the Pyrenophoraceae in the Pleosporales (Barr 1979b). *Macroventuria* (van der Aa, 1971) is added; it is obviously related to *Leptosphaerulina* by cultural characteristics. *Norrlinia* is another relative of *Leptosphaerulina*, parasitic in lichen thalli, and was placed here by Hawksworth (1980). *Scleropleella* is separated from *Leptosphaerulina* and removed to the Dothideaceae; the narrowly obovoid-fusoid, transversely septate ascospores of the former are quite different from the broadly obovoid often muriform ascospores of the latter. The recent article by Shoemaker and Babcock (1987) presents a revision of the species of *Wettsteinina* and removes a number of taxa from that genus.

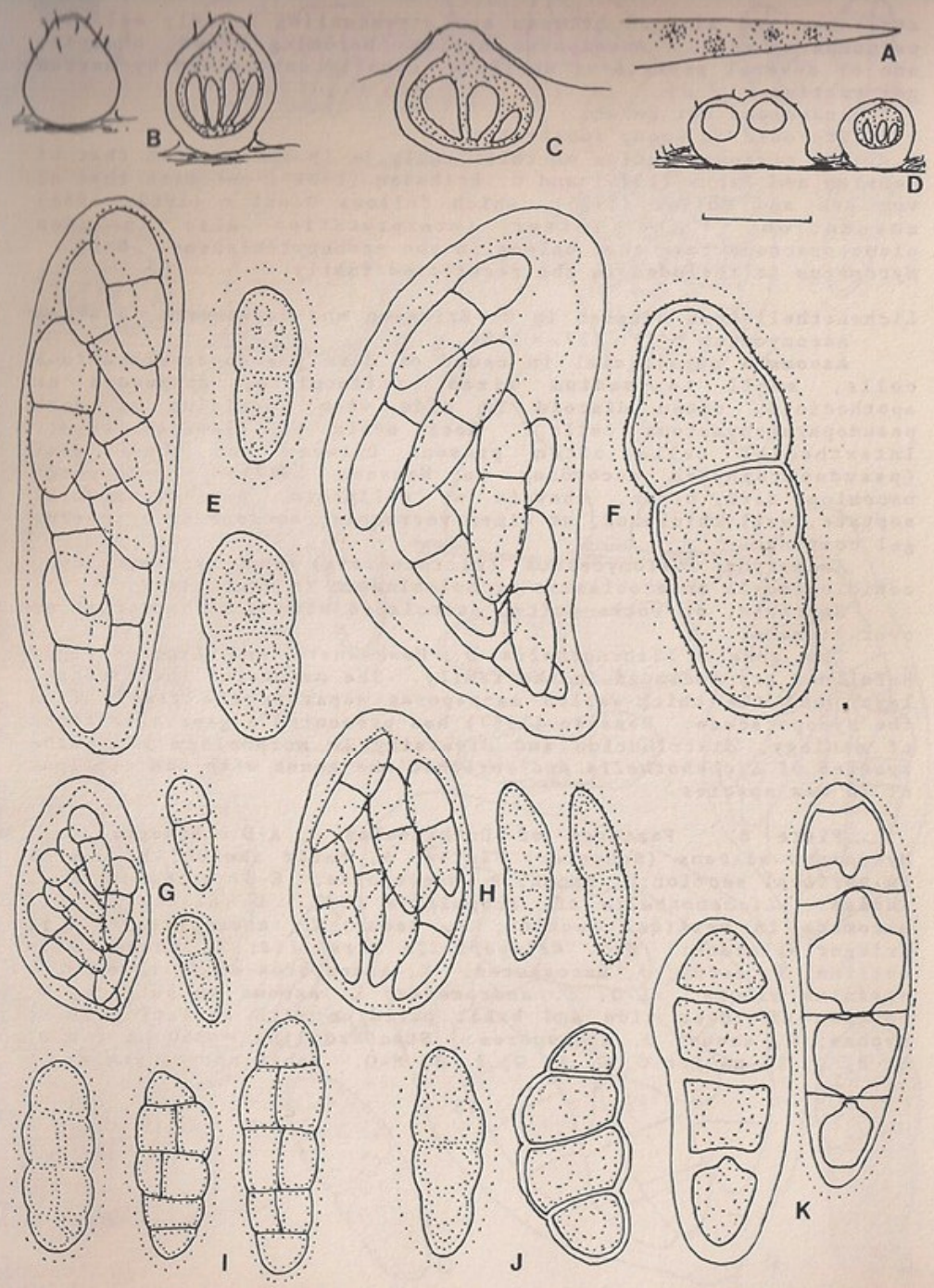
Key to Species

1. Ascomata small to medium sized; peridium relatively broad; ascospores with broad gel coating.....*Wettsteinina*
1. Ascomata minute to small sized; peridium relatively narrow; ascospores with broad or narrow gel coating.....2
    2. Ascomata setose over apex; ascospores hyaline, broadly obovoid, one septate, septum median and constricted.....*Macroventuria*
    2. Ascomata glabrous or bearing trailing hyphal appendages; ascospores hyaline or becoming brown, obovoid, ellipsoid or elongate fusoid, one or several septate or muriform.....3
3. Ascospores usually muriform, obovoid or ellipsoid; biotrophic and causing leaf spots or saprobic.....*Leptosphaerulina*
3. Ascospores one (three) transversely septate.....4
    4. Ascospores one septate, fusoid; saprobic....*Monascostroma*
    4. Ascospores one (three) septate, obovoid; ascomata superficial, biotrophic on leaf spots in Agavaceae....*Stomatogene*

Mycoporaceae Zahlbruckner in Engler & Prantl, Nat. Pflanzenfam. 1(1): 77. 1903; non emend. Riedl, 1962.

Ascomata superficial in thin hyphal weft or immersed erumpent, small to medium sized, uniloculate and sphaeroid or as locules in pulvinate stromata, discoid in side view; stroma tissues of pseudoparenchymatous cells, peridium not separable, with broad pore opening by disintegrating cells, discoid when dried, thallus as a hyphal weft. Asci basal in interthecial tissues, saccate or oblong. Interthecial tissues at times

Plate 7. Features of Dothideales. Pseudosphaeriaceae: A. Habit sketch of *Stomatogene agaves* (Ellis & Everh.) Theissen. B-D. Ascomata in vertical section: B, *Macroventuria wentii* van der Aa; C, *Wettsteinina mirabilis* (Niessl) von Höhnel; D, *Stomatogene agaves*. E-K. Asci and ascospores: E, *Macroventuria wentii*; F, *Wettsteinina mirabilis*; G, *Stomatogene agaves*; H, *Monascostroma innumerosa* (Desm.) von Höhnel; I, *Leptosphaerulina australis* McAlpine; J, *Wettsteinina dryadis* (Rostrup) Petrak; K, *W. macrotheca* (Rostrup) Müller. Standard line = 150 µm for B-D, 15 µm for E-k. Habit not to scale.



stretched and aligned between asci, resembling broadly cellular pseudoparaphyses. Ascospores hyaline becoming brown, obovoid, one or several septate or muriform, usually surrounded by narrow gel coating.

Anamorphs not known.

Saprobic on woody substrates.

The circumscription of this family is in accord with that of Henssen and Jahns (1974) and O. Eriksson (1981), not with that of von Arx and Müller (1975), which follows Riedl's (1962, 1964) emendation. The latter interpretation also includes pleosporaceous taxa that belong in the Arthopyreniaceae. Only *Mycoporum* is included in the restricted family.

Lichenotheliaceae Henssen in O. Eriksson and Hawksworth, Systema Ascomycetum 5(1): 137. 1986.

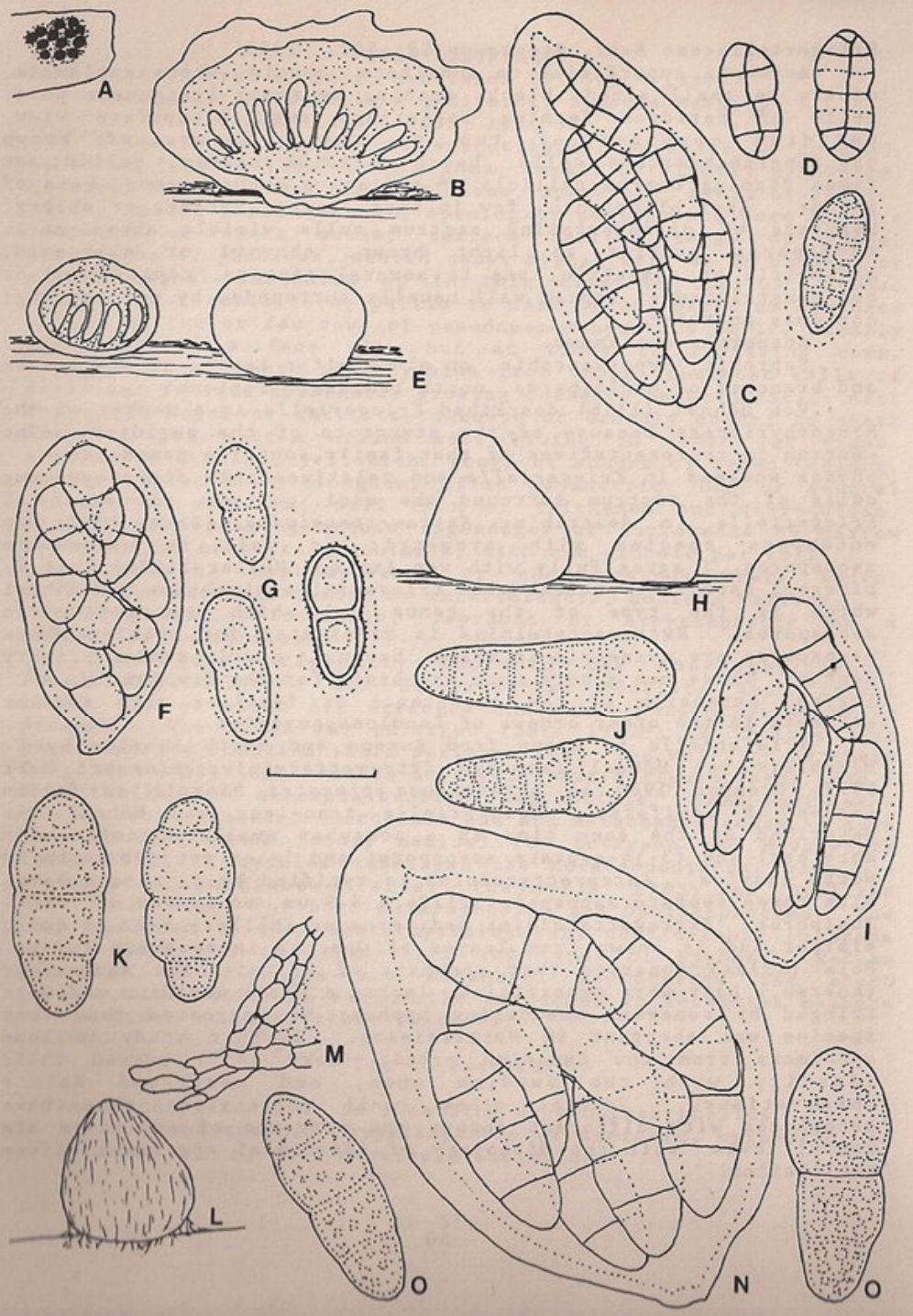
Ascomata superficial in crust of dark pseudoparenchymatous cells, small to medium sized, uniloculate, sphaeroid or apothecioid, often discoid in side view; peridium of dark pseudoparenchymatous cells. Asci ovoid or clavate, basal. Interthecial cells often present between and above asci (pseudoparaphyses according to Henssen 1987). Ascospores becoming dark brown, obovoid or ellipsoid, one or several septate, wall thickened, at times verrucose, surrounded by narrow gel coating.

Anamorphs coelomycetous (microconidia) and hyphomycetous, conidiogenesis enteroblastic or holoblastic (macroconidia).

Saprobic, on rocks (often associated with cyanobacteria) or over lichens.

The genera *Lichenothelia* D. Hawksworth and *Lichenostigma* Hafellner are included in the family. The nature of the crustose layer and the thick-walled ascospores separate the family from the Mycoporaceae. Henssen (1987) has presented a general account of ecology, distribution and diversity in morphology among the species of *Lichenothelia* and enriched the genus with descriptions of 18 new species.

Plate 8. Features of Dothideales. A-D. Mycoporaceae: *Mycoporum elabens* (Schaerer) Flotow: A, habit sketch; B, ascoma in vertical section;C, ascus; D, ascospores. E-G. Lichenotheliaceae: *Lichenothelia cf. scopularia* (Nyl.) D. Hawksworth: E, ascomata in vertical section; F, ascus; G, ascospores. H-O. Kriegeriellaceae: H-J. *Kriegeriella mirabilis*: H, ascomata in outline; I, ascus; J, ascospores. K, ascospores of *Extrawettsteinina minuta*. L-O. *E. andromedae*: L, ascoma in outline; M, portion of lower side and basal peridium with radiating short hyphae; N, ascus; O, ascospores. Standard line = 150 µm for B, E, H, L, 15 µm for C, D, F, G, I, J, M-O. Habit not to scale.



Kriegeriellaceae Barr, Mycotaxon 29: 502. 1987.

Ascomata superficial on substrate, conoid, bases applanate, minute to small sized, black, opening by small lysigenous pore; cells of peridium forming radiating rows in surface view, peridium composed of two or three layers of brown pseudoparenchymatous cells, basal peridium narrow, pallid; at times forming narrow pellicle of radiating hyphae around base of ascoma. Asci bitunicate, few in basal layer, saccate or oblong. Remnants of disintegrating centrum cells visible above asci. Ascospores hyaline to light brown, obovoid or ellipsoid, asymmetric or symmetric, one to several septate, constricted or not constricted at septa; wall usually surrounded by gel coating; contents guttulate.

Anamorphs not known.

Saprobic, hypersaprobic, on old conifer leaves or old leaves and branches of angiosperms, north temperate regions.

Von Höhnel (1918) described *Kriegeriella* as a member of the Microthyriaceae because of the structure of the peridium. The centrum in representatives of that family contains pseudoparaphyses whereas in *Kriegeriella* and relatives only disintegrating cells of the centrum surround the asci. I was not aware of *Kriegeriella* in describing *Extrawettsteinina* (Barr 1972) to encompass species with symmetric as well as asymmetric ascospores. I agree fully with von Arx and Müller (1975) that *E. pinastri* Barr is identical with *Kriegeriella mirabilis* von Höhnel which is the type of the genus and which has asymmetric ascospores. *Extrawettsteinina* is reinstated for species whose ascospores are symmetric in shape, having a nearly median primary septum. These two genera form the basis for the new family, a logical extension of the acceptance of families with similar ascomata in the other orders of Loculoascomycetes.

Kriegeriella is known from Europe and North America by *K. mirabilis* von Höhnel (synonym *Extrawettsteinina pinastri* Barr 1972; Gremmen 1960 as *Lophiostoma pinastri* Niessl) on fallen leaves of conifers. *Kriegeriella transiens* von Höhnel was described at the same time as a somewhat smaller species with more asci and (3-)4-septate ascospores and is as yet not known in North America. *Extrawettsteinina* is typified by *E. minuta* Barr, with three-septate ascospores 21-24 x 8-9 um, on leaves of *Juniperus*. *Extrawettsteinina mediterranea* (Müller) Barr is quite similar and is known from leaves of *Quercus* in southern Europe. Holm (1975a) observed that ascomata of *Wettsteinina andromedae* (Auersw.) Barr were superficial, lacked a basal peridium and were fringed by somewhat meandering hyphae; he suggested that this species was aberrant in *Wettsteinina*. Further study on some specimens from the Canadian arctic (Barr 1959) proved their identity with the Swedish ones, and confirmed Holm's observations. Several other small collections that have ascospores with different shapes and patterns of septation are known; these wait the discovery of additional specimens before publication.

CHAETOTHYRIALES

Batista & Ciferri ex Barr, Mycotaxon 29: 502. 1987.

Chaetothyriales Batista & Ciferri, Sydowia Beih. 3: 4. 1962; nom. inval. ICBN, Art. 36.

Ascomata superficial or subcuticular, separate or grouped, at times forming locules in stroma, darkly or lightly pigmented, at times nearly translucent, globose, sphaeroid, ovoid or lenticular, apical papilla short, opening by periphysate pore or pore composed of short setae; surface bearing setae or hyphal appendages or glabrous, seated under hyphal weft or on compact or slight hyphal subiculum or in thin crustose thallus; hyphae cylindric or moniliform, pallid to dark brown; peridium composed of one or two or few rows of pseudoparenchymatous cells, usually irregular in surface view but at times in radiating rows. Hamathecium of short periphysoids from upper innermost cells of peridium; in some apparently growing downward between asci. Asci basal, in layer or fascicle, saccate or broadly oblong to short clavate; gel matrix around asci bluing in iodine at times. Ascospores hyaline, yellowish, rosy, or shades of brown, oblong, fusoid, obovoid or elongate, often asymmetric, one or several septate or muriform; wall thin or thickened and verruculose, occasionally bearing setose appendages or surrounded by narrow gel coating; contents granular or with one globule per cell.

Anamorphs hyphomycetous or coelomycetous where known; conidiogenesis holoblastic or enteroblastic; conidia various.

Epiphytic, biotrophic, saprobic or hypersaprobic on a variety of substrates.

The order originally included the Chaetothyriaceae, Phaeosaccardinulaceae and Euceramiaceae (Batista and Ciferri 1962), all of which are arranged under the Chaetothyriaceae at present. The order was enlarged (Barr 1979b) to include taxa whose centrum contains short periphysoids. The majority of these fungi are superficial on the substrate, but *Strigula* forms both a thin thallus and ascomata beneath leaf cuticle. Some families--the Chaetothyriaceae, Coccodiniaceae and Metacapnodiaceae -- have been grouped under "sooty moulds" (O. Eriksson and Hawksworth 1985, 1986). Reynolds submerged the Metacapnodiaceae with his expanded Capnodiaceae after (Reynolds 1985) he utilized *Limacinula* Neger for both *Metacapnodium* and *Ophiocapnocoma*. The taxa assigned to the Chaetothyriales vary considerably in shape of ascomata and in consistency and types of hyphae. Median sections of ascomata are essential to observe the short periphysoids, although eventually one comes to recognize members of the order by their other features.

Key to Families

1. Ascomata lichenized, in sheathing or crustose thallus.....2
1. Ascomata biotrophic, hypersaprobic or saprobic, epiphytic, on or beneath thin or well-developed subiculum.....4

2. Thallus composed of sheathing mycelium around *Scytonema* filaments; ascospores smoky black.....Pyrenothricaceae*
2. Thallus crustose; ascospores hyaline to grayish brown..3
3. Thallus subcuticular, ascomata sphaeroid; ascospores hyaline. .....Strigulaceae
3. Thallus superficial as thin crust; ascomata globose; ascospores grayish brown.....Microtheliopsidaceae*
4. Ascomata lenticular (scutate with both upper and lower walls developed), surface of radiating rows of cells..... .....Trichopeltidaceae
4. Ascomata globose, sphaeroid or ovoid, surface not of radiating rows of cells.....5
5. Hyphae forming subiculum often abundant, dark brown, moniliform with short broad cells constricted at septa, tapering to ends; ascomata globose or ovoid; epiphytic; ascospores brown. .....Metacapnodiaceae
5. Hyphae forming subiculum or thin pellicle pallid or dark, cylindric, sometimes branching at right angles; ascomata globose, ovoid or sphaeroid, collabent at times.....6
6. Ascomata formed beneath pellicle of light brown hyphae; superficial epiphytes (?biotrophs) on leaves; ascospores hyaline or lightly pigmented (yellowish, rosy)..... .....Chaetothyriaceae
6. Ascomata formed on pallid or dark brown sparse or well-developed subiculum.....7
7. Ascomata small to medium sized, glabrous or bearing hyphal appendages or setae; saprobic; ascospores hyaline, yellowish or clear to reddish brown.....Coccodiniaceae
7. Ascomata minute to small sized, usually short setose, occasionally glabrous; saprobic or hypersaprobic; ascospores hyaline or mostly grayish brown .....Herpotrichiellaceae

*The lichenized families Microtheliopsidaceae O. Eriksson and Pyrenothricaceae Zahlbruckner are not considered in more detail at this time. Santesson (1952) provided a detailed description of *Microtheliopsis uleana* Mull. Arg.; O. Eriksson (1981) noted many similarities between this organism and species in the Herpotrichiellaceae. O. Eriksson (1981) also compared *Pyrenothrix nigra* Riddle to *Coccodinium bartschii* Massal.

Chaetothyriaceae Hansford ex Barr, Mycologia 71: 943. 1979.
Chaetothyriaceae Hansford, Mycol. Pap. 15: 139. 1946, nom. inval., ICBN, Art. 36.

Ascomata sphaeroid, often collabent at maturity, small, formed beneath thin pellicle of brown, cylindric narrow hyphae, often branched at right angles; apex short papillate, pore periphysoid; peridium thin, of few rows of soft brown cells. Hamathecium of short apical periphysoids. Asci basal, oblong, saccate or ovoid. Cellular remnants or old ascus walls breaking down as gel matrix, lightly blued in iodine. Ascospores hyaline (rosy brown in mass), fusoid, narrowly obovoid or oblong cylindric, (one)several septate or muriform, contents guttulate.

Anamorphs not known.

Epiphytic, mostly tropical, a lesser number temperate in distribution.

Hansford (1946) described the morphology of the ascomata and their development beneath a thin pellicle. Reynolds (1972) clarified what had been confusion between *Phaeosaccardinula* and *Limacinula*, the latter genus assigned in this study to the Coccodiniaceae. Hughes (1976) summarized information on the Chaetothyriaceae in separating this family from other sooty mould taxa. The family names Phaeosaccardinulaceae Batista & Ciferri (Sydowia Beih. 3: 31. 1962; nom. inval., ICBN, Art. 36) and Euceramiaceae Batista & Ciferri (Sydowia Beih. 3: 121. 1962; nom. inval., ICBN, Art. 36) are both merged under the Chaetothyriaceae.

Only a few taxa are known from temperate regions, and are separated in the following key to genera. Pohlad and Reynolds (1974) described and illustrated *Treubiomyces pulcherrimus* von Höhnel from a Florida collection. The type genus is included in the key, but is tropical in distribution. Other tropical genera with phragmospores could be *Actinocymbe* with greatly elongate ascospores and *Yatesula* with short ascospores (von Arx and Müller 1975). Didymosporous taxa could be *Microcallis* with setae and *Akaropeltis* without setae on the pellicle, according to Müller and von Arx (1962), although von Arx and Müller (1975) later relegated *Akaropeltis* to synonymy with *Stomiopeltis* (see Micropeltidaceae, Pleosporales).

Key to Genera

1. Ascospores transversely septate.....2
1. Ascospores muriform.....3
2. Ascomata and/or pellicle setose.....*Chaetothyrium*
2. Ascomata and/or pellicle glabrous.....*Ceramothyrium*
3. Ascomata and/or pellicle setose.....*Treubiomyces*
3. Ascomata and/or pellicle glabrous.....*Phaeosaccardinula*

Coccodiniaceae von Höhnel ex O. Eriksson, Opera Bot. 60: 42. 1981.
Coccodiniaceae von Höhnel, Sitzungsber. Kaiserl. Akad. Wiss. Math.-Naturwiss. Cl. Abt. 1, 127: 386. 1918; nom. inval., ICBN, Art. 18.

Ascomata small to medium sized, globose, ovoid or sphaeroid and collabent on drying, apex rounded or short papillate, pore periphysate; peridium relatively soft, composed of several rows of pseudoparenchymatous cells, setose or glabrous, at times with deep sterile base; hyphae cylindric, light brown, as delicate weft, or dark as thin crust or well-developed subiculum. Hamathecium of short periphysoids. Asci basal, ovoid, saccate or broadly oblong, in gel matrix that blues in iodine. Ascospores hyaline, yellowish or reddish brown, one to several septate or muriform.

Anamorphs forming rosettes of phialidic conidiogenous cells

from ascospores (Hughes 1976) or hyphomycetous (described as *Microxyphium*).

Epiphytic or biotrophic, widespread in distribution.

O. Eriksson (1981) clarified the confusion that had existed in the literature between *Coccodinium* and *Naetrocymbe*. *Naetrocymbe* and the family Naetrocymbaceae belong in the Arthopyreniaceae of the Pleosporales. In both genera ascomata are superficial and frequently collabent on a dark subiculum. *Coccodinium bartschii* Massalongo forms periphysoids above the asci and the hymenial gel often turns blue briefly in iodine, whereas *Naetrocymbe fumago* (Wallr.) Dalla Torre & Sarnth. forms pseudoparaphyses between and above asci and the hymenium does not blue in iodine. O. Eriksson and Hawksworth (1986) recognized three genera in the family: *Coccodinium, Limacinula* and *Dennisiella*. Reynolds (1972) has monographed *Limacinula*.

Strigopodia (Hughes 1968) is tentatively inserted in the Coccodiniaceae. The subiculum is well developed, composed of both repent and erect, cylindric, branched hyphae. Both holoblastic phragmosporous conidia (*Hormisciella*) from hyphae and phialides and phialoconidia from hyphae and ascospores (*Capnophialophora*) are produced. Ascomata bear hyphal appendages, short periphysoids are present in the centrum above the saccate asci, ascospores are brown and dictyosporous (Corlett, Hughes and Kaufert 1973). This genus was not assigned to family by Hughes (1968) but von Arx and Müller (1975), Hawksworth et al. (1983), and O. Eriksson and Hawksworth (1986) have it in the Capnodiaceae s. lat. That family is treated in the much restricted sense of Hughes (1976) as part of the Capnodiales, and *Strigopodia* does not fit in that concept.

Key to Genera

1. Ascospores several septate, occasionally muriform in one or two cells.....2
1. Ascospores conspicuously muriform.....3
    2. Ascospores light brown; ascomata setose.....*Dennisiella*
    2. Ascospores dark brown; ascomata bearing hyphal appendages .....*Strigopodia*

Plate 9. Features of Chaetothyriales. A-F. Chaetothyriaceae: A, B, Ascomata of: *Chaetothyrium cf. vermisporum* Hansford; B, *Ceramothyrium linnaeae* (Dearness) Hughes. C-F, Asci and ascospores of: C, D, *Chaetothyrium vermisporum*; E, F, *Ceramothyrium linnaeae*. G-S. Coccodiniaceae: G-J. Ascomata of: G, *Coccodinium bartschi*; H, *C. corticola* (Ellis & Everh.) Barr; I, *Limacinula samoensis* von Höhnel; J, *Dennisiella cf. babingtonii* (Berkeley) Batista & Ciferri. K-O. Asci and ascospores: K, L, *Coccodinium bartschi*; M, *C. corticola*; N, *Limacinula samoensis*; O. *Dennisiella babingtonii*. P-S. *Strigopodia batistae* Hughes: P, ascoma, Q, ascospores, R, conidium, S, phialides. Standard line = 150 µm for A, B, G-J, P, 15 µm for C-F, K-O, Q-S.