FOSSIL FUNGI FROM TERTIARY DEPOSITS IN THE SOUTHERN HEMISPHERE. PART I.

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(Plates xi–xiv.)

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Introduction.

During the examination of acetolysed residues prepared primarily for the purpose of Tertiary pollen and spore analyses, detached shield-shaped fruit-bodies with radial structure were observed. They showed a close resemblance to the ascomata or thyriothecia of the Microthyriaceae.

Subsequent examination of mummified leaves of *Oleinites Willisii* Cookson (1947) revealed additional closely-related types and gave further information regarding one of the forms mentioned above.

In this paper the more clearly defined fungi, discovered by these means, will be described. The remaining forms, when better understood, will form the subject of a second paper.

A few fossil fungi of suggested microthyriaceous affinities have been identified in European Tertiary deposits. While the identity of some of these appears to be somewhat uncertain, such excellently preserved ascomata as those of *Phragmothyrites eocaenica* Edw. from Mull in Scotland (Edwards, 1922) leave no doubt of the existence there of the family Microthyriaceae in early Tertiary times.

The demonstration, as the result of the present investigation, of this family in rocks of the Southern Hemisphere is therefore not surprising. However, some stratigraphical and palaeoecological significance attaches to this discovery. Of mycological interest is the record of two allied families, hitherto unrepresented by fossil species.

Source and Age of Fossils.

The deposits in which the fossil fungi are contained occur in places as widely separated as Kerguelen Archipelago and New Zealand.

For the material from Kerguelen Archipelago, I am indebted to Sir Douglas Mawson, who kindly made available for examination specimens collected there by the B.A.N.Z. Antarctic Research Expedition. For samples of coal from New Zealand, as well as for information concerning them, I wish to thank Mr. W. F. Harris and Mr. Martin Te Punga. The Australian localities are, in the main, those discussed in a previous paper (Cookson, 1946). In no instance can an exact statement be made regarding the age of the beds in question. The generally accepted approximations will be given below.

Kerguelen Archipelago.

Kerguelen Island, near Port Jeanne d'Arc. Carbonaceous sandstone associated with lignite. Specimen No. C.250. Late Oligocene (Mawson, 1933).

Australia.

Yallourn, Victoria. Leaves of *Oleinites Willisii*, from State Electricity Commission's open cut. ? Oligocene-Miocene.

Hazelwood, south of Maryvale, Victoria. Leaves of *O. Willisii*, S.E.C. Bore 28 at 150 feet. Oligocene-Miocene.

Traralgon, east of Yallourn. Ligneous clay from S.E.C. Bore 23 at 497 to 500 feet. Oligocene-Miocene.

Sentinel Rock, Aire Coast, Victoria. Post-Middle-Miocene (Singleton, 1941, p. 74).

Kiandra (New Chum Hill), New South Wales. Soft lignitic shale, 135 feet below base of basalt. Dulhunty collection, coal sample 103. Oligocene-Miocene.

Vegetable Creek, New South Wales. Mudstone. Oligocene-Miocene.

New Zealand.

Ohai, Birchwood Mine. Highly cleaved black coal, Geological Survey of New Zealand coal sample 243. ? Oligocene.

Systematic Position of Fossils.

All the fossil fungi to be described below are members of the order Hemisphaeriales Theiss. This order is typified by the dimidiate form of the fruit-body or ascoma as well as by the frequency of its radial construction.

Three of the six families of the order (Ainsworth and Bisby, 1943) are represented in the present collection of types. The majority of these have flat, superficial ascomata with radial structure and fall within the limits of the Microthyriaceae Sacc. One form, on account of its thalloid nature, is clearly a member of the Trichopeltaceae Theiss. Another example with plectenchymatous structure represents the Micropeltaceae Clements and Shear.

Ascospores, the characters of which provide a valuable distinction between the living genera of these families, have not been detected either within or in close association with the fossil ascomata. Moreover, the treatment to which these bodies have been subjected implies loss of such additional diagnostic characters as the form of the asci and presence or absence of paraphyses. Detailed systematic determinations and the establishment of close affinity between living and fossil genera are therefore not possible, although, in some cases, there may be striking morphological agreement between them. The genus *Phragmothyrites*, described by Edwards as having phragmoseptate spores, is, for the same reason, not open for use.

For convenience in future reference, new genera, based on external morphological characters, are here created for the reception of these southern Tertiary fungi. In order to minimize their number, generic descriptions are made as broad as possible; distinctions, which amongst living species would certainly be considered of generic rank, being regarded as only of a specific value.

Descriptions of Fossil Fungi.

1. Family Microthyriaceae Sacc.

The grouping of the living genera of this family into two sub-families is based upon the presence or absence of a mycelium when the ascomata are mature (Stevens and Ryan, 1939). Those genera in which the mycelium is evanescent are placed in the sub-family Microthyreae Sacc. and Syd., those in which a free mycelium persists constituting the sub-family Asterineae Sacc. and Syd.

This character is a difficult one to determine when ascomata are unrelated to leaf cuticles. In such cases the apparent absence of mycelial hyphae might be a natural feature or one due either to faulty preservation or to the mode of treatment of the matrix in which the fossils occur. In cuticular preparations this feature can be relied upon with greater confidence, and it is information gained from such material that allows the adoption of the following classification.

Sub-family Microthyreae.

Genus Notothyrites, n. gen.

Ascomata without free mycelium, superficial, rounded, radiate, ostiolate. Ostiole prominent, bordered by three to five layers of dark brown, thick-walled cells. Ascospores unknown.

NOTOTHYRITES SETIFERUS, n. sp. Plate xi, figs. 1–6.

Ascomata flattened-hemispherical with a somewhat sinuous outline, 70–135μ in diameter, solitary, composed of radiating hyphae connected throughout their whole length. Cells approximately 4–13μ long and 4–10μ thick, frequently becoming more elongated towards the periphery. Cell walls of the majority of cells thin but the outer walls of the peripheral layer frequently strongly thickened to form the firm, entire margin of the ascoma (Plate xi, figs. 3, 4). The ostiole is well defined, distinctly elevated and either centrally or slightly excentrically placed. It is 10–16μ in diameter and bordered by three or four layers of dark brown, thick-walled cubical cells. The border is cylindrical and some of the cells bear setae, the number approximating to eight. The setae are short, about 13μ, non-septate, and their walls are thick and brown below, thinning towards lighter, bluntly-pointed apices (Plate xi, fig. 4).

Type Localities: Kerguelen Island, and Kiandra, New South Wales.

From the Vegetable Creek matrix, as well as from the type localities, ascomata, similar in other respects to those regarded as being typical of *N. setiferus*, have been observed which appear to be glabrous. The possibility suggests itself that this condition may have resulted from the destruction of setae either during fossilization or the chemical treatment to which the ascomata were subjected. This point of view is supported by the considerable numerical variability of the setae. It seems highly improbable, for example, that the observed range of from one to eight (Plate xi, figs. 1–3) is a natural one. For the present, therefore, these doubtful examples will be included in *N. setiferus*.

In its typical form *A. setiferus* strongly resembles the living species *Chaetothyriopsis panamensis* Stevens and Dorman (Stevens, 1927) from Panama-Darien, the border of the ostiole and the development of setae being features common to both. The setae of *C. panamensis*, however, are considerably longer and apparently less numerous than are those of *N. setiferus*.

NOTOTHYRITES AIRENSIS, n. sp. Plate xi, fig. 7.

Ascomata flattened-hemispherical, glabrous, 90–160μ in diameter, composed of radiating hyphae united along their whole length, cells thin walled, cubical to rectangular, 2·5–5·5μ thick and 3 to 13μ long. Margin thin, entire. Ostiole well defined, 8μ in diameter, surmounting a prominently-raised, dark brown, conical border composed of four or five layers of thick-walled cells, the base of which is 29·5μ in diameter.

Sentinel Rock beds, Aire Coast, Victoria.

This description is based on five specimens from the Sentinel Rock beds, the characters in which they appear to differ from *N. setiferus* being evident in all of them. The main distinctions are the narrower ostiole, the conical form and degree of prominence of its border and the absence of setae. The finer texture of the ascomal membranes becomes evident when the specimen illustrated in Plate xi, figure 7, is compared with specimens of *N. setiferus* shown in Plate xi, figures 3 and 5.

A small piece of upper epidermis of *Oleinites Willisii* from Yallourn (C.s. 38) shows two ascomata of *Notothyrites in situ*. These seem closer to *N. airensis* than to *N. setiferus* and are therefore provisionally placed in that species. No hyphae accompany these ascomata, so that the opinion formed from a study of detached examples that the mycelium of *Notothyrites* was evanescent is substantiated by them.

Sub-family ASTERINEAE.

(A). ASCOMATA ROUND.

Genus ASTEROTHYRITES, n. gen.

Mycelium superficial, persistent. Ascomata round, flat, radiate. Ascospores unknown.

ASTEROTHYRITES SINUATUS, n. sp. Plate xii, fig. 8.

Amphigenous; mycelium fine, hyphae brown, non-hyphopodiate, about 2·5μ thick, somewhat flexuous. Ascomata scattered, brown, astomate, 74–106μ in diameter, composed of rather slender, straight or slightly flexuous radiating hyphae; central cells small,

hexagonal or cubical, peripheral cells cubical to rectangular thin walled, approximately 2·5–3·5μ thick and 2·5–3·5μ long. Margin of ascoma entire and sinuous; dehiscence by means of a stellate fissure.

On leaves of *Oleinites Willisii* from Yallourn and Hazelwood, Victoria.

Asterothyrites delicatissimus, n. sp. Plate xii, fig. 9.

Amphigenous; mycelium fine, brown, non-hyphopodiate, hyphae about 2μ thick. Ascomata scattered, brown, astomate, 66–106μ in diameter, composed of thin, straight, radiating hyphae joined throughout their whole length. Cells thin walled, rectangular, 2·0–2·5μ thick. Margin delicate, not fimbriate.

On leaves of *Oleinites Willisii* from Yallourn, Victoria.

This species is readily distinguished by the fine construction of the ascomata and the fact that the marginal and peripheral layers are seldom preserved.

Asterothyrites minutus, n. sp. Plate xii, fig. 10.

Amphigenous; mycelium sparse, brown, non-hyphopodiate, about 2–2·5μ thick. Ascomata scattered, small, 47–80μ in diameter, composed of united hyphae which radiate from a single central cubical or hexagonal cell; cells almost cubical to rectangular, about 3μ thick, rather thick walled; margin thin, not fimbriate.

On leaves of *Oleinites Willisii* from Yallourn, Victoria.

In lignitic shale, Kiandra, New South Wales.

Asterothyrites ostiolatus, n. sp. Plate xii, fig. 11.

Epiphyllous; mycelium sparse, brown, hyphae about 2·6μ thick. Ascoma stomate, flattened, 106μ in diameter, composed of somewhat tortuous hyphae; cells cubical or rectangular, 2–5μ thick, thick walled; margin uneven and slightly fimbriate; stoma round, 13μ in diameter, formed by the breaking down of the central cells.

On a leaf of *Oleinites Willisii* from Yallourn, Victoria.

The limits of this species are less clearly defined than are those of the three preceding species of *Asterothyrites*. One reason is the fact that the single specimen on which it is based is not perfect, the margin being incomplete in several places. Nevertheless, it is clearly distinct from the previous types and thus warrants description.

Several fragments of ostiolate ascomata from Sentinel Rock beds suggest comparison with the Yallourn species. They are recorded as doubtful additional examples of *A. ostiolatus*.

(b). Ascomata linear.

Genus Euthythyrites, n. gen.

Mycelium superficial; ascomata linear, radiate. Characters of spores unknown.

Euthythyrites oleinitis, n. sp. Plate xiii, figs. 12, 13.

Amphigenous; ascomata scattered, brown, 226–540μ × 90–160μ, elliptical, forked or triradiate with rounded ends, dehiscing by a longitudinal slit along the length of the ascoma; cells cubical to rectangular, 5·0–10·5μ long and 2·5–5·0μ thick, rather thick walled. Mycelial hyphae non-hyphopodiate, brown, 3–4μ thick, straight, radiating from the marginal cells of the ascoma.

On leaves of *Oleinites Willisii* from Yallourn and Hazelwood, Victoria.

It is of interest to note that two living species with linear ascomata and a persistent mycelium have been recorded on extra-Australian oleaceous leaves. They are *Aulographum hederae* Lib. var. *oleae* Sacc. and *Lembosiopsis oleae* (Tracy and Earle) Theiss; both agree with *Euthythyrites oleinitis* in having a non-hyphopodiate mycelium.

Microthyriaceae incertae sedis.

Genus Microthyriacites, n. gen.

Ascomata radiate and dimidiate. Information regarding the presence of a free mycelium either uncertain or wanting; ascospores unknown.

Microthyriacites fimbriatus, n. sp. Plate xiii, fig. 17.

Ascomata round, flattened, astomate, brown, sometimes confluent, 74–133μ in diameter, composed of hyphae which radiate from a large, thick-walled, hexagonal, central cell 8–13μ in diameter. The more centrally-placed cells thick walled and almost cubical, peripheral cells rectangular, 2·6–5μ thick, with thinner walls. Margin slightly fimbriate.

In ligneous clay, Traralgon Bore 23,500 feet.

Microthyriacites grandis, n. sp. Plate xiv, figs. 20, 21.

Ascoma large, round, flattened, astomate, 280μ in diameter, composed of stout, thick-walled, completely united hyphae which radiate from a central group of hexagonal cells. Cells 6·6–10·0μ thick.

In coal, Birchwood Mine, Ohai, New Zealand.

My object in describing this single imperfectly preserved specimen is to provide evidence of the occurrence of the Microthyriaceae in New Zealand during the Tertiary period. It is to be hoped that additional specimens will give the information regarding the margin necessary to complete the specific description.

The specimen from Traralgon, Victoria, illustrated in Plate xiv, fig. 21, although considerably smaller (186μ in diameter), is compared with *M. grandis* on account of its similar construction. Unlike the type specimen, the margin which is thick and non-fimbriate is preserved.

Microthyriacites sp. Plate xiii, figs. 18, 19.

Ascomata astomate, flattened-hemispherical, brown, about 103–106μ in diameter, composed of united radiating hyphae, central cells hexagonal, peripheral cells cubical to rectangular, 5·0–8·5μ thick, thin walled. Margin not fimbriate.

On under epidermis of *Oleinites Willisii*, Yallourn, Victoria.

On an unidentifiable fragment of cuticle in coal from Birchwood Mine, Ohai, New Zealand.

These ascomata were found in insufficient numbers for specific assignment. It is not clear that they represent mature ascomata, and it is possible that they are developmental stages of a large species such as *M. grandis*. In both specimens hyphae were observed on the cuticular surface, but their association with the ascomata in question is by no means certain.

2. Family Trichopeltaceae Theiss.

Members of this family are distinguished from the Microthyriaceae by the lateral union of mycelial hyphae to form a one-layered, radially-constructed thallus. This may be irregularly strap-shaped as in the sub-family Trichopeltineae Theiss. or more or less circular in outline as in the sub-family Brefeldineae Theiss. (Theissen, 1914).

No fossil representative of the Brefeldineae has hitherto been recorded, nor has this type been observed during the present investigation; but the branched ribbon-like thalli typical of the Trichopeltineae occur frequently and in considerable numbers on leaves of *Oleinites Willisii*.

As was the case with the fossil Microthyriaceae, the absence of information regarding ascospore characters prevents assignment of this thalloid form to any one of the living species of the Trichopeltineae. For this reason, in naming it, I propose to combine the name of the sub-family with the suffix *-ites*.

Genus Trichopeltinites, n. gen.

Thallus that of the Trichopeltineae. Ascomata developed as thickened areas of the thallus and dehiscing by an irregular ostiole as in *Trichopeltis* Theiss. (Stevens, 1925). Ascospores unknown.

Trichopeltinites pulcher, n. sp. Plate xiv, figs. 22, 23.

Thallus epiphyllous, dark brown, from 18–150μ in width, frequently narrow-elongate with many lobes and some branches, sometimes broader and more leaf-like in form.

Cells 3–7μ broad and 5–8μ long with straight, firm walls. Ascomata 72–90μ in diameter, darker brown than thallus, opening by an irregular fissure.

On upper surface of leaves of *Oleinites Willisii* from Yallourn and Hazelwood, Victoria.

T. pulcher is strikingly similar to *Trichopeltis reptans* Speg. and undoubtedly is closely allied to, if not identical with, that species.

3. Family Micropeltaceae Clements and Shear.

This family is distinguished from the Microthyriaceae and Trichopeltaceae by the non-radiate construction of the flattened ascomata. The structure of the ascomal membrane or "scutellum" varies within the family and provides the basis for its sub-division into three sub-families (Stevens and Manter, 1925). Only one of these, namely, the Plochmopeltineae Theiss., is represented in the present collection. This sub-family contains a small number of living species all of which are characterized by the sinuous plectenchymic structure of the "scutellum".

Genus Plochmopeltinites, n. gen.

Fossil ascomata of dimidiate form with ascomal membranes of sinuous plectenchyma. Ascospore characters unknown.

Plochmopeltinites Masoni, n. sp. Plate xiii, figs. 14, 15.

Ascomata superficial rounded, brown, glabrous, ostiolate 106–200μ in diameter with an entire, irregularly sinuate margin. Covering membranes prosenchymatous composed of slender, wavy hyphae from 2–5μ thick, those of the central region being, sometimes, thicker walled than those of the periphery. Straighter branches may become free and extend beyond the limits of the ascoma. Ostiole 9–25μ in diameter surrounded by a dense, slightly-raised border.

In carbonaceous sandstone, Kerguelen Island.

On unidentifiable fragments of cuticle in lignitic shale, Kiandra, New South Wales.

In ligneous clay, Bore 23, at 500 feet Traralgon, Victoria.

I have pleasure in naming this species in honour of Mr. E. W. Mason, M.A., who gave helpful advice concerning its taxonomy.

Conclusion.

The living members of the families just discussed live superficially on leaves, and some of them may be considered as components of "sooty-mould" associations. The Microthyriaceae are believed to be ecto-parasitic "sooty-moulds" (Fisher, 1939, p. 401). The Trichopeltaceae, on the other hand, are considered by Fraser (1936) to be "true saprophytes living on 'honey dew' like members of the Capnodiaceae". The mode of nutrition of the Micropeltaceae has not been studied in any detail and these "fly speck" fungi have not been identified as endemic components of "sooty-mould" communities.

Such fungi are most abundant in warm-temperate and tropical zones, but their incidence in such areas appears to be due to high humidity rather than to high temperatures. Edwards (1922, p. 71) reports Arnaud as having asserted that "asterinoid" fungi are confined to parts of the globe with more than one metre of rainfall per annum.

In Australia a few species of Microthyriaceae have been recorded from Queensland and Victoria (Cooke, 1899), that is, from tropical and cool-temperate latitudes. Their "hosts", however, inhabit either rain-forest areas or moist mountain gullies, as in southern Victoria.

The same applies to the Trichopeltaceae. Fraser (loc. cit.) has recorded three species from rain-forest trees in New South Wales, and Theissen identified *Trichopeltis reptans* on leaves of *Drimys lanceolata* (Poir.) Baill. (*aromatica* F.v.M.) from Tasmania. Dr. Eileen Fisher in 1945 observed, but did not record, Trichopeltaceae on leaves of *Nothofagus Cunninghami* (Hook.) Oerst from fern gullies near Marysville, Victoria.

The family Micropeltaceae as a whole has not been investigated by Australian mycologists and its absence from our fungal flora is probably more apparent than real. The sub-family Plochmopeltineae, with which this investigation is concerned, has not been recorded for Australia. Its few species are restricted to such tropical regions as British Guiana, Hawaii, Ceylon, India and Africa. The fossil genus *Plochmopeltinites*, by its occurrence in southern latitudes at Kerguelen Island and in southern Australia, indicates a far wider distribution for this sub-family during the Tertiary epoch.

From experimental data concerning the temperature and moisture requirements of certain "sooty-moulds" (Fisher, loc. cit.), it seems safe to assume that the humidity in the regions where these deposits were accumulating was at least as great as it is now in situations favourable to the growth of such fungi. The occurrence of *Microthyriacites* in New Zealand coals of approximately the same age as the deposits in Australia and Kerguelen Island suggests that similar climatic conditions prevailed in these widely-spaced sub-antarctic regions.

Temperature does not seem to be a major factor in determining the presence or absence of these species. Nevertheless, the fact that the Plochmopeltineae have not, as yet, been found outside the tropics provokes the thought that the temperature in southern latitudes during the Tertiary epoch may have been higher than it is at present.

The occurrence of several of these species on the leaf referred to as *Oleinites Willisii* requires brief mention. This particular leaf has characteristic peltate hairs on both surfaces. If these hairs were glandular in character, the so-frequent occurrence and often copious growth of fungi on their surfaces might be explained.

Perfectly preserved developmental stages in ascoma formation have often been met with but no attempt has been made, as yet, to relate these to any of the species just dealt with.

The photographic illustrations of this paper were prepared by Mr. E. Matthaei, of the Faculty Workshop of the University of Melbourne; their cost was generously defrayed by the State Electricity Commission of Victoria.

Summary.

Eleven new fossil species belonging to the order Hemisphaeriales of the Ascomycetes have been described.

Three families of the order are represented, namely, the Microthyriaceae, Trichopeltaceae and Micropeltaceae.

These fungi were discovered in Tertiary deposits of Kerguelen Archipelago, Australia and New Zealand.

The palaeoecological significance of this occurrence is discussed.

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EXPLANATION OF PLATES XI–XIV.

All the figures are from untouched negatives. C.s. before a specimen number refers to the Cookson Slide Collection. Duplicate slides, where possible, will be deposited at the Imperial Mycological Institute, Kew, England.

Plate xi.

Fig. 1.—*Notothyrites setiferus.* An ascoma with two setae viewed from above. Kiandra, New South Wales. × 520. (C.s. 26.)

Fig. 2.—*N. setiferus.* Covering membrane of an ascoma showing seta. Kiandra, New South Wales. × 520. (C.s. 27.)

Fig. 3.—*N. setiferus.* Ascoma, with setae, folded back and viewed from the side. Kerguelen Island. × 520. (C.s. 28.)

Fig. 4.—*N. setiferus.* Portion of an ascoma showing two setae and thick margin. Kerguelen Island. × 520. (C.s. 29.)

Fig. 5.—*N. setiferus.* Covering membrane of an ascoma viewed from beneath. Kerguelen Island. × 520. (C.s. 30.)

Fig. 6.—*N. setiferus.* An ascoma viewed from beneath. Vegetable Creek, New South Wales. × 520. (C.s. 31.)

Fig. 7.—*N. airensis.* An ascoma viewed from above. Sentinel Rock beds, Victoria. × 520. (C.s. 32.)

Plate xii.

Fig. 8.—*Asterothyrites sinuatus.* An ascoma on upper epidermis of *Oleinites Willisii.* Yallourn, Victoria. × 520. (C.s. 33.)

Fig. 9.—*Asterothyrites delicatissimus.* An ascoma showing disconnected portions of the margin, on the upper epidermis of *O. Willisii.* Yallourn, Victoria. × 520. (C.s. 34.)

Fig. 10.—*Asterothyrites minutus.* An ascoma on upper epidermis of *O. Willisii.* Yallourn, Victoria. × 520. (C.s. 35.)

Fig. 11.—*Asterothyrites ostiolatus.* An ascoma on upper epidermis of *O. Willisii.* Yallourn, Victoria. × 520. (C.s. 36.)

Fig. 12.—*Euthythyrites oleinitis.* A small ascoma on upper epidermis of *O. Willisii.* Yallourn, Victoria. × 175. (C.s. 37.)

Fig. 13.—*E. oleinitis.* A large ascoma, showing origin of mycelial hyphae, on upper epidermis of *O. Willisii.* Yallourn, Victoria. × 170. (C.s. 38.)

Plate xiii.

Fig. 14.—*Plochmopeltinites Masoni.* "Scutellum" on fragment of cuticle. Bore 23, 497-500 feet, Traralgon, Victoria. × 520. (C.s. 39.)

Fig. 15.—*P. Masoni.* Portion of another ascoma. Kiandra, New South Wales. × 520. (C.s. 40.)

Fig. 16.—*Microthyriacites fimbriatus.* A group of ascomata showing confluent habit and fimbriate margin. Bore 23, 497-500 feet, Traralgon, Victoria. × 520. (C.s. 41.)

Fig. 17.—*M. fimbriatus.* Another example showing fimbriate margin. Bore 23, 497-500 feet, Traralgon, Victoria. × 520. (C.s. 42.)

Fig. 18.—*Microthyriacites* sp. An ascoma on leaf of *O. Willisii.* Yallourn, Victoria. × 520. (C.s. 43.)

Fig. 19.—C.f. *Microthyriacites* sp. An ascoma on fragment of cuticle. C.S. 243, Birchwood Mine, Ohai, New Zealand. × 520. (C.s. 44.)

Plate xiv.

Fig. 20.—*Microthyriacites grandis.* An ascoma. C.S. 243, Birchwood Mine, Ohai, New Zealand. × 260. (C.s. 45.)

Fig. 21.—C.f. *Microthyriacites grandis.* An ascoma. Bore 23, 499-500 feet, Traralgon, Victoria. × 260. (C.s. 46.)

Fig. 22.—*Trichopeltinites pulcher.* Thallus on upper epidermis of *O. Willisii.* Yallourn, Victoria. × 260. (C.s. 47.)

Fig. 23.—*T. pulcher.* Branched thallus showing an ascoma. × 260. (C.s. 37.)