

# Kirschsteiniothelia, a new genus for the Microthelia incrustans-group (Dothideales)

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Received August 1984, accepted for publication November 1984

HAWKSWORTH, D. L., 1985. **Kirschsteiniothelia, a new genus for the Microthelia incrustans-group (Dothideales).** The new generic name *Kirschsteiniothelia* is introduced for the group of species close to *Microthelia incrustans*. The genus belongs to the Dothideales and is referred to the Pleosporaceae. Six species are accepted: *K. acerina*, *K. aethiops* (anamorph: *Dendryphiopsis atra*), *K. maritima*, *K. recessa*, *K. striatispora* and *K. thujina*. A key to the species is provided and illustrations showing the variations in ascomatal development and ascospore sizes and shapes are included. In a review of the nomenclature of *Microthelia* it has been found necessary to provide a lectotype for *Amphisphaerina* and *A. texensis* is referred to *Arthopyrenia*.

ADDITIONAL KEY WORDS:—*Dendryphiopsis* – fungi – *Kirschsteiniella* – *Kirschsteiniothelia* – Pleosporaceae – Pyrenomycetes.

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## INTRODUCTION

In the course of investigations of all species referred to the genus *Microthelia* Körber, a generic name which has been misapplied and must be rejected (Hawksworth & Sherwood, 1981), several groups of species have been identified which belong to different orders or families of pyrenomycetes from most species to which this name has been applied (Hawksworth, 1985). Two such extralimital groups have already been reported upon, *Astrosphaeriella* Sydow (Hawksworth, 1981a) and *Lichenothelia* D. Hawksw. (Hawksworth, 1981b), and

the present contribution is concerned with a third, the group of species close to *Microthelia incrustans* (Ellis & Everh.) Corlett & S. Hughes. This group of species is referable to the family Pleosporaceae Nitschke in the order Dothideales (Ascomycotina).

*Microthelia incrustans* has had a chequered nomenclatural history. For many years it was included in *Amphisphaeria* Ces. & de Not.; a disposition that cannot be accepted because *Amphisphaeria* is the type genus of the Amphisphaeriaceae Winter (Xylariales) and includes species in which the asci are not fissitunicate but do have an apical ring that turns blue in iodine. Petrak (1923) introduced the new generic name *Kirschsteiniella* Petrak for this species but regrettably misapplied the name of the species designated as type of the genus; *Kirschsteiniella* has to be treated as a synonym of the coelomycete genus *Cyclothyrium* Petrak as discussed by Hawksworth (1981a).

Scheinflug (1958) took up the genus name *Astrosphaeriella* Sydow for this taxon, incorrectly using the epithet '*applanata*' as had Petrak, but this genus belongs to the Melanommataceae and has quite a different ascomatal structure and a hamathecium composed of paraphysoids (trabeculate pseudoparaphyses) rather than true pseudoparaphyses (cellular pseudoparaphyses) (Hawksworth, 1981a).

In applying *Microthelia* Körber to this species, Corlett & Hughes (in Hughes, 1978) were unaware of the nomenclatural difficulties and diverse uses of that generic name and did not discuss its affinities further.

*Amphisphaerina* Höhnelt (Höhnelt, 1919 : 581) was also considered as a possible genus name for the species here referred to *Kirschsteiniothelia*. *Amphisphaerina* included three species, *A. recessa* (Cooke & Peck) Höhnelt, *A. texensis* (Cooke) Höhnelt (*Sphaeria texensis* Cooke) and *Amphisphaeria anaxaea* Speg. However, *A. recessa* has brown ascospores and so is excluded as a possible lectotype for *Amphisphaerina* which was established by Höhnelt for *Amphisphaeria*-like fungi differing in the colourless ascospores. The holotype of *Sphaeria texensis* (U.S.A., Texas, Houston, on old oak rails, 14 April, H. W. Ravenel 250, K) does have ascospores which remain colourless and so is a more appropriate choice as lectotype for the genus; it is formally selected as such here. *Sphaeria texensis* has clypeate ascomata and clearly belongs to *Arthopyrenia sensu stricto*. *Amphisphaerina* should therefore be added to the list of synonyms of *Arthopyrenia*. *Amphisphaerina texensis*, which appears to be non-lichenized, also requires formal transfer to *Arthopyrenia* (see Appendix).

No other appropriate generic name has been found for the group of species around *Microthelia incrustans*, so it is necessary to introduce a new generic name to accommodate these fungi.

#### *KIRSCHSTEINIOTHELIA* D. HAWKSW.

#### ***Kirschsteiniothelia* D. Hawksw. genus novum**

DERIVATION: After the German mycologist W. Kirschstein (b. 1863–c. 1946) who made major contributions to our knowledge of pyrenomycete fungi and *θηλῆ*, nipple-, after the shape of the ascomata), also recalling the relationship to taxa formally referred to *Microthelia* Körber. Petrak (1923) intended to apply the name *Kirschsteiniella* Petrak to the holotype species of *Kirschsteiniothelia*.

GENUS ad Pleosporaceae Nitschke pertinens. ASCOMATA singulariter, dispersa vel laxe aggregata, erumpescentia, superficialia ubi maturitatae, nigra, hemisphaerica vel subglobosa, basi plerumque applanata; plerumque ostiolata; peridium pseudoparenchymaticarum, e cellulis atrobrunneis subglobosis, polyhedricus vel elongatis compositum (textura angularis ad prismatica). PARAPHYSES (pseudoparaphyses), persistentes, ramosae et anastomosantes; centrum cum iodo plerumque non reagens. ASCI bitunicati, fissitunicati, subcylindrici vel elongato-clavati, 4–8-sporei. ASCOSPORAE pleurumque distichae, ellipsoideae, 1-septatae, brunneae,  $\pm$ verruculosae vel striatae, vaginae gelatinosae desunt.

GENUS belonging to the family Pleosporaceae Nitschke. ASCOMATA usually arising singly, scattered or loosely aggregated, erumpent,  $\pm$ entirely superficial when mature, black, hemispherical or subglobose, usually with a distinctly applanate base; usually ostiolate but a well-defined ostiole absent in one species; peridium pseudoparenchymatous, composed of dark brown subglobose to polyhedral or elongated thick-walled cells (textura angularis to textura prismatica), elongation almost always seen in the angles of the ascomatal cavity. PARAPHYSES (pseudoparaphyses) cellular, persistent, branched and anastomosing; centrum not usually turning blue in iodine. ASCI bitunicate, fissitunicate, subcylindrical or elongate-clavate, with an internal apical beak, 4–8-spored. ASCOSPORES usually distichously arranged in the asci ( $\pm$ uniseriate in one species), ellipsoid or soleiform, 1-septate, the upper cell often somewhat larger, slightly constricted at the septum, brown,  $\pm$ verruculose or striate, without a distinct gelatinous sheath.

TYPE SPECIES: *Kirschsteiniothelia aethiops* (Berk. & Curtis) D. Hawksw. (syn. *Sphaeria aethiops* Berk. & Curtis, holotypus).

ANAMORPH: *Dendryphiopsis* S. Hughes in the type species. None reliably reported from other species of the genus.

ACCEPTED SPECIES: Six species are accepted here but additional species are to be expected as 1-septate brown-spored pyrenomycetes are more critically studied.

HOSTS: Saprophytes on woody substrata.

DISTRIBUTION: Perhaps widespread in temperate regions and known from Europe, N America and Australasia (New Zealand). Not, or not reliably, reported from S America, Asia or Africa.

The genus *Kirschsteiniothelia*, as circumscribed here, belongs to the family Pleosporaceae and not the family Melanommataceae. The latter family includes *Astrosphaeriella*, a genus to which some species placed in *Kirschsteiniothelia* were referred by Scheinpfug (1958), as noted above.

*Kirschsteiniothelia* is closest to another genus introduced for some taxa formerly referred to *Microthelia*, *Peridiothelia* D. Hawksw., in which the ascomata are applanate from the first with a peridium composed of small cells forming a textura globulosa or textura intricata and lacking elongate radiating cells, a centrum which always turns blue in iodine, and ascospores with a distinct gelatinous sheath which also tend to have more consistently rounded ends (Hawksworth, 1985). No anamorphs are known in the *Peridiothelia* species so far recognized.

KEY TO THE SPECIES OF *KIRSCHSTEINIOTHELIA*

- |     |   |                        |
|-----|---|------------------------|
| 1.  | Ascomata ostiolate . . . . .  | 2                      |
| 1'. | Ascomata non-ostiolate . . . . .  | <i>K. acerina</i>      |
| 2.  | Ascospores $\pm$ smooth or with a minute verruculose ornamentation . . . . .  | 3                      |
| 2'. | Ascospores with a striate ornamentation . . . . .   | <i>K. striatispora</i> |
| 3.  | Mean length of ascospores more than 21 $\mu$ m . . . . .  | 4                      |
| 3'. | Mean length of ascospores less than 20 $\mu$ m . . . . .  | 5                      |
| 4.  | Ascospores (21-)25-33(-38) $\times$ (7.5-)8.5-12.0(-14.0) $\mu$ m . . . . .   | <i>K. aethiops</i>     |
| 4'. | Ascospores (29-)36-50(-55) $\times$ (12-)15-17(-19) $\mu$ m . . . . .   | <i>K. thujina</i>      |
| 5.  | Ascospores (13.5-)15.0-19.0(-21.0) $\times$ 5.0-6.0(-7.5) $\mu$ m, length: breadth ratio about 4 : 1, apices tending to be attenuated . . . . . | <i>K. maritima</i>     |
| 5'. | Ascospores (14.0-)15.0-17.5 $\times$ 5.0-6.5(-7.0) $\mu$ m, length: breadth ratio about 3 : 1, apices rounded . . . . .                         | <i>K. recessa</i>      |

## ACCEPTED SPECIES

*Kirschsteiniothelia acerina* (Rossman & Wilcox) D. Hawksw.

***Kirschsteiniothelia acerina*** (Rossman & Wilcox) D. Hawksw. **comb. nova**

BASIONYM: *Microthelia acerina* Rossman & Wilcox, *Mycologia*, 77: 162 (1985).

ASCOMATA arising singly or in small groups, scattered, colonies not delimited, finally  $\pm$  entirely superficial, hemispherical, applanate at the base, 185-240  $\mu$ m diameter, 145-200  $\mu$ m tall, black; ostiole not well defined, asci often discharging through fissures in the upper parts of the ascoma, peridium dark reddish-brown, 20-40  $\mu$ m thick, composed of subglobose to polyhedral pseudoparenchymatous cells forming a textura angularis, arranged as  $\pm$  radiating plates (cephalothecoid); cells elongated in the outer and lower layers, 6-12  $\times$  4-8  $\mu$ m, the outermost with most strongly thickened walls and the lumina sometimes almost occluded; basal tissue similar in structure to the sides of the peridium but less well developed and becoming vertically orientated at the edges. PARAPHYSES (pseudoparaphyses) cellular, persistent, regularly septate, branched and anastomosing, 1.5-2.0  $\mu$ m thick. ASCI arising from the base of the ascomatal cavity, vertically orientated, subcylindrical, short-stalked, bitunicate, 85-95  $\times$  20-24  $\mu$ m, (4-)8-spored. ASCOSPORES distichously arranged in the asci, ellipsoid, rounded at the apices, 1-septate, the lower cell often somewhat smaller, slightly constricted at the septum, brown to dark brown, verruculose, not guttulate, lacking a distinct gelatinous sheath, 22-26  $\times$  8-11  $\mu$ m.

ANAMORPH: Unknown.

ILLUSTRATIONS: Rossman & Wilcox (1985: figs 1-11).

Figure 1.

HOSTS: On the surface of absorbing mycorrhizal rootlets of *Acer saccharum* Marsh. Apparently not mycorrhizal or pathogenic.

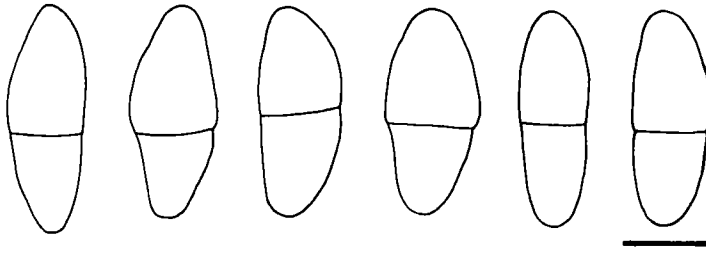


Figure 1. *Kirschsteiniothelia acerina*, ascospore outlines (IMI 245174). Scale = 10  $\mu$ m.

**DISTRIBUTION:** U.S.A. (New York, Onondaga County). Evidently not uncommon in Syracuse along streets, in cemeteries and forested areas according to Rossman & Wilcox (1985).

This species, which has been well described and illustrated by Rossman & Wilcox (1985), is unusual in the genus in that the ostiole is not well defined and the asci tend to discharge through irregular fissures in the upper parts of the ascoma. A plate-like or cephalothecoid structure of ascomata is seen in a wide range of genera with a subterranean habit and is perhaps most appropriately interpreted as an adaptation to this specialized ecological niche (Hawksworth, 1979; Malloch & Cain, 1972); there are now numerous genera in which both ostiolate and non-ostiolate species are recognized (von Arx, 1973; Cannon & Hawksworth, 1982). The method of ascomatal opening on its own is not interpreted by me as meriting separations at the genus level, and the tendency to produce elongate peridial cells is also seen in *Kirschsteiniothelia acerina* and *K. aethiops*. This fungus is consequently included within *Kirschsteiniothelia* here as it agrees in all other major characters with the type species of that genus.

**SPECIMEN EXAMINED:** U.S.A.: NEW YORK: Onondaga County, on *Acer saccharum* roots in cemetery, 7 xi 1979, *H. E. Wilcox* (IMI 245174—paratype of *Microthelia acerina* Rossman & Wilcox).

*Kirschsteiniothelia aethiops* (Berk. & Curtis) D. Hawksw.

***Kirschsteiniothelia aethiops*** (Berk. & Curtis) D. Hawksw. **comb. nova**

**BASIONYM:** *Sphaeria aethiops* Berk. & Curtis, *Grevillea*, 4: 143 (1876).

**SYNONYMS:** *Amphisphaeria aethiops* (Berk. & Curtis) Sacc., *Sylloge Fungorum*, 1: 722 (1882).

*Amphisphaeria betulina* f. *pinicola* Rehm, *Ascomyceten*, Fasc. 3 no. 135 (1872); *nom. inval.* [Art. 13].

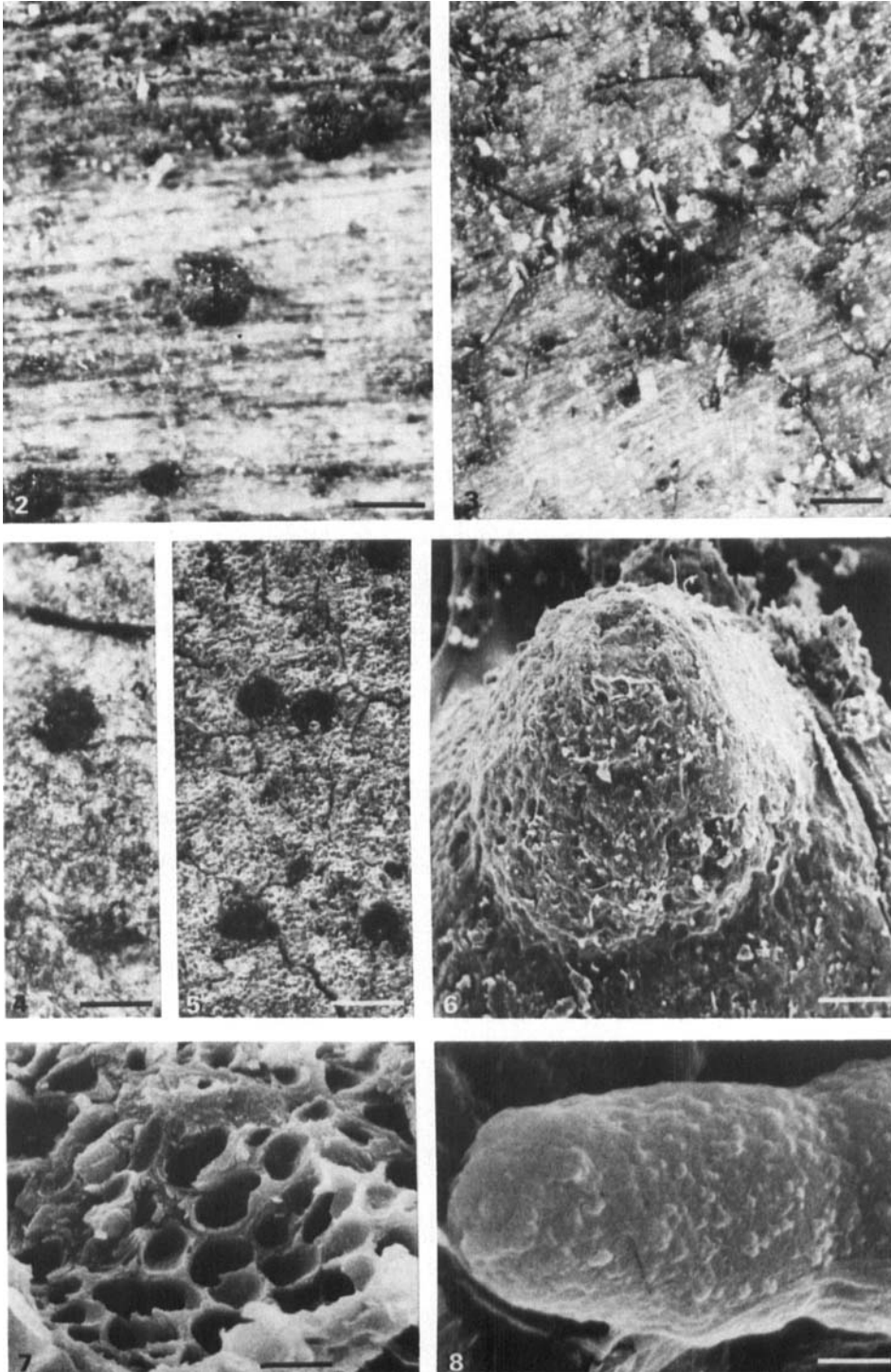
*Melanopsamma suecicum* Rehm, *Hedwigia*, 21: 120 (1882).

*Amphisphaeria suecica* (Rehm) Sacc., *Sylloge fungorum*, 9: 742 (1891).

?*Amphisphaeria heteromera* Briard & Sacc., in Saccardo, *Revue Mycologique*, 7: 159 (1885).

*Amphisphaeria magnusii* Sacc., Bommer & Rouss., in Bommer & Rousseau, *Bulletin Société Royal Botanique de Belge*, 26: 205 (1887).

*Amphisphaeria magnusiana* Rehm, *Ascomyceten*, fasc. 21 no. 1038 (1891), as "Sacc. Bomm. Rouss."; *nom. illegit.* [Art. 63].



Figures 2–8. *Kirschsteiniothelia aethiops*. Fig. 2. Ascomata on *Carpinus* wood (IMI 13524), scale = 500  $\mu$ m. Fig. 3. Ascoma on *Agathis* wood, note the conidiophores of the *Dendryphiopsis* anamorph (DAOM 94146a), scale = 250  $\mu$ m. Fig. 4. Ascomata on *Pinus* (Rehm, *Ascomyceten* no. 135, K), scale = 500  $\mu$ m. Fig. 5. Ascomata on *Tsuga* (*Microthelia inops* holotype, herb. Degelius), scale = 500  $\mu$ m. Figs 6–8. Scanning electron micrographs (Petrak, *Florae Bohemoslovacae et Moraviae*, ser. 2, no. 1040, K). Fig. 6. Ascoma, scale = 50  $\mu$ m. Fig. 7. Vertical section of part of peridium showing the pseudoparenchymatous structure, scale = 5  $\mu$ m. Fig. 8. Ascospore to show the irregular verruculose ornamentation, scale = 2  $\mu$ m.

*Amphisphaeria incrustans* Ellis & Everh., *North American Pyrenomycetes*: 201 (1892).

*Microthelia incrustans* (Ellis & Everh.) Corlett & S. Hughes, in Hughes, *New Zealand Journal of Botany*, 16: 360 (1978).

*Microthelia inops* Degel., *Arkiv für Botanik*, 30(3): 16 (1942).

ASCOMATA arising singly or in small groups, scattered, colonies not delimited,  $\pm$  superficial except at the base which can remain immersed, hemispherical to subglobose, base slightly to strongly applanate, (200–)300–600(–700)  $\mu\text{m}$  diameter, black; ostiole short papilliform or  $\pm$  plane, 20–30  $\mu\text{m}$  diameter; peridium dark brown, (30–)40–60(–70)  $\mu\text{m}$  thick, composed of thick-walled subglobose to polyhedral pseudoparenchymatous cells forming a textura angularis, cells mainly 5–8  $\mu\text{m}$  diameter, the outermost more deeply pigmented with thicker walls and sometimes with the lumina becoming occluded, basal tissue similar in structure to the sides of the ascoma, very variable in the extent of development, mainly 20–40  $\mu\text{m}$  thick, the cells becoming vertically orientated and pallisade-like in the angles of the ascomatal cavity, especially in old ascomata, and then to 10–15  $\mu\text{m}$  long. PARAPHYSES (pseudoparaphyses) cellular, persistent, abundant, regularly septate, branched and anastomosing, (2–)2.5–3(–3.5)  $\mu\text{m}$  thick; centrum sometimes turning blue in iodine but usually negative. ASCI arising from the base of the ascomatal cavity, vertically orientated, broadly subcylindrical, short-stalked, bitunicate, (60–)70–90(–120)  $\times$  12–15(–20)  $\mu\text{m}$ , 4- or 8-spored. ASCOSPORES distichously arranged in the asci, ellipsoid, rounded or somewhat constricted at the apices, 1-septate, the upper cell usually larger in size, somewhat constricted at the septum, brown, sometimes appearing almost smooth but at high magnification ( $\times$  1500) a delicate verruculose ornamentation is evident, not guttulate, lacking a distinct gelatinous sheath, (21–)25–33(–38)  $\times$  (7.5–)8.5–12.0(–14.0)  $\mu\text{m}$ .

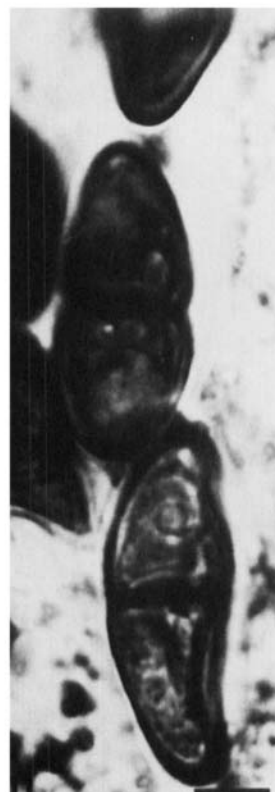
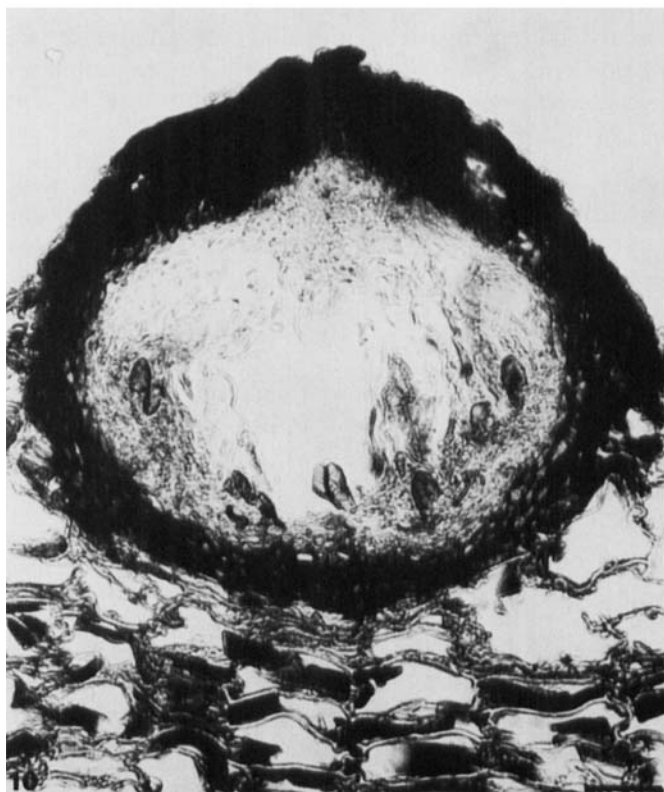
ANAMORPH: *Dendryphiopsis atra* (Corda) S. Hughes. The anamorph is commonly found growing together with the ascomata, especially in N American collections, and sometimes conidiophores form a fringe around the base of the ascomata. Good illustrations of the anamorph are provided by Ellis (1971), Hughes (1978) and Sivanesan (1984); its extensive synonymy is listed by Hughes (1958) and Sivanesan (1984).

EXSICCATAE: Fuckel, *Fungi rhenani*, no. 932 (as *Sphaeria applanata*; K).—Petrak, *Florae Bohemoslovacae et Moraviae*, ser. 2, no. 1040 (as *Amphisphaeria applanata*; K).—Rehm, *Ascomyceten*, no. 135 (isotype of *A. betulina* f. *pinicola*; K), no. 1038 (as *A. magnusiana*; BR), no. 1038b (as *A. suecica*; K), no. 2063 (as *A. applanata*; DAOM 96890, K).

ILLUSTRATIONS: Dennis (1968: fig. 20k); Munk (1957: fig. 167b); Parguey (1966: fig. 19, pl. 2, fig. 6); Scheinpflug (1958: fig. 17); Sivanesan (1984: fig. 229). Figures 2–15.

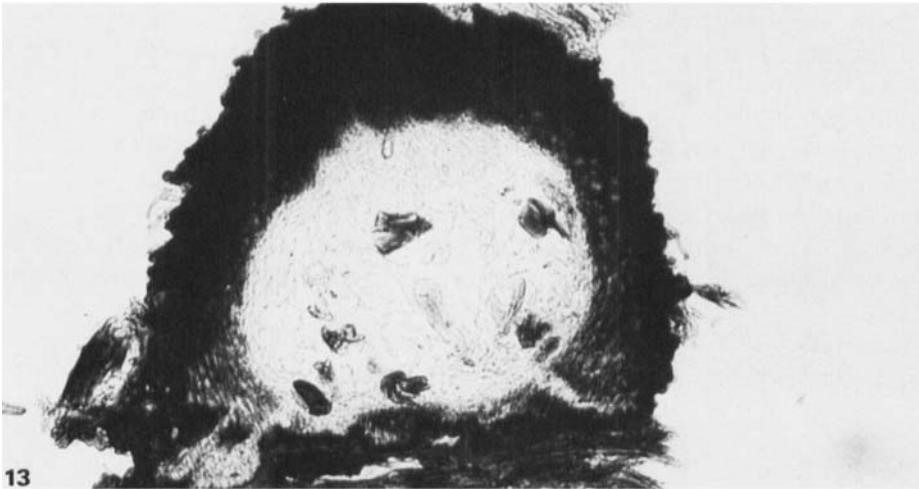
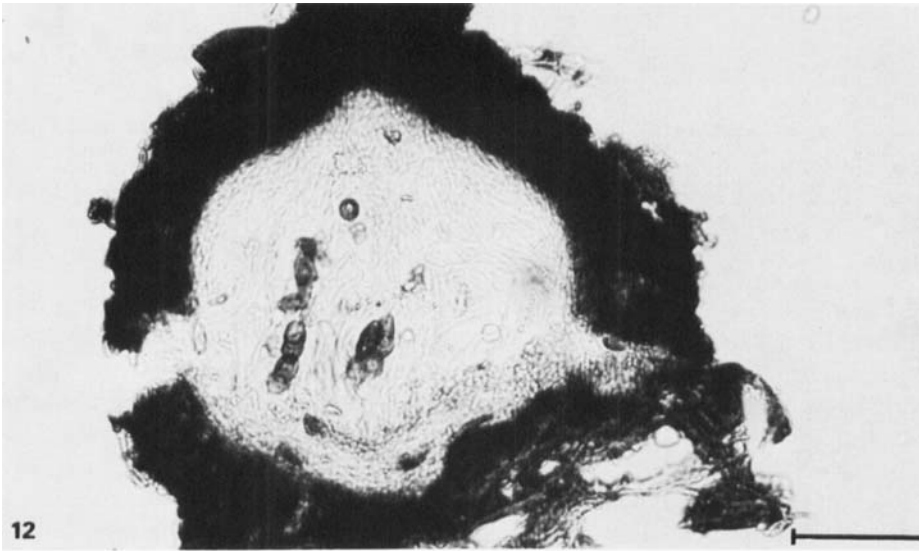
HOSTS: On decorticate wood (lignum), more rarely twigs or cones, of a wide range of trees including *Agathis australis* Salisb., *Alnus rubra* Bong., *Carpinus betulus* L., *Fagus sylvatica* L., *Pinus*, *Quercus*, *Salix*, *Thuja*, *Tilia* and *Tsuga canadensis* Carr.

DISTRIBUTION: Probably widespread in temperate regions. I have examined material of the teleomorph from Austria, Belgium, the British Isles (England



Figures 9–11. *Kirschsteiniothelia aethiops*. Figs 9, 10. Vertical sections of ascomata. Fig. 9 (DAOM 44956), scale = 30  $\mu$ m. Fig. 10 (*Microthelia inops* holotype, herb. Degelius), scale = 30  $\mu$ m. Fig. 11. Ascospores (DAOM 44956), scale = 6  $\mu$ m.





Figures 12-14. *Kirschsteiniothelia aethiops* (*Microthelia inops* paratype, herb. Degelius). Vertical sections of ascomata showing variations in the degree of flattening of the base, scale = 60  $\mu$ m.

and Scotland), Canada (British Columbia, Quebec and Ontario), Czechoslovakia, Germany, New Zealand and the U.S.A. (Nebraska, New York, Tennessee and Wisconsin; probably also Michigan and Minnesota, *fide* Harris, 1973). Other reliable reports include ones from Denmark (Munk, 1957), and France (Parguey, 1966; see below). The mention from Kenya by Sivanesan (1984) was based on an identification of the anamorph which merits further study.

This species varies in the degree of flattening of the base of the ascoma. For a long time I tried to distinguish two taxa on the basis of this feature, especially as the kind with a more rounded base is more usually associated with the *Dendryphiopsis* anamorph. However, flattening becomes most apparent on hard wood and in old ascomata; young ascomata always appear to be rounded to varying degrees. Considerable variation in this feature can also be seen in single collections (Figs 12–14). Ranges in ascospore dimensions (Table 1) overlap and as other characters to support such a separation were not detected, only the recognition of a single species could be justified at the present time. Single-ascospore cultures could perhaps shed some further light on this problem as a few European collections with a flattened base in IMI are associated, although perhaps fortuitously, with a *Septonema*-like conidial fungus.

In almost all collections the centrum does not turn blue in iodine, but a few exceptions were found in material from coniferous substrata. Variability in such reactions was noted for the group by Harris (1973).

This species has frequently been referred to as *Kirschsteiniella applanata* (Fr.) Petrak, but that name cannot be used as the type material of its basionym, *Sphaeria applanata* Fr., actually represents a *Cyclothyrium* species (Hawksworth, 1981a).

Sivanesan (1975) recognized the synonymy of *Sphaeria aethiops* with *Kirschsteiniella applanata* auct. and his observations were confirmed by my own

Table 1. Ranges of ascospore sizes in selected individual collections of *Kirschsteiniella aethiops*

Length (µm)*	Width (µm)*	Collection
26.0–32.0	8.5–12.0	BR ( <i>magnusii</i> lectotype)
23.0–38.0	8.5–12.5	DAOM 44956
29.0–35.0	8.5–14.0	DAOM 44956b
21.0–32.0	8.5–11.0	DAOM 158688
26.0–36.0	11.0–14.0	DAOM 94146a
24.0–30.0	9.0–12.0	DAOM 136381
25.0–32.0	8.0–11.0	DAOM 172327
24.0–29.0	8.0–10.5	herb. Degelius ( <i>inops</i> holotype)
25.0–29.5	7.5–10.0	IMI 13524
24.5–31.0	8.5–11.0	IMI 60387
24.5–34.0	7.5–11.0	IMI 53483
23.0–30.5	8.5–11.0	IMI 22035
23.0–29.5	10.0–12.0	IMI 63813
25.0–33.0	8.5–11.5	K (Rehm, <i>Ascom.</i> no. 1038b)
24.5–31.5	9.0–14.0	K (Rehm, <i>Ascom.</i> no. 1038)
24.0–34.0	9.0–14.0	K ( <i>aethiops</i> holotype)
24.0–35.0	7.5–12.0	NY ( <i>incrustans</i> holotype)

\*Measurements made to nearest 0.5 µm.

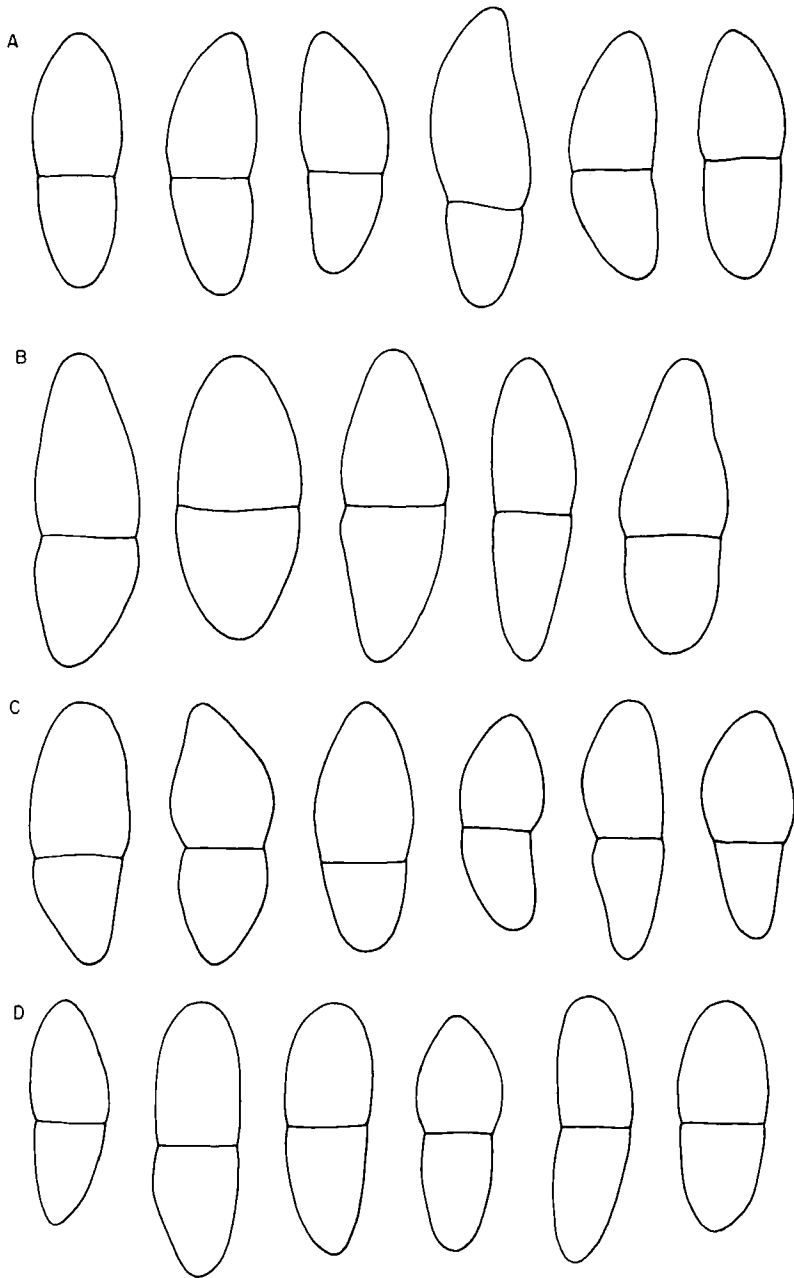


Figure 15. *Kirschsteiniothelia aethiops*, ascospore outlines to show variation in size and shape. A (DAOM 158688). B (DAOM 44956b). C (DAOM 136381). D (*Microthelia inops* holotype, herb. Degelius). Scale = 10  $\mu$ m.

studies; *S. aethiops* proves to be the earliest available name for this fungus. However, *Amphisphaeria melantera* Ellis & Everh., which Sivanesan also referred to this species, proves to be more appropriately placed in *Splanchnonema* Corda.

The epithet '*pinicola*' was taken up for this species by Scheinpflug (1958: 372) but when validated and raised to species rank it was illegitimate and must be

automatically typified by the type of *Didymosphaeria alpina* Hazslin, a name of uncertain application as already pointed out by Hawksworth (1981a).

*Melanopsamma suecicum* Rehm was originally described from fagaceous branches collected in Sweden by Britzelmayer but this could not be located in S (Å. Strid, personal communication). The epithet is placed as a synonym here on the basis of material on *Carpinus* issued by Rehm under this epithet in *Ascomyceten* no. 1938b.

In the original description of *Amphisphaeria magnusii*, the habitat was given as "sur le bois du chêne et du charme". In BR and PAD only one collection made in the type locality prior to the publication of the name could be located. This was on *Carpinus betulus* and is designated as lectotype for the name; it is not a holotype as the authors clearly also saw material on *Quercus* before their name was published.

*Amphisphaeria heteromera* is placed as a tentative synonym following Rehm (1906: 260); type material of that taxon has not been seen by me.

According to notes kindly supplied by Dr M. E. Barr (personal communication), *Sphaeria phileura* Cooke & Peck (*Grevillea* 5: 55, 1876; syn. *Amphisphaeria phileura* (Cooke & Peck) Sacc., *Sylloge Fungorum* 1: 725, 1882) may also be a synonym of *K. aethiops* but the material she examined (New York, Heidelberg Mountains, on *Tilia americana* L. bark, C. H. Peck, NYS) has somewhat smaller ascospores than is usual for the species ( $15.5\text{--}21.0 \times 6.5\text{--}8.5\ \mu\text{m}$ ) but they do recall those of *K. aethiops* rather than *K. recessa* in shape.

The anatomical study reported by Parguey (1966: 601–604) under the name '*Microthelia fusispora*' utilized material from dead wood collected in the park at Chantilly, near Paris by Chadeaud in 1962. The spore shape, size ( $25 \times 9\ \mu\text{m}$ ) and verruculose ornamentation, and further the habitat, leave little doubt that her material belonged to *Kirschsteiniothelia aethiops* and not the fungus now called *Astrosphaeriella stellata* (Pat.) Sacc. (Hawksworth, 1981a). Parguey noted that the basal tissue was formed of almost pallisade-like pseudoparenchymatous cells and documented ascus development, structure and discharge in some detail. Her material was unfortunately too scant to enable a thorough ontogenetic study to be made.

**SPECIMENS EXAMINED** (excluding exsiccatae listed above): AUSTRIA: Sternberg an Mühe in (?), on *Fagus* wood, x 1931, comm. F. Petrak (IMI 22035). BELGIUM: Groenendal, on decorticate *Carpinus betulus*, xi 1883, M. Bousseacy (?) (BR—lectotype of *Amphisphaeria magnusii*). Basse Ardennes, on *Fagus* wood, 19 iv 1956, C. Booth (IMI 63813). BRITISH ISLES: Hertfordshire, Ashridge Park, on (?) *Fagus* wood, v 1955, C. Booth (IMI 60387). Surrey, Glover's Wood, on *Carpinus betulus* wood, 22 iv 1935, E. W. Mason 1299 (IMI 13524); Glover's Wood, 29 iii 1936, E. W. Mason (IMI 13525). Sussex, Stoke Wood, Funtingdon, on *Quercus*, 26 iv 1972, B. J. Coppins & F. Rose (IMI 240439). Perthshire, Dunkeld Abbey, on *Tilia* wood, ix 1953, M. B. Ellis (IMI 53483). Roxburghshire, Richard Cleuch, Campteros, on (?) *Salix*, 19 iv 1975, B. J. Coppins 820 (IMI 240438). CANADA: British Columbia, Queen Charlotte Islands, Yakoun River, on decorticated *Alnus rubra* branch, 18 vi 1979, K. Egger 246 (DAOM 172327). Ontario, Thunder Bay District, nr Dorio, Ouimet Canyon, on decorticated wood, 25 viii 1965, B. Malloch 120 (DAOM 136381); Peel County, northwest of Palgrave, on *Thuja*, 24 ix 1966, B. Malloch (DAOM

136394); Nipissing District, Algonquin Park, near Margaret Lake, 21 vii 1966, *B. Malloch* 194 (DAOM 13465). Quebec, Gatineau Park, near Old Chelsea, on a rotten log, 21 x 1954, *S. J. Hughes* (DAOM 44956b). CZECHOSLOVAKIA: Bohemia, Krkonosé Mountains, on *Pinus 'montana'* Miller, viii 1927, *J. Velenovský* (PR 148820, IMI 243776); Krkonosé Mountains, Kotel, on *P. mugo* Turra, 4 xi 1979, *D. W. Minter* (IMI 243611). Slovakia, Nizky Tatry, on *P. mugo*, 7 ix 1960, *M. Svrček* (PR 614294, IMI 243775). GERMANY: W. Baden, Schwarzwald, Sonnhelde, Stokren, *Fagus* in old valley forest, 24 vii 81, *F. Rose* (Herb. Rose). NEW ZEALAND: Auckland, Coromandel-Whitianga Road, on *Agathis australis* wood, 6 ix 1963, *S. J. Hughes* 1263 (DAOM 158688); Auckland, Orere, on *A. australis* wood, 20 ii 1963, *J. Dingley* (DAOM 94146a). NORWAY: *Salix nigra* Marsh dead twigs *G. Mathiasen Fm 275/81* (IMI 290371). U.S.A.: Nebraska, Milford, on old wood, x 1887, ?*J. B. Ellis* (NY—holotype of *Amphisphaeria incrustans*). New York, on old logs, *M. A. Curtis* 4414 (K—holotype of *Sphaeria aethiops*). Tennessee, Great Smoky Mountains, Cherokee Orchard, on *Tsuga canadensis*, 11 ix 1939, *G. Degelius* (herb. Degelius—holotype of *Microthelia inops*); Great Smoky Mountains, near National Park Office, on *Tsuga*, 18 ix 1939, *G. Degelius* (herb. Degelius). Wisconsin, Squaw Point, north of Bayfield, on decorticated twig, 21 viii 1965, *B. Malloch* (DAOM 136397).

*Kirschsteiniothelia maritima* (Linder) D. Hawksw.

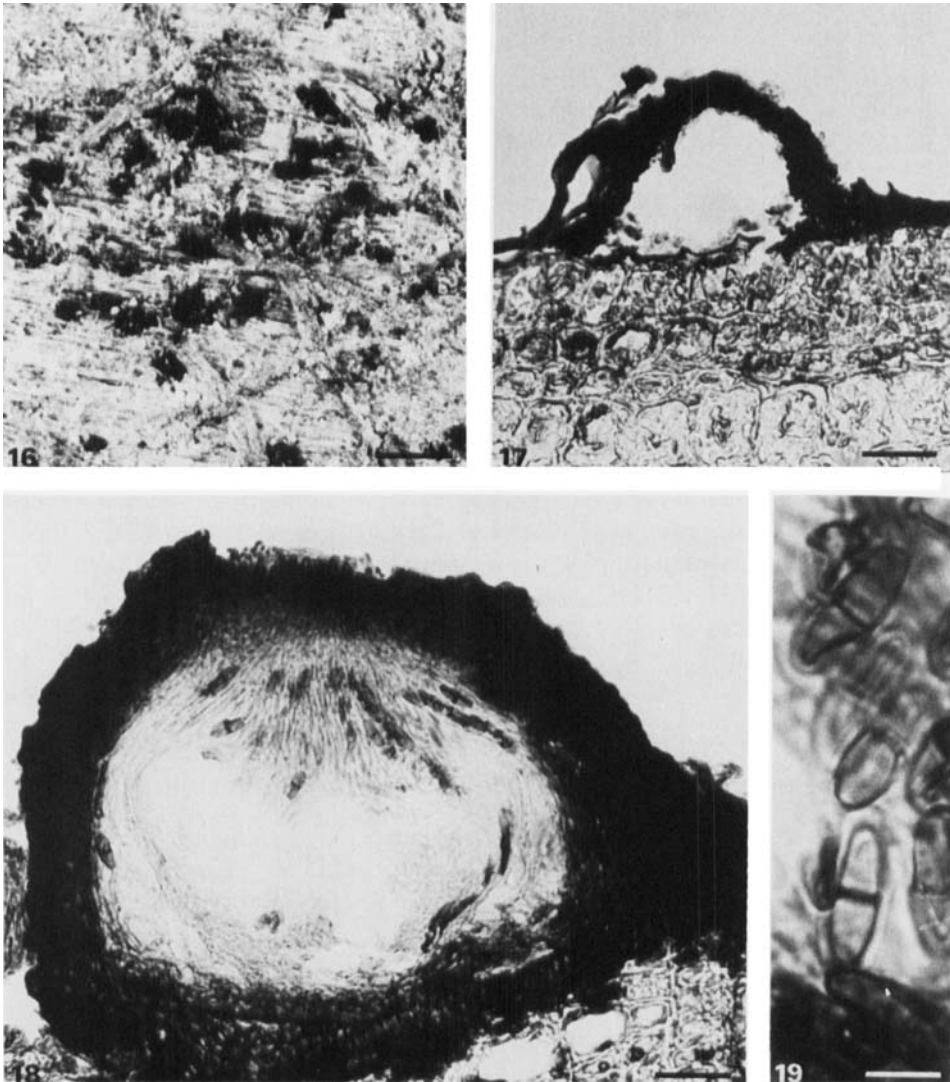
***Kirschsteiniothelia maritima*** (Linder) D. Hawksw. **comb. nova**

BASIONYM: *Amphisphaeria maritima* Linder, *Farlowia*, 1: 411 (1944).

SYNONYMS: *Microthelia maritima* (Linder) Kohlm., *Nova Hedwigia*, 2: 322 (1960); *nom. illegit.* [Art. 64.1], *non Microthelia maritima* B. de Lesd. *ex anno* 1910.

*Microthelia linderi* Kohlm., *Transactions of the British Mycological Society*, 57: 483 (1971).

ASCOMATA arising singly or in small groups, scattered, colonies not delimited, erumpent, almost entirely superficial at maturity, with only the base immersed, hemispherical to almost subglobose, base applanate, 100–270 µm diameter, 55–130 µm tall, ostiole plane to slightly papillate, black; peridium very dark reddish-brown to almost black, 30–35 µm thick, composed of layers of subglobose to rather angular pseudoparenchymatous cells mainly 4–6 µm diameter, the interstices and lumina becoming occluded with reddish-brown material, forming a *textura angularis*; basal tissue poorly developed to almost absent, interrupted, composed of a single layer of strongly compressed pseudoparenchymatous cells forming a layer 2.5–5.0 µm thick; centrum not turning blue in iodine. PARAPHYSES (pseudoparaphyses) cellular, persistent, rather sparse, septate, irregularly branched, 2.0–3.5 µm thick. ASCI arising from the base of the ascomatal cavity, ± vertically orientated, elongate-clavate, often broadest towards the base, short-stalked, bitunicate, with a small internal apical beak, 35–60(–75) × 8–14 µm, 8-spored. ASCOSPORES distichously arranged in the asci, elongate-ellipsoid, 1-septate, constricted at the septum, the apices tending to be attenuated, pale brown, almost smooth but sometimes with a very sparse verruculose ornamentation, lacking a distinct gelatinous sheath, (13.5–)15–19(–21) × 5–6(–7.5) µm.



Figures 16–19. Figs 16, 17. *Kirschsteiniothelia maritima* (*Microthelia maritima* holotype, FH). Fig. 16. Ascomata on wooden test block, scale = 500  $\mu$ m. Fig. 17. Vertical section of ascoma, scale = 40  $\mu$ m. Figs 18, 19. *K. recessa* (*Sphaeria recessa* holotype, K). Fig. 18. Vertical section of ascoma, scale = 30  $\mu$ m. Fig. 19. Ascospores, scale = 10  $\mu$ m.

ANAMORPH: Unknown.

ILLUSTRATIONS: Kohlmeyer (1959: figs 17–19); Kohlmeyer & Kohlmeyer (1964: tab. 39, figs 1–66; 1979; fig. j); Linder (1944: pl. 3, figs 13–16). Figures 16–17, 20.

HOST: On wood, especially resin-coated coniferous wood, in the sea. On test-blocks and also driftwood.

DISTRIBUTION: British Isles, Canary Islands, Canada, Denmark, Iceland, France, Germany, Norway and the U.S.A.

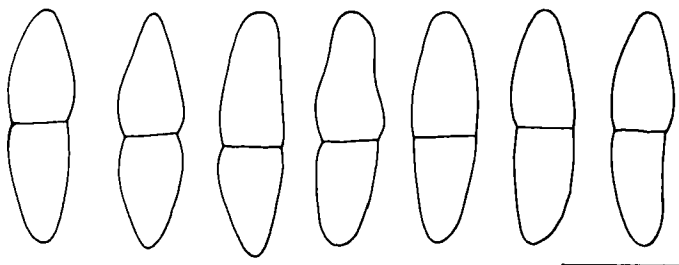


Figure 20. *Kirschsteiniothelia maritima* (*Microthelia maritima* holotype, FH), ascospore outlines.  
Scale = 10  $\mu$ m.

This is evidently a widespread species in the oceans of the Northern Hemisphere which has been repeatedly found by marine mycologists. The information on this species is summarized by Kohlmeyer & Kohlmeyer (1979: 430–431) and the above description and notes on habitat and distribution are based partly on their account. These authors report periphyses inside the ostiole but I could not confirm this in the holotype.

This species is closest to *Kirschsteiniothelia recessa* but differs in the relatively narrower ascospores (length: breadth ratio about 4:1) which tend to be constricted apically. The epithet '*maritima*' must be reinstated for the species when it is removed from *Microthelia* into *Kirschsteiniothelia* as that epithet is not already preoccupied in the latter genus and predates '*linderi*'.

Cultures from ascospores were obtained by Kohlmeyer (1960: 322) who found that they germinated in tap water at 23°C. Cultures grew particularly well on oat-malt agar forming a cottony light-brown aerial mycelium, and a darker-brown mycelium in the substrate. No anamorph or ascomata developed.

SPECIMEN EXAMINED: U.S.A.: Massachusetts, Woods Hole, on test block 7 ft below low water immersed 13 x 1941 to 13 vi 1942, *S. E. Barghorn 3a* (FH—holotype).

*Kirschsteiniothelia recessa* (Cooke & Peck) D. Hawksw.

***Kirschsteiniothelia recessa* (Cooke & Peck) D. Hawksw. comb. nova**

BASIONYM: *Sphaeria recessa* Cooke & Peck, *Report of the Botanist, New York State Museum*, 29: 61 (1878) ["1875"].

SYNONYM: *Melanopsamma recessa* (Cooke & Peck) Sacc., *Sylloge Fungorum*, 1: 579 (1882).

ASCOMATA arising singly or more usually in small groups, scattered, colonies not delimited,  $\pm$ superficial except at the base, hemispherical, base slightly rounded to applanate, 150–250  $\mu$ m diameter, black; ostiole short-papilliform; peridium dark reddish-brown, 50–75  $\mu$ m thick, composed of thick-walled subglobose to polyhedral pseudoparenchymatous cells forming a *textura angularis*, cells mainly 4–7  $\mu$ m diameter, the outermost often with the lumina becoming occluded; basal tissue similar in structure to the sides of the ascoma, well developed, mainly 8–20  $\mu$ m thick, the cells tending to be vertically orientated and palisade-like. PARAPHYSES (pseudoparaphyses) cellular, persistent, abun-

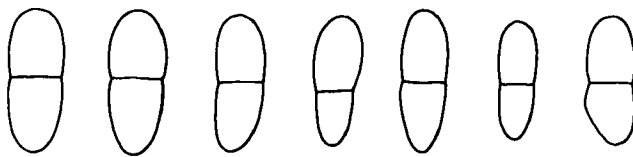


Figure 21. *Kirschsteiniothelia recessa* (*Sphaeria recessa* holotype, K), ascospore outlines. Scale = 10  $\mu$ m.

dant, regularly septate, branched and anastomosing, 2–3  $\mu$ m thick. ASCI arising from the base of the ascomatal cavity, vertically orientated, subcylindrical, short-stalked, bitunicate, *c.* 90  $\times$  10  $\mu$ m, 8-spored. ASCOSPORES distichously arranged in the asci, elongate-ellipsoid, rounded at the apices, 1-septate, cells equal in size or the lower slightly smaller, slightly constricted at the septum, pale brown, almost smooth or with a very weak verruculose ornamentation, not guttulate, lacking a distinct gelatinous sheath, (14–)15–17.5  $\times$  5–6.5(–7)  $\mu$ m.

ANAMORPH: Erect red-brown septate thick-walled conidiophores 3.5–4.0  $\mu$ m thick are scattered over the holotype specimen. No attached conidia were found, but in one preparation a single broken conidium that could indicate this was a *Dendryphiopsis* species was seen. Fresh material and single-ascospore cultures are needed to pursue the nature of this putative anamorph further.

ILLUSTRATIONS: Figures 18–19 and 21.

HOST: On rotten wood.

DISTRIBUTION: U.S.A. (New York). Only known from the original collection.

This species is very similar to *Kirschsteiniothelia aethiops* in the structure of the ascomata but differs in the much smaller size of these ascomata and also in the much smaller ascospores. The degree of flattening of the base of the ascomata appears to vary in a similar way to that seen in *K. aethiops* (Figs 18 & 24).

SPECIMEN EXAMINED: U.S.A., New York, Seneca Co., Tyre, on rotten wood, September [1875?], C. H. Peck 141 (K—holotype of *Sphaeria recessa*; NY—*isotype n.v.*).

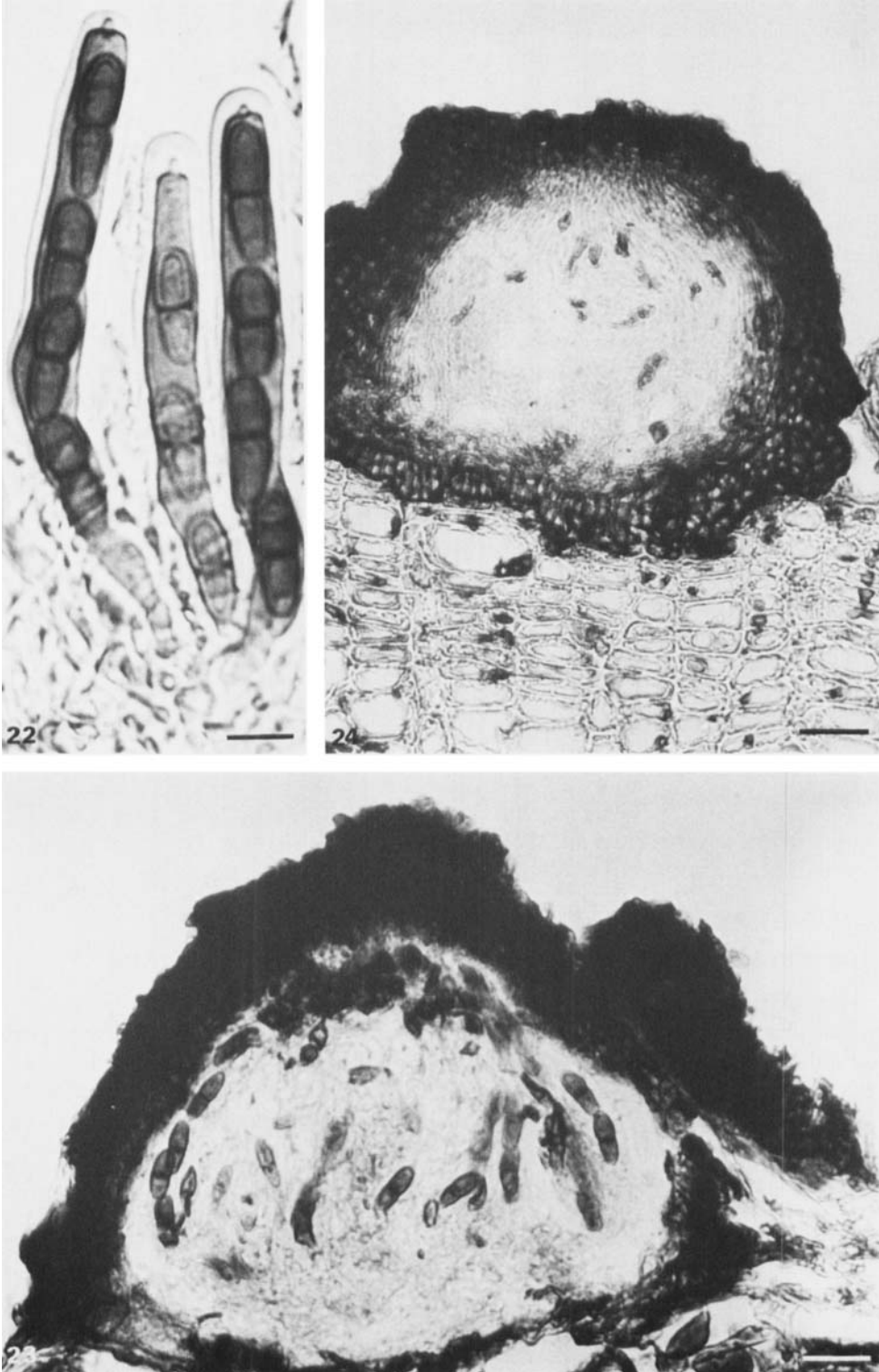
*Kirschsteiniothelia striatispora* (Aebi *et al.*) D. Hawksw.

***Kirschsteiniothelia striatispora*** (Aebi, Harr & E. Müller) D. Hawksw.  
**comb. nova**

BASIONYM: *Microthelia striatispora* Aebi, Harr & E. Müller, *Nova Hedwigia*, 22: 641 (1972).

ASCOMATA arising singly, scattered, colonies not delimited, erumpent, almost entirely superficial at maturity, hemispherical, base applanate, 150–250  $\mu$ m diameter, 120–150  $\mu$ m tall, black, lacking a distinct basal fringe; ostiole almost plane to slightly papillate; peridium dark reddish-brown, 15–32  $\mu$ m thick, composed of irregular layers of subglobose to polyhedral pseudoparenchymatous cells mainly 5–7  $\mu$ m diameter, the outermost thick-walled, becoming occluded, *textura angularis*; basal tissue very variable, always poorly developed, continuous or interrupted, composed of angular to subglobose pseudoparen-





Figures 22–24. Figs 22, 23. *Kirschsteiniothelia striatispora* (*Microthelia striatispora* holotype, ZT). Fig. 22. Asci with included ascospores, scale = 10  $\mu$ m. Fig. 23. Vertical section of ascoma, scale = 20  $\mu$ m. Fig. 24. *K. recessa* (*Sphaeria recessa* holotype, K), vertical section of ascoma, scale = 30  $\mu$ m.

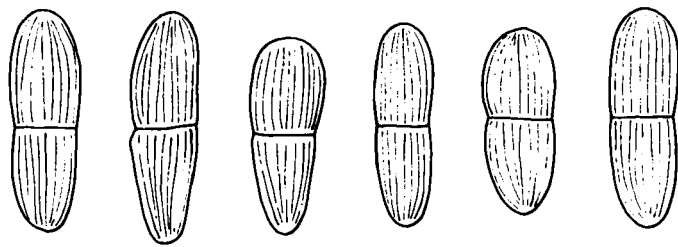


Figure 25. *Kirschsteiniothelia striatispora* (*Microthelia striatispora* holotype, ZT), ascospore outlines. Scale = 10  $\mu$ m.

chymatous pale reddish-brown cells forming a layer to only about 10  $\mu$ m thick in parts, basal part of the ascomatal cavity occupied by subhyaline to hyaline densely intermixed and compressed hyphae and pseudoparenchymatous cells; centrum not giving a distinct blue reaction with iodine. PARAPHYSES (pseudoparaphyses) cellular, persistent, numerous, septate, very irregularly branched and anastomosing, the cells irregular in shape, 2–3  $\mu$ m thick. ASCI arising from the base of the ascomatal cavity,  $\pm$  vertically orientated, subcylindrical, short-stalked, bitunicate, with a distinct pimple-like internal apical beak, 65–75  $\times$  9–11  $\mu$ m, 4-spored. ASCOSPORES overlapping–uniseriately arranged in the asci, ellipsoid to somewhat soleiform, 1-septate, constricted at the septum or scarcely so, the cells equal in size or the lower slightly smaller, apices rounded, reddish-brown, slightly granular at first but finally with up to five longitudinal or sinuate furrows visible in face view at high magnifications using light microscopy, lacking a distinct gelatinous sheath, (14–)15–18(–19)  $\times$  5.0–6.5  $\mu$ m.

ANAMORPH: Unknown.

ILLUSTRATIONS: Aebi, Harr & Müller (1972: 646, tab. 1e–g). Figures 22, 23, 25.

HOST: *Juniperus communis* L. subsp. *nana* Syme, small dead twigs.

DISTRIBUTION: Switzerland. Known only from the original collection.

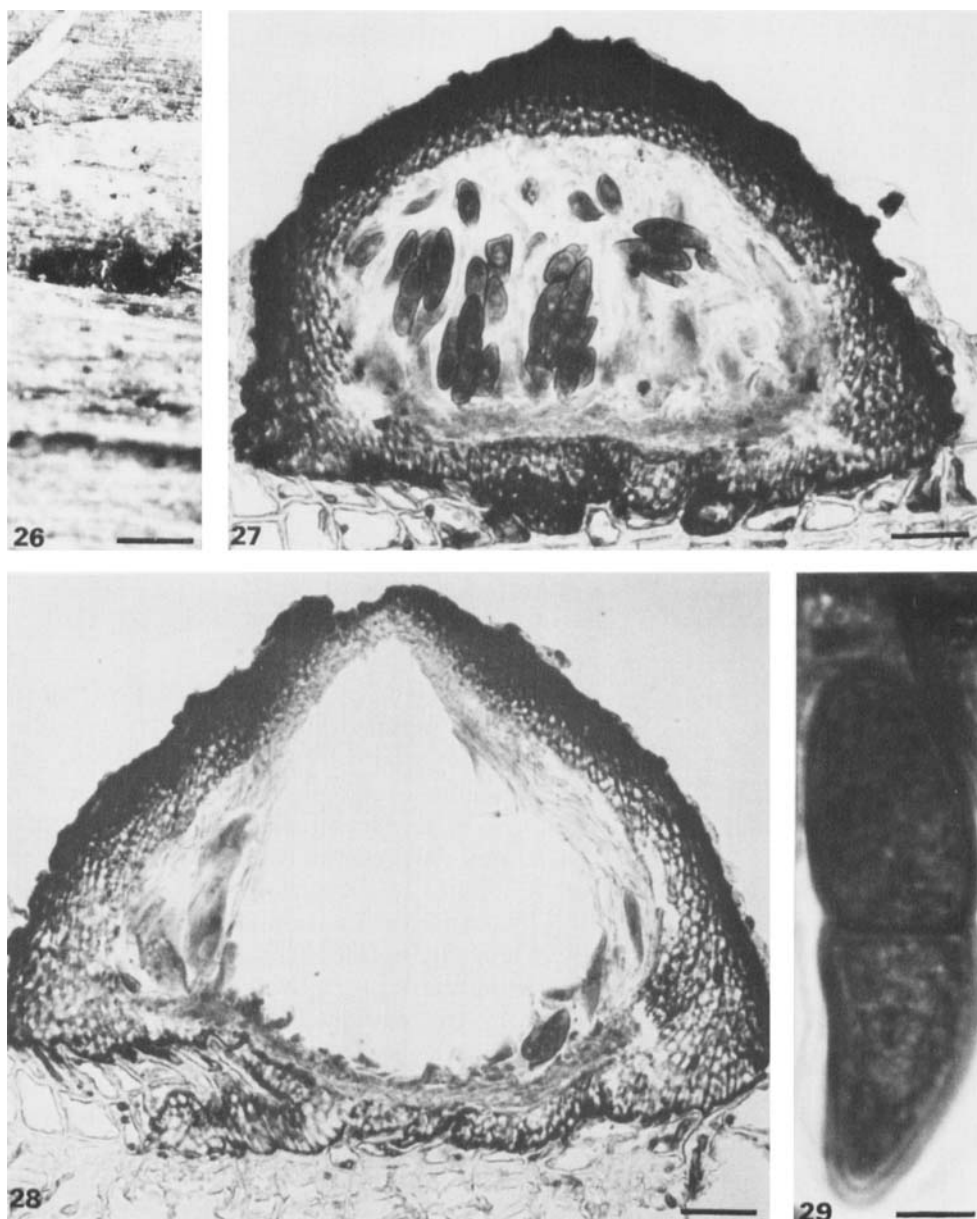
This species is included within *Kirschsteiniothelia* on the basis of the structure of the ascomata, but the distinctive furrow-like ornamentation on the ascospores and subcylindrical asci set the species apart from other members of the genus. This ornamentation should be studied by SEM when more material is available; too few ascomata were present on the holotype to enable me to do this without destroying much of the collection.

SPECIMEN EXAMINED: SWITZERLAND, Kanton Wallis, Aletschreservat, Brig, on *Juniperus communis* subsp. *nana*, 21 ix 1965, E. Müller & F. Casagrande (ZT—holotype).

*Kirschsteiniothelia thujina* (Peck) D. Hawksw.

***Kirschsteiniothelia thujina* (Peck) D. Hawksw. comb. nova**

BASIONYM: *Sphaeria thujina* Peck, *Report of the Botanist, New York State Museum*, 27: 110 (1875) [“1873”].



Figures 26–29. *Kirschsteiniella thujina* (*Sphaeria thujina* holotype, NYS). Fig. 26. Ascomata on *Thuja* wood, scale = 500 µm. Fig. 27. Vertical section of maturing ascoma, scale = 40 µm. Fig. 28. Vertical section of old ascoma showing the more flattened base, scale = 40 µm. Fig. 29. Ascospore, scale = 4 µm.

SYNONYMS: *Amphisphaeria thujina* (Peck) Sacc., *Sylloge Fungorum*, 1: 226 (1882).

*Kirschsteiniella thujina* (Peck) Pomerl. & Ether., *Mycologia*, 53: 160 (1962) ["1961"].

ASCOMATA arising singly or in small groups, scattered, colonies not delimited, originating in the outer layers of the host but soon erumpent and  $\pm$  superficial at maturity, hemispherical, base applanate, (300–)350–500(–600) µm diameter, 300–500 µm tall, black, ostiole short-papilliform to conical, to *c.* 75 µm wide

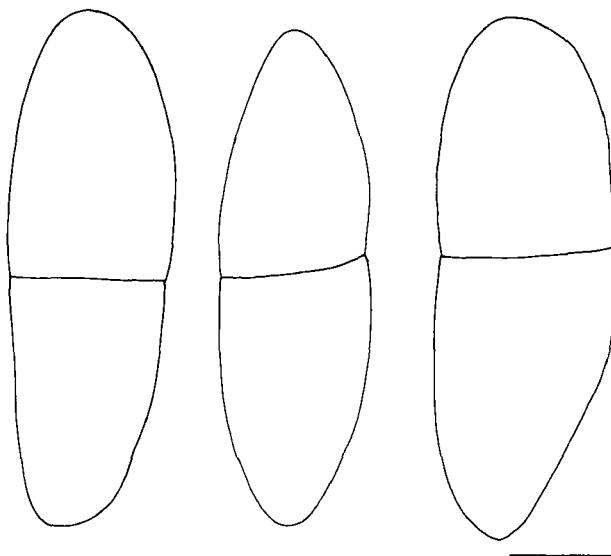


Figure 30. *Kirschsteiniothelia thujina* (*Sphaeria thujina* holotype NYS), ascospore outlines.  
Scale = 10  $\mu$ m.

at maturity; peridium deep reddish-brown, 40–60(–75)  $\mu$ m thick, composed of thick-walled subglobose to polyhedral pseudoparenchymatous cells forming a *textura angularis*, cells mainly 7–10  $\mu$ m diameter, the outermost often with the lumina becoming occluded; basal tissue similar in structure to the sides of the peridium, well developed, mainly 25–40  $\mu$ m thick but with teeth-like projections to 80  $\mu$ m long extending into the host tissue, continuous, the cells tending to be vertically orientated and pallisade-like; centrum not turning blue in iodine. PARAPHYSES (pseudoparaphyses) evidently cellular, persistent, abundant, rather sparsely septate, branched and anastomosing, 2.5–3.5  $\mu$ m thick. ASCI arising from the base of the ascomatal cavity,  $\pm$  vertically orientated, subcylindrical to elongate-clavate, short-stalked, bitunicate, 100–140  $\times$  17–22  $\mu$ m, 8-spored. ASCOSPORES irregularly to distichously arranged in the asci, elongate-ellipsoid, slightly attenuated towards the apices, 1-septate, the cells mainly equal in size, the lower cell sometimes somewhat smaller, dark brown, apparently smooth walled, often guttulate, without a distinct gelatinuous sheath, (29–)36–50(–55)  $\times$  (12–)15–17(–19)  $\mu$ m.

ANAMORPH: Unknown.

ILLUSTRATIONS: Pomerleau & Etheridge (1962: figs 1–6, 8–13).  
Figures 26–30.

HOST: *Abies balsamea* Mill. and *Thuja occidentalis* L. wood. Causing a blue stain in the wood. It should be noted that *K. aethiops* can also occur on *Thuja* (see above).

DISTRIBUTION: Canada (Quebec) and the U.S.A. (New York). Probably widespread in coniferous forests in subboreal zones in N America.

This species has been studied in detail by Pomerleau & Etheridge (1962) and the above description includes information from their account in addition to my own studies of the type material. These authors determined that this fungus was

the causal agent of a blue stain in the wood of *Abies balsamea* and were able to isolate it into pure culture both from ascospores and infected wood. The hyphae in these cultures often had pointed incrustations but no conidia were produced; optimum growth occurred between 22 and 28°C.

On the basis of the structure of the ascomata this species is very close to *Kirschsteiniothelia aethiops* from which it can be separated by the larger and apparently smooth ascospores, although these have not been studied by SEM. If the spores became more than 1-septate and the pseudoparaphyses were narrower and trabeculate this fungus might be accommodated in *Trematosphaeria* Fuckel; ontogenetic studies of this species would therefore be of particular interest.

SPECIMEN EXAMINED: U.S.A.: New York, Adirondack Mountains, on *Thuja occidentalis* wood, C. H. Peck (NYS—holotype of *Sphaeria thujina*).

#### APPENDIX: ARTHOPYRENIA

A new combination is necessary for the species previously known as *Sphaeria texensis* Cooke.

***Arthopyrenia texensis* (Cooke) D. Hawksw. comb. nova**

BASIONYM: *Sphaeria texensis* Cooke, *Journal of the Linnean Society of London*, 17: 143 (1878).

SYNONYM: *Amphisphaerina texensis* (Cooke) Höhnelt, *Sitzungsberichten der Akademie der Wissenschaften in Wien, mat.-nat. Klasse*, I, 128: 581 (1919).

*Arthopyrenia texensis* appears to be rather close to the recently recognized *Arthopyrenia minor* R. C. Harris (Harris, 1975: 59), a species known from Florida, Louisiana and Texas, but *A. texensis* differs from *A. minor* in its somewhat smaller ascospores (10–12 × 3–4 µm).

#### ACKNOWLEDGEMENTS

I am grateful to Dr M. E. Barr for helpful discussions on generic concepts and drawing my attention to *Sphaeria phileura* and *S. recessa*; to Dr A. Y. Rossman for allowing me to study *Microthelia acerina*; to Dr Å. Strid for information on Rehm's material in Stockholm; and to Dr P. B. Topham for carrying out preliminary statistical tests on variations in spore size in *Kirschsteiniothelia aethiops*. The following institutional herbaria kindly made type or other material available for study: BR, DAOM, FH, F, K, NY, NYS, PAD, PR and ZT. Professor G. Degelius also made important collections from his private herbarium available.

Mrs C. Thatcher is thanked for preparing the microtome sections figured.

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