Hyde, K. D.), pp. 141–156. Hong Kong Univ. Press, Hong Kong.
- Hyde, K. D., Fröhlich, J. and Taylor, J. E. 1998. Fungi from palms. XXXV. Reflections on unitunicate ascomycetes with apiospores. *Sydowia* **50**: 21–80.
- Kang, J. C., Kong, R. Y. C. and Hyde, K. D. 1998a. Studies on the Amphisphaeriales 1. Amphisphaeriaceae (*sensu stricto*) and its phylogenetic relationships inferred from 5.8S rDNA and ITS2 sequences. *Fungal Diversity* **1**: 147–157.
- Kang, J. C., Hyde, K. D. and Kong, R. Y. C. 1998b. Studies on the Amphisphaeriales 2. The Amphisphaeriaceae (*sensu stricto*). *Mycol. Res.* **103**: 53–64.
- Kirschstein, W. 1939. Ueber neue, seltene und kritische Ascomyceten und Fungi imperfecti. II. *Ann. Mycol.* **37**: 88–140.
- Lambotte, E. 1887. La flore mycologique de la Belgique, Suppl. 1. *Mém. Soc. R. Sci. Liège, sér. 2*, **14**: 1–350.
- Miller, J. H. 1949. A revision of the classification of the Ascomycetes with special emphasis on the Pyrenomycetes. *Mycologia* **41**: 99–127.
- Munk, A. 1957. Danish Pyrenomycetes. *Dansk Bot. Arkiv.* **17**: 1–491.
- Penzig, O. and Saccardo, P. A. 1897. Diagnoses fungorum novorum in insula Java collectorum. Series secunda. *Malpighia* **11**: 491–530.
- Petrak, F. 1923. Mykologische Notizen. VI. Numbers 201–300. *Ann. Mycol.* **21**: 182–335.
- Rappaz, F. 1987. Taxonomie et nomenclature des Diatrypacees à asques octospores. *Mycol. Helvetica* **2**: 285–648.
- Saccardo, P. A. 1978. Fungi veneti novi vel eritici vel mycologiae venetae addendi, 9. *Michelia* **1**: 361–445.
- Samuels, G. J. and Rossman, A. Y. 1987. Studies in the Amphisphaeriaceae (*sensu lato*) 2. *Leiosphaerella cocoas* and two new species of *Oxydothis* on palms. *Mycotaxon* **28**: 461–471.
- Samuels, G. J. and Rogerson, C. T. 1990. New Ascomycetes from the Guayana Highland. *Mem. N.Y. Bot. Gard.* **64**: 165–183.
- Schröter, J. 1897. Die Pilze Schlesiens. In: Kryptogamen-Flora von Schlesien, (ed. by Cohn, F.), **3** (2): 1–385.
- Spooner, B. M. 1986. New or rare British microfungi from Esher Common, Surrey. *Trans. Br. Mycol. Soc.* **86**: 401–408.
- Swart, H. J. 1981. Australian leaf-inhabiting fungi XI. *Phyllachora eucalypti*. *Trans. Br. Mycol. Soc.* **76**: 89–95.
- Winter, G. 1887. Die Pilze Deutschlands, Oesterreichs und der Schweiz. 2 Abt., Ascomyceten: Gymnoasceen und Pyrenomyceten. In: Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz, (ed. Rabenhorst, L.), 2 Aufl., **1** (2): 1–928.