

Five new genera in the new family Pseudeurotiaceae

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Received April 30, 1970

MALLOCH, D., and R. F. CAIN. 1970. Five new genera in the new family Pseudeurotiaceae. *Can. J. Bot.* 48: 1815-1825.

The Pseudeurotiaceae, a new family of cleistothecial Ascomycetes, is established. Members of this family are characterized by nonostiolate ascocarps which are frequently dark in color, irregularly disposed asci, and hyaline or brown ascospores which lack germ pores. The conidia are usually borne on simple phialides or sympodulae. *Cryptendoxyla*, *Hapsidospora*, *Leuconeurospora*, *Mycorachis*, and *Nigrosabulum* are described as new genera and included in the Pseudeurotiaceae. A key to the genera of the Pseudeurotiaceae is also given and some comments are offered on the previously established genera.

In recent years it has become increasingly apparent that the cleistothecial Ascomycetes represent a group of fungi with very diverse origins. While, in the past, only one or two families contained all of the genera, we now find that it is more satisfactory to distribute them among several families. The present paper is one of those redistributions of genera requiring establishment of a new family.

Pseudeurotiaceae Malloch & Cain, fam. nov.

Ascogonia convoluta. Ascocarpace nonostiolatae, nonstromaticae, cum cavitatis solitariis. Asci irregulare dispositi, subglobosi ad globosi. Ascosporeae uni- vel bi-loculares, hyalinae vel brunneae, sine porae. Conidia phialosporae vel sympodulosporae.

Ascocarp initials coiled. Ascocarps nonostiolate, nonstromatic, with a single cavity, hyaline to dark brown. Asci irregularly disposed, subglobose to globose. Ascospores one- or two-celled, hyaline or brown, smooth or roughened, without germ pores. Conidia borne on phialides or sympodulae.

As with most families of fungi, no single character seems to characterize the Pseudeurotiaceae. It appears to be a strictly cleistothecial group with consistently irregularly disposed, subglobose to globose asci. The ascospores are usually quite small, always lack germ pores, and thus swell considerably upon germination. The conidial stages are usually either *Sporothrix* or *Cephalosporium* but can also be other simple phialide or sympodulospore types.

The family Pseudeurotiaceae is somewhat similar to the Eurotiaceae, but differs in several respects. Unlike any of the Eurotiaceae, the members of this family often produce brown ascocarps or ascospores. While the conidial

stages of the Eurotiaceae are usually highly developed phialide types characterized by complex conidiophores, those of the Pseudeurotiaceae are usually very simple. Members of the Pseudeurotiaceae never produce the two-valved type of ascospores common in the Eurotiaceae.

One of the features common to several members of the Pseudeurotiaceae is the arrangement of the peridial cells to form plate-like complexes (Figs. 3 and 16). Each of these plates is made up of radiating groups of cells and is separated from adjacent plates by well-defined lines of dehiscence. Such plates can be quite small and simple (Fig. 16) or very large and complex (Fig. 3). We are using the term "cephalothecoid" to describe such structures. This term refers to the genus *Cephalotheca* Fuckel, used by many authors (Höhnel 1917; Chesters 1935; Ciferri 1958) to accommodate many of the cleistothecial genera with such peridial structures. We have observed this type of peridium in a large number of unrelated groups and thus cannot recognize it as being of taxonomic importance above the species level. The genus *Cephalotheca* itself is retained to accommodate only the type species, *C. sulfurea*. We have not been able to observe ascospore germination in this species and are thus unable to say whether or not it belongs in the Pseudeurotiaceae. If germination studies indicate that germ pores are lacking it would probably belong in this family. Since the family Cephalothecaceae (Höhnel 1917) is older it would take precedence as the correct name for this family.

In addition to four previously established genera which belong in the Pseudeurotiaceae we shall describe another five. The reason that five new genera appear here is not due to any kind of "splitting" but to the fact that the number of undescribed cleistothecial Ascomycetes is still very high.

KEY TO THE GENERA OF THE Pseudeurotiaceae

1. Ascospores one-celled.....2
 1. Ascospores two-celled.....9
2. Ascocarp peridium cephalothecoid, made up of "plates" of radiating cells which separate at maturity along well-defined lines of dehiscence.....3
 2. Peridium not as above.....5
3. Ascospores hyaline, marked by a few low, longitudinal ridges.....*Leuconeuropa*
 3. Ascospores brown.....4
4. Ascospores reniform; conidia borne on sympodulae.....*Fragosphaeria*
 4. Ascospores cylindrical; conidia borne on phialides (*Chalara*).....*Cryptendoxyla*
5. Ascospores hyaline in mass at maturity.....*Nigrosabulum*
 5. Ascospores brown in mass at maturity.....6
6. Ascospores with reticulations, "wings" or crests.....7
 6. Ascospores smooth.....8
7. Ascospores spherical, reticulate.....*Hapsidospora*
 7. Ascospores ellipsoidal, with "wings" or crests.....*Emericellopsis*
8. Ascospores ellipsoidal or spherical.....*Pseudewotium*
 8. Ascospores reniform.....*Fragosphaeria*
9. Ascospores hyaline, smooth.....*Mycocarachis*
 9. Ascospores brown, reticulate.....*Testudina*

***Cryptendoxyla* Malloch & Cain, gen. nov.**

Ascocarpaceae subglobosae ad globosae, glabrae, fuscobrunneae, cum peridio cephalothecoidae. Asci pyriformes vel subglobosi, octospori. Ascosporeae cylindraceae, brunneae, unicellares. Conidia mode phialosporarum, endogena producta (*Chalara*).

TYPUS GENERIS: *Cryptendoxyla hypophloia* Malloch & Cain.

ETYMOLOGY: Greek, *kryptos* = hidden, and *Endoxyla*, a genus with similar ascospores.

Ascocarps subglobose to globose, dark brown to black, glabrous, nonstiolate, with a cephalothecoid peridium. Asci irregularly disposed, pyriform to subglobose, eight-spored, evanescent. Ascospores cylindrical, brown, one-celled, without germ pores. Conidial stage consisting of simple phialides bearing conidia from within the neck (*Chalara*).

Cryptendoxyla hypophloia, the only species of the genus so far known, can be characterized by its cephalothecoid peridium and cylindrical brown ascospores which lack germ pores. It produces a *Chalara* conidial stage and may be related to the genus *Pseudewotium* but is maintained separately because of these characteristics and because of its habitat.

***Cryptendoxyla hypophloia* Malloch & Cain sp. nov.**

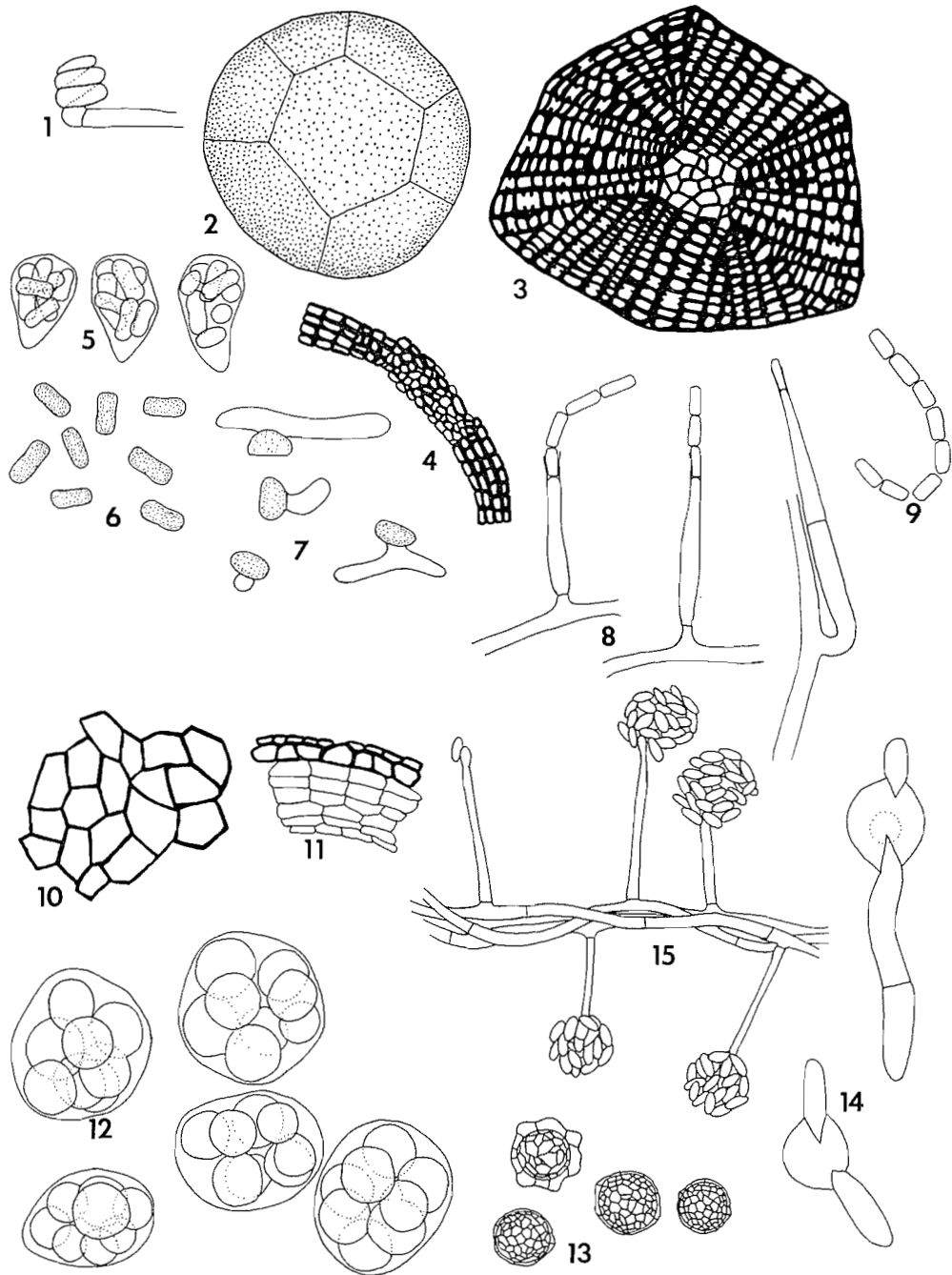
Figs. 1-9

Coloniae in agar Weitzman et Silva-Hutner secundum diametrem aetate 35 dierum 7.5 cm, floccosae; ascocarpaceae subglobosae vel globosae, nigrae, glabrae, 70-160 μ in diametrate; asci a pyriformibus subglobosi, octospori, evanescentes, 8-12 \times 5.5-7.0 μ ; ascosporeae cylindraceae, brunneae, laeves, 4.2-5.5 \times 2.0-3.0 μ ; conidiophorae hyalinae, simplices, rare ramosae, attenuatae, 17-50 \times 2.0-3.0 μ ; phialosporae cylindraceae, hyalinae, laeves, 3.0-7.0 \times 1.5-2.5 μ , ex conidiophoribus in catenis extrusae.

HOLOTYPUS: In ligno acerino putrido, infra corticem, S of Dorset, Haliburton Co., Ontario, Canada, 13 Sept. 1967, *Cain*. In Cryptogamic Herbarium, University of Toronto (TRTC 45320).

ETYMOLOGY: Greek, *hypo* = beneath, and *phlois* = bark, referring to the position of the ascocarps beneath the bark of dead trees.

COLONIES on Weitzman and Silva-Hutner's medium (Weitzman and Silva-Hutner 1967) attaining a diameter of 7.5 cm in 35 days at room temperature, felty to somewhat cottony, brown at the center where the ascocarps are mature, white toward the margin, azonate; reverse



FIGS. 1-9. *Cryptendoxyla hypophloia*. Fig. 1. Ascocarp initials, $\times 1500$. Fig. 2. Ascocarp, showing arrangement of cephalothecoid plates, $\times 325$. Fig. 3. Peridial plate, $\times 650$. Fig. 4. Peridium cross section, $\times 650$. Fig. 5. Asci, $\times 1500$. Fig. 6. Ascospores, $\times 1500$. Fig. 7. Germinating ascospores, $\times 1500$. Fig. 8. Conidiophores, $\times 1500$. Fig. 9. Conidia, $\times 1500$. FIGS. 10-15. *Hapsidospora irregularis*. Fig. 10. Peridium surface, $\times 1500$. Fig. 11. Peridium cross section, $\times 650$. Fig. 12. Asci, $\times 1500$. Fig. 13. Ascospores, $\times 1500$. Fig. 14. Germinating ascospores, $\times 1500$. Fig. 15. Conidial stage, $\times 650$.

pinkish to pale olive green; MYCELIUM hyaline to light brown, frequently anastomosing, branched, remotely septate, narrowest when aerial, 2–10 μ in diameter; ASCOCARP INITIALS at first simple coils, soon becoming compact and contorted as a result of profuse branching, not involving neighboring hyphae or involving it only to a slight extent, with filaments 2–3 μ wide; ASCOCARPS subglobose to globose, black by reflected light, opaque, nonostiolate, smooth, 70–160 μ in diameter; ASCOCARP PERIDIUM cephalothecoid, made up of several plates of radiating cells which separate along well-defined lines of dehiscence, dark brown, about 7–18 μ thick, consisting of an outer dark layer and a hyaline inner layer; peridial cells of the outer layer dark brown, mostly isodiametric in cross section but with walls appearing much thickened and round when viewed perpendicularly to the radiating lines, nearly square in surface view, thickened by dark nodular growths of wall material around the periphery of the septa and other points, about 2–5 μ in diameter; peridial cells of the inner layer hyaline, flattened in cross section, evanescent; ASCI arising from croziers on a branched ascogenous system, distributed evenly throughout the centrum, eight-spored, pyriform to subglobose, short-stipitate, evanescent, 8–12 \times 5.5–7.0 μ ; ASCOSPORES cylindrical, slightly constricted around the middle, nonseptate, smooth, light brown by transmitted light, dark brown in mass, without germ pores, 4.2–5.5 \times 2.0–3.0 μ , swelling slightly on one side upon germination and producing a single germ tube; CONIDIAL STAGE a *Chalara*; CONIDIOPHORES hyaline, simple or more rarely branched, septate near the base, tapering slightly to an open tip from which the conidia are borne, 17–50 \times 2.0–3.0 μ , larger if terminating a hypha; CONIDIA cylindrical, hyaline, one-celled, smooth, 3.0–7.0 \times 1.5–2.5 μ , borne in chains at the tips of the conidiophores.

SPECIMENS EXAMINED: CANADA: Ontario: Muskoka District: S of Dorset, on wood of dead standing maple, 13 Sept. 1967, *Cain* (TYPE, TRTC 45320); on wood of dead standing maple, 16 Sept. 1967, *Malloch* (TRTC 45335); on wood of dead standing birch, 1 Nov. 1969, *Malloch* (TRTC 45682). Lanark Co.: Pakenham, on rotten log, 27 June 1962, *S. J. Hughes* (DAOM 88795).

Cultures derived from TRTC 45320 and 45682 have been deposited with the American Type Culture Collection, and the Centraalbureau voor Schimmelcultures and the Commonwealth Mycological Institute.

Like many cleistothecial forms *C. hypophloia* is probably dispersed by arthropods. Its habitat beneath the bark of dead trees would prevent it from being dispersed directly by the wind. It was noted at the time the collections were made that there were numerous mites present among the ascocarps. Some of the ascocarps had broken loose, were trapped among the hairs on the bodies of the mites, and were dispersed in this manner. Some of the ascocarps had also broken open and the ascospores had become attached to the mites. The ecology of this species may not be very different from species of *Ceratocystis* except that it occurs at a much later stage of decay. The *Chalara* imperfect stage, also known for *Ceratocystis*, may also figure in arthropod dispersal.

The cephalothecoid peridium in this species is quite interesting. Unlike most forms with this peridium type, *C. hypophloia* has only a few large plates. When examined under a dissecting microscope the lines of dehiscence are seen to extend around the ascocarps. Under the drying effect of the microscope lamp the ascocarps split along the dehiscence lines and spread open.

Microscopically the most prominent feature is the ascospore morphology. The ascospores are nearly cylindrical but are usually somewhat constricted around the middle. This constriction gives them a girdled or bone-shaped appearance.

Emericellopsis van Beyma, Antonie van Leeuwenhoek, 6: 264. 1940.

TYPE SPECIES: *E. terricola* van Beyma, l.c. p. 265.

Emericellopsis is characterized by dark ascospores with wing-like appendages and a *Cephalosporium* conidial stage. The peridium is usually thin and very light colored or hyaline.

The taxonomy of *Emericellopsis* is still somewhat unsettled. Some authors (Grosklags and Swift 1957; Backus and Orpurt 1961; Mathur and Thirumalachar 1960, 1962) recognize up to nine species while others (Durrell 1959; Maag *et al.* 1959) recognize as few as two. The reader is referred to these papers for detailed accounts of the species.

Fragosphaeria Shear, *Mycologia* 15: 124. 1923.

TYPE SPECIES: *F. purpurea* Shear, l.c.

Fragosphaeria is characterized by brown, reniform ascospores and very small conidia borne on sympodulae. The peridium in the two known species is cephalothecoid (although often very obscure in *F. reniformis*).

Both species were studied by Chesters (1935) as species of *Cephalotheca*. The species Chesters studied as *C. reniformis* is a "good" *Fragosphaeria* and is transferred here to that genus as

Fragosphaeria reniformis (Saccardo & Therry) Malloch & Cain comb. nov.

BASIONYM: *Cephalotheca reniformis* Saccardo & Therry, *Michelia*, 2: 312. 1881.

Both species are well described and illustrated by Chesters (1935).

The genus *Cephalotheca* Fuckel was described with a single species *C. sulfurea* Fuckel collected on decaying oak boards in Rheingau (Fuckel 1871). Cultures of this species have not been available and ascospore germination has not been observed. Consequently, we are unable to determine the position of the genus and the family Cephalothecaceae.

Hapsidospora Malloch & Cain, gen. nov.

Ascocarpaceae globosae, fusco-virides ad nigrae, laeves. Asci subglobosi ad globosi, octospori, evanescentes. Ascosporeae globosae, fusco-olivaceae ad brunneae, reticulatae. Conidia modo phialosporarum (*Cephalosporium*).

TYPUS GENERIS: *H. irregularis* Malloch & Cain.

ETYMOLOGY: Greek, *hapsis* = net, and *spora* = spore, referring to the reticulate ascospores.

Ascocarps globose, dark green to black, smooth, glabrous, nonstipitate. Asci subglobose to globose, eight-spored, evanescent. Ascospores one-celled, dark olive green to brown, reticulate, without germ pores. Conidia one-celled, pink to orange, borne in wet masses at the tips of simple phialides (*Cephalosporium*).

TYPE SPECIES: *H. irregularis* Malloch & Cain.

Hapsidospora is a fairly characteristic member of the Pseudeurotiaceae, differing from other genera in having globose, dark reticulate ascospores. It seems closest to *Pseudeurotium* which has dark, one-celled, smooth ascospores and *Testudina* which has two-celled, brown, reticulate ascospores.

There is only one species.

Hapsidospora irregularis Malloch & Cain, sp. nov. Figs. 10–15

Coloniae in agarō Weitzman and Silva-Hutner secundum diametrem aetate 30 dierum 5 cm, appressae, roseo-aurantiatae, zonatae; ascocarpaceae globosae, fusco-virides ad nigrae, glabrae, 100–320 μ secundum diametrem; asci subglobosi vel globosi, octospori, evanescentes, 10–16 μ secundum diametrem; ascosporeae globosae, ab olivaceis brunneae, reticulatae, 4.0–8.0 μ , secundum diametrem; conidiop horaehyalinae, simplices, attenuatae, 20–50 \times 1.5–2.0 μ , phialosporae unicellares, a roseis aurantiatae, ab ellipsoideis allantoideae, 3.5–5.5 \times 2.0–3.0 μ , ex conidiophoribus in capitulum mucosum successive extrusae.

HOLOTYPE: In graminis putridis, Toronto, York Co., Ontario, Canada, July 1966, *W. Collins*. In Cryptogamic Herbarium, University of Toronto (TRTC 44852).

ETYMOLOGY: Latin, *irregularis*, referring to the irregular size of the ascospores.

COLONIES on Weitzman and Silva-Hutner's medium (Weitzman and Silva-Hutner 1967) attaining a diameter of 5 cm in 30 days at room temperature, appressed, pink to orange, black where ascocarps abundant, closely zonate; reverse pink, black where ascocarps abundant; MYCELIUM hyaline, branched, remotely to abundantly septate, 1.0–3.5 μ in diameter; ASCOCARPS arising from coiled ascocarp initials, superficial or immersed, black by reflected light, dark green to black by transmitted light, glabrous, nonstipitate, 100–320 μ in diameter; ASCOCARP PERIDIUM consisting of a dark outer layer and a hyaline inner layer; peridial cells of the outer layer pseudoparenchymatous, somewhat flattened to isodiametric in cross section, dark olive green to brown, thick-walled, 2–12 \times 2–4 μ , two cells deep in cross section; peridial cells of the inner layer hyaline, thin-walled, flattened, three to five cells deep in cross section; ASCI irregularly disposed, subglobose to globose, eight-spored, evanescent, nonstipitate, 10–16 μ in diameter; ASCOSPORES globose, olive-green to brown by transmitted light, dark green to black in mass, reticulate with low ridges, without germ pores, variable in size within the same ascus, 4.0–8.0 μ in diameter, germinating by the production of one to three germ tubes which rupture the spore wall; CONIDIAL STAGE a *Cephalosporium*; CONIDIOPHORES borne on intertwining "ropes" of hyphae

or from solitary hyphae, tapering from the base to the apex, ending as a phialide, hyaline, $20\text{--}50 \times 1.5\text{--}2.0 \mu$; conidia nearly hyaline by transmitted light, pink to orange in mass, ellipsoidal to somewhat allantoid, $3.5\text{--}5.5 \times 2.0\text{--}3.0 \mu$, collecting in wet masses at the tips of the conidiophores.

SPECIMEN EXAMINED: CANADA: Ontario: York Co.: Toronto, on lawn grass compost heap incubated in a moist chamber, July 1966, *W. Collins* (HOLOTYPE, TRTC 44852).

Cultures derived from TRTC 44852 have been deposited in the American Type Culture Collection, the Centraalbureau voor Schimmelcultures, and the Commonwealth Mycological Institute.

***Leuconeurospora* Malloch & Cain gen. nov.**

Ascocarps subglobosae vel globosae, rufo-brunneae, glabrae, nonstiolatae, cum peridio cephalothecoideo. Asci subglobosi vel globosi, octospori. Ascospores hyalinae, costis longitudinalibus praeditae, sine porae, nonseptatae. Conidia ignota.

TYPUS GENERIS: *Eurotium pulcherrimum* Winter.

ETYMOLOGY: Greek, *leucos* = white, and the genus *Neurospora*, referring to the ribbed ascospores which are white in mass.

Ascocarps globose, dark reddish brown, glabrous, nonstromatic, nonstiolate, with a cephalothecoid peridium. Asci irregularly disposed, subglobose to globose, eight-spored. Ascospores hyaline, marked by thick longitudinal ridges, without germ pores, unicellular. No conidial stage known.

Although authentic material of *Eurotium pulcherrimum* has not been seen, it is described in sufficient detail by Winter to allow for recognition.

Leuconeurospora is characterized by hyaline, longitudinally ridged ascospores without germ pores. The ascocarps are made up of cephalothecoid plates and are dark reddish brown. Because it has never been studied in culture its inclusion in the Pseudeurotiaceae can only be tentative.

There is only one species.

***Leuconeurospora pulcherrima* (Winter) Malloch & Cain, comb. nov.** Figs. 16–19
= *Cephalotheca pulcherrima* (Winter) Höhnelt, Ann. Mycol. 15: 360. 1917.

BASIONYM: *Eurotium pulcherrimum* Winter, Vidensk. Meddel. Naturh. Foren. Kjøbenhavn 1876: 311. 1877.

ASCOCARPS scattered irregularly inside and on the surface of the substrate, globose, dark reddish brown to almost black, smooth, glabrous, $150\text{--}350 \mu$ in diameter; ASCOCARP PERIDIUM cephalothecoid, made up of polygonal plates of radiating cells which separate at maturity along well-defined lines of dehiscence, dark orange-brown; peridial cells nearly isodiametric and $4\text{--}14 \mu$ in diameter at the center of the plates, elongate and $5\text{--}14 \times 3\text{--}7 \mu$ toward the margins, thick-walled, one to three cells deep in cross section; ASCI irregularly disposed, subglobose to globose, nonstipitate, eight-spored, evanescent, $8\text{--}11 \mu$ in diameter; ASCOSPORES one-celled, hyaline, white in mass, ellipsoidal-fusoid, marked by thick anastomosing ridges which sometimes form a reticulum, without germ pores, $5.5\text{--}7.0 \times 3.5\text{--}5.0 \mu$, arranged in a compact mass in the ascus; conidial stage unknown.

HABITAT: on dung of dog, fox, porcupine, rabbit, and rat.

DISTRIBUTION: Canada, Denmark, and Germany.

SPECIMENS EXAMINED: CANADA: Alberta: Banff National Park, Parker Ridge, Sunwapta Pass, on rodent dung, 9 Aug. 1962, *Cain* (TRTC 38936). Ontario: Leeds Co.: 9 mi E of Brockville, Brown Park, on porcupine dung, 5 Sept. 1966, *Krug* (TRTC 45332).

***Mycocarachis* Malloch & Cain gen. nov.**

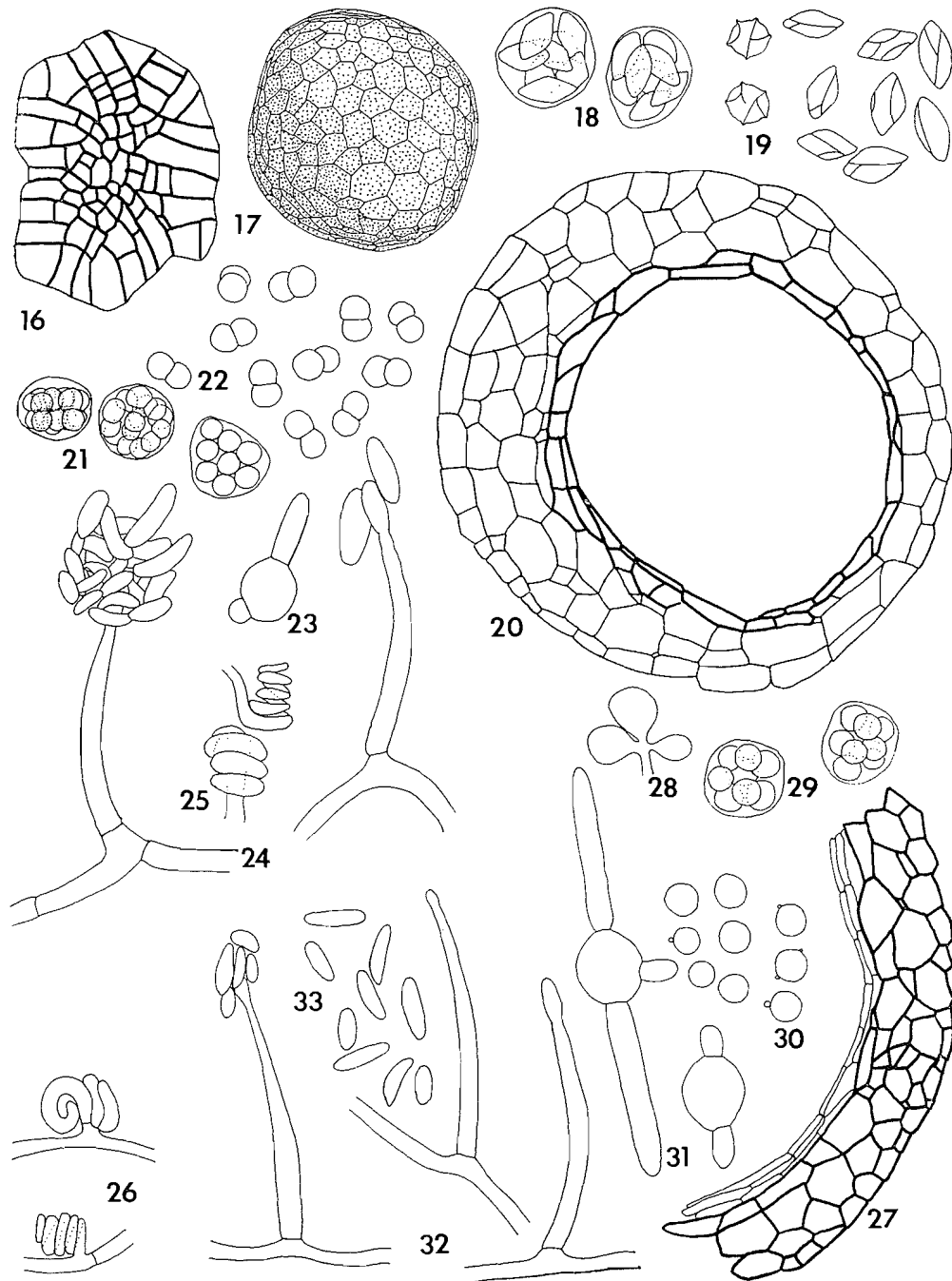
Ascocarps subglobosae ad globosae, ad olivaceis nigrae, nonstiolatae, glabrae. Asci subglobosi vel globosi, octospori, evanescentes. Ascospores uniseptatae, hyalinae, laeves. Conidia modo phialosporarum (*Cephalosporium*).

TYPUS GENERIS: *M. inversa* Malloch & Cain.

ETYMOLOGY: *myco* from the Greek *mykes* = fungus, and *Arachis*, the generic name of the cultivated peanut, and refers to the peanut-shaped ascospores.

Ascocarps subglobose to globose, dark olive-green to black, nonstiolate, nonstromatic. Asci irregularly disposed, subglobose to globose, eight-spored. Ascospores two-celled, hyaline, smooth, without germ pores. Conidia borne in clusters at the tips of simple phialides, one-celled, hyaline, smooth (*Cephalosporium*).

Mycocarachis is readily recognized by its two-celled hyaline ascospores. It appears to be most closely related to *Nigrosabulum*, which differs in having one-celled ascospores.



FIGS. 16-19. *Leuconeurospora pulcherrima*. Fig. 16. Peridial plate, $\times 650$. Fig. 17. Ascocarp, showing arrangement of cephalothecoid plates, $\times 130$. Fig. 18. Asci, $\times 1500$. Fig. 19. Ascospores, $\times 1500$. FIGS. 20-25. *Mycoarachis inversa*. Fig. 20. Peridium cross section, $\times 650$. Fig. 21. Asci, $\times 1500$. Fig. 22. Ascospores, $\times 1500$. Fig. 23. Ascospore with one cell germinating and one ungerminated cell, $\times 1500$. Fig. 24. Conidiophores, $\times 1500$. Fig. 25. Ascocarp initials, $\times 1500$. FIGS. 26-33. *Nigrosabulum globosum*. Fig. 26. Ascocarp initials, $\times 1500$. Fig. 27. Peridium cross section, $\times 650$. Fig. 28. Immature asci, $\times 1500$. Fig. 29. Asci, $\times 1500$. Fig. 30. Ascospores, $\times 1500$. Fig. 31. Germinating ascospores, $\times 1500$. Fig. 32. Conidiophores, $\times 1500$. Fig. 33. Conidia, $\times 1500$.

Only one species, *M. inversa* is known so far, but it appears to be widely distributed. The peridium in this species appears to be reversed when compared with that of most species (hence the specific epithet "inversa"). As is often the case, the peridium is made up of a light and a dark layer of cells, but, contrary to the usual condition, the light-colored layer is exterior to the dark layer. A comparison of Figs. 11, 20, and 27 illustrates this difference. Because of this the ascocarps, when dry, have a characteristic metallic sheen which makes them appear as tiny pieces of metal scattered over the substrate.

Mycoarachis inversa Malloch & Cain, sp. nov.
Figs. 20–25

Coloniae in agar YpSs (Emerson 1958) secundum diametrem aetate 30 dierum 5.0–6.5 cm, ab appressis floccosae, a roseis aurantiacae; ascocarphae subglobosae vel globosae, ab olivaceis nigrae, nonostiolatae, glabrae, 50–200 μ crassae; peridium ex strato fusco interno et strato pallido externo compositum; asci subglobosi vel globosi, octospori, evanescentes, 5.5–11.0 μ secundum diametrem; ascosporae a cylindraceutis ellipsoideae, hyalinae, laeves, 5.0–5.5 \times 3.0–3.5 μ septo medio praeditae, ad septum constrictae; conidiophorae hyalinae, simplices, rare ramosae, attenuatae, 14–35 \times 2.0–3.5 μ ; phialosporae ellipsoideae, fusoidae, ovoideae, a cylindraceutis allantoideae, hyalinae, laeves, unicellares, ex conidiophoribus in capitulum mucosum successive extrusae.

HOLOTYPE: In fimo elephanto, Mweya Lodge, Queen Elizabeth National Park, Uganda, 27 July 1966, *Cain, Griffin, and Krug*. In Cryptogamic Herbarium, University of Toronto (TRTC 66.2166f).

ETYMOLOGY: Latin, *inversus* = turned upside down, referring to the reversed layers of the peridium.

COLONIES on YpSs medium attaining a diameter of 5.0–6.5 cm in 30 days at room temperature, appressed to cottony, pink to orange, dark green to black where ascocarphae are abundant, azonate to closely zonate, tending to produce sectors of greater and lesser fertility; reverse pink to orange, black under areas of abundant ascocarp production; MYCELIUM hyaline, remotely septate, branched, 1–3 μ in diameter, occasionally developing very thick, dark-staining cell walls in the neighborhood of the septa and

swelling up to 7 μ in diameter; ASCOCARP INITIALS at first simple coils with filaments about 1–3 μ in diameter, later becoming compact and contorted as a result of abundant proliferation; ASCOCARPS subglobose to globose, metallic in appearance by reflected light when dry, dark green to black by transmitted light, nonostiolate, glabrous, 50–200 μ in diameter; ASCOCARP PERIDIUM 11–30 μ thick, consisting of a light-colored outer layer and a darker inner layer; peridial cells of the outer layer pseudoparenchymatous, hyaline to pale brown, 3–22 μ in diameter, one to five cells deep in cross section; peridial cells of the inner layer dark brown, flattened, 4–20 \times 2.0–10.5 μ , one or two cells deep in cross section; ASCI irregularly disposed in small clusters, eight-spored, subglobose to globose, evanescent, nonstipitate, 5.5–11.0 μ in diameter; ASCOSPORES cylindrical to broadly ellipsoidal, hyaline, with a single median septum which divides the spore into two equal globose cells, constricted at the septum, smooth, without germ pores, 5.0–5.5 \times 3.0–3.5 μ , with each cell swelling up to 8.5 μ upon germination and producing one to three germ tubes; CONIDIAL STAGE a *Cephalosporium*; CONIDIOPHORES arising from the substrate mycelium, simple or sparingly branched, septate, tapering from the base to the apex, ending in a phialide, 14–35 \times 2.0–3.5 μ ; PHIALOSPORES ellipsoidal, fusoid, ovoid, cylindrical or allantoid, hyaline, smooth, nonseptate, borne in moist clusters at the tips of the conidiophores, 3–10 \times 1.5–3.5 μ .

SPECIMENS EXAMINED: TANZANIA: Mt. Kilimanjaro, N of Lyamungu, on herbivore dung, 11 Aug. 1966, *Cain, Griffin and Krug* (TRTC 66.1707a). UGANDA: Queen Elizabeth National Park, Mweya Lodge, on elephant dung, 27 July 1966, *Cain, Griffin and Krug* (HOLOTYPE, TRTC 66.2166f). U.S.A.: Nebraska, Cheyenne Co.: Potter, on cow dung, 16 Aug. 1964, *Cain* (TRTC 45341).

Cultures derived from all of these collections have been deposited with the American Type Culture Collection, the Centraalbureau voor Schimmelcultures, and the Commonwealth Mycological Institute.

Nigrosabulum Malloch & Cain, gen. nov.

Ascocarphae subglobosae vel globosae, nigrae, glabrae, nonostiolatae. Asci subglobosi vel globosi, octospori, evanescentes. Ascosporae globosae, unicellares, hyalinae, laeves. Conidia modo phialosporarum (*Cephalosporium*).

TYPUS GENERIS: *N. globosum* Malloch & Cain.

ETYMOLOGY: Latin, *niger* = black, and *sabulum* = sand, referring to the black, granular masses of ascocarps produced in culture.

Ascocarps subglobose to globose, black, glabrous, nonostiolate, nonstromatic. Asci irregularly disposed, subglobose to globose, evanescent. Ascospores one-celled, hyaline, smooth, without germ pores. Conidia borne on tapering unbranched conidiophores which end in a phialide, one-celled, hyaline, collecting in wet masses at the tips of the conidiophores (*Cephalosporium*).

Nigrosabulum probably comes closest to being the "typical" cleistothecial Ascomycete. If the descriptions of all the genera of cleistothecial Ascomycetes are placed together, side by side, it is found that, for each character, *Nigrosabulum* falls with the majority. Only in having spherical ascospores is *N. globosum*, the only species, at all unusual.

The genera most similar to *Nigrosabulum* are *Mycoarachis* and *Pseudeurotium*. *Mycoarachis* differs in having two-celled ascospores and *Pseudeurotium* in having brown ascospores and a thinner ascocarp peridium. In addition, *Pseudeurotium*, a soil fungus, has never been reported from dung and *Nigrosabulum* is not known from any other substrate but dung.

Nigrosabulum globosum Malloch & Cain, sp. nov.

Figs. 26–33

Coloniae in agar Weitzman and Silva-Hutner secundum diametrem aetate 30 dierum 6.0–6.5 cm, ab appressis granulosae, a griseis fusco-virides, zonatae; ascocarpae subglobosae vel globosae, nigrae, laeves, glabrae, 75–350 μ diametraliter; asci subglobosi vel globosi, octospori, evanescentes, 6–9 μ diametraliter; ascosporae globosae, laeves, hyalinae, 3.0–4.0 μ diametraliter; frequenter particulis minutis ornatatae; conidiophorae simplices, attenuatae, 20–32 \times 2–3 μ ; phialosporae ellipsoideae, unicellares, hyalinae, laeves, 3.5–8.5 \times 1–3 μ , ex conidiophoribus in capitulum mucosum successive extrusae.

HOLOTYPE: In fimo vaccino, E of Cheyenne, Laramie Co., Wyoming, U.S.A., 16 Aug. 1964, *Cain*. In Cryptogamic Herbarium, University of Toronto (TRTC 43288).

ETYMOLOGY: Latin, *globosum* = globose, referring to the ascospores.

Homothallic; COLONIES on Weitzman and Silva-Hutner's medium (Weitzman and Silva-Hutner 1967) attaining a diameter of 6.0–6.5 cm in 30 days at room temperature, appressed to granular, grey to dark green, closely zonate; reverse dark green; MYCELIUM fairly delicate, hyaline, remotely septate, branched, 1–3 μ in diameter; ASCOCARP INITIALS produced as distinct cylindrical coils, soon becoming compact and contorted as a result of abundant proliferation, not involving the neighboring mycelium greatly, with filaments 1–2 μ in diameter; ASCOCARPS subglobose to globose, black by reflected light, opaque, smooth, glabrous, nonostiolate, 75–350 μ in diameter; ASCOCARP PERIDIUM 15–33 μ thick, carbonaceous, consisting of a dark outer layer and a hyaline inner layer; peridial cells of the outer layer dark brown, pseudoparenchymatous, nearly isodiametric in cross section, thick-walled, 3–10 μ in diameter, two to six cells deep in cross section; peridial cells of the inner layer hyaline, thin-walled, evanescent, forming an indefinite number of layers, up to 18 μ in diameter; ASCI borne in irregularly disposed clusters, subglobose to globose, eight-spored, evanescent, nonstipitate, 6–9 μ in diameter; ASCOSPORES globose, hyaline, smooth, without germ pores, often with small particles adhering to the wall, 3.0–4.0 μ in diameter, swelling to 6–8 μ upon germination and producing one to four germ tubes; CONIDIAL STAGE a *Cephalosporium*; CONIDIOPHORES arising from the aerial or substrate mycelium, unbranched, septate, tapering from the base to the apex and ending in a phialide, 20–32 \times 2–3 μ ; PHIALOSPORES ellipsoidal, fusoid, ovoid or allantoid, hyaline, smooth, nonseptate, borne in moist clusters at the tips of the conidiophores, 3.5–8.5 \times 1.0–3.0 μ , swelling upon germination and producing one to several germ tubes.

SPECIMENS EXAMINED: MEXICO: Nuevo Leon, 60 mi N of Matehuala, on rodent dung, 7 Aug. 1961, *Cain* (TRTC 1961b). SOUTH WEST AFRICA: Gamsberg Pass, 95 km W of Rehoboth, on baboon dung, 24 April 1963, *Nordenstam* (TRTC 45651). TANZANIA: Mt. Kilimanjaro, N side, W of Loitokitok, on dung, 17 Aug. 1966, *Cain*, *Griffin* and *Krug* (TRTC 66.1741g). U.S.A.: Wyoming: Laramie Co.: E of Cheyenne, 16 Aug. 1964, *Cain* (HOLOTYPE, TRTC 43288).

Cultures derived from these collections have been deposited with the American Type Culture

Collection, the Centraalbureau voor Schimmelcultures, and the Commonwealth Mycological Institute.

The distribution of *N. globosum* is interesting in that it is similar to that of *Mycocarachis inversa*. Apparently both are fungi of warm dry climates.

The ascospores of *N. globosum* often have small particle-like attachments. These have been observed on all of the collections examined. It is not known whether they are part of the ascospore wall or simply adhering particles of some kind.

On the natural substrate *N. globosum* always grows very superficially and is never closely attached to the substrate. Because of this the ascocarps are very easily removed and are usually nearly free of contamination.

The conidial stage was very abundant on the cultures of the type collection, rare on TRTC 66.1741g, and apparently absent on TRTC 45651. There is some indication that the nature of the medium may affect the amount of conidial production.

Pseudeurotium van Beyma, Zentrabl. f. Bakt. II, 96: 415. 1937.

TYPE SPECIES: *P. zonatum* l.c., p. 416.

Pseudeurotium is a fairly typical member of the Pseudeurotiaceae distinguished by brown, smooth ascospores. *Nigrosabulum* differs in having hyaline ascospores and a much thicker ascocarp peridium.

The conidial stage of *Pseudeurotium* species is usually reported to be a sympodulospore type (*Sporothrix*). While this appears to be the case in *P. ovalis*, those of *P. zonatum* appear to us to be phialides. The two types of conidium production, however, may be phylogenetically related in groups such as this, with the sympodulospore type being derived from the phialospore (or annellospore) type by reduction of the phialides to conidia. Sympodulae and phialospores (or annellospores) are found in the same genus in several families, including the Microascaceae and the Ophiostomataceae.

A number of species of *Pseudeurotium* have been described, but most have been shown to be members of other genera. Of the species treated by Booth (1961), for example, we would recognize only *P. zonatum* and *P. ovalis*. *P. punctatum* (Panasenka 1964) may also be a "good" species.

Some of the species studied by the above authors have been treated also by Stolk (1955) and Udagawa (1965). Routien (1957) and Milko (1965) have described and illustrated *P. zonatum* as *Levispora terricola* Routien.

Testudina Bizzozero, Fung. Ven. 1, 1885.

TYPE SPECIES: *T. terrestris* Bizz., l.c.

Testudina has a cephalothecoid peridium and two-celled, brown ascospores with reticulate markings. In this respect it combines characters of both *Mycocarachis* and *Hapsidospora*. The conidia were reported by Marchal (1895) to be borne in chains in the synonymous species *Marchaliella zopfiioides* Bomm. and Rouss. Marchal's illustration (the only illustration of this genus) shows chains of conidia arising from an unbranched phialide-like conidiophore.

Acknowledgments

We thank Dr. B. Boivin for correcting the Latin.

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