STUDIES IN AUSTRALIAN TERTIARY PALAEOBOTANY

An epiphyllous flora from Kiandra, New South Wales.

David Robert Selkirk

A thesis submitted to the University of Sydney for the degree of Doctor of Philosophy. June, 1969.

STUDIES IN AUSTRALIAN TERTIARY PALAEOBOTANY

Ph. D. thesis D.R. Selkirk June, 1969.

The thesis consists largely of taxonomic descriptions of a number of epiphyllous fungi from Tertiary (possibly Oligocene-Miocene) sub-basaltic sediments from Kiandra, New South Wales. Mummified leaves of Myrtaceae and Lauraceae in these sediments bear a number of well-preserved epiphyllous organisms, including a form strongly resembling the epiphyllous moss Ephemeropsis.

Fourteen new species of fossil fungi belonging to the "Microthyriales" are described, and three of these are regarded as belonging to modern genera (Asterina, Morenoina and Vizella). The remainder are assigned to form-genera. Two new form-genera are established, and the generic diagnoses of four previously established form-genera are emended in the light of better preserved material and recent work on the taxonomy of modern epiphyllous fungi. The delimitation of form-genera within the family Microthyriaceae (sensu Stevens and Ryan) is discussed in detail.

Several forms belonging to recognised form-genera, but not sufficiently well-preserved to warrant specific description, are described, together with other forms whose identification is uncertain.

The host leaves bearing the epiphyllous flora are described briefly. The principal host leaves are identified only to the family level.

The palaeoecological significance of the epiphyllous flora, in conjunction with the pollen and macroflora previously described from the sediments, is discussed, and tentative conclusions are reached regarding the climate at the time of deposition of the sediments.

PREFACE.

The work described in this thesis was carried out in the Botany Department, School of Biological Sciences, University of Sydney during the period March, 1964 - June, 1969. Except where specified in the text the work described is my own and has not previously been presented for a degree at any university.

I wish to thank the University of Sydney for provision of a Teaching Fellowship for the period March, 1964 - December, 1968, during which time the major part of this thesis was completed; Dr. A.R.H. Martin for supervision and general direction of the work; Dr. D.L. Dilcher for loan of fossil material and helpful correspondence; Mr. P. Wellman for providing unpublished data on K-Ar dating; the former Kosciusko State Park Trust for permission to collect the material; Mr. J. Walker and Dr. P. Valder for helpful discussion; the late Professor A.C. Batista for comment on some specimens; the Director, Commonwealth Mycological Institute, Kew for loan of the type material of *Vizella hendrickxii* (Hansf.) Hughes; the Board of Trustees, National Museum, Melbourne for loan of type material of Australian fossil fungi; Mrs. E.M.P. Thiem, Miss D. Williams, Mrs. H.V. Moss and Mrs. W.F. Connell for technical assistance; Mr. B.T. Lester and Mr. R. Oldfield for photographic assistance; the staff and fellow students of the School of Biological Sciences for discussion. Special thanks are due to Mrs. S. McKay for typing the manuscript.

ADDENDUM

Since the completion of the taxonomic portion of this thesis Mr. P. Wellman has kindly provided unpublished data on K-Ar age determinations of two basalts in the Kiandra area. One sample analysed was a fine grained basanite from the eastern side of New Chum Hill, between the New Chum and Giandarra diggings. Both samples have an indicated age of Lower Miocene, which conflicts with the dating of the sediments on palaeontological grounds in Gill and Sharp (1957).

As has been mentioned in the discussion of the significance of the fossil flora (p.87), the palaeontology of the sediments has not yet been thoroughly investigated, and dating on palaeontological criteria must rely heavily on a limited number of species. The macrofossils and fossil fungi recorded from the sediments are of no value in dating.

Many of the pollen species recorded from the sediments have geological ranges which extend at least into the Miocene (e.g. Dacrydiumites florinii, Nothofagus spp., Triorites harrisii, Sphagnites australis, Myrtaceidites mesonesus) and so do not conflict with a Lower Miocene age. On the other hand, the presence of Trisaccites micropterus appears to indicate an older age. Cookson and Pike (in Gill and Sharp, 1957) regarded the presence of this species as indicating a Lower Tertiary age, and the species is not known from sediments younger than Oligocene (Dr. P.R. Evans, personal communication). The presence of Phyllocladus palaeogenicus also appears to indicate a Lower Tertiary age.

The full implications of the apparent conflict between radiometric and palaeontological dating of the sediments will not be clear until more work has been done on the palynology of the deposits. Gill and Sharp regarded the basalts and sediments as at least penecontemporaneous, and on the basis of the radiometric age determination the sediments are considerably younger than has previously been thought, possibly Upper Oligocene-Lower Miocene. For the purposes of this thesis an Oligocene-Lower Miocene age has been accepted, but this needs to be regarded with caution until more palynological work has been done. Where the

age of the sediments is quoted in description of fossil species, for Eocene-Oligocene read Oligocene-Lower Miocene throughout.

TABLE OF CONTENTS

INTRODUCTION.

Early Tertiary sub-basaltic sediments occur over a wide area in the northern section of Kosciusko National Park, New South Wales. Extensive working for alluvial gold during the latter half of the nineteenth century has exposed the deposits in a number of localities near Kiandra, lat. 35°47'S long. 148°29'E; altitude 4600' (Gill and Sharp, 1957). Very good exposures occur at New Chum Hill, northwest of Kiandra, where the old gold diggings have lately been used as a source of sand by the Snowy Mountains Hydro-electric Authority. All specimens described in this work were obtained from exposures in Homeward Bound Claim, the easternmost of the diggings in New Chum Hill (see Gill and Sharp, 1957, Pl.2.).

Geology.

The geology of the area has been described by Gill and Sharp (1957) who considered that physiographic rejuvenation of an Eocene or older peneplain led to the development of youthful river channels up to 60' deep, and gold was included in the sediments formed by these active streams. Regional tectonic disturbances then led to cessation of erosion and deposition of up to 300' of lacustrine sediments over an area of ca. 200 square miles.

Gill and Sharp recognised three cycles of sedimentation, controlled by regional disturbances. Each cycle began with a quartz sand facies showing evidence of deposition in moving water and ended with a highly fossiliferous still-water clay-lignite facies. Short periods of intercycle erosion occurred. Sedimentation was brought to an end by disturbances culminating in outpouring of olivine basalts which covered a wide area and sealed off the sediments. Some of the earliest basalt flows are intercalated with sediments, and the basalts were regarded by Gill and Sharp as essentially contemporaneous with the sediments. Subsequent movements formed the present Great Dividing Range which is straddled by the sediments and basalts, obviously antedating it.

Palaeontology.

The only animal fossils recorded from these sediments are fresh water sponge spicules. The flora has previously been studied by Cookson and Pike (in Gill and Sharp, 1957) and Cookson (1947) recorded three species of fungi from the deposits. A list of the species recognised by these authors is given in Table 1. The distribution of these species in deposits at various localities in the Kiandra area is given in Gill and Sharp (1957).

TABLE 1

Species recorded from Tertiary deposits in Kiandra area

FUNGI.

Notothyrites setiferus.....Pe
Asterothyrites minutus.....Pe
Plochmopeltinites masoni.....Pe

ALGAE.

Melosira granulata
Navicula viridis
Gomphonema intricatum
Vanhuerckia rhomboides

BRYOPHYTES.

Sphagnites australis.....S

PTERIDOPHYTES.

Cyatheacidites annulatus.....S
fronds.....X
spores

CONIFERS.

?Podocarpus.....X
Dacrycarpites australiensis..P
Dacrydiumites mawsonii.....P
" florinii.....P
Phyllocladus palaeogenicus...P
" leaves.....X
Microcachrydites antarcticus.P
Trisaccites micropterus.....P

ANGIOSPERMS.

Fagaceae
Nothofagus aspera.....P
" cincta.....P
" deminuta.....P
" emarcida.....P
" goniata.....P
" hetera.....P
" incrassata.....P
" vansteenisi.....P

Lauraceae. - leaves.....X

Proteaceae.

Beaupreaidites elegansiformis...P
Proteacidites symphyonemoides...P

Sapindaceae.

Cupanieidites? major.....P

Myrtaceae.

Myrtaceidites mesonesus.....P

Unknown.

Triorites harrisii.....P
unknown dicotyledon pollen
reeds.....X
cuticle fragments.....X

P....pollen; Pe.....perithecia; S.....spores; X....macro-remains

Cookson and Pike concluded that the absence of Acacia pollen and the small percentage of eucalypt-type pollen indicate the flora as pre-Pliocene. The presence of Trisaccites micropterus Cookson and Pike (Jurassic-Eocene), and the difference of the flora from the Mesozoic-Paleocene flora in Victoria was taken to indicate an Eocene, or possibly Early Oligocene age.

Materials and Methods.

a) Extraction of leaves.

All fossil material described was obtained from exposures of the lowest lignite horizon in Homeward Bound Claim. In some parts this lignite consists almost entirely of closely compacted leaf mummifications, with only a small amount of mineral material between individual leaves. Badly weathered surface material was discarded and bulk samples ca. 30cm cubed of the fresh lignite were placed in sealed plastic bags for transport to the laboratory. Specimens collected in this way showed no deterioration after three years' storage.

Chemical methods of freeing the fossil leaves from each other and adherent mineral material were found to be relatively ineffective. The small amount of mineral material present was entirely removed by hydrofluoric acid, but the leaves remained closely adpressed, becoming very brittle, and could not be separated without tearing. Better separation of the leaves was obtained with nitric acid. Unfortunately, all concentrations of nitric acid above 30% caused violent exothermic reaction when the lignite was added, and the leaves were badly shattered, most being reduced to small fragments of cuticle. Concentrations of nitric acid below 25% had no apparent action, even after prolonged treatment. Since no method could be developed which would work satisfactorily with all material mechanical methods of separation were adopted.

Blocks of material were stored in plastic bags until required and then allowed to air-dry at room temperature for two weeks. Dried

blocks ca. 5cm thick were placed in acetone for thirty minutes. The dry material swelled by up to half its original volume and some of the humic substances present dissolved. The acetone rapidly became discoloured, and many leaf fragments isolated were much lighter in colour than before treatment. Some leaves gave clean cuticular preparations after treatment with acetone alone.

The blocks were then broken into smaller pieces, drained of excess acetone for five minutes, and immersed in water. The fossil material by this stage was soft and pliable and could be separated with forceps without tearing. Agitation of the material in water sometimes led to separation of the leaves without dissection. Isolated specimens were washed in water for one hour and stored in 50% ethyl alcohol or 50% glycerine.

b) Treatment of cuticle and epiphyllous organisms.

No standard method for preparation of cuticles could be used owing to the variable response of the material. The most transparent leaves yielded clean cuticular preparations after treatment with 5% potassium hydroxide. Darker leaves were treated with concentrated nitric acid until they became transparent and were then placed in 5% potassium hydroxide until separation of the cuticles occurred. Cuticles were washed thoroughly in water and examined under a dissecting microscope for epiphyllous fungi. Specimens selected were mounted in glycerine jelly, Euparal or Canada balsam.

Some of the more delicate forms present were badly affected by more than a few minutes' acid treatment. The worst affected were the protonemal filaments of cf. Ephemeropsis, most of the filament disappearing in 2 minutes. More transparent leaves on which cf. Ephemeropsis could be detected prior to maceration were treated for extended periods (up to three weeks) in 5% potassium hydroxide. The protonemal filaments appeared to withstand this treatment well, but the structure of the haptera was not as clear as in acid treated specimens.

Treatment of fossil fungi with nitric acid for longer than five minutes led to excessive bleaching of more delicate forms. On the other hand, forms with large dark perithecia (e.g. Asterina kiandrensis) often

required treatment for longer periods before the structure of the perithecium became clear, otherwise perithecia remained very dark, even after prolonged treatment with alkali.

Dilcher (1965) considered that treatment of fossil leaves with alkali alone was sufficient to give both good cuticular and fungal preparations. My own experience is that the technique must be varied according to the material, watching each maceration process carefully, and stopping the reaction when the right stage has been reached. This gives much better results than trying to develop a single technique applicable in all cases.

Since most fossil epiphyllous forms encountered are reddish-brown after maceration, most specimens were mounted unstained. The parasitic form in the cells of Trichopeltinites kiandrensis (see p.62) and the free hyphae of Callimothallus pertusus were first detected under phase contrast illumination. The specimens were removed from the slides, stained in a saturated alcoholic solution of methylene blue, and remounted.

Delicate structures such as asci and paraphyses would appear unlikely to be preserved during fossilisation, and even if preserved liable to be destroyed by maceration prior to examination. It is possible that treatment may play a large part in the absence of delicate structures, and more work needs to be done to determine what is likely to be preserved, and to develop appropriate techniques of preparation. Wolf (1968) has shown that acetolysis may cause the walls of some hyaline fungal spores to become dark, and there is a possibility that fossil fungal specimens may either lose or gain colour during fossilisation or treatment.

c) Treatment of modern epiphyllous fungi.

Specimens of modern epiphyllous fungi for comparison with the fossils were obtained by use of cellophane peels stripped from the surface of living and herbarium leaves. Colourless forms were stained in methylene blue or safranin, by immersion of the cellophane peels in saturated alcoholic solutions of the stains. The cellophane peels were then mounted in glycerine jelly. In

some cases living material was fixed and cleared for study of epiphyllous forms.

Sections of modern Vizella spp. were prepared by embedding in paraffin wax and sectioning at 10μ. Sections were stained in safranin and aniline blue. Sections of Vizella discontinua were stained in safranin.

Cuticles of modern leaves bearing colonies of Vizella were isolated using 70% modified Jeffreys' solution as described by Stace (1965). As much mesophyll as possible was cut away from the upper cuticle before treatment. The cuticle was placed in the solution and watched carefully until it just became colourless (ca. ten minutes). The cuticle was then transferred to water and as much as possible of remaining mesophyll and epidermis was removed with a small brush. The cuticles were then mounted in Euparal. Mycelial setae of a member of the Chaetothyriaceae for comparison with those of the fossil cf. Vitalia were artificially "fossilised" using this solution.

d) Preparation of cuticles of modern Myrtaceae.

All but a few of the fossil fungi described occur on leaves closely resembling those of some modern members of the Myrtaceae (subfamily Myrtoideae). Cuticles of living and herbarium material of modern species were prepared for comparative purposes. Herbarium material was rehydrated by boiling for ca. one hour in water with a little added detergent. The leaves were then cut into sections and macerated overnight in 70% Jeffreys' solution (Stace, 1965). Isolated cuticles were washed in water, stained in Sudan IV and mounted in polyvinyl alcohol or glycerine jelly. Fossil material for cuticular study was stained in safranin or basic fuchsin or mounted in glycerine jelly unstained.

DESCRIPTION OF SPECIMENS.

All the fossil fungi described here belong to the group described by Hansford (1946) as "foliicolous ascomycetes". The modern group contains

many forms which have been comparatively neglected by mycologists. Most of the parasitic forms are of little economic importance. Most are ectoparasitic, and do little if any damage to the host. No evidence of pathological development of the host leaf has been seen in fossil specimens on which parasitic forms are present. Saprophytic forms such as members of the Trichopeltaceae appear to have no effect on leaves bearing them.

The taxonomy of some groups has been considerably modified as a result of recent work, and concepts of genera, families and orders have been modified. Many characters used in the classification of modern forms (e.g. ascus structure, paraphyses) are lacking in fossil material, and Dilcher (1965), in comprehensively reviewing the literature, commented on this as a general feature of fossil epiphyllous forms. Dilcher, listing all reports of supposedly epiphyllous fungi, points out that many early reports of epiphyllous fungi are founded on dubious material, and are of little use.

Pioneer work on the fossil fungi of the Southern Hemisphere was done by Cookson (1947), who instituted a number of form-genera which remain, with some modification, the basis for much of the classification of fragmentary material.

Cell measurements in fossil material.

All measurements of cell size are given in the following form:-

minimum-(mean; standard deviation; number of measurements)-maximum observed.

All measurements are based on camera lucida drawings at X1750. Minima and maxima are generally given to the nearest micron. There appears to be no significant difference between specimens prepared using different maceration techniques (see Table 2).

TABLE 2

Variation in Length of Short Cells of Vizella discontinua with Different Treatments

The figures given below are measurements in millimetres of the lengths of drawings at X1750 of the short cells of four colonies of Vizella discontinua. Ef23 was treated with alkali only, Ef24 was treated with nitric acid and alkali.

Alkali only : Ef23				Acid and Alkali : Ef24			
Colony 1 (mm)		Colony 2 (mm)		Colony 1 (mm)		Colony 2 (mm)	
9	11	11	11	12	10	8	9
10	11	14	11	9	9	9	9
11	11	12	10	8	10	10	12
9	7	9	10	10	12	10	10
8	9	12	11	10	9	10	7
9	9	11	9	11	13	8	9
9	10	9	13	9	10	9	11
11	10	9	10	17	16	9	12
10	10	10	10	12	14	11	14
13	8	9	11	13	10	14	12
10	8	11	10	10	12	11	12
11	11	9	9	12	12	11	11
11	10	10	12	9	12	8	12
11	11	10	12	10	9	9	11
10	13	10	10	10	8	10	14
12	15	10	10	10	10	13	13
11	12	10	13	11	9	13	13
11	11	10	11	9	12	12	12
11	12	8	8	10	10	11	11
15	13	10	10	15	8	12	12
14	10	10	10	9	9	10	11
10	10	11	13	11	7	9	10
12	12	12	10	12	11	11	11
10	8	11	10	9	10	12	10
10	11	9	12	10	10	9	12
Mean and Standard Deviation	10.62 ± 1.7	10.46 ± 1.3		10.60 ± 2.0		10.78 ± 1.7	

An analysis of variance gives variance ratio F= 0.30; $n_1 = 3$; $n_2 = 196$; hence differences in cell length between colonies are less than differences in length between cells of the same colony. There is no significant effect of treatment on cell length in this species. It is assumed that the same holds for all species described in this work.

Disposition of specimens.

All fungal specimens described are lodged in the Herbarium, New South Wales Department of Agriculture, Rydalmere, N.S.W. (cited in text as Herb. DAR). Where possible, duplicate specimens will be lodged in the collections of the Geology Department, University of Sydney.

Class ASCOMYCETES

subclass Euascomycetidae

Order ERYSIPHALES

family Meliolaceae

form-genus Meliolinites gen. nov.

Generitype: Meliolinites spinksii (Dilcher) comb. nov.

1965. Meliola spinksii Dilcher, Palaeontographica 116B, p.8, Pl.2, figs.9-11, Pl.3, figs.12-14.

Fossil fungal colonies having the general characters of members of the Meliolaceae but lacking sufficient diagnostic features for assignation to a modern genus.

Meliolinites nivalis sp. nov.

Syntypes: Herb. DAR 17201, 17202. Figs 1-7

Diagnosis: Colonies up to 3mm. across. Hyphae straight, branches alternate, antrorse, forming dense reticulate network. Hyphal cells 19-(27.8;3.2;50)-34µ long X 7-(9.2;1.0;50)-11µ wide. Capitate hyphopodia alternate, unilateral where crowded, antrorse at ca.60° to hyphae, or widely spreading, 22-(29.0;3.4;66)-39µ long. Stalk cells cylindrical, often slightly expanded distally, rarely almost cuneate, 5-(8.9;1.9;66)-15.5µ long X 6-(8.1;1.1;66)-11µ wide; head cells irregularly globose, 14-(20.1;2.1;66)-26µ long X 11-(15.8;2.2;66)-23µ wide. Perithecia borne on a disc of radiate hyphae. Spores psilate, straight, oblong with rounded ends, 3-septate, slightly constricted, 62-(66.7;3.1;1.7)-72.5µ long X ca.18µ wide. Modified Beeli formula: ?101.6230(1).

(1) For an explanation of this formula see Appendix 2.

Occurrence: upper surface, leaves of Myrtaceae, Kiandra, N.S.W. Eocene-Oligocene.

Description.

Individual colonies of this species are easily visible to the naked eye. The perithecium is centrally located within the mycelial network. Colonies are often confluent and considerable areas of the cuticle may be covered by a network of hyphae.

The hyphae are straight, but long branches may have considerable flexure. Hyphae branch frequently (fig.1) and ca.20% of the hyphal cells bear branches. Most branches are alternate, but they may be unilateral where crowded. The majority form an angle of 60°-70° with the parent hyphae, but the angle varies from 40°-90° and a few recurved branches also occur. Hyphal walls are 1.5-2.5μ thick and cross-septa, 1μ thick, have a distinct pore 2-2.5μ - diameter.

Approximately 50% of the hyphal cells bear capitate hyphopodia at the distal end. The majority of capitate hyphopodia are antrorse, but widely spreading specimens are common and a few recurved specimens also occur. No mucronate hyphopodia occur. Most head cells are globose (figs. 2,5) but the wall is often sinuate, and the head cell is occasionally almost lobate. A distinct septal pore is present between the head and stalk cells.

Head cells have a distinct pore in the lower surface (fig.5). A hyaline process extends through the cuticle from this pore, presumably the remnant of a haustorial filament which penetrated the host (fig.6). Hansford (1961) described haustoria of members of the Meliolaceae as ovate to globular, but no expanded portion has been seen on any of the filaments examined.

A single apparently mature perithecium is present in one colony, appearing as an almost structureless black body 286μ diameter. The perithecium may originally have been globose, but is cupulate in the specimen. Hansford (1961) reports that the perithecia of the group often become cupulate-collapsed on drying. The structure of the perithecial wall is obscure, but the

paler central area shows a tangled mass of hyphae (fig.3). There are indications of papillate projections from the cells of the wall, but the preservation is so poor that no definite statement on the structure of the wall can be made. The perithecium is borne on a radiate disc of hyphae which can be seen extending from beneath it, and a number of such hyphal discs occur in other colonies (figs.1,4). No stages in the development of the disc or perithecium are recognisable. Hyphae of the disc lack the capitate hyphopodia of the normal vegetative mycelium.

Germinated spores persist in the centre of colonies (fig.7). The end cells (average length=15.3μ) are slightly shorter than the central cells (average length=18μ) and have thinner walls. The spore is slightly arched away from the surface of the leaf. All spores have a germinal capitate hyphopodium produced from each end cell, both directed to the same side of the spore. These presumably represent the first stage in germination of the spore of this species, as in modern members of the Meliolaceae (Hansford, 1961). Hyphae are produced from all cells of the spore, from the ends of the end cells and from the lower face of the central cells. One spore has two hyphae produced from one end cell.

Meliolinites sp.

figs. 9-11

Specimens: Herb. DAR 17208, 17210

Description.

Fragmentary remains of this form occur on the lower cuticle of leaves of Lauraceae. The hyphae are straight and most branches are opposite, although sometimes unilateral (fig.9). Hyphal cells are 12-(15.5;2.1; 39)-21μ long X 6-(6.9;0.6;39)-9μ wide, and most bear capitate hyphopodia at their distal end. The majority of hyphopodia are alternate (ca.10% opposite) and antrorse, 12.5-(17.6;1.7;63)-23μ long. The stalk cell is shortly cylindrical or almost cuneate, 2-(3.9;0.8;63)-17μ long X 5-(6.6;0.9;63)-8μ wide. Head cells are mostly obtuse conoid, 9-(13.8;1.4;63)-17μ long X 7-(8.9;1.0;63)-12μ wide (figs9,10).

Some head cells are cylindrical with broadly rounded ends. An indistinct pore is present at the apex of the head cell in most specimens.

A single spore has been seen attached to the hyphae (fig.11). The spore is 46μ long X 16.5μ wide, 3-septate, slightly constricted, psilate. The end cells (ca.8.5μ long) are markedly shorter than the central cells (ca. 14μ long). A single germinal hyphopodium is developed from each end cell. The spore is associated with fragmentary hyphae of another form, possibly belonging to the Meliolaceae, with rounded head cells and a distinct pore, but when hyphae developed from the spore are traced the capitate hyphopodia are of the type described above. Mucronate hyphopodia are absent.

Sterile mycelia, possibly Meliolaceae

At least two other forms with mycelia similar to those described above occur on leaves of Lauraceae and Podocarpus.

Type 1.

Specimen: Herb. DAR 17209

A single colony occurs on the lower cuticle of a member of the Lauraceae. The colony is 1.5mm diameter, and remains of four fructifications are present (fig.12). The hyphae are straight when growing free from each other, but may be considerably bent when crowded. The hyphae branch alternately forming a dense reticulate network. Hyphal cells are 19-(23.2;2.9;19)-29μ long X 7-(8.2; 0.7;19)-10μ wide. Most cells bear antrorse capitate hyphopodia which are alternate or unilateral where crowded. The hyphopodia are 22-(25.5;2.1;16)-29μ long. The stalk cell is cylindrical, often slightly wider distally, 4-(7.8;2.1;16)-11μ long X 7-(8.4;0.8;16)-10μ wide. Head cells are subglobose to cylindrical with a broadly rounded apex, 15-(17.8;1.2;16)-20μ long X 11-(12.4;1.0;16)-15μ wide (fig.14). No mucronate hyphopodia are present. The central part of the fructifications has fallen away, and the portions which remain possibly represent the margin of a radiate hyphal disc on which the perithecium is borne in modern Meliolaceae (fig.13).

Type 2.

Specimen: Herb. DAR 17200

Fragments of this form occur on the upper surface of leaves of Podocarpus sp. and on the bilateral leaves of Podocarpus praecupressinus. Hyphal branching is opposite. The cells are 18-(23.0;3.0;31)-32μ long X 7-(9.7;1.3;31)-13μ wide. Hyphal walls are 1.5-2μ thick, and distinct pores ca.2μ diameter are present in the cross-septa. Capitate hyphopodia are alternate or unilateral, and seem to have no preferred orientation (fig.15). The stalk cells are shortly cylindrical, 3-(6.5;1.7;43)-10μ long X 6-(8.9;1.5;43)-12μ wide. Head cells are globose, 13-(15.8;1.4;43)-29μ long X 10-(13.7;1.7;43)-19μ wide. Many head cells have a distinct pore in the lower face ca.2μ diameter (fig.16). Total length of the hyphopodia is 17-(22.3;2.3;45)-26μ. No mucronate hyphopodia are present.

Discussion.

Meliolinites nivalis, although obviously a member of the Meliolaceae, cannot definitely be assigned to any of the genera recognised by Hansford (1961) because of the lack of mycelial setae and poor preservation of the perithecium. Hansford placed all species with mycelial setae in Meliola and divided the others among a number of genera on the structure of the perithecial wall.

Though absence of mycelial setae in the fossil form makes it appear improbable that it belongs to Meliola, the distinction between Meliola and the other genera on the basis of setae is not absolute in the modern species. Some species of Meliola produce setae on some colonies only, and even the majority of colonies may lack then (Hansford,1961). In other species setae may be developed only around the base of the perithecium. Thus examination of a wide range of material may be necessary for correct identification. Development of setae and even of perithecia may be suppressed if the colony is attacked by hyperparasites (Stevens, 1927; Hansford, 1961), and similar effects can presumably be expected in

fossil specimens. Several perithecia of a form provisionally ascribed to the Trichothyiaceae (p.69) occur in close contact with hyphae of Meliolinites nivalis and many hyphae are invested by narrow, pale hyphae of another form (fig.8). Some hyphal cells appear to have been attacked, and it seems possible that the fossil colonies have been attacked by a hyperparasitic form.

Absence of setae in fossil specimens may thus have three causes:

1. complete absence of setae in the fossil organism
2. suppression of seta formation by hyperparasites
3. insufficient material for determination of whether setae occur or not.

It would seem impossible to decide which of these is the correct interpretation, and absence of setae cannot be used for generic identification in the fossil form. Dilcher (1965) described Meliola spinksii which also lacks setae, and that species is here regarded as the type species of the form-genus Meliolinites. A comparison of the two species is given in table 3.

TABLE 3.

COMPARISON OF FEATURES OF Meliolinites nivalis AND Meliolinites spinksii+

	Meliolinites nivalis	Meliolinites spinksii
hyphae	straight	straight
branching	alternate-unilateral	opposite or alternate
hyphal cells	19-34μ X 7-11μ	14-50μ X 5-9μ
capitate hyphopodia	alternate	opposite
	22-39μ long	10-18μ long
stalk cell	cylindric	cuneate to cylindric
	5-15.5μ long	2-5μ long
head cells	irregular globose	oblong to ovoid
	14-26μ X 11-23μ	8-13μ X 5-10μ
perithecia	286μ diam (1 specimen)	not known
spore	straight, oblong	straight, oblong
	3-septate	4-septate
	62-72.5μ X 18μ	37-43μ X 12-15μ

+ after Dilcher, 1965.

The perithecium of Meliolinites nivalis is borne on the surface of a disc of radiating hyphae, which removes it from the genus Amazonia in which the perithecium is covered by a layer of radiating hyphae, and resembles the fructification of forms such as Asterina. In Irenopsis and Appendiculella the perithecial wall bears setae and larviform appendages respectively, while in Asteridiella the wall lacks appendages of any kind although the cells of the wall may be papillate. Papillae may occur in the fossil form (p. 11) but the poor preservation of the perithecium makes it inadvisable to assign the specimens to Asteridiella.

Hansford (1961) listed 1814 species in the Meliolaceae. Of those growing on leaves of Myrtaceae the only species with three-septate ascospores and lacking setae is Asteridiella eucalyptorum (2101.6240). This species can be separated from the fossil form on the basis of mycelial branching, and the shape of the capitate hyphopodia (Table 4).

TABLE 4

COMPARISON OF FEATURES OF Meliolinites nivalis AND Asteridiella eucalyptorum

	Meliolinites nivalis	Asteridiella eucalyptorum
hyphae	straight	sinuous to crooked
branching	alternate-unilateral	opposite-irregular
hyphal cells	19-34μ X 7-11μ	20-30μ X 8-9μ
capitate hyphopodia	alternate	alternate
	22-39μ long	22-35μ long
stalk cell	cylindric	cylindric
	5-15.5μ long	7-15μ long
head cell	irregular globose	versiform rounded angulose-irregularly lobate
	14-26μ X11-23μ	15-25μ X 12-17μ
perithecia	286μ diam. (1 specimen)	up to 330μ diam.
spore	straight, oblong	bent ellipsoid
	3-septate	3-septate
	62-72.5μ X 18μ	56-69μ X 17-20μ

The only other genus recognised in the Meliolaceae is Diporotheca, a subterranean form parasitic on roots of Solanum spp. in North America (Gordon and Shaw, 1960). On the basis of habitat and spore structure this genus can be excluded here.

Thus the fossil specimens cannot be definitely included in a modern genus and a new form-genus in the Meliolaceae is created for the reception of such material.

The specimens of Meliolinites sp. are too fragmentary to warrant specific description, but appear to have been devoid of setae. Both Meliolinites nivalis and Meliolinites sp. lack mucronate hyphopodia which are a common feature of modern members of the group. Mucronate hyphopodia are also absent in the two forms described above as sterile mycelia. These very probably represent other members of the Meliolaceae, but two-celled hyphopodia occur in many species of Asterina and its allies, and, in the absence of spores and fructification, definite assignation to this family is inadvisable.

Order DOTHIORALES

family Asterinaceae

genus Asterina Léveillé

Asterina kiandrensis sp. nov.

Syntypes: Herb.DAR 17215,17216,17218,17219,17245,17253(a),17256,17257

Figs. 17-39

Diagnosis: Fossil fungi. Colonies up to 4mm diameter. Mycelium dark. Hyphae straight, cells 19-(30.5;4.5;84)-47µ long X 4.5-(6.2;1.2;84)-10µ wide, branches alternate or unilateral at 90° forming a reticulate network. Hyphopodia 1-celled, alternate or unilateral, subglobose to cylindrical with broadly rounded apex, 9-(11.4;1.6;36)-15µ long X 5-(8.0;1.3;36)-10µ wide. Perithecia scattered or crowded, up to 450µ diameter, composed of radiating hyphae; margin fimbriate, paler than central area. Central portion of wall multilayered, margin single layered. Spores ovate-elliptical, 1-septate, constricted, cells of unequal length, walls thin,

almost colourless, granulose. Walls of spore become thick and dark after germination and further septa may develop.

Occurence: upper and lower surface, leaves of Myrtaceae, Kiandra, N.S.W. Eocene-Oligocene.

Description.

This species is very common on leaves of Myrtaceae, and most colonies are developed on the upper surface. Individual colonies are visible to the naked eye as dark patches on the cuticle. Perithecia appear as scattered or crowded dense black bodies in the network of hyphae. Individual colonies often coalesce and the surface of some leaves is almost entirely covered by mycelium (fig.17).

An expanded terminal portion of the hyphae is formed when one hypha contacts another, and different mycelial branches do not anastomose (fig. 19). Branches usually arise from cells without hyphopodia, but if a hyphopodium is present the branch arises opposite it. Hyphae are thick-walled (ca.1.5μ); and cross-septa are 1-1.5μ thick, with a distinct pore 1.5μ diameter. Cells in hyphae on the lower surface of the leaf are generally longer than those on the upper surface. Walls of individual cells are often sinuate but hyphae are straight when seen at low magnification.

Most hyphopodia are at right angles to the cell bearing them, but many are slightly antrorse, and reflexed specimens also occur (figs.18,25). All hyphopodia have a distinct pore up to 2.5μ diameter towards the distal end, usually surrounded by a dark thickened rim ca.1.5μ wide. The pores presumably represent the position of penetration of the host by haustoria, but no haustorial structures are visible beneath the cuticle.

Perithecia are extremely variable in size, ranging from 78-448μ diameter in 58 specimens measured. The wall is strongly arched away from the cuticle, and groups of hyphae from the multilayered central portion may grow out as free hyphae with the same structure as the vegetative mycelium (fig. 18). Hyphae at the margin of the perithecium are paler than the vegetative mycelium, with indistinct cross-septa, and form a tissue in which individual hyphae are only

clear when growing out freely at the margin (fig.18). Free hyphae produced from the margin only rarely possess hyphopodia.

Many larger perithecia have cracks radiating from the centre, or else the wall is irregularly broken (figs. 17,18). In modern Asterina spp. the spores escape through radial or irregular fissures (Doidge, 1920) and splits in the fossil perithecia may represent dehiscence. Two specimens have been seen in which split perithecia contain spores, but it is impossible to discount the possibility that splits may be due only to mechanical damage to the brittle fossil material. Often the entire central portion of the perithecium has broken away, and its position is represented by the persistent paler marginal hyphae.

A complete series of stages in perithecial development is often present in a single colony. Fructifications first appear as small lobed outgrowths either from a medial hyphal cell (fig.19) or terminating a short lateral branch (figs. 20,22). Older fructifications form a flat plate of radiating hyphae under, or to one side of, the hyphae. Some specimens have distinct cross-septa (fig. 23) while others of similar size have indistinct septa or appear to lack them altogether (fig. 24). The margin of young fructifications eventually becomes uneven due to differential growth of the component hyphae (fig. 25). Hyphae of very young fructifications may grow out as free hyphae with hyphopodia (fig.21). The fructification rapidly assumes the appearance of a diminutive perithecium.

192 germinated spores, which persist attached to hyphae when the colony is of considerable size and has apparently mature perithecia, were studied. The spores are ovate, with one end truncate, 21-(26.8;2.6;73)-40μ long X 12-(14.5,1.1,73)-17μ wide. The walls are thick (ca.1-1.5μ) and dark. Spores vary from 0-3-septate (1-4 celled) (figs.26-30). Measurements of spores and component cells are given in Table 5.

TABLE 5

MEASUREMENTS OF SPORES AND COMPONENT CELLS, *Asterina kiandrensis*

spore septation	number	% total	mean length	mean width	mean length component cells +			
					1	2	3	4
1-celled	44	22.92	26.5μ	13.8μ				
2-celled	122	63.54	26.4μ	14.6μ	11.0μ	15.0μ		
3-celled	25	13.02	28.8μ	14.2μ	10.4μ	8.9μ	9.5μ	
4-celled	1	0.52	28.0μ	15.0μ	9.1μ	6.9μ	5.1μ	7.4μ

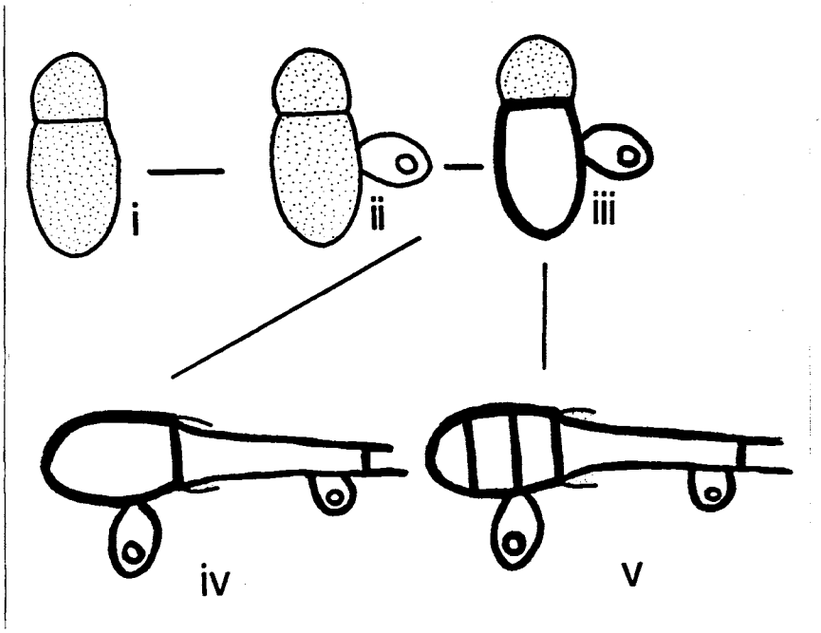
+ measured in succession from rounded end of spore.

Free hyphae are developed from the truncate end of the spore (fig.27,28), but hyphae occasionally arise from both ends of the spore (fig.32). Almost all spores have a single lateral germinal hyphopodium (figs. 28,29), similar to hyphopodia on the mycelium, but often more irregular in shape. Some specimens lack a germinal hyphopodium (fig.31) and one specimen has two.

In some specimens the spore wall is distinctly two-layered (fig.27) while "spore-in-spore" structures occur in others (figs.31,32). Spores found attached to the hyphae represent only the single modified large cell of an initially two-celled spore, the various septation patterns developing after spore germination. The reconstructed pattern of germination is shown in text-figure 1.

Text-figure 1

SPORE GERMINATION IN Asterina kiandrensis



i) thin-walled spore as shed from perithecium; ii) development of germinal hyphopodium; iii) thickening of the large cell of spore; iv) production of free hyphae from thickened cell; v) two-septate thickened cell.

An initially two-celled, thin-walled spore (i) develops a germinal hyphopodium (ii). Once penetration of the host has been affected the large cell of the spore becomes thickened (iii). Hyphae then develop from the thickened cell, which may remain unicellular (iv) or else become variously septate (v).

A few broken perithecia contain apparently immature spores, but only a few are in such a position as to show the structure clearly (fig.33). The immature spores are ovate-elliptical, 37μ long X 18μ wide, with a single septum, much more distinct than the almost colourless and slightly granular

spore wall. The septum divides the spore into a large cell ca. 25μ long and a short cell ca. 12μ long. The spore is slightly constricted at the septum. Spores appear to have been shed from the perithecium when immature, and a few similar spores occur on the cuticle not obviously associated with a fructification (fig.34). A single thin-walled spore which has germinated to form a germinal hyphopodium has been seen (fig.35).

Many apparently unicellular germinated spores have an almost hyaline protrusion from the truncate end of the thickened cell (fig.36). This hyaline structure shows a distinct pattern characteristic of the immature cell, and represents the small cell of the immature spore borne on the thickened large cell. In some cases the remains of this colourless cell are visible at the base of the hyphae produced from the large cell (fig.28). In some specimens a thicker-walled structure, representing the beginning of free hyphae appears within the hyaline cell (figs.38,39). In some spores where thickening of the wall of the large cell has not been extreme the granular pattern of the wall is still apparent (fig.37) but this is not visible on specimens with thicker walls.

If this interpretation of germination is correct, the "spores" found attached to free hyphae represent only the much modified large cell of the spore. The dimensions of the large cell of the immature spore appear to be in close agreement with measurements of "spores" given in Table 5. Similarly, the dimensions of 1-celled "spores" are similar to those of 2,3 and 4-celled specimens. Many fungal spores which penetrate the host before the production of free hyphae may become variously modified, development of further septa being fairly common (Dr. P. Valder, personal communication), and it appears that this is the case in the fossil form. "Spore-within-spore" structures in the fossil probably represent another form of modification of the contents of the spore. In fig.39 a similar structure is seen within the large cell of a septate "spore".

Discussion.

The only other report of Asterina as a fossil is from Eocene deposits in the United State (Dilcher, 1965). Asterina eocaenica Dilcher

is described as having both perithecia and pycnidia, although there are no pycnospores to verify the presence of the two types of fruiting body. Dilcher distinguished the two types on size, pointing out that several of the smaller fruiting bodies were split, indicating maturity. In the Kiandra specimens many of the smaller perithecia are split, while many of the largest specimens are intact, and it seems likely that splitting may be due to mechanical damage alone. Unless spores are found within the fruiting structure splitting should not be regarded as definite evidence of maturity.

Dilcher described a second species, Asterina nodosaria, on the basis of mycelial characters. No fruiting bodies or spores of this form were seen. The species is based on hyphae with intercalary "node-cells" associated with seta bases, whose connection with the hyphae has not been convincingly demonstrated. Hyphae with intercalary node-cells are not confined to Asterina. At least three other genera of the "Microthyriales" possess similar hyphae:- Asterolibertia, Circosia and Wardina (Hansford, 1946). It appears doubtful whether mycelia should be ascribed to a genus without evidence from fructifications and spores, and even if such are present generic determination may be difficult. Dilcher mentions the presence of "very young developmental stages of fruiting bodies ..... producing a thin crenulated disk", and figures portion of a small fruiting body beneath the hyphae of Asterina nodosaria (Dilcher, 1965, Pl. 9, fig. 75). Only an examination of the type specimens would show whether this form can be ascribed to a form-genus such as Asterothyrites Cookson, and until such examination this report is best regarded as a report of sterile mycelium of uncertain affinity.

?Parasterina plectopelta Dilcher is also based on hyphopodiate hyphae lacking fructifications and spores, and is best regarded similarly. Müller and von Arx (1962) regard Parasterina as a synonym of Asterina

genus Morenoina Theissen

Morenoina kiandrensis sp. nov.

Syntypes: Herb. DAR 17231 figs. 40-47

Diagnosis: Fossil fungi. Free mycelium superficial, sparse. Hyphae straight,

branched, without hyphopodia, arising from marginal cells of the ascoma. Ascomata scattered, linear when mature, dehiscing by a longitudinal slit. Upper wall of ascoma of radiate, dichotomously branched hyphae; cells square to rectangular, 1.5-(3.9;0.8;210)-6.5μ long X 1-(2.2;0.6;102)-3.5μ wide, walls ca. 0.5μ thick. Ascospores two-celled, smooth, transparent, almost colourless.

Occurrence: upper and lower surfaces, leaves of Myrtaceae, Kiandra, N.S.W. Eocene-Oligocene.

Description

No measurements of ascomal size are included in the diagnosis owing to the small number of specimens. Ascomata range in size from 56μ long X 34μ wide to 280μ long X 64μ wide in an old dehisced specimen. Smaller, immature ascomata are ovate-elliptical with a distinct radial arrangement of the upper wall (fig. .43). Larger ascomata are elongate, growth from the radial central portion having taken place in one direction only (fig.42) or in two directions (fig.40). The radiate structure of the central portion is visible even in old dehisced ascomata.

A distinct almost hyaline longitudinal band occurs in the centre of the ascoma before dehiscence (fig.42). The walls of the hyphae are markedly thinner than elsewhere in the ascoma, and the band almost certainly represents a zone of weakness along which the ascoma dehisces at maturity. Up to three adjacent hyphae are involved in the formation of the band.

A single group consisting of six spores is present in one of the ascomata, but only one spore is in such a position as to show the structure clearly (fig.47). The spore is two-celled, 7μ long, divided into equal cells 3.5μ long X 3μ wide, with rounded free ends. The spore is constricted at the junction of the two cells, very pale brown in colour, smooth and transparent.

The margin of the ascoma is fimbriate, some of the marginal cells growing out to form free hyphae (figs.40,41). The hyphae are sparse, 2-3μ wide, very light brown to almost colourless, and extend widely over the surface of the leaf, branching at irregular intervals. Very indistint cross-septa occur at

intervals, but the hyphae are often folded and it is difficult to determine whether some features are cross-septa or simply folds. No attempt has been made to measure cell size in the free hyphae. There appears to have been no penetration of the leaf, either through the cuticle or through the stomatal cavities. One small pore has been seen in a hypha but this is the only indication of a possible penetration point.

A complete series of stages in the formation of small fruiting bodies has been recognised. Large numbers of small fruiting bodies, circular in outline, occur scattered over the surface of the leaf, apparently developed underneath the free hyphae. Organic connection of these structures with linear ascomata has been proved in only two cases. The earliest stage present is a small lobed outgrowth from the hypha. Further growth leads to the development of a small circular plate underneath the hypha (figs. 44,45). The structure at this stage is distinctly radial, but no distinct cross-walls are visible in the dichotomously branched hyphae. The largest of these small fructifications seen is much darker in colour than younger stages and shows distinct cross-septa in the hyphae (fig.46). This specimen is only 4μ shorter in diameter than the maximum diameter of the smallest ascoma described above, and would appear to be indistinguishable from the young ascomal specimens. There is no sign of any spore or dehiscence mechanism in these small fructifications, and they are regarded here as young stages in the formation of ascomata.

Discussion.

Müller and von Arx (1962) list eight genera in the Asterinaceae which possess linear ascomata opening by a longitudinal slit. The fossil form appears to be closest to the genera Lembosina, Echidnodella and Morenoina The genus Lembosina is distinguished from the other two by the presence of a hypostroma, which may develop just underneath the cuticle, in the epidermis, or deeper within the host tissue. The presence or absence of this character is almost impossible to determine in a fossil specimen where the cuticle is the only part of the leaf structure remaining. There is always the possibility that the hypostroma

may have been present originally, but has been either not preserved, or lost in course of treatment of the specimen.

In Lembosina the hypostroma appears to be developed from hyphae which penetrate the cuticle of the leaf, expanding beneath the cuticle into a well-developed hyphal zone. There is no evidence of penetration of the leaf in the fossil form either through the cuticle or the stomata (with the exception of the single pore mentioned above). Many of the modern members of this group of genera form dark cell complexes in the stomata, but no such structures have been seen in the fossil specimens, although hyphae often grow around or across a stomate. There is no indication of penetration of the leaf by any of the cells under the ascoma. This has been determined by examination of the cuticle surface where an ascoma has been flaked off. The absence of any evidence of penetration is taken as indicating that a hypostroma is absent in this form.

Echidnodella contains parasitic forms with dematoid mycelium and brown ascospores. Morenoina contains saprophytic forms in which the mycelium is delicate and sometimes evanescent, The ascospores are very small and hyaline (Müller and von Arx, 1962). The mycelium of the fossil form is certainly not dematoid, and best fits the description of the hyphae in Morenoina. Some of the larger ascomata have no free hyphae associated with them and the mycelium may have been evanescent, or at least very indistinct in the fossil form. The ascospores likewise appear to be very faintly coloured (as is the case in Morenoina antarctica) and are transparent. The size of the single ascospore examined appears to point to Morenoina rather than to Echidnodella in which the ascospores are larger.

Cookson (1947) created the form-genus Euthythyrites for forms belonging to the subfamily Asterineae of the Microthyriaceae with linear, X-, or Y-shaped ascomata with linear dehiscence and possessing free hyphae. Stevens and Ryan (1939) included four genera with such ascomata, but without free hyphae, in the subfamily Microthyrieae of the Microthyriaceae:-Lembosidium, Aulographella, Lembosina, Morenoina. All these genera have since been shown to possess free hyphae, or to be synonyms of forms which do so, and are now included in the family Asterinaceae (Müller and von Arx, 1962). The form-genus

Euthythyrites can probably be regarded as containing members of that family. The ascomata of Morenoina kiandrensis are similar to those of Euthythyrites oleinitis (Cookson, 1947) but are linear rather than triradiate as in the latter form. The presence of spores makes it inadvisable to include the Kiandra specimens in the form-genus, and they are referred to the modern genus Morenoina.

family Entopeltaceae

genus Vizella Saccardo (sensu Hughes, 1953)

1965. Shortensis Dilcher, Palaeontographica 116B, p.29

Vizella discontinua sp. nov.

Syntypes: Herb. DAR 17203, 17204(a), 17205(a), 17206, 17246, 17247(b), 17263 Figs. 48-59.

Diagnosis: Fossil fungi. Colonies up to 5mm diameter. Mycelium entirely intracuticular, composed of alternating long and short cells; long cells brown or colourless, 13-(23.5;5.1;50)-37μ long, short cells brown, 4-(6.0;0.9;150)-10μ long X 4-(5.5;0.9;150)-8μ wide, square to rectangular. Main hyphae dichotomously branched at an acute angle; lateral branches opposite or alternate, arising from long cells only, never dichotomously branched, at right angles to the main hyphae. Perithecia intracuticular, 85-125μ diameter when mature, outer wall pseudoparenchymatous, dark, ostiolate. Ascospores ovate-elliptical, 9-(12.1;1.2;91)-15μ long X 3-(5.2;0.6;91)-6μ wide, 1-septate, composed of a large dark upper cell 7-(9.3;0.9;91)-11μ long X 3-(5.2;0.6;91)-6μ wide and a small paler basal cell 2-(2.9;0.9;91)-4μ long X 2-(2.8;0.4;91)-4μ wide. Hyaline band present in upper cell; ca 1.5μ wide.

Occurrence: upper cuticle, leaves of Myrtaceae, Kiandra, N.S.W. Eocene-Oligocene.

Description.

The alternating long colourless and short dark cells in hyphae of this species give colonies a discontinuous appearance when seen at low magnification (figs.48,49). In the centre of some colonies the long cells are the same colour as short cells, with distinct, bulging lateral walls (fig.58). Only a

small number of long cells are involved, and away from the centre of a colony the long cells are colourless with thin lateral walls (figs.49,50). Lateral walls of the short cells are much thicker than those of the long cells and straight or slightly curved. The cross-septa are markedly thicker than the lateral walls, and are interrupted by a distinct pore ca. 1μ diameter. The hyphae and perithecia are covered by a layer of cuticle 3-4μ thick (fig.56).

Differences between long cells in the centre of a colony and those towards the periphery may be developmental. All colonies must have originated from spores on the surface of the cuticle, and the first few cells of a colony may be on the surface of the cuticle or at least not so deeply immersed in the cuticle as later formed cells. The extra thickening of the initial cells may in fact represent adaptation to resist desiccation, the later formed cells, more deeply embedded in the cuticle, having thinner walls.

The main hyphae branch dichotomously or pseudodichotomously (figs.48,49). The angle of branching is variable, but always acute, and shows no consistent pattern within a colony, or from colony to colony. Either long or short cells may give rise to a dichotomy, but short cells do so only rarely. The initial dichotomous system bears lateral branches at frequent intervals, branches being borne only on long cells of the initial system (fig.49). The lateral branch is frequently borne on a small thickened projection of the lateral wall of the long cell, often constricted at the base (fig.50). The first cell of the lateral branch may be either a short or a long cell, and both types may occur when two lateral branches are given off from the same long cell (fig.50). Most lateral branches are opposite, and reproduce the structure of the main hyphal system, but never branch dichotomously.

Some lateral branches are associated with fructifications and form part of the fruiting body. More than one lateral branch may be associated with a fructification, and laterals from the same or different branches of the initial system may be involved. No specimens examined show the development of a fruiting body from the cells of the dichotomous system as recorded in Shortensis

memorabilis (Dilcher,1965). The majority of lateral branches are not associated with fructifications, but themselves bear laterals, until lateral branches of the third and fourth orders produce an anastomosing network (fig.50). Ultimate laterals do not show regular division into short and long cells, but are colourless hyphae up to 4μ wide with incomplete cross-septa at irregular intervals (figs,50,54).

In some colonies small pores are irregularly scattered along the hyphae, often surrounded by a pronounced thickened rim (fig.57). More than one pore may be present in a single long cell. Most pores are in the lower face of the hyphae, but a few also occur in the upper face, the thickened rim not being so pronounced as in pores in the lower surface. The pores strongly resemble those in Shortensis memorabilis (Dilcher, 1965). No signs of haustoria penetrating the cuticle have been seen, and the presence of pores in the upper surface of the hyphae makes it doubtful whether they have any parasitic function.

The mature perithecium has a dark-brown pseudoparenchymatous wall, strongly arched away from the surface of the leaf (fig.55). The wall is one layer thick in cross-section, (fig.56). In specimens where the outer wall has broken away an irregular arrangement of cross-septa in the hyaline hyphae of the basal layer is apparent. A distinct central ostiole up to 20μ diameter is present in the mature perithecium, apparently formed by the breakdown of a few of the central cells of the wall. No specialised cells surround the ostiole (fig.59).

A number of stages in the development of the fruiting body are present. The earliest recognisable stage is an irregular grouping of what appear to be cross-septa in colourless hyphae (fig.53). In later stages the walls of the cells become thicker and more evident, and the fructification becomes dark (figs.53,54).

Many perithecia contain ascospores, which are distinctly two-celled, with a hyaline band encircling the large cell ca.4μ from the free end (figs. 51,52). The spores are often fractured along the hyaline band which may indicate that the walls are thinner in this position. Ascospores are usually clumped in groups within the perithecium and are arranged in somewhat radial fashion with the small basal cell to the outside. A similar positioning is

reported in Shortensis memorabilis, and is a reflection of the positioning of the ascospores in the ascus of modern Vizella spp. (p. 35, fig. 89). No stages in germination of spores have been observed, nor are there any indications of a germ pore in the spore as in Shortensis memorabilis and other Vizella spp. One colony has what may be the remains of an ascospore in the centre (fig. 58). The small cell projecting from the hypha possibly represents the small cell of the ascospore.

form-genus Entopeltacites gen. nov.

Generitype: Entopeltacites attenuatus sp. nov.

Fossil fungal colonies. Mycelium with general characteristics of Vizella Sacc. (sensu Hughes, 1953), intracuticular. Fructification pseudoparenchymatous, ostiolate or not, intracuticular. Spore characters unknown or uncertain.

Entopeltacites attenuatus sp. nov.

Syntypes: Herb. DAR 17248, 17249. Figs. 60-67

Diagnosis: Colonies epiphyllous, up to 5mm across, intracuticular. Hyphae dark, dichotomously branched, bearing lateral branches which are themselves dichotomously branched, angle of branching 50°-60°. Hyphal cells 2-(11.3;5.3;120)-24μ long X 1-(1.7;0.4;100)-3μ wide; cross-septa thicker than the lateral walls. Fructifications ostiolate, wall pseudoparenchymatous, dark. Spore characters uncertain.

Occurrence: upper surface, leaves of Lauraceae, Kiandra, N.S.W. Eocene-Oligocene.

Description.

The hyphae extend widely over the surface of the leaf, giving the appearance of fine lines on the cuticle (figs, 60,61). In the central area of a colony the hyphae are dark brown, but become paler towards the edge of the colony, and are often almost colourless, the cross-septa being the only visible portion of the hypha. The cross-septa have a distinct pore.

The initial hyphal system is dichotomous, and some cells bear opposite or alternate lateral branches (fig. 62). The lateral branch is often borne on a short projection of the lateral wall of the cell, ending in a thick

cross-septum (fig.63). Lateral branches have the same structure as the main branches, and the angle of branching of the two orders is approximately the same. Lateral branches bear laterals of higher order, which are often almost colourless, and the mycelium forms an anastomosing network.

Smaller lateral branches may have short dark cells scattered along the hyphae, joined by a number of short or long colourless cells (fig.63). This is similar to the structure described above in Vizella discontinua, but there is no regularity in the arrangement of the cells, and the feature is not constant. The lateral branches are the only ones which have these short cells darker in colour than the cells joining them.

The cuticular covering of the hyphae is extremely thin (fig.67), and in some parts the upper wall of the hyphae is on a level with the surface of the cuticle, or even slightly raised above it.

The fructifications are dark, and the wall is strongly arched away from the surface of the leaf. The outer wall is pseudoparenchymatous, composed of cuboidal cells (fig.66). There appears to be only one layer of cells in the wall, but sections of the fructification have not been cut to verify this. In the centre of many fructifications there is a distinct ostiole, apparently formed by breakdown of a number of central cells. There are no modified cells surrounding the ostiole. The ostiole is up to 6μ diameter in the specimens examined, and its presence has been accepted as indicating maturity of the fructification, although no spores have been seen to verify this. Mature fructifications are up to 65μ diameter, but the small number present makes it inadvisable to include fructification diameter in the diagnosis.

In the centre of many colonies there appear to be remnants of spores which gave rise to them (figs.64,65). The small cell extending laterally from the hyphae may represent the small basal cell of a two-celled ascospore as in Shortensis memorabilis and Vizella discontinua. The hyphal cell beneath this small cell would then represent the large cell of the ascospore which has given rise to hyphae in two-directions. No spores have been seen in, or in association with the fructifications, and the exact nature of the spore-like structures is questionable.

Further specimens may show them to be two-celled ascospores.

Entopeltacites irregulare sp. nov.

Syntypes: Herb. DAR 17313, Figs. 68-74.

Diagnosis: Colonies intracuticular. Hyphae irregularly branched, forming close anastoming network, very pale brown to hyaline, cross-septa distinct; cells 2-(6.6;3.4;110)-14μ long X 1.5-(2.4;0.5;70)-3.5μ wide. Fructification pseudoparenchymatous; only immature specimens seen. Spore characters unknown.

Occurrence: upper surface, leaves of Lauraceae, Kiandra, N.S.W. Eocene-Oligocene.

Description.

The mycelium of this species is very indistinct, in general the most prominent part of the hyphae being the cross-septa (figs.70,71,72). In some places the hyphae are pale brown, but most of the mycelium is colourless. Alternating long and short cells occur in some parts of all colonies, but this character is not constant, and in most hyphae the cells are of variable length (figs.70,72).

Hyphal branching is irregular (figs.68,69). Dichotomies occur rarely, the hyphae usually branching at right angles, forming a close anastomosing network. Fructifications are covered by a very thin layer of cuticle, as are most of the hyphae, but in some places hyphae appear to be on the surface of the cuticle (figs.73,74).

No mature fructifications have been seen. Numbers of small (14-40μ diameter) fruiting bodies, which have an obvious pseudoparenchymatous structure, are present (figs.70,71). The fructifications appear to have developed in the same way as in Vizella discontinua (see above), the earliest recognisable stages consisting of an irregular grouping of thickened walls which closely resemble the cross-septa of the mycelium. As the fructification becomes larger the tissue becomes darker. No spores have been seen associated with fruiting bodies or hyphae.

ERRATUM. page 32
line 18 should read:
periphery, and are brown (fig. 77). In lateral branches, and away from the centre of the colony, the hyphae have an irregular arrangement of brown and hyaline cells (figs. 77, 79). Approximately 33% of the cells are brown. Lateral walls of the hyaline cells are thin, often

Entopeltacites cooksoni sp. nov.

Syntypes: Herb. DAR 17258 Figs.75-81.

Diagnosis: Colonies up to 1.5mm across, intracuticular. Hyphae forming anastomosing network, main branches dichotomously branched, bearing lateral branches which may themselves be dichotomously branched. Hyphae brown in the centre of the colony, becoming irregularly brown or hyaline in lateral branches and towards the periphery. Hyphal cells 3-(6.7;2.1;207)-15µ long X 4-(5.6;1.0;192)-8µ wide, square, rectangular or cuneate; cross-septa markedly thicker than the lateral walls, septal pore present. Lateral "stigmopodia" - like structures present, mainly confined to the centre of colonies. Fructifications pseudoparenchymatous; outer wall dark, presence of ostiole uncertain; lower layer hyaline, of irregularly septate hyphae. Spore characters unknown.

Occurence: upper surface, unidentified leaf, Kiandra, N.S.W. Eocene-Oligocene.

Description.

The mycelium of this species is very distinctive. Colonies have an initial dichotomous system bearing frequent lateral branches (figs. 75,76). Hyphae in the centre of most colonies are thinner than those towards the periphery, and are brown. Lateral walls of the hyaline cells are thin, often apparently lacking altogether. Lateral walls of the brown cells are distinct, but markedly thinner than the cross-septa. At the ends of branches the hyphae are usually hyaline, and the cross-septa are the only parts visible (fig.77). Hyphal cell shape is variable. Most are rectangular, but a number of cuneate cells are present (fig.79). In some cases the cells are divided by a longitudinal septum.

Irregular brown outgrowths of the hyphal cells up to 10µ long X 5µ wide, strongly resembling the stigmopodia in Shortensis memorabilis (Dilcher, 1965) are common in the centre of colonies (fig.77). They are irregular in shape, brown or hyaline. The walls are often indistinct, apparently lacking altogether at the apex of many specimens. In some cases the outgrowths appear to be simple evaginations of the parent cell wall, lacking any form of division from the cell (fig.78). In others there is a distinct wall between the parent cell and the outgrowth. In one specimen outgrowths from two hyphal cells form a continuous

ERRATUM. page 33
the citation Batista et al, 1963 in the last line should read:
Batista, Peres and Maia, 1963.

loop over an intervening hyphal cell. Outgrowths in the centre of the colony are directed downwards from the cells bearing them, apparently penetrating deep into the cuticle. Those towards the margins of the colony do not show such strong downward bending.

Small 2-or 3-celled lateral branches are common. The basal cells of these branches often resemble the outgrowths described above, which possibly represent either modified or abortive lateral branches. There is no evidence of pores in the lower face of the "stigmopodia" - like structures and they appear to have no role in penetration of the cuticle by haustoria.

The cuticular layer covering the hyphae is 2.5μ thick. All fructifications are seen in surface view, and no indication is given of the thickness of the cuticle covering them, if they are indeed subcuticular.

Only a few relatively intact fructifications are present. Most lack almost all the upper wall, which has broken away leaving only the margins. The upper wall is dark, composed of irregular cells (fig.79). The apical portion of all fructifications is damaged, and I have been unable to decide whether an ostiole is present or not. The fructifications are 100-110μ in diameter. A number of young stages are recognisable (fig.80) showing the typical irregular arrangement of cross-septa in hyaline hyphae as described above for Vizella discontinua. One fructification in which the outer wall is mostly lacking has faint indications of a basal layer with irregular cross-septa (fig.81). No spores have been found associated with the fructifications or hyphae.

Discussion.

Dilcher (1965) established the genus Shortensis for "species of the genus Manginula for which perfect stages are known." He discussed the similarity between Shortensis memorabilis and Manginula perseae Arn. and pointed out that Shortensis memorabilis differs from that species in details of hyphal structure and in the epicuticular nature of the colonies. Both Manginula perseae and Manginula leucospermi Batista and Maia are entirely subcuticular (Arnaud, 1918; Batista et al, 1963).

Dr. D.L. Dilcher has kindly sent me some leaflets of Sapindus bearing colonies of Shortensis memorabilis. These show the hyphae covered by a thin layer of cuticle, the mycelium being intracuticular or subcuticular rather than epicuticular as described. The thin layer of cuticle covering the hyphae is visible in both sectional and surface view, and consists almost entirely of cuticular striations (figs.82,83). Some parts of the hyphae appear to be on a level with the surface of the cuticle, and are not crossed by the striae (fig.83). A pycnidium in the same specimen has a layer of cuticle covering those sections of the wall which remain (fig.84). No perithecia are present. However, the perithecia and pycnidia are very similar in structure (Dilcher, 1965) and I have little doubt that the perithecia will also prove to be subcuticular. Because of the subcuticular colonies S. memorabilis even more closely resembles Manginula perseae.

Dilcher (1965)regarded Shortensis as a new genus within the Micropeltaceae (order Microthyriales). Hansford (1946)placed all members of the Microthyriales in which the perithecium is subcuticular in the family Stigmateaceae, a classification previously adopted by Tehon and Stout (1929)and followed by Batista (1959)and Batista et al (1960). Within this family Hansford included Vizella Sacc. Hughes (1953)included in Vizella the genus Entopeltis v. Höhnel, and pointed out the similarity of the mycelium of Entopeltis hendrickxii Hansf. (Hansford, 1947) to that of Manginula perseae. Hughes also stated that "the pycnidia of V. hendrickxii very probably may be referred to as the Manginula state." He thus regarded Vizella as containing perfect stages of at least some forms of Manginula.

On the basis of mycelium, fructification and spore structure Shortensis is here regarded as a synonym of Vizella Sacc. sensu Hughes, 1953.

Vizella Sacc. as defined has unicellular ascospores (Saccardo, 1883; Petrak and Sydow, 1929; Petrak, 1954). This conflicts with the identification of the fossil specimens to that genus. However, the modern species described by a number of authors extend the limits of the genus. Species with

truly unicellular ascospores are Vizella psychotriae, V. crescentiae, V. splendida (Batista et al, 1960) and V. interrupta (von Arx and Müller, 1954). Vizella gustaviae, the only species described as having two-celled ascospores, has spores with a large upper cell and a small basal cell, the spore constricted or not at the junction of the two cells. The ascospores figured for V. gustaviae are similar to those of V. bingervilliana (Moreau and Moreau, 1951) which are described as "unicellulaires, munies à la base d'un très court appendice hyaline." Similar ascospores occur in V. royenae (Von Arx and Müller, 1954). Hughes (1953) regarded V. bingervilliana as probably synonymous with Vizella gomphispora (Berk. et Br.) Hughes, which he described as having ascospores "composed of a large upper cell usually with a basal appendage.", a situation which also occurs in V. hendrickxii (Hansf.) Hughes. Hughes does not discuss the precise nature of this appendage.

Ascospores of the type specimen of Vizella hendrickxii (Hansf.) Hughes (Herb.IMI 47458) have a large dark cell girdled by a hyaline band (a common feature of the genus), with a small cell-like hyaline appendage at one end (fig.85). Specimens of a form apparently belonging to Vizella on leaves of Acmena smithii (Myrtaceae) from Somersby Falls near Gosford, N.S.W. have spores of the same type, but with a darker appendage on the large cell (figs.87,88). Sections through the ascus show the small appendage as basal, and containing definite cytoplasm (fig.89). The basal appendage described in many Vizella spp. is in fact a small basal cell, and reports of species with appendages are here taken as referring to forms with two-celled ascospores as in Vizella gustaviae. Hughes (1953) concluded that "the presence or absence of a basal appendage is not considered to be a good generic character." Ascospores in the type collection of Vizella conferta (the type species of the genus) may either have or lack appendages (Hughes, 1953). Hansford (1946) lists Vizella as "phaeodidymae" in his key to the genera of the Stigmateaceae. Clements and Shear (1931) describe Vizella as having hyaline muriform spores which adds further to the confusion.

Similarities between spores of Vizella memorabilis, Vizella discontinua and Vizella hendrickxii and Vizella sp. from Somersby Falls show that the fossil forms can be included in the modern genus as understood by

Hughes (1953).

The hyphae of Vizella are fairly characteristic. Most species have pale to hyaline hyphae, with cross-septa very much thicker and darker than the lateral walls. In species with hyaline hyphae these thickened septa are the only part of the hyphae visible (fig.90). In other species the cross-septa may be more difficult to distinguish, but are thicker than the lateral walls. This general type of hyphal construction is seen in all the fossil specimens here assigned to the family Entopeltaceae. Dilcher's figures of Shortensis memorabilis show very distinct cross-septa in most parts of the colonies, although they are somewhat obscured in more deeply coloured parts of the hyphae. In Entopeltacites irregulare, and in ultimate lateral branches of Vizella discontinua, cross-septa are often the only parts of the hyphae visible (figs.70,54), and the same applies in some parts of the mycelium of Entopeltacites cooksoni (fig.77). Vizella interrupta has hyphae similar to those in ultimate lateral branches of Vizella discontinua (compare figs.90,54).

The hyphae of Vizella discontinua closely resemble those of V. hendrickxii (fig.86) and Manginula perseae. In all cases the hyphae have alternating long and short cells, the short cells darker than the long cells in both Manginula perseae and Vizella discontinua.

Lateral "stigmopodia" (Arnaud,1918) occur in Shortensis memorabilis, Manginula and Entopeltacites cooksoni. In most modern species of Vizella the hyphae are branched irregularly, but a dichotomous hyphal system occurs in V. hendrickxii, Vizella sp. from Somersby Falls and possibly also in Vizella splendida which is described as having hyphae branched at 45° (Batista et al, 1960). Dichotomous branching of the hyphae is a regular feature of all the fossil forms described above, except Entopeltacites irregulare where such branches occur only rarely.

Only one modern species of Vizella has a superficial mycelium. This is V. bingervilliana in which the perithecia, however, are subcuticular (Moreau and Moreau,1951). Most forms have a thin layer of cuticle covering the hyphae, often so thin that it is difficult to see unless stained.

The cuticle covering the fossil forms is thin in Shortensis memorabilis and two species of Entopeltacites. In Vizella discontinua and Entopeltacites cooksoni the cuticle is thick, as in the unidentified form on leaves of Acmena from Somersby Falls.

Thus, although there is considerable variation in the appearance of hyphae, the modern Vizella spp. and the fossil species described above form a coherent group.

Comparison of the fructifications of the fossil forms with those of modern Vizella spp. shows that all forms appear to have very similar fruiting bodies. Although Hughes (1953) had regarded Entopeltis v. Höhnel as a synonym of Vizella, the two genera were regarded as separate by von Arx and Müller (1954) who removed both genera from the Microthyriales on the basis of the bitunicate nature of the ascus. These authors regarded the genera as separable on the structure of the outer wall of the perithecium. Vizella has a multi-layered wall; Entopeltis a single layered wall. The two genera are similar in hyphal characters, and both are described as having single-celled ascospores.

If this division of the genera is accepted, all the fossil species are closer to Entopeltis than Vizella. A transverse section of the wall of the perithecium of Vizella discontinua shows a single layer of cells with no indication that any deeper layers have broken away (fig.56). Careful focussing does not reveal any deeper layers in the wall when the intact perithecium is examined in surface view. Insufficient material of the three forms of Entopeltacites was available to allow sectioning, but no deeper layers are detectable in the wall of these. Thus the fossil forms appear to belong to Entopeltis, where they can easily be accomodated. Vizella discontinua can also be assigned to that genus because of the similarity of its hyphae and spores to those of Entopeltis hendrickxii. The problem is really one of the taxonomy of the modern forms, and a complete revision of the morphology of the modern species and genera would be necessary before a final decision could be made. A number of apparently undescribed forms which belong to the group have been found on leaves collected from a

number of localities in N.S.W., and these would need to be included. I have accepted the limits of the genus Vizella as interpreted by Hughes (1953) as the basis for the description of the fossil forms, and regard one of the fossils as a new species in that genus, Vizella discontinua. All the other forms, lacking spores, are referred to the family containing Vizella (Entopeltaceae, von Arx and Müller, 1954) and placed in a new form-genus.

The apparent immaturity of the fructifications in Entopeltacites irregulare, and the poor preservation of these structures in E. cooksoni makes the fructification of little value in the separation of the three species assigned to Entopeltacites. The species are best distinguished on the structure of the mycelium.

Differences in branching pattern occur and such structures as "stigmopodia" are also of importance. The length of hyphal cells in E. irregulare and E. cooksoni is identical, but the species differ in the width of the hyphae. The most obvious differences are, however, those of colour of the hyphal cells, and the possibility that the differences between the cells in E. cooksoni is an artefact needs to be considered. Colour in some of the cells could be due to retention of oxidised material in the thicker-walled cells after maceration. In some modern Vizella spp. dark cells may occur in otherwise colourless hyphae, and the feature is very pronounced in Manginula perseae, which has alternating coloured and colourless cells. Since colour differences between hyphal cells occur in modern species of the group to which the fossil forms are believed to belong, this character in fossils can probably be fairly safely regarded as reflecting the state in the fossil as a living organism.

The species of Entopeltacites may be keyed as follows:-

1. Hyphal branching irregular; hyphae pale, only the cross-septa distinct .... E. irregulare.

1+ Hyphal branching dichotomous; hyphae dark, or composed of mixed light and dark cells.

2. Hyphal cells dark in centre of colony, mixed light and dark in lateral branches and towards the periphery of main branches. Lateral "stigmopodia" present ..... E. cooksoni.

2+ Hyphal cells dark, slightly paler towards the periphery of the colony. Lateral "stigmopodia" absent.....E. attenuatus.

Order "MICROTHYRIALES"

family Microthyriaceae (sensu Stevens and Ryan, 1939)

A number of form-genera belonging to this family have been described (see Table 6), the basis for their classification being Stevens and Ryan's (1939) monograph of the family.

TABLE 6.

FORM-GENERA IN THE Microthyriaceae (sensu STEVENS and RYAN, 1939).

Microthyriaceae

Phragmothyrites Edwards, 1922

Microthyriacites Cookson, 1947

subfamily Microthyrieae	subfamily Asterineae
(free hyphae evanescent)	(free hyphae persistent)
Notothyrites Cookson, 1947	Asterothyrites Cookson, 1947
Microthallites Dilcher, 1965	Euthythyrites Cookson, 1947
Callimothallus Dilcher, 1965	

Stevens and Ryan (1939) separated the genera into two subfamilies on mycelial characters. Genera in which free hyphae are evanescent (lacking at maturity) were placed in the Microthyrieae, genera with a persistent

superficial mycelium in the Asterineae. Previous authors have assumed that absence of free hyphae in fossil specimens is equated with evanescent hyphae in the fossils as living organisms, and have included all ascomata without free hyphae in the Microthyrieae. This assumption appears to be doubtful.

Absence of hyphae in such fossil specimens may have three causes:-

1) preservation of mature ascomata in which the free hyphae have degenerated (i.e. evanescent hyphae)
2) non-preservation of free hyphae originally present in the living organism
3) absence of free hyphae at any stage in the living organism.

It seems difficult to determine which of these factors is responsible for the state of the fossils, particularly when material is sparse and fragmentary.

Maturity of fossil fructifications can only be determined with "certainty" if apparently mature spores are seen within the fruiting body. Indirect evidence may be gained if an ostiole is present, but this character is best used with caution. In modern Microthyrium spp. the centre of the ascoma is often occupied by delicate cells which break down to form the ostiole opening at maturity. In fossil forms where the ostiole is open this may be due to faulty preservation of such delicate cells, and may not be evidence that the ascoma was mature and dehisced. An ostiole in which the central area is delicate occurs in Plochmopeltinites masoni (p.66), and though the central cells are missing in many of the fructifications the maturity of these is not certain because spores are absent. In some fossil forms (e.g. Asterothyrites sinuatus, Cookson, 1947; Asterina eocaenica, Dilcher, 1965) it has been assumed that splitting of the fructification wall is due to dehiscence at maturity. In the absence of a definite organised ostiole it appears preferable to regard splitting of the wall as possibly due to mechanical damage alone, and to accept it as evidence of maturity with caution. Determination of evanescence of hyphae by direct means is impossible, since the same specimens cannot be studied at different developmental stages.

In at least some fossil forms absence of hyphae may be due to faulty preservation. Many specimens of Plochmopeltinites masoni show a complete

absence of free hyphae, while others have well-developed free hyphae (p.65). If insufficient material of this form had been available it would have been possible to have studied a series of fructifications which entirely lacked free hyphae, as in the original description of the species (Cookson, 1947). In this species, absence of free hyphae in a particular series of specimens is insufficient basis for a statement that they do not occur at all, and it is suggested that the same argument probably holds for the form-genera listed under Microthyrieae above.

Von Arx and Müller's (1954) and Müller and von Arx's (1962) recent taxonomic treatments of members of the Microthyriales have led to considerable changes in understanding of the group. The concept of the order Microthyriales has been abandoned, and members of the group are scattered in different orders. In particular the limits of the family Microthyriaceae sensu Stevens and Ryan have undergone major revision, and Müller and von Arx's classification in many instances cuts across the separation of the genera into subfamilies used by Stevens and Ryan (see Appendix 1.). Within the subfamilies Stevens and Ryan separated some genera on presence/absence of paraphyses, a character regarded by later authors (Hansford, 1946) as of no significance(1).

As a result of difficulties in determining with any degree of certainty whether free hyphae are lacking, evanescent, or not preserved in fossil material, and the doubtful nature of the separation of the modern genera into subfamilies, all the form-genera listed above in the Microthyrieae are here regarded as belonging to the Microthyriaceae as a whole, rather than to either subfamily. The genus Asterothyrites may be treated similarly, although the basis for its assignation to the Asterineae is more certain.

Microthallites Dilcher and Microthyriacites Cookson differ

(1) In identifying fossil material the keys presented by Stevens and Ryan (1939) form a useful basis for initial identification of generic groups to which the fossil may belong. The synonymy of these forms can then be traced and final identification made using the keys presented in Müller and von Arx (1962). In this study, where assignation of a fossil form to a modern genus has been possible the classification adopted in the latter paper has been followed. Where form-genera only are recognised the concepts of the order Microthyriales and Microthyriaceae sensu Stevens and Ryan have been retained.

solely on the degree of certainty as to the absence or otherwise of free hyphae. In Microthyriacites "information regarding the presence of free mycelium" is "either uncertain or wanting" (Cookson, 1947). In Microthallites free hyphae are absent (Dilcher, 1965). I suggest that absence of free hyphae in Microthallites is equivalent to insufficient information regarding the presence of free hyphae, and regard Microthallites as a synonym of Microthyriacites.

This classification avoids the problem of scattering closely related and perhaps identical forms in a number of artificial genera. If the separation of the two genera is retained it would be possible for specimens of the same form to be placed in different genera depending on whether found in palynological residues (where presence/absence of free hyphae is not known) or on the surface of cuticle (where absence of hyphae may be due to preservation).

Cookson (1947) in discussing the form-genera created for fossil forms, stated: "In order to minimize their number, generic descriptions are made as broad as possible; distinctions, which amongst living species would be certainly considered of generic rank, being regarded as only of specific value." In view of the difficulties in using presence/absence of hyphae as a generic character in some modern species, hyphal characters are here regarded as of specific rank only, and the form-genera are defined primarily on the structure of the fructification.

All Microthyriacites spp. described by previous authors have ascomata in which the component hyphae are straight and laterally attached throughout their entire length. No component hyphae grow out at the margin as free hyphae. Similar ascomata occur in Asterothyrites sinuatus and A.delicatissimus (Cookson, 1947). Ascomata of these forms found without attached free hyphae would certainly be included in Microthyriacites Cookson. These species are here regarded as belonging to Microthyriacites (Cookson) emend.

A second type of fructification is seen in Asterothyrites kiandrensis and A. hyphopodiatus described below. In these forms some of the component hyphae of the upper wall of the ascoma grow out at the margin as free hyphae, and there is no sharp border to the fruiting body. Similar construction is

seen in Asterina kiandrensis (p.17). This type of structure is here regarded as characteristic of Asterothyrites (Cookson) emend.

The form-genera assigned to the Microthyriaceae can then be distinguished as follows:-

1. ascomata linear, X-, or Y-shaped, dehiscing by a longitudinal slit ....Euthyrites Cookson
1+ ascomata rounded, ostiolate or not, not dehiscing by a longitudinal fissure.
2. hyphae of ascoma wall attached along entire length, or free for a very short distance at the margin, never growing out as free hyphae. Margin of the ascoma definite.
3. cells of the ascomal wall with pores .....Callimothallus Dilcher
3+ cells without pores
4. ostiole present, surrounded by 3-5 rows of thickened cells .... Notothyrites Cookson
4+ ostiole present or absent, if present, not surrounded by zone of thickened cells .....Microthyriacites (Cookson) emend.
2+ individual hyphae of the ascomal wall growing out as free hyphae. Margin of the ascoma not definite .....Asterothyrites (Cookson) emend.

Phragmothyrites Edwards has been excluded from consideration here. The exact status of the single species, P. eocaenica is uncertain. Edwards (1922) described ascomata, phragmospores and stigmocysts in association, and regarded them all as belonging to the same organism, although organic connection was not demonstrable. The ascoma could be included in Microthyriacites.

form-genus Notothyrites Cookson

Notothyrites kiandrensis sp. nov.

Syntypes:- Herb. DAR 17222, 17266. Figs. 91-100

Diagnosis: Fossil fungal ascomata, rounded, margin entire to crenate, irregularly lobed. Central ostiole up to 17μ diameter, cells pale, thin-walled isodiametric, surrounded by prominent raised border of dark thick-walled (ca.1μ) square to

rectangular cells, 1.5-(3.5;0.8;31)-5μ long X 1.5-(2.8;0.5;31)-3.5μ wide, border up to 6 cells wide. Walls of ascoma of radiating dichotomously branched hyphae, cells 2-(6.9;1.5;175)-11μ long X 1-(3.2;0.9;175)-7μ wide.

Occurrence: lower surface leaves of Lauraceae, Kiandra, N.S.W. Eocene-Oligocene.

Description.

Ascomata of this species occur in close association with stromata of Callimothallus pertusus (figs.92,95). The ascomata fall away from the cuticle very readily, and a number of isolated specimens have been found (figs.93, 94).

The wall of the ascoma is composed of radiating dichotomously branched hyphae, but the hyphae are often contorted towards the margin (fig. 96). Many hyphal branches end blindly against adjacent hyphae. In young specimens the wall is fairly pale, with thin-walled hyphae (fig.91), but in older, larger specimens the hyphal walls are very much thickened, except at the margin (figs.94). Ascomata seen are 140-330μ diameter.

The hyphae are attached along their complete length, but groups of adjacent hyphae may extend slightly beyond the others to form a crenate margin, and in most specimens the margin is irregularly lobed (figs.92,96).

The raised border surrounding the ostiole is much darker than the rest of the ascomal wall in younger specimens (figs.93,97). In older specimens the border is difficult to discern against the dark thickened wall (fig. 94). The cells within the border break down to form the ostiole opening, and fragments of the cells can be seen within the opening in some specimens (figs.98).

Notothyrites setiferus is also recorded in palynological residues from Kiandra (Cookson, 1947). This form is much smaller than N. kiandrensis, with up to eight setae produced from cells of the raised border of the ostiole. No specimens of N. setiferus have been seen during the present study.

form-genus Microthyriacites (Cookson) emend.

Generitype: Microthyriacites fimbriatus Cookson, Proc. Linn. Soc. N.S.W., 72, 1947, p.211, Pl.13, fig.17

1965. Microthallites Dilcher, Palaeontographica, 116B, p. 16.

Radiate, dimidiate fossil fungal ascomata. Individual hyphae of the upper wall attached along entire length, or free for a very short distance at the margin. Margin distinct. Ostiole present or absent, if present, not surrounded by a zone of thickened cells. Free hyphae, if present, not formed by outgrowth of hyphae of the upper wall of the ascoma. Ascospore characters unknown or uncertain.

Microthyriacites kiandrensis sp. nov.

Syntypes: Herb. DAR 17207, 17214, 17220, 17225, 17227, 17228, 17239(a), 17243, 17252. Figs.101-113

Diagnosis: Ascomata dimidiate, rounded, flattened-hemispherical, the central area often slightly depressed, astomate. Upper wall of radiate dichotomously branched hyphae, dark to light brown. Cross-septa often indistinct, more or less at the same level, but not forming concentric rings, markedly thinner than the lateral walls; cells proximal to dichotomous branching 5-(7.1;1.1;78)-10μ long X 5-(6.9;1.0;78)-9μ wide; cells between dichotomies and at the periphery of the ascoma 2-(6.3;1.3;207)-10μ long X 3-(4.6;0.9;207)-7μ wide. Margin entire, thick. Central cells often darker than rest of the upper wall, rectangular to polygonal, often arranged irregularly, same size as the peripheral cells. Basal layer of the ascoma hyaline, of radiate dichotomously branched hyphae which may show indistinct cross-septa. Free hyphae uncertain.

Occurrence: upper and lower surface, leaves of Myrtaceae and leaves of Lauraceae, Kiandra, N.S.W. Eocene-Oligocene.

Description.

Ascomata are scattered over the surface of the cuticle occasionally close together, but usually well-separated. No confluent ascomata have been observed. Complete ascomata seen are 25-(70.8;18.8;39)-116μ diameter. A fragmentary ascoma which was probably ca.130μ diameter is also present. There is no evidence of an ostiole, nor are there any spores as evidence of maturity, and ascomal diameter has not been included in the diagnosis. Most ascomata are

flattened-hemispherical, often with a slight circular depression in the upper wall surrounding the dark central cells, which are ca.2μ above the floor of the depression.

The central cell, or small group of central cells is usually darker than cells towards the periphery of the ascoma, with walls ca.1μ thick (figs.103,109,110). The central cell is often surrounded by a narrow zone or irregularly arranged cells which separate it from the radial portions of the wall (fig.109). In some specimens the zone of irregular cells is not present.

Individual hyphae of the wall have walls 0.5-1μ thick. Cells proximal to branching are polygonal with an apex in the direction of growth of the hypha (figs.104,109). Cells between the dichotomies are square to rectangular. Cross-septa are often rather indistinct, sometimes apparently absent in young specimens (fig.101,102). and more or less at the same level (fig.113). The extremities of the hyphae are often very slightly inflated (fig.107).

Small pores ca.0.5μ diameter are scattered over the surface of some ascomata, occasionally surrounded by a thickened rim which may be very dark brown (fig.108). The pores have no definite arrangement, and may be due to hyperparasitic attack as in the thallus cells of Trichopeltinites (p.62).

The lower layer of the ascoma is hyaline or very pale brown, composed of radiating hyphae the same width as those in the upper wall. The hyphae are dichotomously branched, and may show very indistinct cross-septa (figs. 105,106).

Some specimens are in very close contact with hyaline to pale brown hyphae (figs.111,112). In some cases the hyphae encircle the ascoma in very close contact with the margin, and occasionally give the appearance of radiating from beneath the ascoma. However, the relation of the hyphae to the ascoma is problematical, as no actual organic connection has been demonstrated.

Ascomata of M. kiandrensis closely resemble those described by Cookson (1947) as Microthyriacites sp. on leaves of Oleinites willisii (Oleaceae) from Yallourn, Vic., for which the measurements, in so far as they are comparable, agree with the above. Both are flattened-hemispherical, with the walls

of some of the cells pale (e.g. Cookson, 1947 fig.18). Cell walls in Microthyriacites kiandrensis are pale when viewed slightly out of focus. In both, the centre of the ascoma is slightly depressed. Cross-septa, particularly towards the margin of the ascoma, are indistinct and markedly thinner than the lateral walls of the hyphae.

Microthyriacites obscurus sp. nov.

Syntypes: Herb. DAR 17212, 17235, 17250, 17255. Figs. 114-120

Diagnosis: Stroma round, radiate, flat to flattened hemispherical, composed of radiating hyphae which branch dichotomously; astomate. Central area of stroma often darker than peripheral area. Hyphal walls and cross-septa thin, dark or hyaline. Central cells rectangular to irregular, sometimes almost circular, up to 6μ across. Cells in radiate hyphae 3-(4.9;1.1;201)-9μ long X 2-(2.9;0.7;196) -5μ wide. Margin crenate or fimbriate.

Occurence: upper surface, leaves of Myrtaceae, Kiandra, N.S.W., Eocene-Oligocene.

Description.

The stromata examined are 25-(75.4;33.8;47)-145μ diameter. In many specimens the central area is darker than the rest of the stroma and strongly convex away from the surface of the leaf, surrounded by a flat paler rim (figs.115,116). Other specimens appear to lack this paler margin (fig. 114). In most specimens the hyphal walls are very indistinct, and the cross-septa even more so, appearing as fine white lines between the hyphae (figs. 117,118). In some specimens there is a central zone of irregular cells with thin dark walls (fig. 117). The dark walls and cross-septa of this area often appear hyaline when viewed slightly out of focus. In many specimens, however, the walls are hyaline and no dark cross-septa are visible.

Some stromata show concentric bands formed by local thickenings of the hyphae, possibly related to environmental conditions. The bands appear as small "steps" in the surface of the stroma. The hyphae appear to end in a thickened wall, and further growth continues from the lower face (fig. 120). The step-like structure of the hyphae is particularly noticeable in more convex stromata.

The margin of the stroma varies from crenate (fig. 120) to fimbriate (fig. 119), individual hyphae growing out for a short distance and ending in a tapered or lobed apex.

Microthyriacites delicatus sp. nov.

Syntypes: Herb. DAR 17224, 17234. Figs.121-132

Diagnosis: Colonies amphigenous. Ascomata scattered, circular, composed of radiate dichotomously branched hyphae, margin entire, astomate. Central cells polygonal, mostly thick-walled; peripheral cells square to rectangular, 1-(3.2;0.7;67)-5μ long X 1-(2.2;0.6;67)-4μ wide, cross-septa and hyphal walls thin. Free hyphae straight to sinuous, 2-3μ wide, widely spreading, very pale brown, exhyphopodiate, indistinctly septate, pores present in hyphae. Branching opposite at a wide angle. Free hyphae attached either centrally or peripherally. Ascomata develop beneath the hyphae.

Occurrence: upper and lower surfaces, leaves of Myrtaceae, Kiandra, N.S.W., Eocene-Oligocene.

Description.

Ascomata seen are up to 91μ diameter. The wall is distinctly radiate, the individual hyphae having thin walls and indistinct cross-septa (figs. 122-125, 127). In most specimens the central cells of the ascoma have thick-walls (fig.122), but a few specimens have been seen in which the central cells are very indistinct, and cross-septa towards the periphery appear to be absent. The individual hyphae are dichotomously branched, and there is a progressive increase in width of the hypha between two branchings. The cell proximal to branching is polygonal with an apex in the direction of growth of the hypha. The margin of the ascoma is entire to very slightly fimbriate. The ends of the individual hyphae are thin, and all at the same level, although they are occasionally slightly invaginated (figs. 126,127). Several fructifications have irregular fissures in the wall (figs. 124,126) but these may be due to mechanical damage only, and not evidence of dehiscence.

The free hyphae are very pale brown in colour, often almost hyaline, and are widely spreading (figs. 121,125). On the upper cuticle

the hyphae are straight, and show distinct opposite branches at ca. 90° (fig.122). On the lower cuticle the hyphae appear to be more extensively developed, and are sinuous (probably as a result of the sculpture of the cuticle) (fig. 121). The hyphae have indistinct cross-septa at irregular intervals, but distinct hyphal "cells" are occasionally recognisable (fig. 131). Numerous small pores occur in the lower face of the hyphae, sometimes with a slightly thickened rim, and probably represent the position of penetration of the host leaf by haustoria (figs. 128,131,132).

Several young stages of the ascomata occur on Herb. DAR. 17234. The fructification arises as an outgrowth from the lower face of the hypha, and shows the radiate structure of the ascoma at a very early stage (figs.129, 130). One of the larger ascomata seen shows free hyphae attached centrally. In other specimens the free hyphae are attached at the margin of the ascoma. (figs. 126,127).

Discussion.

Microthyriacites delicatus closely resembles Asterothyrites sinuatus Cookson (Microthyriacites sinuatus comb. nov. in the definition of genera adopted here) in the structure of the fructification. The stellate fissures in Asterothyrites sinuatus, which Cookson regarded as evidence of dehiscence, may be due to mechanical damage as also those in Microthyriacites delicatus. Asterothyrites sinuatus (holotype, P26028, National Museum, Melbourne, Victoria) lacks the hyphal pores seen in Microthyriacites delicatus, nor are there any young ascomal stages present.

Microthyriacites cf. fimbriatus Cookson

Herb. DAR 17240, upper cuticle, leaves of Lauraceae, Kiandra, N.S.W. Eocene-Oligocene.

Only two poorly preserved ascomata have been seen. They are confluent (fig . 187) with large polygonal central cells ca.8μ diameter. The radial structure extends right to the central cell which is surrounded by a number of polygonal cells 5-8μ long X 5-8μ wide. Towards the periphery of the ascoma the

cross-septa are indistinct. Most of the margin of the ascomata is missing, but in one of the pair the margin varies from thick, smooth, entire with very slightly inflated hyphal extremities to slightly crenate and thin. No definite fimbriate section of the margin has been seen. These specimens appear to be close to Microthyriacites fimbriatus, but are only doubtfully referred to that species due to lack of material and poor preservation.

Cookson (1947) records this species from ligneous clay at 500', Traralgon Bore, east of Yallourn, Oligocene-Miocene.

Microthyriacites sp.1

Herb. DAR 17240, 17247(a), upper surface, leaves of Myrtaceae and Lauraceae, Kiandra, N.S.W. Eocene-Oligocene. Figs. 133-141.

Only 15 specimens of this form have been seen. The ascomata are 28-(34.9;5.5;15)-48μ diameter, rounded and flattened-hemispherical. The upper wall is dark reddish-brown in colour, and in many specimens has flaked away, revealing a pale or hyaline lower layer on the surface of the cuticle (figs. 133-139).

The outer wall has a group of central cells 3-(4.7;1.1;37)-8μ long X 3-(4.0;0.7;37)-5μ wide, rectangular, square or polygonal with walls ca. 0.5μ thick. One specimen has a distinct square central cell with a pore ca.1μ diameter in the outer face (figs. 133,134,137). Peripheral to the central zone of distinct cells the radiate structure of the wall is obvious. The hyphae have very indistinct cross-walls, apparently completely absent in most specimens. The hyphae are 3-6μ wide proximal to branching and 2-3.5μ wide at the base of a newly formed branch.

The lower layer is composed of hyaline radiate hyphae which may have indistinct cross-septa (figs. 139,141). The margin of this species is very characteristic. The extremities of the hyphae are often slightly invaginated and are capped by a distinctly fimbriate or crenulate zone, up to 3μ wide, of amorphous brown material. The individual lobes of this material may be entire (fig.138) or very finely divided (fig. 140). Where the ascoma has flaked away from the surface of the cuticle this marginal brown material remains, forming

a ring marking the former position of the ascoma, and often surrounding the apparently structureless lower layer (fig. 139).

These specimens very probably represent young stages of microthyriaceous fructifications, and are consequently not described as a new species, pending the discovery of further material.

Microthyriacites sp.2

Herb. DAR 17259, 17260, 17261, upper surface, leaves of Lauraceae, Kiandra, N.S.W. Eocene-Oligocene. Figs.142-147

A few fragments of a very large form apparently belonging to this genus have been found. The stroma is circular, ca.1mm diameter in one specimen and ca.0.5mm diameter in another fragmentary specimen (figs.142,143).

The stroma is dark, composed of radiating hyphae which are occasionally branched. The hyphal walls are very dark, ca.1.5μ thick (fig. 144). The individual hyphal cells are 9-(14.0;2.7;26)-18μ long X 4-(5.9;0.9;26) -7μ wide. Cells towards the centre of the stroma are very dark, almost opaque, often with a colourless area at the proximal end (fig.147). Cells towards the margin are markedly lighter in colour.

The margin of the stroma varies from entire (fig. 145) to fimbriate (fig.144). The individual hyphae are often divided at the apex (fig.146) or the end may be slightly inflated. Some hyphae may project a short distance from the margin, or else the margin is distinctly fimbriate (figs. 144,146). Some areas of the margin have a structure resembling that of the margin in Microthyriacites sp.1 above. The hyphae are capped by a zone of amorphous dark material ca.3μ wide, sometimes divided into lobes (fig.146).

This form is very striking because of the large size of the stroma and the hyphal cells, but the poor preservation of the specimens makes it inadvisable to describe the specimens as a new species.

Twelve species of Microthyriacites Cookson (including Microthallites Dilcher), and a number of unnamed forms assigned to the genus have so far been described. Not all species have been shown to be dimidiate, and the structure of the basal layer of the ascoma is described only in the two species

discussed by Dilcher, 1965.

The quality of description of the species is variable, and some appear to have been founded on unsuitable material. Straus(1961) described three species; Microthyriacites quercus, M. schlangei and M. buxi. M. quercus is based on poorly preserved material which had previously been recorded (Straus, 1952) as "cf. Microthyrium". The only measurement given for the species is the ascomal diameter, and there are no details of the structure of the ascomal wall given. The description of the other two species likewise give ascomal diameter as the only measurement, but details of the ascomal wall are included. Re-examination of the type material of these species will be necessary before adequate descriptions are available. Golovin and Popov(1963) included ascomal diameter as the only measurement in their description of M. rotundus and M. angulatus, but the descriptions are adequate, and the species appear to be easily recognisable.

In view of the number of species now recognised in the genus, descriptions of new species should be as complete as possible, and based on as large a range of material as possible. General features such as shape, size and colour of the ascoma, ostiole characters, if present, detailed structure of the upper and lower layers (where possible) and the character of the margin should all be included in descriptions of forms belonging to the genus.

form-genus Callimothallus Dilcher emend.

Generitype: Callimothallus pertusus Dilcher, 1965, Palaeontographica, 116B, p.13, Pl.5, figs.37-42; Pl.6, figs.43-46; Pl.7, figs.47-55

Diagnosis: Fossil fungal ascomata, round, radiate, dimidiate, astomate. Cells of the upper wall with a pore at the proximal end. Free hyphae present or absent. Spore characters unknown.

Callimothallus pertusus (Dilcher) emend.

Diagnosis: Ascomata scattered or confluent, rounded, often slightly lobate, astomate, up to 250μ diameter. Upper wall of radiate dichotomously branched hyphae, cells 3-15μ long X 2-8μ wide. Small pore present at the proximal end of most cells, may be absent in some specimens. Central cells of the upper wall of

the ascoma often darker than the rest, irregularly shaped to isodiametric, 3-5μ diameter, may proliferate, forming a mound of cells above the general level of the wall. Basal layer paler than the upper wall, of radiate dichotomously branched hyphae. Margin of ascoma entire to crenate. Free hyphae superficial, straight to sinuous, irregularly branched forming an anastomosing network, sometimes absent. Hyphae pale to colourless, indistinctly septate, cells 5-(8.8;2.1;70)-15μ long X 2-(3.5;0.65;70)-6μ wide.

Specimens: Standard specimens showing hyphae: Herb. DAR 17229, 17233, 17222, 17223, lower surface, leaves of Lauraceae, Kiandra, N.S.W. Eocene-Oligocene.

Description.

This species is extremely common on the lower surface of leaves of Lauraceae, often associated with Plochmopeltinites masoni (fig.165). Specimens have also been seen on the upper surface of such leaves, as well as being found isolated.

There are no obvious differences between the ascomata of the Kiandra specimens and those described by Dilcher (1965) from the Eocene of Tennessee, and the two groups of specimens are regarded as conspecific on the basis of the structure of the ascoma. The ascomata are rounded, often slightly lobed, and composed of radiating dichotomously branched hyphae (figs.166-170). Individual cells are 3.5(11.0;1.6;100)-15μ long X 3-(5.1;1.0;100)-7.5μ wide, dimensions which agree well with those originally given for the species, although Dilcher (1965) gave only upper and lower limits for cell size, and no statistical comparison is possible. A pore 1-2μ diameter occurs at the proximal end of many cells. Pores in cells towards the centre of the ascoma are larger than those in cells towards the periphery, and form a distinct opening in the upper face of the cell. Pores towards the periphery are generally less well-defined, and are often covered by an extremely thin layer of wall material. Some specimens lack pores altogether (fig. 169). Ascomata are scattered over the surface of the cuticle, often grouped, and occasionally confluent in groups of varying size.

The structures described here as ascomata were called "stromata" by Dilcher (1965) who implied that they are fructifications by his use

of the term "astomate" and his discussion of the possible significance of the pores in cells. Many "stromata" in the Kiandra material have partially broken away from the surface of the cuticle showing what appear to be paler radiating hyphae of a lower layer (fig.171). The structure is similar to that of the complete stroma, and there is a possibility that they represent only the contact between the cuticle and the dark cells of the stroma. However, it is possible to focus through the upper layer of the intact stroma to a lower layer, the walls of which do not coincide with those of the upper layer and the paler cells on the cuticle are here interpreted as the basal layer of a dimidiate ascoma.

Callimothallus was defined (Dilcher, 1965) as lacking free hyphae. A small number of specimens from Kiandra have delicate, usually poorly preserved, superficial free hyphae. In some specimens the hyphae radiate from beneath the ascoma, and in some specimens where the upper layer has fragmented the free hyphae can be seen apparently attached to the paler basal layer (fig.172). The hyphae are very pale brown to colourless, and stain readily with methylene blue. The hyphae are indistinctly septate, and composed of rectangular thin-walled cells often with slightly bulging walls (figs.173,174). Most cells have a distinct pore 1-2μ diameter in the lower face, often surrounded by a darker rim in stained specimens (fig.174). The pores presumably represent the position of penetration of the cuticle by haustoria, and in a few specimens small processes appear to extend into the cuticle from the pores.

A number of ascomata of Callimothallus occur in close contact with large fructifications described above as Notothyrites kiandrensis (p.44). Ascomata of Callimothallus are often clustered around the margin of the larger fructifications, sometimes partly covered by the latter and occasionally borne on the surface. (fig.95). Some specimens of Callimothallus appear to be in organic continuity with the larger fructifications (fig.99), but in all cases there is a sharp margin to both types of fructification, and their association appears due to growth of two forms in close proximity rather than to different stages of the same species (figs.99,100).

Discussion.

The only difference between Callimothallus and Microthyriacites lies in the presence of small pores close to the proximal end of many cells in the former. Rao (1958) described the cells of Microthyriacites sahnii as having "one or more small aperture-like areas". Sen (1966) described a form belonging to Microthyriacites in which each cell has a pore-like structure towards the centre. Re-examination of these forms of Microthyriacites would be necessary to see whether they are comparable with Callimothallus. Small pores also occur in Microthyriacites kiandrensis (p.46) but are probably due to hyperparasitic attack, and have no taxonomic significance.

form-genus Asterothyrites (Cookson) emend.

Fossil fungi. Ascomata rounded, outer wall of radiating hyphae, which may grow out at the edge to form free hyphae. Margin of ascoma indistinct, fimbriate. Free hyphae hyphopodiate or exhyphopodiate. Ascospore characters unknown or uncertain.

Asterothyrites kiandrensis sp. nov.

Syntypes: Herb. DAR 17221, 17230. Figs.148-154.

Diagnosis: Fructifications scattered, occasionally confluent, rounded, often with wavy outline; margin irregularly lobed to fimbriate. Dehiscence mechanism uncertain. Wall of fructification one layer thick, of straight to slightly wavy hyphae, radiate, dichotomously branched; cells 12-(19.6;3.4;60)-26µ long X 2-(4.0;0.8;60)-5.5µ wide. Individual hyphae at margin and elsewhere in the wall may grow out as free hyphae. Free hyphae darker than the fructification wall, exhyphopodiate, straight or sinuous, branches opposite or unilateral; cells 17-(25.7;3.1;50)-34µ long X 4-(5.2;0.7;50)-7µ wide.

Occurrence: upper surface, leaves of Lauraceae, Kiandra, N.S.W. Eocene-Oligocene.

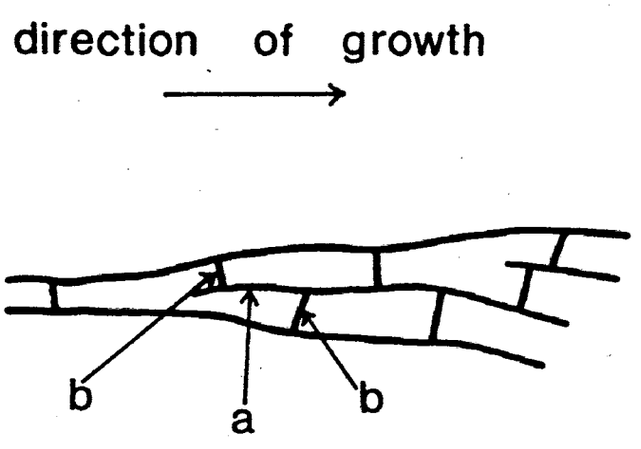
Description.

The fructifications are up to 460µ diameter, mostly scattered, but occasionally confluent (figs.148,149). The wall of the fructification is composed of straight radiating hyphae which branch dichotomously (fig.150). Towards the margin the hyphae may become wavy, forming a sinuous plectenchyma

(fig.151).

The branching pattern of the hyphae is very distinctive (text-figure 2).

Text-figure 2



The branching cell is divided for part of its length by a longitudinal wall (a). The first cross-septa of the daughter hyphae (b) are at different levels, so that the branching cell appears to have two arms, one of which may be much longer than the other. The difference in level of the cross-septa varies from 2-13μ in the cells examined. The cross-septum of the shorter arm of the branching cell is usually slightly distal to the proximal end of the dividing wall, which projects slightly backwards into the branching cell. The projection is usually short (1-2μ) but examples up to 7μ have been seen. Branching cells are included in the figures for cell size given in the diagnosis. Length was measured from the proximal end of the cell to the cross-septum in the longer arm, and width was measured at the level of the proximal end of the dividing wall. The branching pattern appears to be basically a dichotomy in which one branch overtops the other. At the margin of the fructification the hyphal tip often shows a long and a short lobe separated by an invagination of the wall. Further growth leads to the

development of a longitudinal wall from the invagination, while the lobes grow on as daughter hyphae. Not all daughter branches grow on to give rise to further cells, many of them ending blindly against adjacent hyphae.

No definite dehiscence mechanism is apparent in the fructifications. In many specimens there is an irregular hole in the centre which may represent an ostiole, but which could be due to mechanical damage only (fig.149). Others have large areas of the wall missing.

At the margin, the hyphae may all terminate at approximately the same level, remaining in lateral contact, or else individual hyphae may grow out as pale or dark free hyphae (fig.151). The paler hyphae never extend far from the margin.

The free hyphae are darker than the hyphae of the fructification, and may be developed either from the margin or from further towards the centre of the fructification (fig.149). Other free hyphae usually occur extending irregularly over the surface of the fructification and the surrounding cuticle. Most of the hyphae are badly fragmented, but opposite and unilateral branches can be recognised. A few hyphal cells have a small pore in the lower face (fig.154) possibly representing penetration of the host by haustoria, but the pores are rare.

A number of young stages of the fructification have been recognised, resembling those described above for Asterina kiandrensis (see p.18). Young fructifications are borne laterally on the normal hyphal cells, and show a distinct radiate structure (figs. 152,153). A number of darker, more distinctly septate specimens occur on Herb. DAR 17259, but cannot be shown to be in organic connection with large fructifications, as can the others mentioned above. The hyphae bearing these small fructifications appear to be the same as the free hyphae described above, and these probably represent young stages of Asterothyrites kiandrensis, although there remains the possibility that they may belong to another microthyriaceous form. One such specimen is in very close association with a fragment of a large fructification.

Asterothyrites hyphopodiatus sp. nov.

Syntypes: Herb.DAR 17217, 17226. Figs.155-162.

Diagnosis: Colonies epiphyllous, confluent. Fructifications dark red-brown, outer wall of radiating hyphae, margin fimbriate. Individual hyphae may grow out as hyphopodiate free hyphae. Young fructifications borne beneath or lateral to hyphal cells. Older fructifications ovate-elliptical, dehiscence mechanism uncertain. Free mycelium dark, hyphae straight to sinuous, indistinctly septate, branches alternate or unilateral. Hyphal cells 24-(31.5;5.2;40)-46μ long X 4.5-(6.2;0.8;40)-8.5μ wide. Hyphopodia alternate or unilateral, sparse, subglobose to elongate cylindrical with rounded or conical apex, often bent, 10-(12.4;2.0;40)-18μ long X 5-(7.6;1.1;40)-10μ wide. Spore characters uncertain.

Occurrence: upper surface, leaves of Myrtaceae, Kinadra, N.S.W. Eocene-Oligocene.

Description.

This form closely resembles members of the genus Asterina. The fructifications are scattered on a dark hyphopodiate mycelium (figs.155-157). The outer wall of the fructification is dark, multilayered in the centre, single-layered at the margin, and composed of radiating, straight to slightly sinuous septate hyphae which grow out at the edge to give a fimbriate margin (figs. 156-157). Younger fructifications are circular in outline (figs.156,162), but two older fructifications are ovate-elliptical, the largest being 313μ X 205μ. Both large fructifications have a longitudinal paler zone in the central area of the wall. In one specimen there are indications of a longitudinal fissure (fig.157). It is possible that dehiscence in this form is by such a longitudinal fissure, but the possibility of mechanical damage cannot be discounted. Young stages of fructifications are borne on the hyphae which tend to be more obviously septate in the vicinity of the young fruiting body. Hyphal cells near the young fructification are shorter than those elsewhere in the hyphae. The mode of development is very similar to that described above for Asterina kiandrensis, and a number of stages have been recognised (figs.161,162). The hyphae are typical of the genus Asterina. A pore 0.5-1.5μ diameter is present at the apex of the hyphopodium, but is not surrounded by a thickened rim as in Asterina kiandrensis (fig.160).

A single two-celled spore has been seen associated with this form, lying close to a hypha and fragments of a fructification (fig.158). The spore is pale brown, with a psilate wall, conglobate, constricted, ca.32μ long X 16μ wide, and divided into approximately equal cells. A germinal hyphopodium, very similar to the hyphopodia described above, occurs on one of the cells. A process from the end of the other cell may represent the germinal hypha. The structure of the spore and the germinal hyphopodium makes it probable that the spore belongs to this species, but no specimens have been seen within a fructification or in connection with any hyphae, so the possibility of fortuitous association cannot be discounted, and the spore is regarded as only doubtfully belonging to this species. The species is hence placed in Asterothyrites rather than Asterina.

Extraneous thin hyaline hyphae are often present in intimate contact with hyphae of this species. One specimen has a pale, thalloid mycelium, resembling the hyphae of some modern members of the hyperparasitic Trichothyriaceae, overlying the hyphae (fig.159).

Fragments of another species of Asterothyrites occur on the upper surface of leaves of Myrtaceae (Herb. DAR. 17204(b)). Most of the fructifications appear to be young stages still borne beneath the parent hyphal cells. The parent hyphae are still seen centrally attached (fig.164). A few fragments of larger fructifications have been seen. The wall of the fruiting body is composed of irregularly branched and indistinctly septate hyphae, some of which grow out at the edge as free hyphae (fig.163). The largest complete fruiting body seen is 125μ diameter. The free hyphae are indistinctly septate, moderately dark brown, and lack hyphopodia.

Family Trichopeltaceae

sub-family Trichopeltineae

form-genus Trichopeltinites Cookson

Trichopeltinites kiandrensis sp. nov.

Syntypes: Herb. DAR 17205(b), 17211, 17254. Figs.175-185

Diagnosis: Fossil fungal colonies.Epiphyllous. Mycelium a radiate prosenchymatous membrane one cell thick; no free outgrowths from the margin. Mycelial membrane linear, branched, often almost circular where crowded. Individual hyphae dichotomously branched, septate; cells square to rectangular, 4-(11.8;3.7;143)-26μ long X 2-5μ wide; hyphal walls straight, ca. 0.5μ thick. Fructifications formed centrally under the mycelial membrane; 50-(10 6;34.4;21)-185μ diameter when mature. Cells above the fructification markedly shorter than elsewhere in the membrane, 4-(6.4; 1.6;151)-10.5μ long, thick-walled. Upper wall of the fructification of radiate dichotomously branched hyphae.

Occurrence: upper surface, leaves of Myrtaceae and Lauraceae, Kiandra, N.S.W. Eocene-Oligocene.

Description.

The mycelial membrane of this form is typical of modern Trichopeltum spp.(1) Shape of the membrane is variable, ranging from narrow linear thalli through variously branched forms to almost circular colonies with tongue-shaped lobes (figs.175,176), but the membrane is typically a variously branched and lobed long ribbon-like structure. Membrane size is very variable, and all stages from very young colonies to old disintegrating colonies are present. There are no indications of development of very young colonies from recognisable spores, but some of the small colonies have a zone of irregularly arranged rectangular to isodiametric cells from which the radiate structure of the membrane originates (fig.185).

(1) Trichopeltum was proposed by Batista, Costa and Ciferri, (1957) to replace Trichopeltis Speg. which is a synonym of Trichothyrium Speg. (Trichothyriaceae) (Hughes, 1953). Bastista, Costa and Ciferri proposed that the family Trichopeltaceae Theissen be amended to Trichopeltinaceae, based on Trichopeltina Theiss. Trichopeltina is a synonym of Trichopeltis (Stevens, 1925). The fossil form is included in the family Trichopeltaceae as delimited by Theissen.

There is a progressive increase in hyphal width up to the point of branching, and the cell proximal to branching is usually shorter than cells elsewhere in the hyphae. The surface of the membrane is very finely granulate. The ultimate divisions of the hyphae at the margin of the membrane are approximately at right angles to hyphae in the centre (fig.184). Further growth of the ultimate segments may give a characteristic fringed appearance to the membrane (fig.183). "Fringing" growth is not common, and usually occurs in the vicinity of fructifications. "Fringing" growth is characteristic of the recent Trichopeltum reptans (fig.186), in which the centre of the mycelial membrane often appears as a longitudinal strand fringed by lateral outgrowth. The feature is not however constant, being partially or wholly absent in some colonies.

Where two colonies of the fossil form meet, one colony may grow over the other, but a sharp line of demarcation is usually formed and growth occurs in another direction.

Some colonies have darker bands across the membrane. These are similar to the growth bands in recent Trichopeltum spp. The band is formed by the thickened end walls of the hyphae at the growing edge of the thallus, which persist after renewed growth of the colony has occurred. Growth bands are rare in the fossil material

Fructifications occur in most colonies, and there appears to be no relation between the size of the colony and the presence of fruiting bodies. A small colony on Herb. DAR 17254 appears to consist of little more than a fructification surrounded by a small amount of vegetative mycelium. The fructifications appear as darker areas in the membrane, due to the thickened walls of the short cells of the membrane over the fruiting structure (figs.177,178).

The membrane over the fructification is slightly arched away from the leaf surface. In some specimens traces of the upper wall of the fructification developed beneath the vegetative membrane are present. The wall is composed of radiate dichotomously branched hyphae which appear to be outgrowths of the lower face of cells of the membrane. The different orientation of the cells

of the membrane and those of the wall make them easily visible (fig.180). Other, apparently older, fructifications show irregularly arranged cells beneath the membrane, but detailed structure is difficult to discern. One fructification from which the overlying mycelial membrane is missing shows hyaline cells which may represent the basal wall of the fructification (fig. 179).

Many fructifications have a small centrally placed hole which probably represents a lysigenous pseudo-ostiole as developed in modern Trichopeltum spp. (Stevens, 1925). Presence of a pseudo-ostiole has been accepted as evidence that the fructification is mature, but this is questionable, as no spores have been seen within any fruiting body. The pseudo-ostiole is first visible when a few central cells of the membrane have broken down (fig. 178). More and more cells are involved, and the original position of the fructification is eventually represented by a hole in the thallus, as in Trichopeltinites fusilis (Dilcher, 1965). Separation of all cells above the fructification described in T. fusilis also occurs in the Kiandra specimens, but a small pseudo-ostiole is always visible in the centre, and simultaneous separation of all cells does not appear to be a regular method of dehiscence in this species.

A few specimens on Herb. DAR 17254 appear to have been attacked by a parasitic form. Loops of small hyphae ca. 1μ thick occur in most of the membrane cells, and frequently pass through the lateral walls into adjacent cells(fig.181). Pores ca. 0.5μ diameter in the upper face of the membrane cells presumably represent the point of entry of the parasite (fig.182). There does not appear to be any modification of growth pattern of the membrane in response to penetration of the parasitic form.

Discussion. Trichopeltinites kiandrensis appears to be intermediate between T. pulcher (Cookson, 1947) and T. fusilis (Dilcher, 1965) (see Table 7).

TABLE 7

	T. pulcher	T. fusilis	T.kiandrensis
mycelial membrane shape	narrow-elongate to leaf-like	circular to tongue-shaped	narrow-elongate to circular

TABLE 7 (Cont.)

	T. Pulcher	T. fusilis	T.kiandrensis
mycelial membrane width	18-150μ	30-500μ	34-188μ
cell size	5-8μX3-7μ	8-25μX2-4μ	4-26μX2-5μ
fructification diameter	72-90μ	25-50μ	50-185μ

T. kiandrensis appears to be indistinguishable from T. fusilis on the basis of cell length, but no statistical comparison is possible as Dilcher gives only upper and lower limits for cell size. There is some overlap with T. pulcher, but cells of the latter species are generally smaller. Hyphal widths are comparable in all species. On the basis of fructification diameter T. kiandrensis is closer to T. pulcher but there is considerable overlap with T. fusilis if immature fructifications (i.e. lacking a pseudo-ostiole) are included in the measurements. Measurements of fructification diameter in the three species may not be based on exactly comparable specimens from the point of maturity, and the character is best used with caution for distinguishing the species.

T. kiandrensis may easily be distinguished from the other species because of the difference in size between cells above the fructification and those elsewhere in the mycelial membrane.

In the absence of such qualitative characters there would appear to be difficulties in separating fossil specimens on the basis of thallus shape and quantitative characters. Modern Trichopeltum spp. are most easily distinguished on the basis of ascus and spore character, and quantitative characters appear to be of little value. (see Table 8).

TABLE 8

	T. africanum[1]	T. carissae[2]	T. kentaniensis[2]
mycelial membrane width	75-310μ	95-275μ	64-200μ
ascomal diameter	115-192μ	120-140μ	160-180μ

(1) Marasas, 1966 (2) Doidge, 1922

Shape of the mycelial membrane is probably of minimal value as a specific character. In Trichopeltinites kiandrensis shape is extremely variable, and colonies closely resembling the circular colonies of T. fusilis may be formed where colonies are crowded so that growth in any one direction is limited. Similar circular colonies may develop in modern Trichopeltum spp. where crowding occurs, but the majority of colonies are ribbon-like.

Dilcher (1965, pl.12, figs.90,91) described small stromata associated with free hyphae which he took to belong to Trichopeltinites fusilis. The presence of free hyphae would be exceptional in the Trichopeltaceae. There are no indications of such hyphae in T. kiandrensis and they are not recorded in any modern species[1]. The small stromata appear to lack the characteristic structure of the Trichopeltaceae, and may in fact represent the fruiting body of another form (possibly Micropeltaceae). The free hyphae may belong to this form rather than to Trichopeltinites fusilis. Only a re-examination of the figured material will settle the point. Dilcher also described occasional seta bases surrounded by a rosette of mycelial cells. Stevens (1925) states that such structures are often formed when a thallus of Trichopeltum grows around a seta of another epiphyllous form, and the setae may then appear to arise from the mycelial membrane.

(1) Stevens, 1925 described free hyphae in Trichothallus hawaiiensis which he included in the Trichopeltaceae. Hughes (1965) has excluded this genus from the family. Free hyphae do not occur in the family as at present constituted.

family Micropeltaceae.

subfamily Plochmopeltineae

form-genus Plochmopeltinites Cookson emend.

Diagnosis emend. Fossil fungal ascomata of dimidiate form with ascomal walls of sinuous plectenchyma. Free hyphae present or absent. Ascospore characters unknown or uncertain.

Plochmopeltinites masoni Cookson emend.

Diagnosis: Colonies amphigenous. Ascomata superficial, scattered, occasionally crowded and confluent, rounded, glabrous, ostiolate, up to 200μ diameter; margin entire-sinuate or irregularly lobed. Covering membrane prosenchymatous, composed of slender wavy hyphae 2-5μ thick, those of the central area often thicker walled than those towards the periphery. Straight branches may become free and extend beyond the limits of the ascoma. Ostiole up to 25μ diameter, surrounded by a slightly raised border of small, thick-walled cells. Free hyphae dark to almost colourless, indistinctly septate, sometimes forming a pellicle; hyphae often absent.
Lectotype: P26034, National Museum, Melbourne, Victoria. Standard specimens showing hyphae: Herb. DAR 17238, 17236, leaves of Lauraceae, Kiandra, N.S.W. Eocene-Oligocene.
Description.

Cookson (1947) recorded this species from Kerguelen Is., Kiandra and Traralgon, Victoria. Specimens from Kiandra were recorded on fragments of unidentified cuticle. Comparison of the type specimen (P26034, National Museum, Victoria) (fig. 195) with the specimens described here leaves little doubt that the same species is involved.

The ascomata are scattered or crowded, occasionally confluent (figs. 189, 190, 192). In some specimens they are associated with free hyphae (figs. 188, 189) but in others they are not. Ascomata in which the ostiole is fully developed are 68-(112;20.5;54)-157μ diameter, which considerably extends the lower limit recorded for the species by Cookson. The ascomata are convex away from the cuticle, and the wall is often folded. The wall is composed of a single

layer of hyphae which branch repeatedly, forming a sinuous plectenchyma (fig.191). Many of the hyphal branches end blindly against adjacent hyphae without giving rise to further branches. The "cells" are variable in shape and size, usually 1-3μ wide at the cross-septa and 2-4μ wide in the expanded portion of the hypha proximal to branching. Where ascomata are confluent there is complete intermixing of the hyphae of the ascomata

A distinct central ostiole is present in most of the larger ascomata. The ostiole is surrounded by a slightly raised rim of small thickened cells with walls ca.1μ thick. These cells are irregularly shaped to rectangular. In many specimens cellular structure is evident within this thickened rim (fig.198). The cells in the centre are very pale with very thin walls, square, rectangular or irregular, mostly 2-4μ long X 2-3μ wide. In the very centre the cells are usually somewhat obscure. Specimens in which the ostiole is incompletely developed often show remains of pale cells partly blocking the ostiole, which was presumably formed by breakdown of these delicate cells (fig. 193).

Individual colonies may be up to 2mm. across, and are often confluent. The hyphae are 2-4μ wide, straight and widely spreading with opposite or alternate branches at irregular intervals (fig.188). In some specimens the hyphae form a pellicle. Indistinct cross-septa divide the hyphae into cells 7-(12.0;2.7;50)-21μ long. Hyphae towards the periphery of a colony are usually paler than those in the centre, with thinner walls. Many hyphal cells have a small indistinct pore ca0.5μ diam. in the lower face (fig.199). A single hypha has been seen with a thin hyaline process extending through the cuticle. This process is the same size as the pores mentioned above, and probably represents haustorial penetration of the host leaf. There is no evidence of hyphal ramification under the cuticle.

Numerous young stages of ascomata have been seen. These are scattered along the hyphae, often in close proximity to each other (fig.189). The young fructification first appears as a small outgrowth of radiate hyphae either from a medial hyphal cell or terminal on a short lateral branch. The young ascomata are almost hyaline, often with a slightly thickened margin (fig.197), but become darker in colour as the size increases (fig.196). The thickened rim and

ostiole are not apparent until the ascoma is of considerable size.

A number of two-celled spores occur in close association with some of the fructifications (fig.194). The spores are light brown, conglobate, 1-septate, constricted, ca. 14μ long X 8μ wide. Spores have been seen lying on the outer face of the fructification close to the ostiole, and scattered on the cuticle, but none has been seen attached to hyphae or within a fructification and their assignation to this form is questionable.

Taxonomy:

If this form really belongs to the Micropeltaceae the presence of haustoria is unusual. All modern members of the group are entirely superficial but closely adnate to the cuticle (Hansford, 1946), and are presumably saprophytic. However, as with most of the foliicolous groups, the Micropeltaceae probably need much more study to determine whether all are truly superficial, and the presence of possible parasitism in the fossil form is not regarded as of sufficient value to separate this genus from that family.

subfamily Dictyopeltoideae

form-genus Dictyopileos Dilcher

Dictyopileos sp.

Specimens: Herb. DAR 17241, 17242, 17244, leaves of Lauraceae, Kiandra, N.S.W. Eocene-Oligocene.

Description.

The colonies are linear to circular, and irregularly lobed (figs. 200, 201). Large specimens may have irregular holes in the thallus (fig.200). The colonies are superficial and there is no evidence of parasitic action on the leaves bearing them. The smallest specimens cover only a few epidermal cells (figs. 203, 204). The largest is 1050μ across.

In most specimens only the basal portion of the subiculum is present, superficially very similar to the mycelial thallus of the Trichopeltaceae. The subiculum is distinctly radiate (figs.202,205) composed of very pale

brown to colourless hyphae which form a thallus one cell thick. The hyphae are dichotomously branched and septate, but the cross-septa are only distinct in specimens stained with methylene blue (fig.210). The cells are 2-(3.9;1.0;65)-7μ long X 2-(2.7;0.4;65)-5μ wide, square to rectangular.

The subiculum is bordered by 1-2 rows of dark thick-walled (ca.1μ) cells, and thickened cells also occur around holes in the subiculum (figs. 201, 208). Small areas of thick-walled cells may occur where different lobes of the subiculum meet, or an indistinct line of contact of the lobes may be visible (fig. 207). In areas of most recent growth of the subiculum the thick-walled cells are absent or thinner-walled and small lobes grow out from the older areas (figs. 202, 206). The thick-walled cells at the margin of the subiculum are above the pale hyphae of the radial thallus, and appear to represent the remains of an upper layer.

Free hyphae occur at the margin of the subiculum, and where the subiculum is interrupted (figs.208, 209). The hyphae are pale brown to almost colourless and irregularly septate and branched. They are produced only from areas of thick-walled cells, and are not developed from the small lobes of new growth. Free hyphae do not extend far over the cuticle from the subiculum.

Dark ring-like areas formed by irregular proliferation of dark hyphae on the upper surface of the subiculum are present in one specimen (fig.200). These hyphae form an irregular pseudoparenchyma and darker free hyphae extend over the surface of the thalloid mycelium (fig. 212). In a small area of one specimen dark hyphae form a reticulate network over the subiculum, close to the margin (fig. 211).

Discussion:

The specimens from Kiandra closely resemble those described as the basal portion of the subiculum in old specimens of Dictyopileos yalensis (Dilcher, 1965). The largest specimen is considerably larger than those described by Dilcher.

In Dictyopileos yalensis the subiculum is covered by a

reticulate network of anastomosing hyphae, and the whole structure is polyostiolate. The specimens from Kiandra are comparatively poorly preserved, the reticulate network missing in most specimens, but fragments are present in some portions. There is no evidence of ostioles associated with the structures. Dilcher described spores of two types which he regarded as questionably belonging to Dictyopileos yalensis. No spores have been seen associated with the Kiandra specimens.

Owing to the poor preservation of the Kiandra specimens they are not assigned to a species within the genus Dictyopileos although they clearly represent a form very similar to D. valensis.

Provisional assignation: family Trichothyriaceae (order Pseudosphaeriales).
Specimen: Herb. DAR. 17253(b).
Description.

Fructifications of this form occur on the upper surface of leaves of Myrtaceae, associated with hyphae of Asterina kiandrensis and Meliolinites nivalis. The fructifications are scattered or crowded but never confluent (figs. 213, 214). They are circular, or flattened on one side where in close contact. Fructifications seen are up to 108μ diameter, with distinct upper and lower layers (figs. 214, 215). The fructification is often split along the junction of the upper and lower walls, and the isolated lower layer is occasionally found on the cuticle.

The upper wall is much darker than the lower layer and consists of radiate, dichotomously branched hyphae with distinct cross-septa (figs. 213, 214). The cells are square to shortly rectangular, 1.5-(3.4;0.9;213)-8.5μ long X 1.5-(3.2;0.6;213)-5.5μ wide. Cells towards the centre of the fructification are often slightly irregular in shape. The lower layer is pale, and has a similar structure to the upper wall. The hyphae radiate from an apparently structureless central area, and are divided by very indistinct cross-septa which are often visible only towards the margin (fig.216). Most of the margin is smooth and entire (fig. 214) but some marginal cells may have small projections (fig. 213).

A distinct ostiole is present in the centre of the upper wall of most specimens (fig. 213), occuring in all specimens more than 60μ diameter. The ostiole appears to have been formed by breakdown of some of the central cells of the upper wall, and varies from 7-17μ diameter. In many specimens the remains of the cells which break down can be seen within the ostiole cavity (fig.213). The ostiole is slightly raised above the general level of the upper wall, but is on the same level as the margin of the fructifications.

A few almost colourless young fructifications have been recognised. There are indications of the ostiole at an early stage (fig. 219), although the differentiation of the two layers of the wall is not obvious. One of the small specimens has a distinct slightly darker square cell close to the centre of the upper wall (fig.218). The youngest specimen seen is almost colourless (fig.217).

Many fructifications have fragmentary pale hyphae in contact with the lower wall (figs. 220, 221), resembling those seen in close contact with the hyphae of Asterina and Meliolinites. I have been unable to demonstrate organic continuity between the hyphae and the fructifications.

Discussion.

All modern members of the Trichothyriaceae are hyperparasites on other epiphyllous fungi, the hyphae forming a plate-like thallus over the host hyphae, or a reticulum over the surface of the leaf between the host hyphae (Hughes, 1953).

The perithecia of the modern Trichothyriaceae and Microthyriaceae appear to be very similar. The perithecia of the Microthyriaceae are dimidiate, those of the Trichothyriaceae complete. Gaumann (1928) regarded the Trichothyriaceae "as Microthyriaceae which have become specialised for parasitism on other, especially asterinoid, fungi.....As the members of this family do not themselves directly parasitise leaves, their fructifications lie on their own mycelium unprotected beneath by the cuticle of the host. Consequently the basal stromatic parts attain a more marked cover layer character: they become brown and pseudoparenchymatic..."

The only fossil member of the Trichothyriaceae is Trichothyrites pleistocaenica from lower Pleistocene deposits in Minnesota (Rosendahl, 1943). This species was described as having free hyphae attached to the stems and leaves of moss plants in the deposit. No organic connection between the fructifications and hyphae was proved, and the possibility remains that the hyphae are those of the host fungi growing on the moss rather than those of the fructification. Rosendahl commented on the similarity of the fructification of Trichothyrites pleistocaenica to those of Microthyrium spp. Godwin and Andrew (1951), discussing an unidentified ascoma apparently belonging to the Microthyriaceae, list Loranthomyces (Trichothyriaceae) as a possible identification of the form. Rosendahl (1943) comments that it is next to impossible to determine from the surface aspect alone whether the perithecia (ascomata) are dimidiate or complete. All specimens from Kiandra are seen in surface view, and the small number of fructifications has precluded sectioning. The basal layer of the fructification is well-developed, and the structure of the entire fruiting body resembles that of the Trichothyriaceae.

In Trichothyrium reptans the lower wall of the fructifications is composed of brown, radiating, septate hyphae, but is paler than the upper wall and not so distinctly septate (Hughes, 1953). The upper and lower walls often separate at the margin, a conspicuous feature of the fossil specimens from Kiandra. In the modern species of Trichothyrium and in Trichothyrites pleistocaenica the ostiole is borne on a small papilla, above the general level of the upper wall (Hughes, 1953; Rosendahl, 1943). The ostiole in the Kiandra specimens is similarly above the general level of the wall, but in the absence of sections, the presence of a papilla cannot be verified.

In Trichothyrium asterophorum the upper wall of the young fructification bears short erect hyphae from a couple of the central cells (Hughes, 1953). The small darker cell near the centre of the small fructification in the fossil form (fig.218) may represent the base of such an erect hypha. In the modern species all hyphal connections to the thyriothecium are with the lower wall. The hyphae seen in contact with the fossil fructifications all appear to be in

contact with the lower wall, and no hyphae have been seen in contact with the upper wall in any specimens.

The fossil fructifications thus appear to be very close to those of the Trichothyriaceae, but a final assignation of the form will depend on better preserved material and sectioning of the ascoma to determine whether it is complete or dimidiate.

Mycelia sterilia

Type 3: Herb. DAR 17205(c), upper surface, leaves of Myrtaceae.

The mycelium forms a long strap-shaped thallus one cell thick. The individual hyphae are laterally adpressed (fig.244) and are composed of square to rectangular cells 6-(8.9;1.5;55)-14μ long X 5-(7.0;0.9;55)-8.5μ wide. The hyphae are very pale brown to almost hyaline.

Aggregation of the hyphae into a thallus is not complete. At the edge of the thallus some of the component hyphae grow out at an angle and terminate in a small cell. Similar separate hyphae appear at the growing face of the thallus. In places the thallus is broken up and the individual hyphae are separate from each other, but grow parallel (fig.246).

The hyphae are occasionally branched, the two hyphae formed as a result of branching growing parallel in close contact. Branching appears to be lateral. Where an obstacle such as a hair base occurs in the path of the hyphae they grow around it (fig. 247).

Dark brown septate filaments occur scattered over the surface of the thallus (figs.244, 245). Only fragments of these filaments were seen but they are multiseptate, the longest specimen seen having four cross-septa. Septa divide the filament into cells 8-22μ long X 4-8.5μ wide. Some of the filaments show an expanded "terminal" cell (Fig.245), and the cell of the filaments next to this expanded cell is generally much longer than the other cells, which are usually almost square in outline. The dark filaments appear to have been aerial portions, borne on the surface of the prostrate thallus. I have been unable to determine whether the expanded "terminal" cells are basal or apical, since no

ERRATUM. page 73
line 30 should read:
diam.; 27 cells in a specimen 36u diam. The cell walls in the centre of the base are thick and dark, becoming paler

filament has been seen definitely attached to the thallus.

Some of the cells of the thallus have a pronounced dark thickened ring on the upper face (fig.244.). From this, in some cases, can be seen projecting portion of what appears to be an aerial filament. Thallus cells bearing these projections appear normal in other respects. There is no definite thickening of the walls of the cell, which are the same colour as the other hyphal cells. The expanded cell on the filament may represent the apical portion rather than the basal portion, but better material would be needed before this could be decided.

The thallus has a superficial resemblance to that of Trichopeltheca (Hughes, 1965). In this genus the thalli are variously shaped and free hyphae occur at the edges and growing tip of the thallus. Hughes' figures show the setae of Trichopeltheca arising from thickened cells of the thallus which have the same ring-shaped thickening as in the fossil specimen, although the cells in the modern form have thick walls and are darker in colour than the rest of the thallus. These basal cells in Trichopeltheca resemble the "terminal" cells in the aerial filaments of the fossil. The setae and phialophores of Trichopeltheca are multiseptate and distinguished only by presence/absence of phialides.

Whether the aerial filaments of the fossil form are setae or have a spore-bearing function is not known.

Mycelial setae

Type 1.

Specimens of this form occur in large groups on the upper surface of leaves of Myrtaceae. Occasional isolated specimens also occur on the lower surface. The setae are borne on a multicellular base, 17-(29.8;5.7;100)-49μ diameter. The "cells" radiate from a central, thick walled (ca.3.5μ) polygonal to circular cell with a small lumen (figs.225,227,228). In larger specimens the radiate nature of the central portion of the base may be obscured. There is a progressive increase in number of cells with increasing size of the base; 10 cells in a specimen 22μ diam. The cell walls in the centre of the base are thick and dark, becoming paler towards the margin (fig.225). The periphery of the base is irregularly invaginated and the margin is very finely fimbriate, the extensions of the cells being almost colourless (Figs.224, 225).

Many of the cells, particularly those at the margin, have small pores ca.0.5μ diam. in their upper walls (figs. 225,230). More than one pore may be present in a single cell.

In side view the base appears as a small mound ca.9μ high. The apex is slightly depressed, and the structure has concave slopes from the centre towards the margin (fig. 229).

The thick-walled central cell represents the base of the seta which is broken off in most specimens. Complete setae seen have a size range of 44-(77.5;15.4;40)-119μ. Fragments of setae apparently longer than this upper limit have been seen. The seta is dark brown, 4-11μ wide at the base, and tapers gradually to an acute apex which may be slightly bent (figs.223, 224). The base of the seta is slightly expanded and appears to extend almost to the lower surface of the base. The walls of the seta are ca.3.5μ thick at the base, becoming thinner towards the apex. The apex has a continuous thick wall (fig.223). One specimen has the seta divided by thin transverse septa (fig.226). In a few specimens the seta bases are associated with poorly preserved hyaline hyphae which may represent the hyphae bearing the setae.

The late Professor A.C. Batista, University of Recife, Brazil kindly examined some specimens of this form, and stated (Batista, personal communication) that the seta bases are "apparently very similar to Vitalia rickiana (Theiss.) Batista and R. Ciferri." However, in the absence of fructifications and ascospores no exact identification can be made. Some Chaetothyrium spp. have very similar mycelial setae. The fossil form is also very similar to the setae figured for Vitalia eckmanii (Marasas and Rabie, 1966).

Mycelial setae very closely resembling the fossil form, if not identical with it, have been found on leaves of Ackama and Bosistoa from a number of localities in N.S.W. (fig.222). The setae are borne on much-branched, septate hyaline hyphae which form a pellicle over the surface of the cuticle. The hyphae associated with some of the fossil specimens appear to be similar. There are no fructifications or spores present in the modern material, and no identification has been possible. The fossil specimens can be regarded as mycelial setae of a

sooty mould closely allied to Chaetothyrium or Vitalia.

Type 2.

Large groups of this type occur on the upper surface of leaves of Myrtaceae. The longest seta seen is 154μ long. The seta is very dark brown, ca.6μ wide at the base with walls 1.5μ thick, and tapers to an acute apex (fig. 231).

The seta base is acellular, and consists of a dark central portion, often with a hole representing the point of attachment of the seta, surrounded by a wide zone of radiating irregularly branched finger-like processes (figs. 232-235). The base is 14-(21.5;3.7;100)-31μ diameter.

In side view the seta base appears broadly conical, ca.8μ high. The finger-like processes serve to attach the base to the cuticle (figs. 236, 237).

These setae have the same type of structure as those figured for Asterina nodosaria (Dilcher, 1965). However, the specimens described by Dilcher are very much smaller, the setae being only 15-20μ long, and the base 5-10μ diameter. The setae described by Dilcher may not belong to the hyphae he described as Asterina nodosaria, the association being fortuitous.

INCERTAE SEDIS

? Appressoria

The most numerous fungal remains encountered in the course of this study are small lobed "thalli" which appear to be identical to those described by Dilcher (1965) as microthyriaceous germlings. The thalli are circular to elongate in outline, flattened-hemispherical, 8-(10.4;1.1;50)-14μ diameter (figs. 251-260). The margin of the disc is variously lobed by invaginations of the wall. In some specimens the lobing appears to be basically dichotomous (figs.251, 256). The lower face of the thallus is closely pressed against the cuticle, and has a distinct pore ca. 1μ diameter. There is no evidence of a pore in the upper

surface of any of several hundred specimens examined (fig.258). Some specimens appear to show two thalli joined (fig.260). Only one specimen has been seen in which the thalli are associated with hyphae. In this, an almost colourless hyphal fragment appears to be continuous with the upper wall of the thallus (fig. 274). Thalli occur on both surfaces of leaves of Myrtaceae and Lauraceae, and are usually more abundant on the upper surface of the leaf, although the greatest concentration observed is on the lower cuticle of a Lauraceae leaf (fig. 248).

Various suggestions have been made as to the identification of these thalli.

a). Developmental stages of microthyriaceous fructifications.

Dilcher (1965) gave an extended discussion of previous reports and indentifications of these forms, and figured a series of specimens which he regarded as showing the development of fruiting bodies from spores. A similar series can be constructed for the development of the Kiandra specimens from spores (fig. 249-254) but there are no intermediates between the thalli and any fructification type.

Another series of specimens can be fairly convincingly arranged to show development of seta bases from the thalli (figs. 250, 251, 261, 262). Such series need to be regarded with great caution. The large number of specimens examined gives no reason for regarding them as developmental stages. It would seem unlikely that such large numbers of thalli as are present on some leaves would all be in comparable stages of growth if they in fact represented developmental stages of something. One would reasonably expect a number of stages to be present among such a profusion of specimens, but the morphology of the thalli is remarkably uniform. The thalli are very similar indeed to young stages of Microthyrium and Trichopeltum (fig. 267), but there is much more structural detail in young stages of these forms than in thalli of the same size.

b) Zoosporangia of chytrids.

Bradley (1967) assigned the fossil forms described by Dilcher and earlier authors to the Chytridiales, and created a new species of the genus Entophlyctis for them. He commented on the close resemblance of the fossil

forms to the modern Entophlyctis lobata, an aquatic chitinophilic chytrid. Bradley regarded the association of the thalli and epiphyllous forms as accidental, developed as a result of attack on submerged leaves bearing the epiphyllous flora.

Collections of recent rainforest leaves from a number of localities in New South Wales have yielded many specimens of a form very similar to, if not identical with, the fossil forms (figs. 268 - 270). They occur on leaves of a number of species, but are best developed on leaves of Bosistoa (Rutaceae) from Mt. Boss, near Wauchope, N.S.W.(1).

They are best developed on leaves covered with various sooty moulds, and are often associated with parasitic forms such as Asterina and Meliola and epiphyllous algae. The association with epiphyllous forms thus appears to be a reflection of habitat rather than accidental.

One specimen on Bosistoa shows a thallus attached to a hypha apparently derived from a colourless spore (figs. 263, 264). The almost colourless hypha ends in a thickened "junction" which appears to be an outgrowth of the upper wall of the thallus. The thickened walls of the "junction" taper and merge with the upper wall of the thallus (fig.263). A somewhat similar structure occurs in the single fossil specimen described above (fig.274), although there is no evidence of a thickened "junction" in the fossil specimen, and parts of two different fungi may be involved. The attachment of the thallus to a hypha in the modern form is sufficient to remove it from the Chyrtridiales, and this is warranted on other morphological grounds.

The sporangia of modern Entophlyctis spp. are intramatrical and the mature zoospores are liberated to the surface of the substrate by an exit pore or exit tube. The fossil and modern thalli are entirely superficial, and the only pore present is in the lower face, closely pressed against the cuticle, and unlikely to function in the liberation of spores. A few modern thalli have minute pores in the apex of the invaginations in the upper wall (fig.271). The

(1) Other hosts include Acmena smithii: Somersby Falls, nr. Gosford; Whian Whian State Forest, nr. Lismore; Barrington; Syzygium sp. : Boolambayte Ck., nr. Bulahdelah; Rubus sp. : Sullivans Gap, nr. Bulahdelah.

distinct "pore" in the lower face probably represents the position of the short process penetrating the cuticle seen in a sectioned thallus (Dilcher, 1965).

Bradley (1967) described small papillae on the fossil specimens as persistent zoospore cysts, which occur in the living Entophlyctis lobata. Small papillae also occur on some modern thalli, but have not been seen at all in the fossil specimens. In E. lobata the exit pore is developed in close proximity to the zoospore cyst (Willoughby and Townley, 1961). In the modern thalli papillae occur only on the upper face, and the minute pores in the apex of the invaginations are not close to the papillae. The papilla in the modern forms possibly represents the remains of the thickened "junction". In at least one specimen the free end of the papilla is straight (fig. 273) and resembles the "junction", and there appear to be forms intermediate between this type and papillae with rounded apices (fig. 272).

Bradley also commented on the agreement in colour between sporangia of Entophlyctis lobata and the fossil forms. Sporangia of E. lobata become orange (Willoughby and Townley, 1961). The modern and fossil thalli are light or dark brown. However, Willoughby and Townley, 1961, Pl.13, fig.c shows a dehisced sporangium of E. lobata with colourless walls. Sporangial colour in this species may be due to the contents rather than to colouration of the wall, as is the case in Entophlyctis aurea (Sparrow, 1960). The colour in modern thalli appears due to pigmentation of the wall, and the same was probably the case in the fossil specimens. On the basis of morphology and habitat the modern and fossil forms seem unlikely to be chytrids.

c) Young stages of epiphyllous algae

Dilcher (1965) discussed earlier reports of these forms as young stages of the epiphyllous alga Phycopeltis. The resemblance of the thalli to young stages of this alga is striking (figs. 265, 266), even to the indication of a central pore in one algal specimen. The algae are almost completely colourless in herbarium specimens, and there is no possibility of mistaking the two forms when they are seen side by side. The margin of the young algal stage is entire, and not lobed as in the thalli, although the radial walls of the algal stages are very

similar to the invaginations of the wall in the thallus.

d). Appressoria, hyphopodia.

Edwards (1922) and Godwin and Andrew (1951) both mention the presence of fossil thalli in association with the microthyriaceous fructifications they studied. Edwards regarded them as stigmocysts, an identification also followed by Rao (1958). Mr. J. Walker, Plant Pathologist, New South Wales Department of Agriculture, has examined specimens of both modern and fossil forms and states that "they are most probably hyphopodia or appressoria of various possible leaf inhabiting fungi." More work is required on the modern forms before identification of the fossils will be possible with any degree of certainty.

BRYOPHYTA.

Musci.

family Nemataceae.

cf. Ephemeropsis.

Fragmentary remains of an epiphyllous moss apparently closely related to the living Ephemeropsis tjibodensis occur on both surfaces of leaves of Myrtaceae and on the upper surface of leaves of Lauraceae. The only portions of the plant preserved are the haptera borne on the persistent protonema, and in some specimens poorly preserved fragments of the protonemal filament are still present.

The basic structure of the haptera is shown in figs.238 and 240. Haptera are borne in pairs on single cells of the protonema. Each hapteron consists of a square basal cell (b) bearing a terminal conical cell (A) and square lateral secondary basals (sb) bearing conical cells. The conical cells are often slightly expanded at the base. Conical cells are 5-(13.2;3.2;50)-21μ long and up to 8μ wide at the base. Basal cells are 10-12μ square, and the secondary basal cells are slightly smaller (7-10μ square).

Not all haptera are of the basic type described above. In some the conical cells are borne directly on the basal cell and the secondary basals are lacking (fig.239). In others there may be more than one secondary basal cell between the basal cell and the conical cell (fig.242). The number of conical cells on the secondary basals is variable, and in some cases the conical cells may be septate (fig.243). In some cases the conical cells appear to be simple outgrowths of the cell bearing them, and there is no wall between the cells. Conical cells may themselves be similarly lobed (fig.242).

The protonemal filament is branched either oppositely (figs. 241, 243) or unilaterally. Haptera are not developed where the branching is unilateral, but where branching is opposite four haptera are borne on the first cells of the branch. The first cell of the branch bearing the haptera is shorter and thicker-walled than cells elsewhere in the filament. The protonemal filaments are paler than the haptera (fig.240). The cells are square to rectangular, often somewhat barrell-shaped and 26-(32.7;4.8;50)-46μ long X 15-(20.2;2.6;50)-26μ wide. The surface of the cells and the haptera is granulose.

The fossil specimens from Kiandra are very similar to material from Lower Eocene brown coals in Germany described by Magdefrau (1956) as cf. Ephemeropsis. The material described by Magdefrau is in a much better state of preservation, and "propagules" are present. Such structures have not been seen in the Kiandra material. The genus apparently had a widespread occurrence in the Lower Tertiary.

There are only two species in the modern Nemataceae; Ephemeropsis tjibodensis Goeb. (India, Pakistan, Ceylon, Burma, Thailand, Indonesia, Malaya, Philippines, New Guinea) and Ephemeropsis trentepohliodes (Renn) Sainsb. (Tasmania and New Zealand). E. trentepohliodes differs from the fossil material in lacking haptera. The basic structure of the haptera in fossil specimens from both Kiandra and Germany and in E. tjibodensis is similar, and the fossils possibly represent this species. However, in the absence of better material it would be unwise to assign the fossils to the modern species.

HOST LEAVES

GYMNOSPERMAE.

Family Podocarpaceae

genus Podocarpus

section Dacrycarpus

Podocarpus praecupressinus Ett.

Several fragmentary shoots of this species have been found. The largest is a 20mm long portion of a distichous shoot with widely spreading bilateral leaves up to 7mm long X 1-1.5mm. wide (fig 275). The leaves are linear, entire, straight or slightly curved towards the apex, which has a distinct mucronate tip. The leaf base is decurrent along the axis. The midrib is not visible.

Cuticular structure confirms the identification of the species. The leaf is amphistomatic, with stomata in two longitudinal bands from the apex to the base. Stomata are oriented parallel to the long axis of the leaf, and adjacent stomata may share the same polar subsidiary cells (Fig. 276). The normal epidermal cells are elongate along the leaf (fig.277).

Discussion.

This is the first record of macroscopic remains of section Dacrycarpus from Kiandra. Cookson and Pike (1953) recorded Dacrycarpites australiensis pollen from soft lignitic shale 135 feet below the basalt in the New Chum Hill diggings. The leaves of the Kiandra specimen are larger than those of Podocarpus praecupressinus from Yallourn. Cookson and Pike (1953) described specimens in which the leaves were 2.5mm long X 0.5-1mm wide.

LAURACEAE.

Leaves belonging to this family form the bulk of the lignite from which specimens were collected. The leaves are opaque when recovered. The upper surface is smooth, with no indication of venation (fig. 278). The lower surface shows a prominent midrib and lateral veins which arch out from the midrib

and run more or less parallel to the margin (fig. 279). Distinct parallel tertiary veins occur at right angles to the midrib and lateral veins. In cleared specimens a reticulum of fine veins is visible between the tertiary veins and between the laterals and the margin of the lamina. Lateral veins are alternate, but the basal pair is subopposite and basal portions of the leaf may appear triplinerved.

Cuticular structure appears to be typical of the Lauraceae. The upper cuticle has a distinct venation reticulum (fig.280), but the parallel tertiary veins are indistinct. The midrib and lateral veins are poorly defined. Epidermal cells between the veins are square to polygonal and roughly isodiametric. Cells over the veins are tabular. Cell walls are straight and thick.

The lower cuticle has a distinct venation reticulum in which the parallel tertiary veins are well defined (fig.281). The midrib and lateral veins are very distinct (figs. 283,284), and marsupiform domatia (Stace, 1965) are present in the axil of the lateral vein. Stomata are confined to the intervein areas (fig.282) and hair bases occur over the veins. Cells over the veins are square to rectangular with the long axis along the vein. Cells between the veins are more irregular in shape. Cell walls are straight and thick. Stomata have two distinct deeply staining scales (fig.285).

Duigan (1965), discussing fossil Lauraceae, states that there is "no combination of cuticular and morphological characters which can be used to identify such leaves at a generic level." Duigan (M.Sc. thesis, unpublished) has proposed the genus Lauraceophyllum to contain all lauraceous leaves previously described from Australian Tertiary deposits, and described three species from deposits in Victoria. The Kiandra specimens are closest to Lauraceophyllum prominens (Lucifer Mine, Bacchus Marsh), the only species with distinct parallel tertiary veins at right angles to the midrib. In this species, however, there is no polygonal venation reticulum on the upper cuticle as in the Kiandra leaves, and stomatal construction is different. The Kiandra specimens appear to represent a fourth species of the genus.

Myrtaceae.

Mummified leaves belonging to this family are common in the lignite. Most are transparent, and the venation pattern is clearly visible with transmitted light (figs.286-293). The cuticle and cuticular flanges of the epidermal cell walls are well-preserved, but the mesophyll is represented by a structureless brown mass (fig.194). Both cuticles are ca.4μ thick, the upper cuticle slightly darker than the lower cuticle.

The leaves are petiolate, lanceolate to ovate-lanceolate, with an entire margin. A pronounced drip-tip is present in all but a few specimens. The largest intact leaf recovered is 4cm long X 1.5cm wide, but fragments of leaves which must have been considerably larger have been encountered. The midrib is continuous to the apex, and distinct inframarginal veins are present ca.1mm from the margin. Lateral veins are pinnate, and terminate in the inframarginal veins. Most are opposite or sub-opposite, straight, but often broken or looped. Minor veins form a reticulum. In many specimens the venation is "modelled" by fungal hyphae which apparently attacked the vascular elements prior to fossilisation. In others the veins are preserved as brittle, opaque coaly material.

Structure of the upper epidermis.

The midrib is distinct (fig.295) but not as prominent as on the lower surface. Cells over the midrib are arranged in longitudinal rows. They are rectangular to irregular with straight or slightly wavy thick walls. In some specimens the cells are arranged with the long axis transverse to the midrib, but this is not a constant feature. Hair bases are scattered along the midrib, and are joined by longitudinal cuticle ridges (fig.295,296). Each ridge consists of a number of striations, the ridges separated by shallow grooves which roughly coincide with the walls of longitudinal cell rows.

Cells of the lamina are irregular with thick straight walls (fig.297) or sinuous walls (fig.298). Some specimens have cells intermediate between these two types (fig.299). Two-celled gland covers (described below) are scattered over the lamina, often surrounded by a few radially arranged cells.

There are no indications on the cuticle of the position of lateral or minor veins. Hair bases are confined to the midrib.

Structure of the lower epidermis.

The midrib is prominent (fig.300). The arrangement of cells in longitudinal rows is more marked than on the upper cuticle, and most cells have the long axis transverse to the midrib. Hair bases, linked by longitudinal cuticle ridges, are scattered along the midrib (figs.300, 301).

Epidermal cells of the lamina are irregular, with sinuous walls (fig.304). Hair bases are scattered over the lamina (Figs.302, 303). Each hair base is surrounded by a few radially arranged cells, and cuticular striations radiate from the base (fig. 305). Two-celled gland covers (see below) are scattered over the lamina, often with a few radially arranged cells surrounding them (fig.306). Cuticular striations radiate from larger gland covers. Large cork warts occur irregularly (figs.302, 303, 314). The exact nature of these is unknown, but they appear to develop beneath two-celled gland covers, hair bases and stomata. They may represent the site of injury to the leaf.

There are no indications on the lamina of the position of lateral or minor veins.

Stomata are confined to the lamina of the lower cuticle. They are randomly orientated and either scattered (fig.302) or loosely grouped into clusters (fig.303). Stomata do not occur in close proximity to hair bases, two-celled gland covers, or cork warts (fig.302, 303). The stomata are anomocytic, the guard cells surrounded by a ring of unmodified, or very slightly modified epidermal cells (fig.310). Immature stomata are mixed with the mature ones, and a complete sequence in development of the guard cells from a single epidermal cell can be followed (figs. 311, 312, 310).

I have been unable to obtain suitable sections of the cuticle showing the stomatal apparatus, but their probable structure is shown in diagrammatic form in fig.315. This reconstruction is based on the surface view

of the stomata and such sections as have been obtained.

The guard cells have distinct outer ledges which in surface view (Fig.309) have a distinct ring-like appearance, rising above the general level of the cuticle. A complex series of cuticle ridges is apparent in the same view. In lower focus (B in fig.315, fig. 310) the stomatal ledges are obvious. The poral walls of the guard cells are poorly preserved and only faint indications of them are present.

Occasional giant stomata, usually surrounded by a few radially arranged cells, and with distinct cuticular ridges radiating from them, occur irregularly on the lamina (fig. 313).

Identification of the leaf.

Leaves similar to the fossil type are widespread in the subfamily Myrtoideae (e.g. Austromyrtus, Xanthomyrtus, Decaspermum, Pilidiostigma, Eugenia, Syzygium, Acmena), and also occur in some genera of the subfamily Leptospermoideae (e.g. Backhousia). Cuticular preparations of a number of Australian and New Guinea species of these genera have been examined (see Appendix 4) in an attempt to define a group to which the fossil may belong.

The fossil leaf has obvious affinities with members of the family Myrtaceae, but I have as yet been unable to assign the fossil to any particular genus or group of genera. The fossil is unlikely to belong to the genus Backhousia. Both modern species examined have the lateral veins distinct on the lower cuticle, and the stomata are not surrounded by a ring of cells as in the fossil. Both species are also densely hairy on the lower surface.

Stomata of the fossil type have been noted only in an undescribed species of Austromyrtus from Nightcap Range, Whian Whian State Forest, nr. Lismore, N.S.W. However, the modern and fossil cuticles differ in other characters, and the stomatal type appears to be unique in the genus Austromyrtus.

Preparation of an extensive reference collection of certainly identified herbarium material, and detailed analysis of variation within species and genera will be necessary before more precise identification of the fossil

will be possible. The fossil leaf exhibits quite wide variation in cuticular characters (e.g. arrangement of stomata in groups or not) and there may possibly be two species involved. Work along these lines is continuing.

SIGNIFICANCE OF THE FOSSIL FLORA.

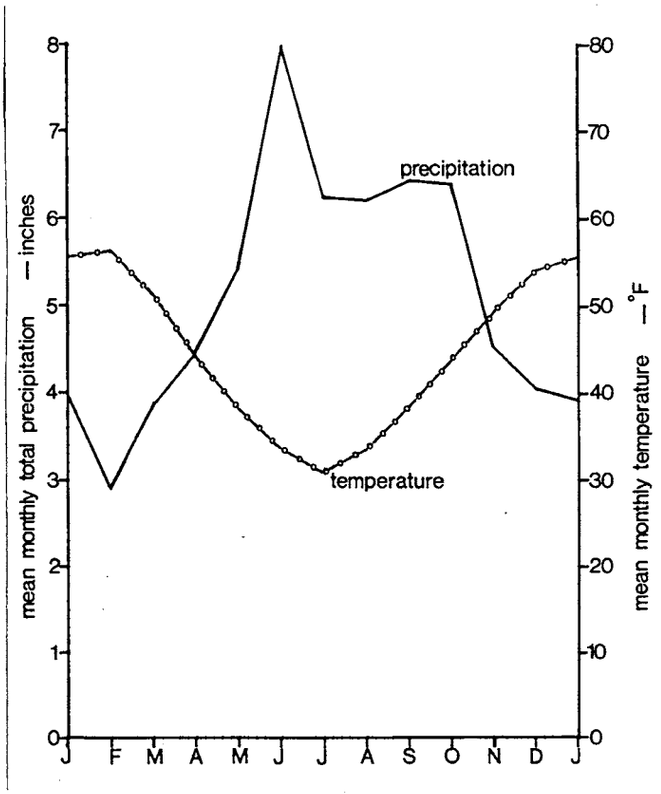
The fossils described above, and those listed in Table 1 (p.2) by no means represent a comprehensive description of the flora of the Kiandra deposits. During this work fragments of leaves belonging to several types other than those mentioned above were encountered. Most are fragmentary, with usually poorly preserved or absent cuticle, and no attempt has been made to include them. Wood also occurs in the sediments, but has not been studied. A superficial study of palynological preparations shows that there are a number of pollen types present other than those recorded. Much work remains to be done before a complete picture of the fossil flora will emerge. However, the fossils so far described give some indication of the conditions prevailing at the time of deposition of the sediments.

Present vegetation and climate.

The present vegetation of the Kiandra area is sub-alpine. Slopes and ridges carry a sub-alpine woodland dominated by snow gums (*Eucalyptus niphophila*). Valley bottoms contain extensive natural grasslands dominated by snow grass (*Poa caespitosa*). Swamps dominated by *Carex gaudichaudiana* are common, and patches of *Sphagnum* bog also occur.

Costin (1954) gave detailed meteorological data for Kiandra.

Mean annual temperature is 44.3°F (mean maximum=54.7°F; mean minimum = 33.2°F) and mean annual precipitation is 60.67". Most precipitation occurs in May-October, much of it as snow. Seasonal temperatures and precipitation are shown in text-figure 3.



Text-figure 3. Mean monthly temperature and precipitation:- Kiandra.

Significance of the epiphyllous flora.

Fossil fungi, which cannot be related to modern genera or species whose ecological requirements are known, are of minimal value as climatic indicators. Fossil microthyriaceous fungi have often been regarded as indicating warm, moist conditions, but such interpretations need to be accepted with caution. Isolated microthyriaceous fruiting bodies occur over a wide latitudinal range in Pleistocene deposits of North America (Wilson, cited in Dilcher, 1965), and in deposits (including interglacial deposits) formed under a wide range of climatic conditions in Britain (Godwin and Andrew, 1951).

Many isolated fossil fructifications resemble thyriothecia of Microthyrium spp. In New South Wales members of the genus are common on leaves of sub-tropical rain-forest species in coastal areas, but the genus extends into sub-alpine areas (on Carex Hebes, Spencers Ck. Kosciusko, Herb. DAR, no number) and into low rainfall areas (on Eucalyptus sp., Spencers Gulf, South Australia,

(Hansford, 1956). Poorly identifiable fossil material belonging to form-genera such as Microthyriacites may not reasonably be expected to indicate any specific climatic conditions. Dilcher (1965) concluded that generalised ecological arguments should not be based on such isolated fossil fungi, but that such reports could be useful if used in conjunction with evidence derived from macrofossils and pollen.

The foliicolous ascomycetes are best developed in tropical and subtropical areas, but extend into other regions where conditions are suitable. There are wide geographic gaps in our knowledge of some of the groups (e.g. Meliolaceae, Hansford, 1961), and knowledge of detailed distribution of genera and species is far from complete. Very little work has been done on Australian members of the group. The group as a whole appears to be limited mainly by moisture. Arnaud (1918) regarded the group as confined to areas where rainfall exceeds ca.39" per annum, and Cookson (1947) commented on the moisture dependence of the microthyriaceous fungi

There is very little autecological data available on any members of the group, but the work of Fraser (1937) on the distribution of sooty mould associations in New South Wales shows the moisture dependence of such fungi. She found that many species are highly resistant to extremes of temperature, but that most are markedly affected by desiccation. Some of the associations she studied contain members of the Trichopeltaceae, and Fraser regarded these associations as best developed in moist well-shaded situations. Trichopeltum reptans is resistant to extremes of temperature, but colonies could not survive two weeks without water. Similar results were obtained with Brefeldiella brasiliensis. Trichopeltinites kiandrensis and other fossil members of the family can probably be regarded as indicating moist conditions, but the possibility that they may represent extinct genera or species with greater tolerance should be borne in mind. A "host" list of modern members of the Trichopeltaceae, based on specimens in Herb. DAR, is given in Appendix 3. Most are species which grow in rainforests or their margins, and many occur along stream banks. Others, such as Xanthorrhea, appear to indicate a somewhat drier habitat, although possibly a moist microhabitat.

Appendix 3 also contains a host list of Asterina spp. Many hosts are rainforest species, while others occur in wet forests, rainforest margins and along stream banks. Australian species of this genus have not been extensively studied, and the details of distribution are probably far from complete. However, the presence of Asterina kiandrensis in the fossil flora probably indicates moist conditions.

Hansford (1953) gave extensive host lists for all the then known species of Meliolaceae in Australia. Most hosts are species which grow in rainforests or moist gullies. Meliolinites nivalis is also probably indicative of moist conditions. The Meliolaceae although best developed in the tropics and subtropics (Hansford, 1961) extend into temperate regions, and Arnaud (1946) stated that members of the genus Meliola occur in the high mountains of Europe. Ciferri (1954) reported members of the family in moist patches in xerophytic forests in the Dominican Republic.

Very little is known about the genus Vizella in Australia. V. interrupta occurs in subtropical rainforest (on Tieghemopanax elegans, Hastings R. brush, N.S.W., Herb. DAR 4413), while other species occur in temperate rainforest (on Nothofagus, Pt. Lookout, New England National Park) and in moist gullies in dry sclerophyll forest (on Acmena smithii, Somersby Falls nr. Gosford, N.S.W.).

The fossil fungi which can be referred to a modern genus (with the exception of Morenoina kiandrensis(1), and those belonging to the Meliolaceae probably indicate moist conditions. They do not, however, give much evidence as to temperature, since modern equivalents occur under a fairly wide range of temperature conditions.

The presence of an epiphyllous moss resembling Ephemeropsis tjibodensis may indicate fairly warm conditions. The modern species is widespread in the Indo-Malaysian region and also occurs in New Guinea. Sainsbury (1951) states that E. tjibodensis "usually grows on the leaves of trees

(1) I am unable to provide any distribution data for this genus in Australia.

in dense moist forest". Another species, E. trentepohlioides, occurs in Tasmania and New Zealand, but lacks the haptera which are characteristic of both E. tjibodensis and the fossil form. The detailed distribution of Ephemeropsis is not well known, and it is best to accept the fossil form as indicative of warm conditions with caution, since it may represent an extinct species. The fossil occurrence, does however, indicate moist conditions.

Significance of the pollen and macroflora.

Of the species listed in Table 1 the conifers (excluding Microcachrys) and Nothofagus are sufficiently well identified to be useful in ecological discussions. Two taxa belonging to the Podocarpaceae are represented by both macro- and micro-remains (Phyllocladus and Podocarpus sect. Dacrycarpus). Nothofagus is represented by micro-remains only. Fragmentary leaves resembling Nothofagus have been encountered, but in the absence of cuticle no firm generic identification has been possible.

Duigan (1965) gave a very full discussion of the ecological significance of fossil podocarps and Nothofagus from Yallourn, and this must form the basis for discussion of the significance of these in the Kiandra deposits.

The fossil flora contains elements which today would be typical of Tasmanian temperate rainforests, and other elements typical of New Guinea lower montane rainforests and New Caledonian forests. In these forest types Nothofagus spp. are associated with members of the Podocarpaceae. Nothofagus pollen makes up ca.50% of the total pollen and spores in a sample from just beneath the lignite from which the fossils described here were recovered. Pollen of brassi type, characteristic of the New Guinea and New Caledonia Nothofagus spp. is the most abundant, but fusca and menziesii type pollens also occur. Both these pollen types are produced by living Australian Nothofagus spp.

The composition of various forest types in which Nothofagus occurs is discussed below.

Temperate rainforest in Tasmania.

Nothofagus cunninghamii which has menziesii type pollen is

often associated with Phyllocladus and Dacrydium in these forests. Such forests are developed where rainfall is 40-100" per annum, and mean annual temperature is ca.50°F (Forestry and Timber Bureau, 1962). The Tasmanian endemic Dacrydium franklinii is the only Dacrydium which produces pollen of mawsonii type found in the Kiandra sediments. The Tasmanian endemic Nothofagus gunnii, confined to wet peaks, is the only Australian Nothofagus which produces pollen of fusca type

Nothofagus cunninghamii extends into Victoria in moist sheltered localities where it forms a large tree. The species also occurs in sub-alpine woodland on the Baw Baw Plateau, Victoria, where humidities are high and there are frequent mists (Costin, 1957). Under these conditions the species grows as a shrub (Ewart, 1930).

Temperate rainforest in New South Wales.

Nothofagus moorei, which has menziesii type pollen, occurs in temperate rainforests in New South Wales, and extends into Queensland. Baur (1957) regarded the Nothofagus association in New South Wales as developed in areas where rainfall exceeds 70" per annum, and where winters are long and severe, with occasional snowfalls.

Lower montane forests in New Guinea.

The main development of Nothofagus forests in New Guinea is between 6000' and 9000', although Nothofagus forests extend from 3000' to 10000'. Meteorological data for these forests is scanty, but rainfall is high, and mean annual temperatures probably lie between 61°F (6000') and 53°F (9000') (Hounan, cited in Duigan, 1965), Extrapolation from these figures suggests that at 3000' mean temperature is ca.69°F and ca.50°F at 10000'. Trees associated with Nothofagus in these forests include Podocarpus sect. Dacrycarpus (which does not occur in Australia at the present day), Phyllocladus and Dacrydium.

Rainforest in New Caledonia.

Nothofagus spp. producing brassi type pollen, Podocarpus sect. Dacrycarpus and Dacrydium all occur in New Caledonia. The distribution of Nothofagus on the island is not well known, but it occurs up to 4000'. Rainfall is probably 80-120" per annum, although subject to wide seasonal variation. Mean

annual temperature is probably ca.57°F at 3500'.

Rainforest in New Zealand.

In the Thames District of New Zealand podocarp-broadleaf forests occur at lower altitudes and Nothofagus forests at higher altitudes, although gradations between the types occur. There are local climatic differences in the area, but rainfall is 50-80" per annum, and mean annual temperature is 56-68°F at sea-level. Nothofagus, Dacrydium and Phyllocladus are all present in these forests.

Broad leaved Lauraceae, which are prominent in the Tertiary sediments, are absent from Tasmania. Their presence in the sediments probably indicates warmer conditions than in the Tasmanian temperate rainforests (i.e. more than 50°F). In New South Wales, broad-leaved Lauraceae are mainly found in the subtropical rainforests and do not extend into the temperate Nothofagus forests. In the New Guinea lower montane forests, however, broad-leaved Lauraceae may be locally abundant in Nothofagus forests, and Lauraceae, associated with Nothofagus and Podocarpaceae are present in the New Zealand forests mentioned above. The Myrtoideae are similarly best developed in forests which are warmer than the temperate Nothofagus forests of Australia, and are abundant in the lower montane forests of New Guinea.

Nothofagus pollen in the Tertiary sediments may possibly represent forests developed at higher altitudes than those represented by the Myrtoideae and broad-leaved Lauraceae which make up the bulk of the lignite studied. Leaves resembling those of Nothofagus are scarce and usually poorly preserved, possibl as a result of transport. The comparatively small percentage of Nothofagus pollen present (Duigan (1965) reports values as high as 90% from Yallourn) may indicate that Nothofagus grew at some distance from the basin of deposition. McQueen, Mildenhall and Bell (1968) accepted Nothofagus pollen of fusca type as a cool climate indicator. Pollen of brassi type is taken as indicating warmer climates. The presence of all three pollen types at Kiandra may represent an altitudinal zonation of Nothofagus types. However, since Nothofagus, Podocarpaceae, Lauraceae

and Myrtaceae all grow together in New Guinea lower montane forests it is preferable not to place too much emphasis on altitudinal variation of the forests.

Much work remains to be done before the climatic implications of the Kiandra fossil flora can be more fully developed. Only a few fossil types are as yet sufficiently well-recognised to be very useful, but these indicate conditions similar to the lower montane forests of New Guinea, together with some features of the temperate rainforests of Tasmania and New South Wales. The presence of the epiphyllous fungi fits this conclusion also, since these forms are present in both subtropical and temperate rainforests, with their maximum development probably in the warmer forests. At the time of deposition of the sediments rainfall was high, probably more than 50" per annum, with mean annual temperature probably in excess of 50°F and possibly somewhat higher.

Appendix 1

The taxonomy of the Microthyriaceae sensu Stevens and Ryan (1939) has been extensively modified. Müller and von Arx (1962) placed the genera in two families: Asterinaceae (Dothiorales) and Microthyriaceae (Pseudosphaeriales). Many genera recognised by Stevens and Ryan have been reduced to synonymy, placed in other families or orders, and some have been rejected altogether.

Genera recognised by Stevens and Ryan are listed below in the first column. Genera to which these have been referred by later authors are shown in the second column, and the assignation of these genera is given in the third column. Where the present classification cuts across the division of the group into subfamilies on the basis of presence/ absence of hyphae an asterisk appears after the name of the family.

1..... Müller and von Arx, 1962

2..... Ainsworth and Bisby, 5th edition, 1966

subfamily Microthyrieae

Stevens and Ryan, 1939	Later authors	Assignation of genus
Myiocopron		
Peltella	Myiocopron 1	
Chaetothyriopsis	Chaetothyrina 1	Micropeltaceae
Calopeltis	Cyclotheca 1	Microthyriaceae
Microthyriolum	Ferrarisia 1	Parmulariaceae
Microthyrium		Microthyriaceae 1
Niesslella		
Seynesia	Pemphidium 2	Sphaeriales
Seynesiopeltis		Microthyriaceae 1
Scutellum	rejected as a valid genus 1	
Halbania		

Caenothyrium		
Actinomyxa		
Phragmothyrium		
Micropeltopsis		
Lembosidium	Lembosia 1	Asterinaceae +
Aulographella	Morenoina 1	Asterinaceae +
Lembosina		Asterinaceae 1+
Morenoina		Asterinaceae 1+
Thyrosoma	Cyclotheca 1	Microthyriaceae
Campoa		Parmulariaceae 1
Pycnopeltis		
Stephanotheca		Myriangiales 2
Pycnoderma		
subfamily Asterineae		
Calothyriella	Microthyrium 1	Microthyriaceae +
Stegothyrium		
Calothyriopeltis	nomen confusum 2	
Caudella		Microthyriaceae 1
Mycolangloisia	Actinopeltis 1	Trichothyriaceae
Calothyrium	Asterinella	Microthyriaceae 1
Aphanopeltis		Asterinaceae 1
Parasterina	Asterina 2	Asterinaceae 1
Englerulaster	"	
Englera	"	
Clypeolella		Asterinaceae 1
Trichasterina		Asterinaceae 1
Asterina		Asterinaceae 1
Asteromyxa	Wentiomyces 1	Dimeriaceae
Thallochaete	parts of two different fungi 1	

Asterinella		Microthyriaceae 1
Polythyrium	Neostomella 1	Asterinaceae
Clypeolina		Micropeltaceae 1
Prillieuxina		Asterinaceae 1
Halbaniella		
Beelia		
Kriegeriella		
Platypeltella		
Yatesula		
Lembosiella		
Lembosiopsis	Aulographum 1	Asterinaceae
Ptychopeltis	Calothyriopsis 1	Microthyriaceae
Aulographum		Asterinaceae 1
Circosia		Asterinaceae 1
Circosiella	Circosia 1	Asterinaceae
Lembosia		Asterinaceae 1
Morenoella	Lembosia 1	Asterinaceae
Echidnodes	Lembosina 1	Asterinaceae +
Echidnodella		Asterinaceae 1
Symphaster		Asterinaceae 1

Appendix 2

All modern members of the Meliolaceae are assigned a modified Beeli formula (Hansford, 1961) and Dilcher, (1965) has extended the use of these to fossil fungi.

Characters to the left of the stop refer to qualitative features, those to the right of the stop to quantitative features.

Composition of the formula as defined by Hansford, 1961 is shown below.

Main characters, numbers to left of stop:-

(1) Spores, normal septation:

2..... 3-septate

3..... 4-septate

(2) Perithecia:

1..... without setae or appendages

2..... bearing "larviform appendages"

3..... bearing uncinate or coiled setae

4..... bearing straight setae

(3) Mycelial setae, including those from perithecial disc and subiculum:

0..... absent

1..... simple, entire, straight, or at least not uncinate or coiled

2..... simple, entire uncinate or coiled

3..... dentate or shortly furcate (below 30μ)

4..... branched, the branches usually over 30μ

(4) Capitate hyphopodia:

1..... alternate or unilateral (less than 1% may be opposite)

2..... regularly opposite, save where crowding will not permit

3..... mixed opposite and alternate

Measurements, numbers to right of stop:-

(5) Spore length, maximum observed for normal spores:

1..... below 20μ

2..... 21-30μ

3.....31-40μ

4.....41-50μ

5.....51-60μ

6.....over 60μ

(6) Spore width, maximum observed in normal spores:

1..... up to 10μ

2..... 11-20μ

3..... 21-30μ

4..... 31μ and over

(7) Perithecia, maximum diameter observed:

1..... up to 100μ

2..... 101-200μ

3..... 201-300μ

4..... over 300μ

(8) Mycelial setae, maximum length:

1..... up to 300μ

2..... 300-500μ

3..... 500-1000μ

4..... over 1000μ

0..... absent

The Beeli formula serves for rapid identification of groups of species. In most species the formula is variable, as the fungi "show considerable variation in different collections, even from the same locality and on the same host." (Hansford, 1961).

Appendix 3

Host list of Trichopeltaceae and *Asterina* in New South Wales, based on collections in Herb. Dar.

TRICHOPELTACEAE

Pteridophyta

Polypodium sp., Barrington (no number)

Xanthorrheaceae

Xanthorrhea sp., Pennant Hills (no number)

Fagaceae

Nothofagus cunninghamii, fern gullies, nr. Marysville, Vic. (Cookson, 1947)

Epacridaceae

Trochocarpa laurina, Barrington (Herb. DAR. 2307), National Park (no number)

Winteraceae

Drimys sp., National Park (no number)

Drimys lanceolata, Tasmania (Cookson, 1947)

Myrtaceae

Tristania sp. Williams R., Mt. Irvine, Mungo, Tambourine (Qld.), Church Point, Comboyne, Macquarie Pass, Barrington (no numbers)

Backhousia, Barrington, Berowra (no numbers)

Acmena smithii, Barrington, Blackheath, Somersby Falls (own collection)

Lauraceae

Cryptocarya meissneri, Comboyne (Herb. Dar. 12725)

Rutaceae

Bosistoa, Comboyne (Herb. Dar. 12719), Bulga (no number)

Citrus, Pennant Hills (no number)

Ebenaceae

Diospyros australia, National Park (no number)

Pittosporaceae

Pittosporum undulatum, Baulkham Hills (Herb. DAR. 6082)

Proteaceae

Lomatia arborescens, Williams R. (Herb. DAR. 2354)

Sapindaceae

Sarcopteryx stipitata, Upper Hastings R. (Herb. DAR. 4779)

Dodonaea triquetra, Upper Hastings R. (no number)

ASTERINA

Rutaceae

Asterolasia carricifolia, Magara Park, nr. Gosford (no number)

Evodia micrococca, Williams R. (Herb. DAR.2361)

Ranunculaceae

Clematis glycinoides, National Park (Herb. DAR. 2267, 2331)

Liliaceae

Cordyline stricta, Mt. Warning (no number)

Cordyline terminalis, Tooloom Ra. Kyogle (no number)

Geitonoplesium cymosum, Lamington National Park (Qld.) (Herb. DAR.4390)

Iridaceae

Libertia paniculata, Blackheath (Herb. DAR. 3564)

Lauraceae

Cryptocarya meissneri, Comboyne (no number)

Cryptocarya rigida, Bulga (no number)

Cryptocarya patentinervis, Salisbury, nr. Dungog; Williams R. (no numbers)

Litsea dealbata, Dorrigo, (Herb. DAR. 3559)

Monimiaceae

Doryphora sassafras, Clyde Mt. (no number)

Winteraceae

Drimys dipetala, Salisbury (no number)

Drimys insipida, Hastings R. brush (no number)

Elaeocarpaceae

Elaeocarpus holopetalus, Blackheath (no number)

Proteaceae

Banksia serrata, Wentworth Falls (no number)

Orites excelsa, Williams R. (Herb. DAR. 2295)

Rubiaceae

Canthium coprosmoides, Hastings R. brush (Herb. DAR. 4372)

Randia sp. Dorrigo (Herb. DAR. 4403)

Bixaceae

Scolopia brownii, Williams R. (Herb. DAR.2353, 4407, 4649)

Pittosporaceae

Citriobatus multiflorus, Williams R. (Herb. DAR.4376)

Pittosporum undulatum, Salisbury (Herb. DAR. 3530), Mt. Warning (Herb. DAR.2379)

Pittosporum revolutum, Williams R. (Herb. DAR.2279), Cambewarra Mt. (Herb.DAR 2336).

Gesneriaceae

Fieldia australis, Mt. Wilson (Herb. DAR.2255), Blackheath (Herb. DAR.2360).

Euphorbiaceae

Mallotis philippinensis, Brisband R. (Qld.) (Herb. DAR.290)

Bignoniaceae

Pandorea pandorana, Elands, via Wingham (no number)

Sapotaceae

Planchonella australis, Tooloom Ra. Kyogle (Herb. DAR.4401)

Myrtaceae

Syncarpia glomulifera, Currarong (Herb. DAR.6668)

Tristania laurina, Elands, via Wingham, N.S.W. (Herb. DAR.3520), Williams R., (Herb. DAR.2371) Upper Williams R., Macquarie Pass, Kangaroo Valley, Dorrigo, Mt. Dromedary, Blackheath, Megalong Valley, Mt. Warning, Cambewarra Mtn., Austinmer (no numbers).

Acmena smithii, Somersby Falls, Blackheath (own collections)

Backhousia, Barrington (own collections)

Syzygium, Boolambayte Ck., nr. Bulahdelah. (own collections)

APPENDIX 4.

Cuticular preparations of modern Myrtaceae examined.

Subfamily Myrtoideae.

Austromyrtus acmenoides
Austromyrtus bidwilli
Austromyrtus dollachiana
Austromyrtus fragrantissima
Austromyrtus hillii
Austromyrtus inophloia
Austromyrtus lasioclada
Austromyrtus sp. (undescribed)

Xanthomyrtus cf. *flavida*
Xanthomyrtus hienghenensis
Xanthomyrtus sp.

Decaspermum blancoi
Decaspermum neurophyllum
Decaspermum paniculatum
Decaspermum sp.

Pilidiostigma glabrum
Pilidiostigma rhytispermum
Pilidiostigma tropicum

Syzygium coolminianum
Syzygium luehmanni
Syzygium floribundum
Syzygium kuranda

Acmena smithii

subfamily Leptospermoideae

Backhousia citriodora
Backhousia myrtifolia

BIBLIOGRAPHY

ARNAUD, G., 1918. Les Asterinées. Annls. Éc. natn. Agric. Montpellier N^lle Série 16: 1-288.

ARNAUD, G., 1946. Distribution géographique des champignons du genre Meliola. C. r. Acad. Sci., Paris 223 : 1019-1021.

ARX, J.A. von, and MÜLLER, E., 1954. Die Gattungen der amerosporen Pyrenomyceten. Beitr. KrytogFlora Schweiz 11(1):1-434.

BATISTA, A.C., 1959. Monografia dos fungos Micropeltaceae. Inst. Micol. Univ. Recife. Publ. 56:1-590.

BATISTA, A.C., and CIFERRI, R., 1957. Contribuição ao estudo dos Ascomicetos Pernambucanos. Sydowia, Beih.1:325.

BATISTA, A.C., COSTA, C.A.A., and CIFERRI, R., 1957. Orgânogênese e sistemática dos fungos Trichopeltinaceae (Theiss.) emend. nobis. Inst. Micol. Univ. Recife Publ. 90: 1-24.

BATISTA, A.C., PERES, G.E.P., BEZERRA, J.L., and MAIA, H. da Silva., 1960.Revisão de alguns fungos Stigmateaceae. Nova Hedwigia 2 : 476-483.

BATISTA, A.C., PERES, G.E.P., and MAIA, H. da Silva., 1963 Dois novos fungos da familia Manginulaceae. Inst. Micol. Univ. Recife. Publ. 223: 1-9.

BAUR, G.N., 1957. Nature and distribution of rain-forests in New South Wales. Aust. J. Bot.5: 190-223.

BRADLEY, W.H., 1967. Two aquatic fungi (Chytridiales) of Eocene age from the Green River formation of Wyoming. Am. J. Bot. 54: 577-582.

CIFERRI, R., 1954. Meliolae of Santo Domingo. Mycopathologia et Mycologia Applicata 7: 81-211.

CLEMENTS, F.E., and SHEAR, C.L., 1931. The Genera of Fungi. Wilson, New York.

COOKSON, I.C., 1947. Fossil fungi from Tertiary deposits in the Southern Hemisphere. Part 1. Proc. Linn. Soc. N.S.W. 72: 207-214.

COOKSON, I.C., and PIKE, K.M., 1953. The Tertiary occurrence and distribution of Podocarpus (section Dacrycarpus) in Australia and Tasmania. Aust. J. Bot. 1: 71-82.

COSTIN, A.B., 1954. A study of the ecosystems of the Monaro Region of New South Wales with special reference to soil erosion. Government Printer, Sydney.

COSTIN, A.B., 1957. The high mountain vegetation of Australia. Aust. J. Bot. 5: 173-189.

DILCHER, D.L., 1965. Epiphyllous fungi from Eocene deposits in Western Tennessee, U.S.A. Palaeontographica, Abt. B, 116: 1-54.

DOIDGE, E.M., 1920. South African Microthyriaceae. Trans. R. Soc. S. Afr. 8: 235-282.

DOIDGE, E.M., 1922. South African ascomycetes in the National Herbarium. II. Bothalia 1: 65-82.

DUIGAN, S.L., 1949. The Tertiary flora of Australia with special reference to fossils from coal deposits in Victoria. M. Sc. thesis, University of Melbourne, unpublished.

DUIGAN, S.L., 1965. The nature and relationships of the Tertiary brown coal flora of the Yallourn area in Victoria, Australia. The Palaeobotanist, 14: 191-201.

EDWARDS, W.N., 1922. An Eocene Microthyriaceous fungus from Mull, Scotland. Trans. Br. mycol. Soc. 8: 66-72.

EWART, A.J., 1930. Flora of Victoria. Melbourne University Press, Melbourne.

FORESTRY and TIMBER BUREAU, 1962. Forest trees of Australia. Government Printing Office, Canberra.

FRASER, L., 1937. The distribution of sooty-mould fungi and its relation to certain aspects of their physiology. Proc. Linn. Soc. N.S.W. 62: 35-56.

GAUMANN, E.A., 1928. translated C.W. Dodge. Comparative Morphology of Fungi. McGraw Hill, New York. 1st edn.

GILL, E.D., and SHARP, K.R., 1957. The Tertiary rocks of the Snowy Mountains, Eastern Australia. J. geol. Soc. Aust. 4: 21-40.

GODWIN, H., and ANDREW, R., 1951. A fungal fruit body common in post glacial peat deposits. New Phytol. 50: 179-183.

GOLOVIN, P.N., and POPOV, P.A., 1963. Microthyriaceae novae periodi Tertiariae in Sibiria occidentale inventae. (in Russian). Bot. Mater. 16: 88-91.

GORDON, C.G., and SHAW, C.G., 1960. A new genus of the Meliolaceae on the roots of Solanum species. Mycologia 52: 327-333.

HANSFORD, C.G., 1946. The foliicolous ascomycetes, their parasites and associated fungi. Mycol. Pap. 15: 1-240.

HANSFORD, C.G., 1947. New and interesting tropical fungi I.Proc. Linn. Soc. Lond. 158: 28-50.

HANSFORD, C.G., 1953. Australian fungi. New species and revisions. I. The Meliolaceae of Australia. Proc. Linn. Soc. N.S.W. 78: 51-82.

HANSFORD, C.G. 1956. Australian Fungi III. New Species and revisions (continued). Proc. Linn. Soc. N.S.W. 81: 23-51.

HANSFORD, C.G., 1961. The Meliolineae. A monograph. Sydowia Beih. 2: 1-806.

HUGHES, S.J., 1953. Fungi from the Gold Coast II.Mycol. Pap. 50: 1-104.

HUGHES, S.J., 1965. New Zealand Fungi 5. Trichothallus and Plokamidomyces, states of Trichopeltheca. N.Z. Jl. Bot.3: 320-332.

M^{c}QUEEN, D.R., MILDENHALL, D.C., and BELL, C.J.E., 1968. Palaeobotanical evidence for changes in the Tertiary climates of New Zealand. Tuatara 16: 49-56.

MÄGDEFRAU, K., 1956. Paläobiologie der Pflanzen. 3 Aufl., Jena.

MARASAS, W.F.O., 1966. New species of ascomycetes and a new genus of Sphaeropsidaceae from Transvaal. Bothalia 9: 203-215.

MARASAS, W.F.O., and RABIE, C.J., 1966. New and interesting records of South African fungi, Part IV. Bothalia 9: 217-227.

MOREAU, C., and MOREAU, M., 1951. Pyrénomycètes du Caféier en Côte d'Ivoire. Révue Mycol. Suppl. colon., 16(1): 12-80.

MÜLLER, E. and ARX, J.A. von, 1962. Die Gattungen der didymosporen Pyrenomyceten. Beitr. Kryptogamen Flora. Schweiz 11(2): 1-922.

PETRAK, F., 1954. Ergebnisse einer Revision der Grundtypen verschiedenen Gattungen der Askomyzeten und Fungi imperfecti. V. Sydowia 8: 287-303.

PETRAK, F., and SYDOW, H., 1929. Kritische-systematische Originaluntersuchungen über Pyrenomyzeten, Sphaeropsideen und Melanconieen. Ann. Mycol.27(1,2): 87-115.

RAO, A.R., 1958. Fungal remains from some Tertiary deposits of India. The Palaeobotanist 7: 43-46.

ROSENDAHL, C.O., 1943. Some fossil fungi from Minnesota. Bull. Torrey bot. Club 70: 126-138.

SACCARDO, P.A., 1883. Sylloge fungorum. Vol.2.Published by the author, Pavia,Italy.

SAINSBURY, G.O.K., 1951. The taxonomy of the moss Archephemeropsis trentepohlioides Renn. Trans. R. Soc. N.Z.79: 203-205

SEN, J., 1966. Occurrence of Microthyriaceae in the Eocene of Western India. Sci. Cult. 32: 140-142.

SPARROW, F.K., 1960. Aquatic Phycomycetes. Uni. Michigan Press, Ann Arbor, 2nd edn. rev.

STACE, C.A., 1965. Cuticular studies as an aid to plant taxonomy. Bull. Brit. Mus. (Nat. Hist.) Botany 4(1): 1-78.

STEVENS, F.L., 1925. Hawaiian fungi. Bernice P. Bishop Museum Bull. 19:1-189

STEVENS, F.L., 1927. The Meliolineae.1. Ann. Mycol. 25:405-469

STEVENS, F.L., and RYAN, Sister Mary Hilaire, 1939. The Microthyriaceae. Ill. Biol. Monogr. 17. 138pp.

STRAUS, A. 1952. Beiträge zur Pliocän flora von Willershausen III. Die Niederen Pflanzengruppen bis zur den Gymnospermen. Palaeontographica, Abt. B, 93: 1-44.

STRAUS, A. 1961. Neue Pyrenomyceten aus dem Pliocän von Willershausen. Z. Pilzk. 27: 88-92.

TEHON, L.R., and STOUT, G.L., 1929. Notes on the parasitic fungi of Illinois IV. Mycologia 21: 180-196.

WILLOUGHBY, L.G., and TOWNLEY, P.J., 1961. Two new saprophytic chytrids from the Lake district. Trans. Brit. mycol. Soc. 44 : 177-184.

WOLF, F.A., 1968. Disintegration of fungus spores. J. Elisha Mitchell scient. Soc. 84 : 328-332.

FIGURES 1 - 4.

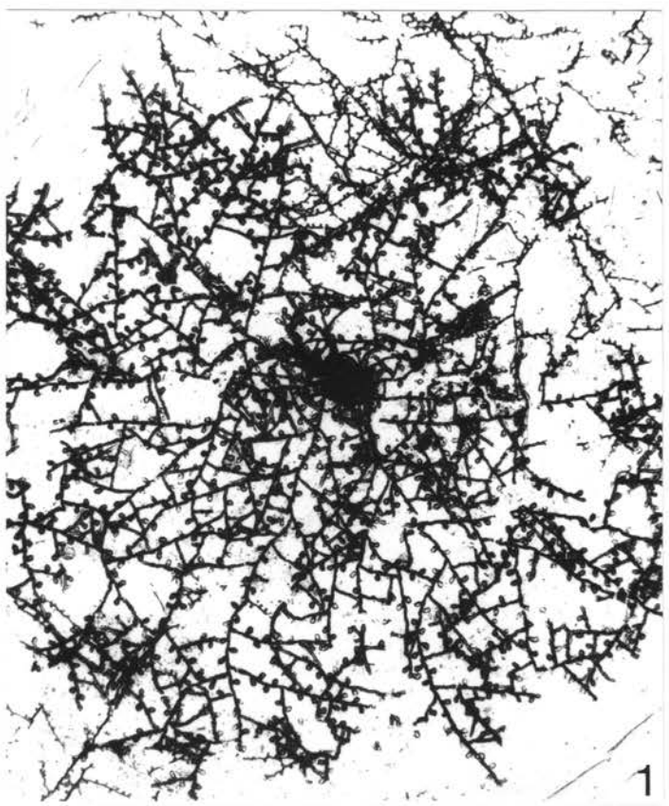
Meliolinites nivalis sp. nov. on Myrtaceae.

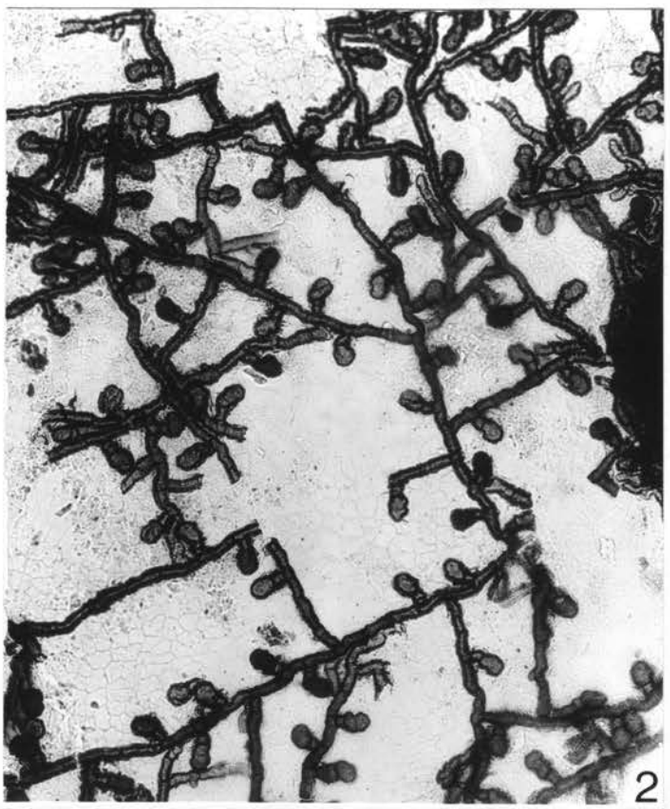
Fig. 1. Single colony with central hyphal disc. Herb.DAR 17201. x40.

Fig. 2. Hyphae and hyphopodia. Herb.DAR 17202. x170.

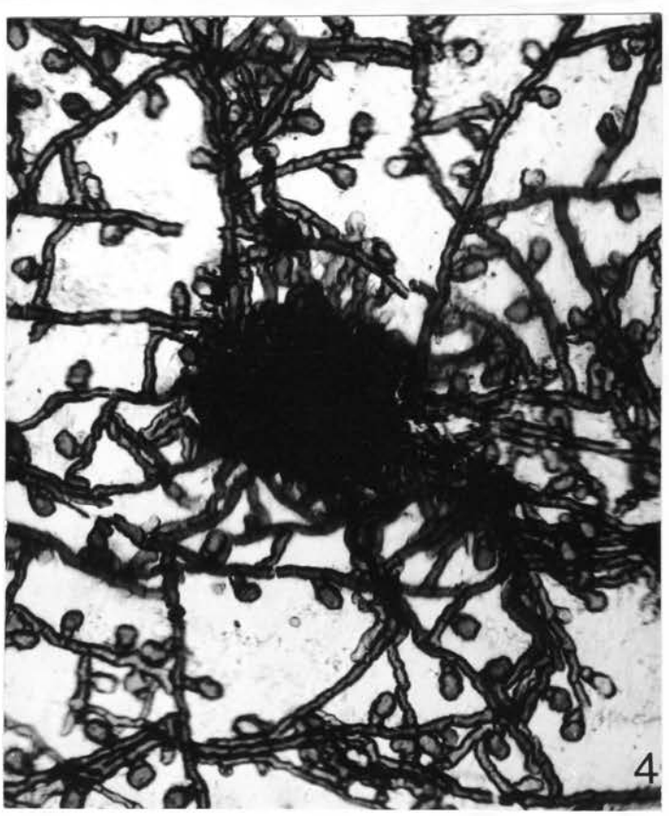
Fig. 3. Perithecium. Herb.DAR 17202. x150.

Fig. 4. Radiate disc of hyphae. Herb.DAR 17201. x150.


1


2


3


4

FIGURES 5 - 11.

Meliolinites nivalis sp. nov.

Fig. 5. Pore in head cell of hyphopodium. Herb.DAR 17201. x900.

Fig. 6. Haustorial filament produced from head cell of hyphopodium. Herb.DAR 17201. x1100.

Fig. 7. Persistent germinated ascospore. Herb.DAR 17201. x500.

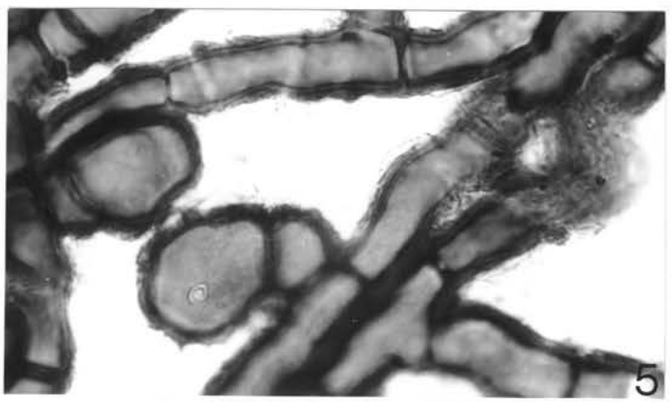
Fig. 8. Hyaline hyphae, possibly hyperparasitic, associated with hyphae of Meliolinites nivalis. Herb.DAR 17201. x900.

Meliolinites sp. on Lauraceae.

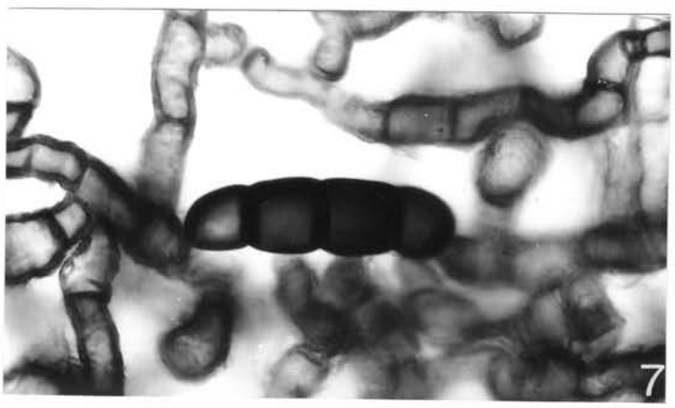
Fig. 9. Fragment of colony showing hyphal branching. Herb.DAR 17210. x150.

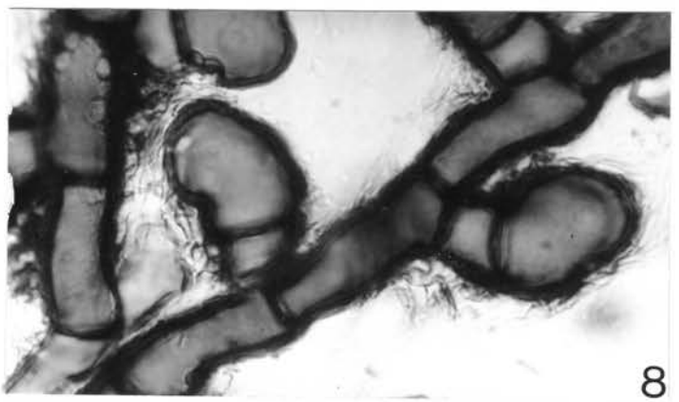
Fig. 10. Hyphopodia. Herb.DAR 17210. x300.

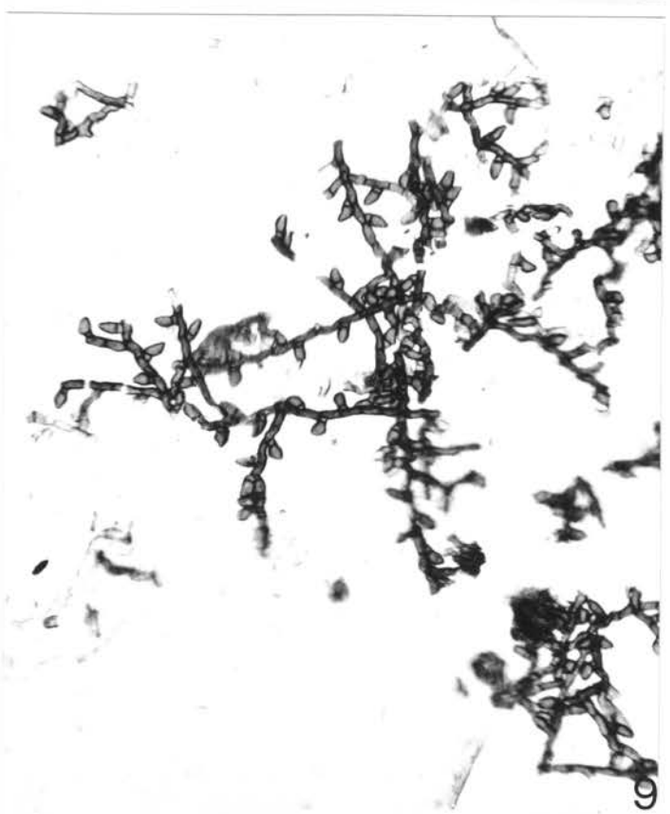
Fig. 11. Ascospore. Herb.DAR 17208. x680.

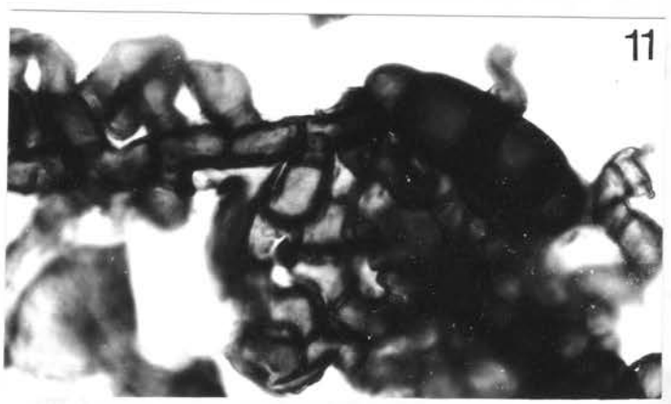

5

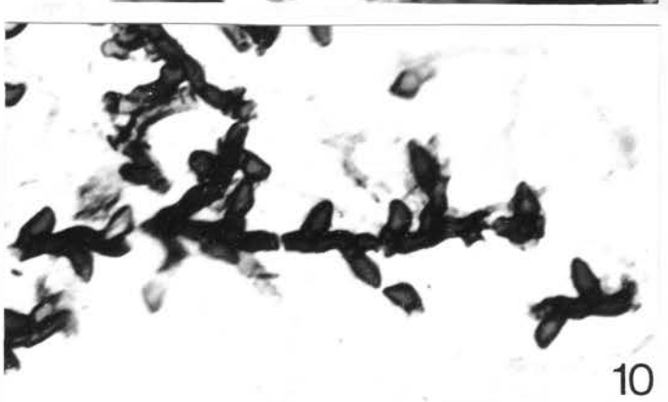

6


7


8


9


11


10

FIGURES 12 - 15

Sterile mycelia, possibly Meliolaceae.

Type 1 on Lauraceae.

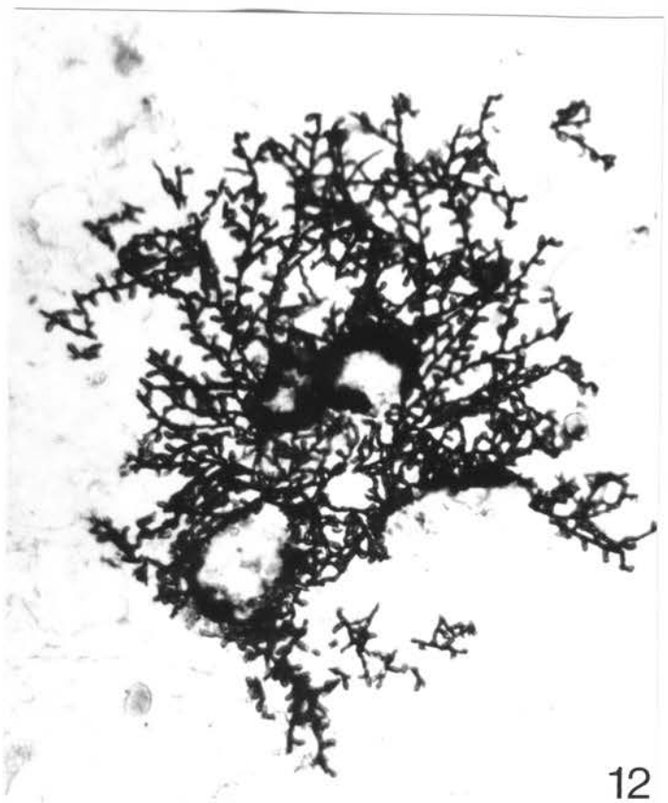
Fig. 12. Colony. Herb.DAR 17209. x60

Fig. 13. Portion of colony, showing remains of fructification. Herb.DAR 17209. x150.

Fig. 14. Hyphopodia. Herb.DAR 17209. x680.

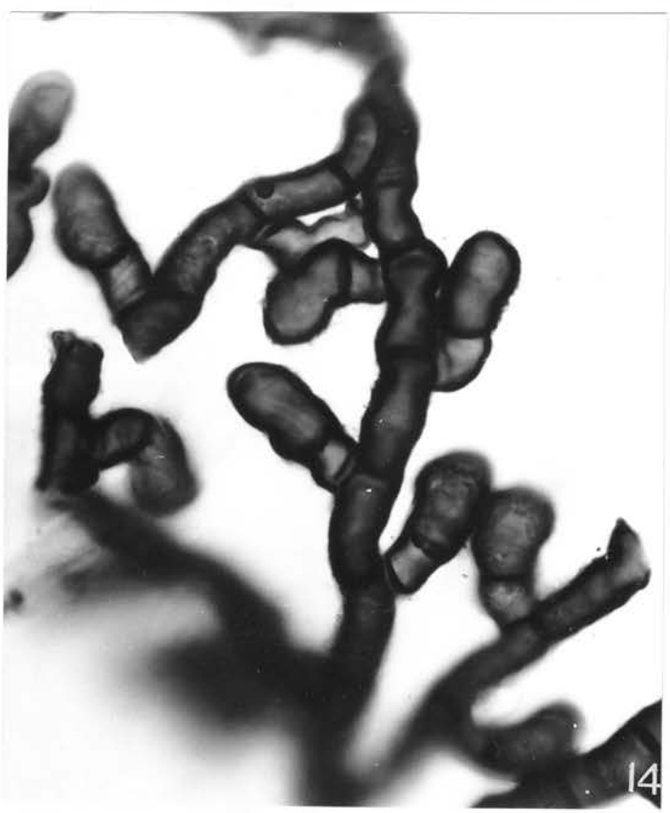
Type 2 on Podocarpus.

Fig. 15. Hyphal fragments showing branching. Herb.DAR 17200. x150.

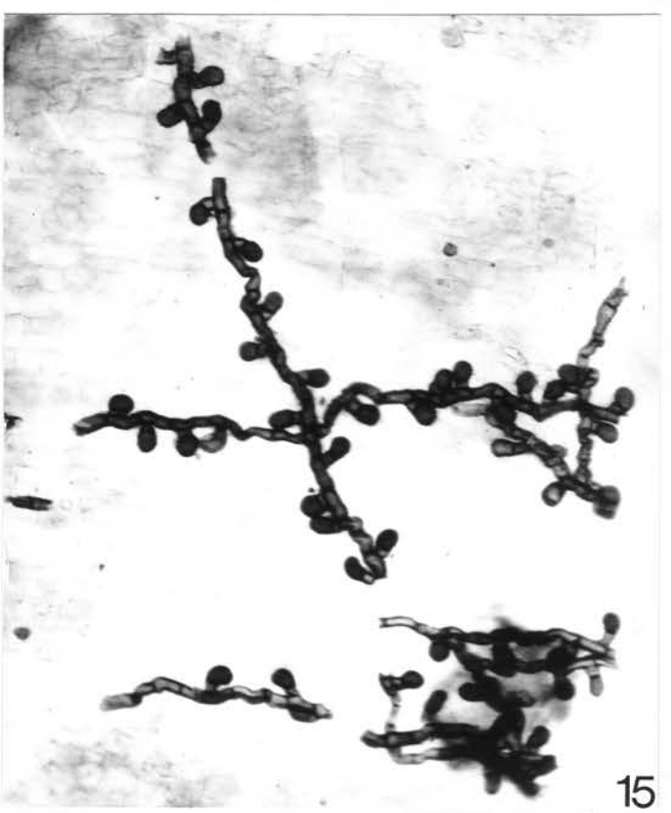


12

13



14



15

FIGURES 16 - 18.

Sterile mycelia, possibly Meliolaceae.

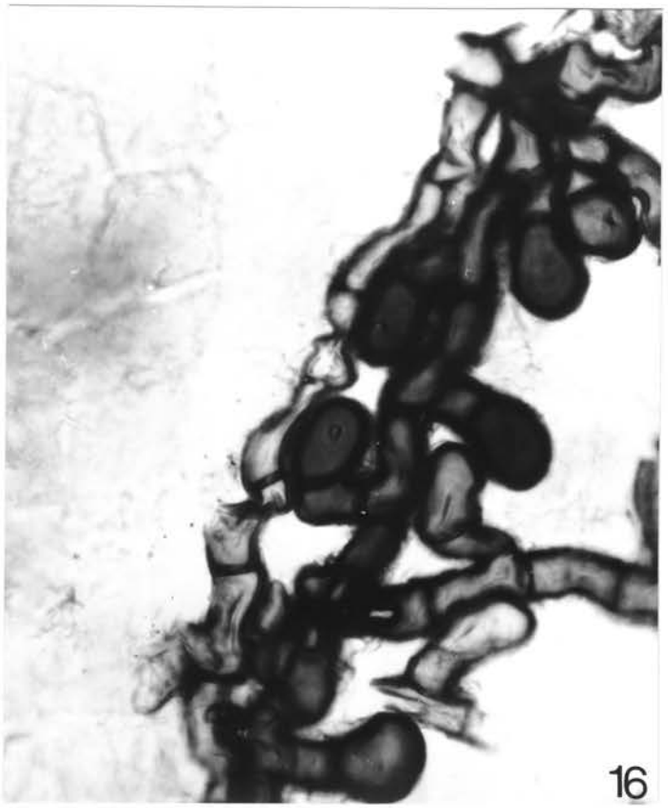
Type 2.

Fig. 16. Hyphopodia showing pores in head cells. Herb.DAR 17200. x680.

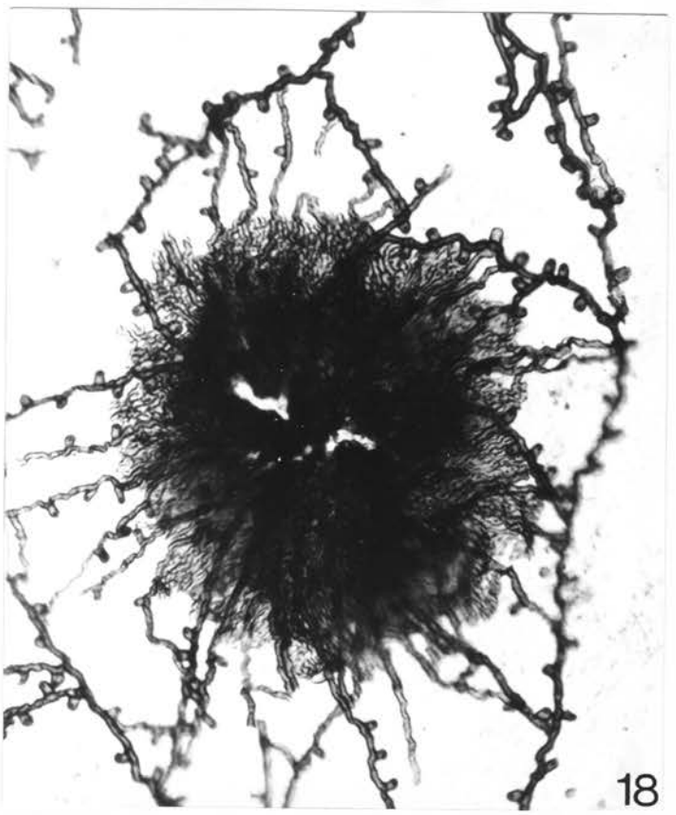
Asterina kiandrensis sp. nov. on Myrtaceae

Fig. 17. Confluent colonies with perithecia. Herb.DAR 17257. x60.

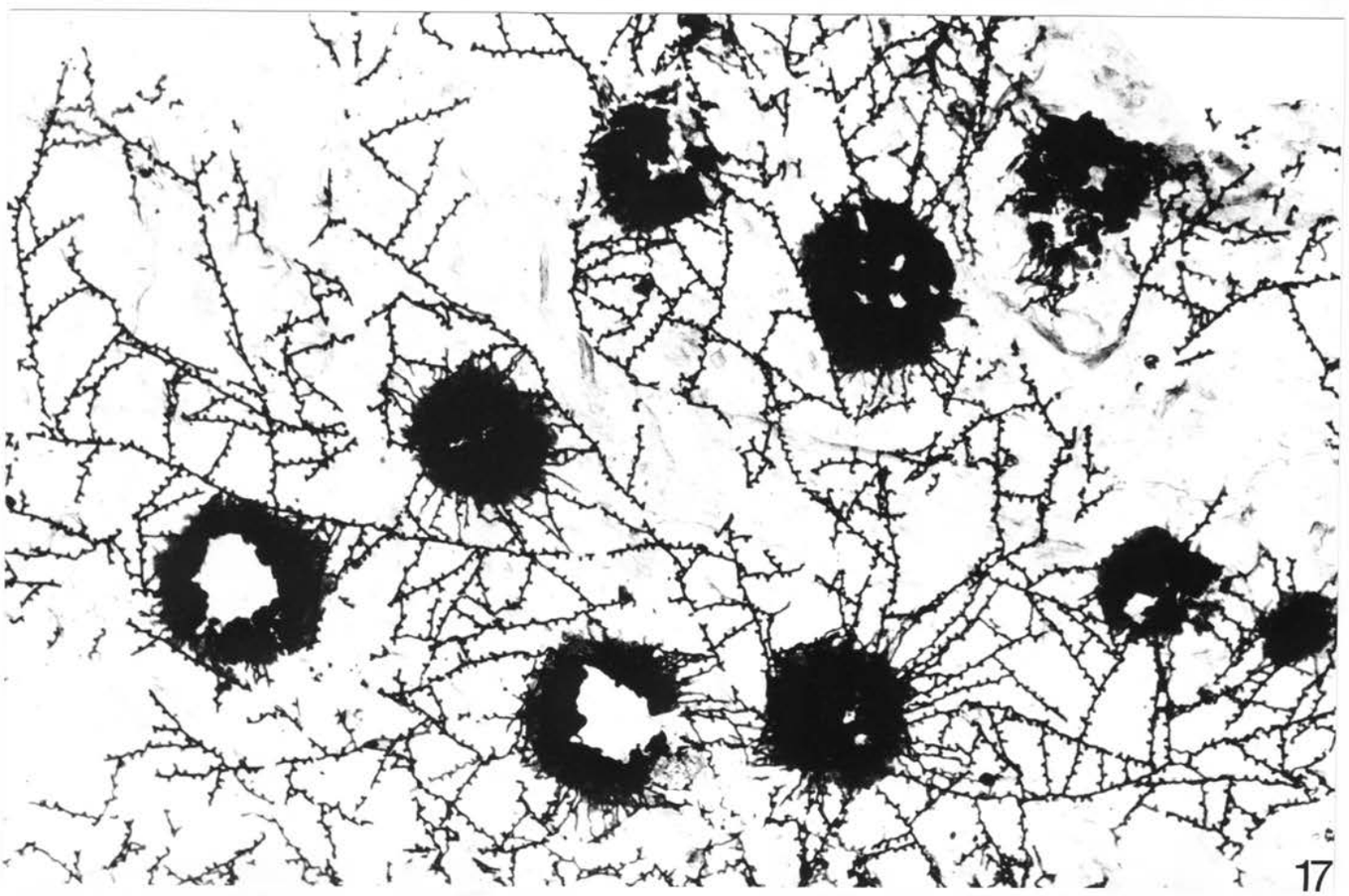
Fig. 18. Perithecium with free hyphae radiating from central part of the wall. Herb.DAR 17257. x150.



16



18



17

FIGURES 19 - 33.

Asterina kiandrensis sp. nov.

Fig. 19. Young fructification developed on medial hyphal cell. Herb.DAR 17215. x500.

Fig. 20. Young fructification on short side branch. Herb.DAR 17245. x500.

Fig. 21. Free Hyphae developed from margin of young fructification. Herb.DAR 17216. x500.

Fig. 22. Young fructification on short lateral branch. Herb.DAR 17216. x500.

Fig. 23. Young fructification with cross-septa. Herb.DAR 17216. x500.

Fig. 24. Young fructification without cross-septa. Herb.DAR 17218. x500.

Fig. 25. Older fructification. Herb.DAR 17216. x500.

Fig. 26. Germinated spore with aseptate large cell. Herb.DAR 17253(a). x1000.

Fig. 27. Germinated spore with 1-septate large cell. Note 2-layered wall. Herb. DAR 17253(a). x1000.

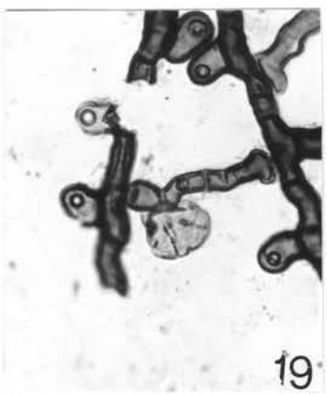
Fig. 28. Spore with remains of small cell around base of hypha. Herb.DAR 17253(a). x1000.

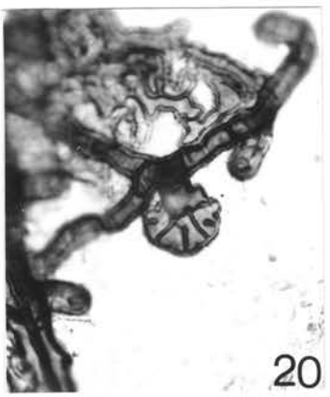
Fig. 29. Germinated spore with 2-septate large cell. Herb.DAR 17253(a). x1000.

Fig. 30. Germinated spore with 3-septate large cell. Herb.DAR 17253(a). x1000.

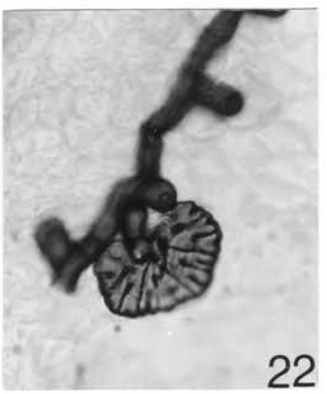
Figs.31-32. Germinated spores showing "spore-within-spore" structure in large cell. Herb.DAR 17253(a). both x1000.

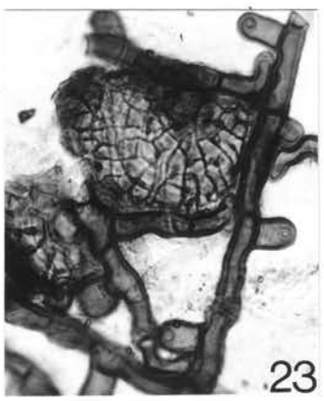
Fig. 33. Spore within perithecium. Herb.DAR 17219. x1000.


19

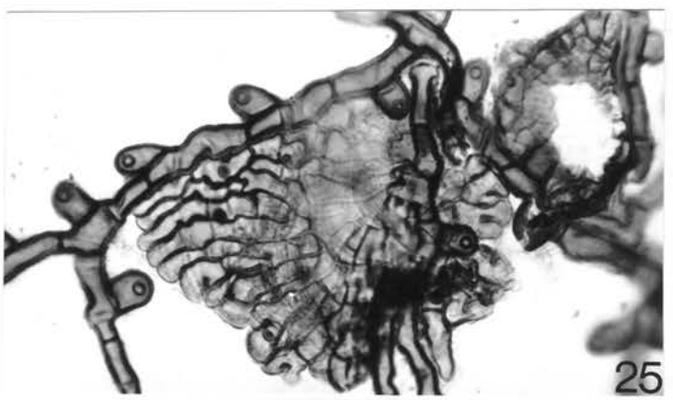

20

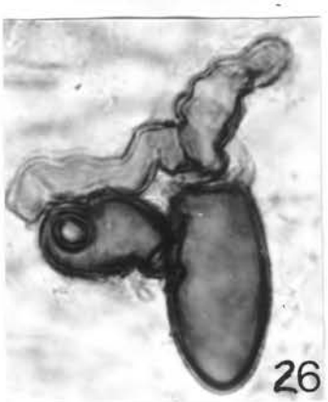

21

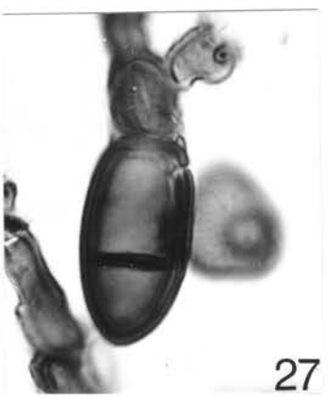

22


23


24

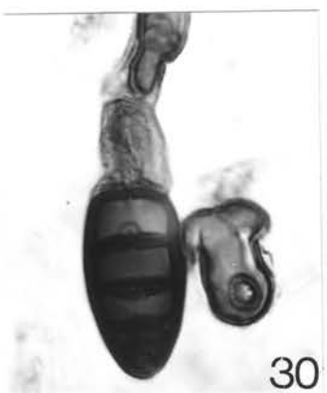

25

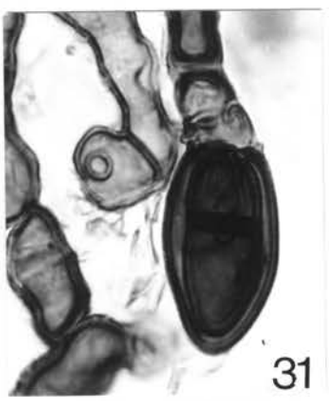

26

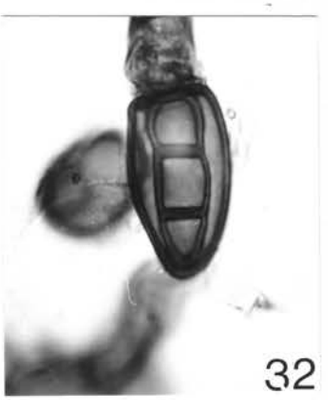

27

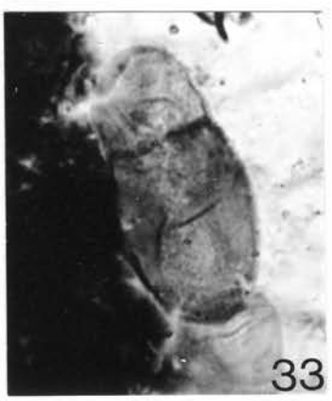

28


29


30


31


32


33

FIGURES 34 - 41.

Asterina kiandrensis sp. nov.

Fig. 34. Ungerminated spore on cuticle. Herb.DAR 17256. x1000.

Fig. 35. Germinated spore. Herb.DAR 17253(a). x1000

Fig. 36. Germinated spore with thickened large cell and germinal hyphopodium. Herb.DAR 17253(a). x1000.

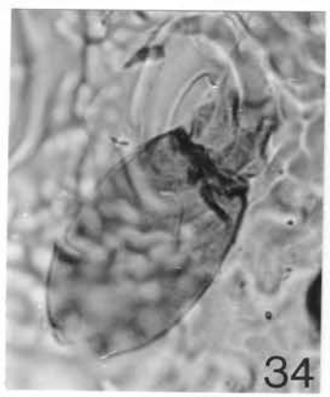
Fig. 37. Thickened large cell of ascospore showing sculpture. Herb.DAR 17256. x1000.

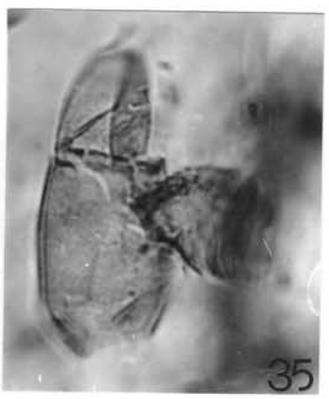
Figs.38-39. Germinated spores showing small cell surrounding germinal hypha. Herb.DAR 17253(a). both x1000.

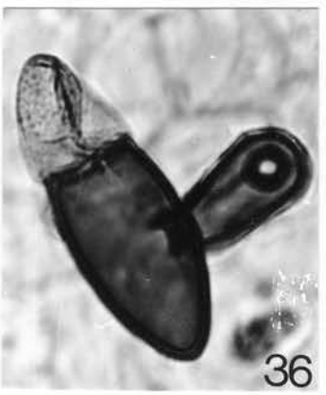
Morenoina kiandrensis sp. nov. on Myrtaceae.

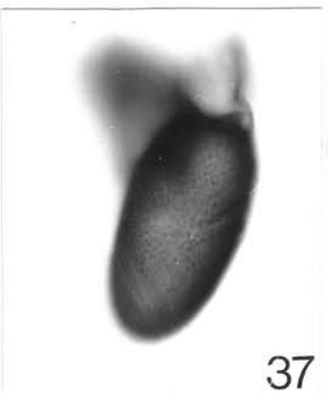
Fig. 40. Linear ascoma showing line of dehiscence and free hyphae produced from the margin. Herb.DAR 17231. x300.

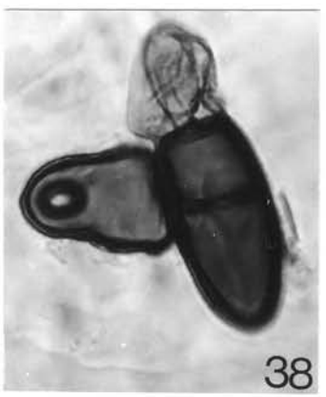
Fig. 41. Portion of ascoma showing free hyphae developed from marginal cells. Herb.DAR 17231. x680.


34

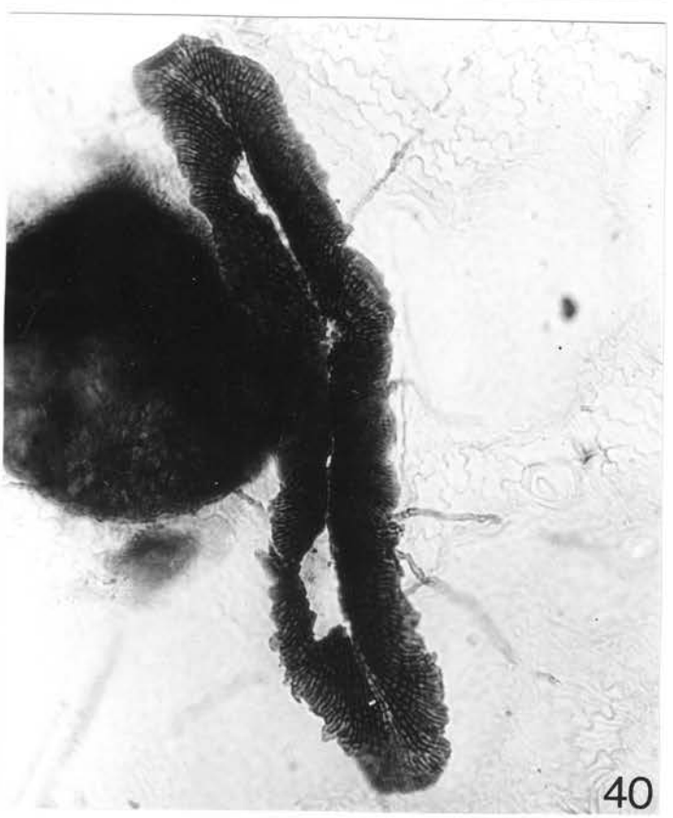

35


36


37


38


39


40


41

FIGURES 42 - 46.

Morenoina kiandrensis sp. nov.

Fig. 42. Young linear ascoma with hyaline hyphae along line of dehiscence. Herb.DAR 17231. x680.

Fig. 43. Young ascoma showing radial construction of the wall. Herb.DAR 17231. x680.

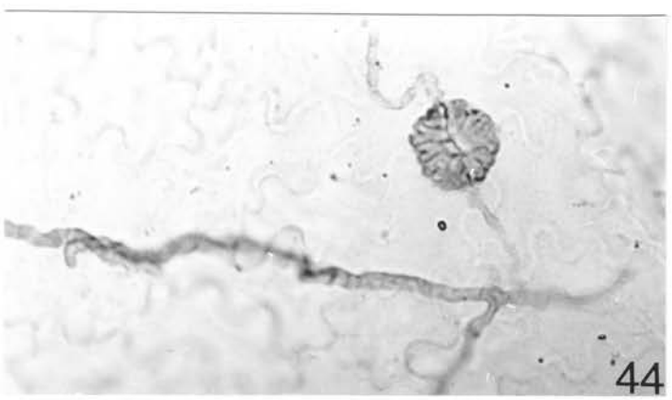
Fig. 44. Very young fructification attached to branched free hyphae. Herb.DAR 17231. x680.

Fig. 45. Young fructification showing dichotomously branched wall hyphae without cross-septa. Herb.DAR 17231. x680.

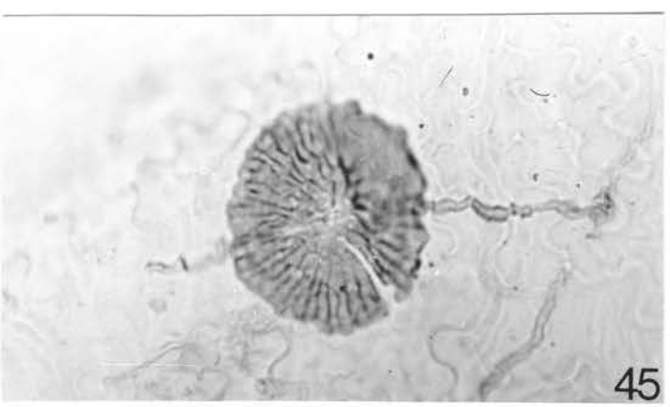
Fig. 46. Young radiate ascoma attached to free hyphae. Herb.DAR 17231. x680.

42

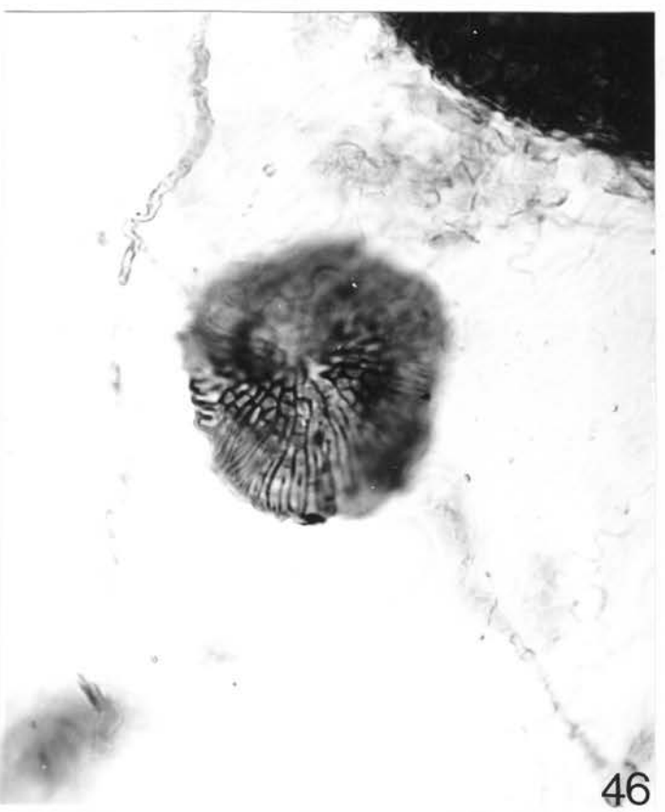
43



44



45



46

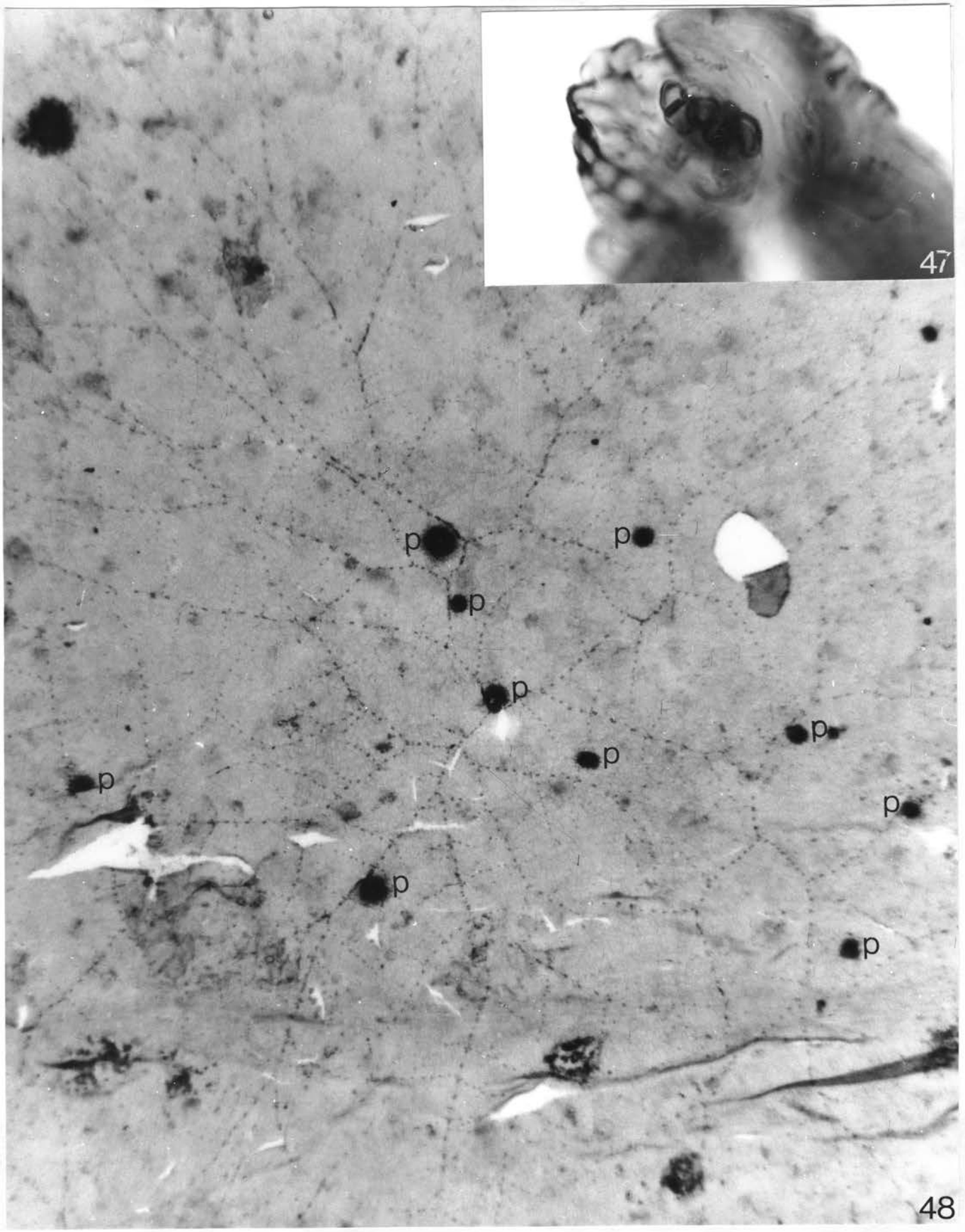
FIGURES 47 - 48.

Morenoina kiandrensis sp. nov.

Fig. 47. Group of spores within ascoma. Herb.DAR 17231. x1500.

Vizella discontinua sp. nov. on Myrtaceae.

Fig. 48. Colony showing dichotomous hyphal system, lateral branches and perithecia (p). Herb.DAR 17246. x60.


47
p
p
p
p
p
p
p
p
p
p
p
48

FIGURES 49 - 52.

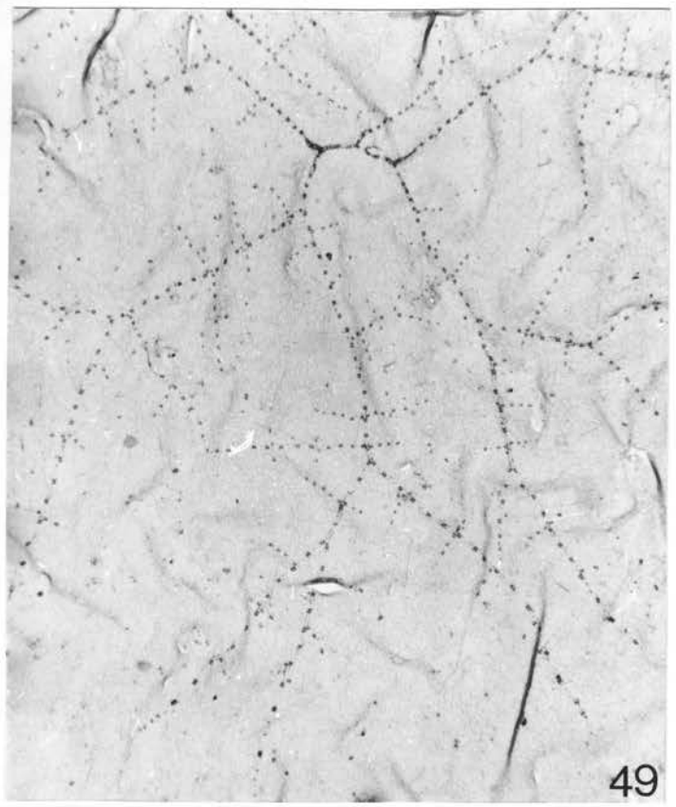
Vizella discontinua sp. nov.

Fig. 49. Portion of a colony. Note small number of dark cells in centre, alternating dark and light cells elsewhere. Herb.DAR 17206. x55.

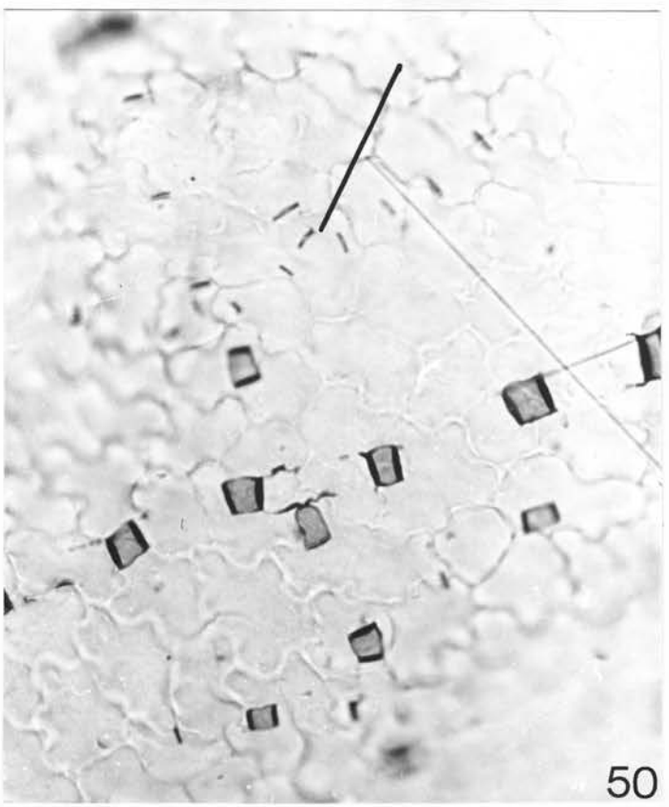
Fig. 50. Opposite lateral branches produced from main hyphal branches. Note cross-septa of ultimate lateral branches. Herb.DAR 17206. x680.

Fig. 51. Ascospores in fragmented perithecium. Herb. DAR 17247(b). x800.

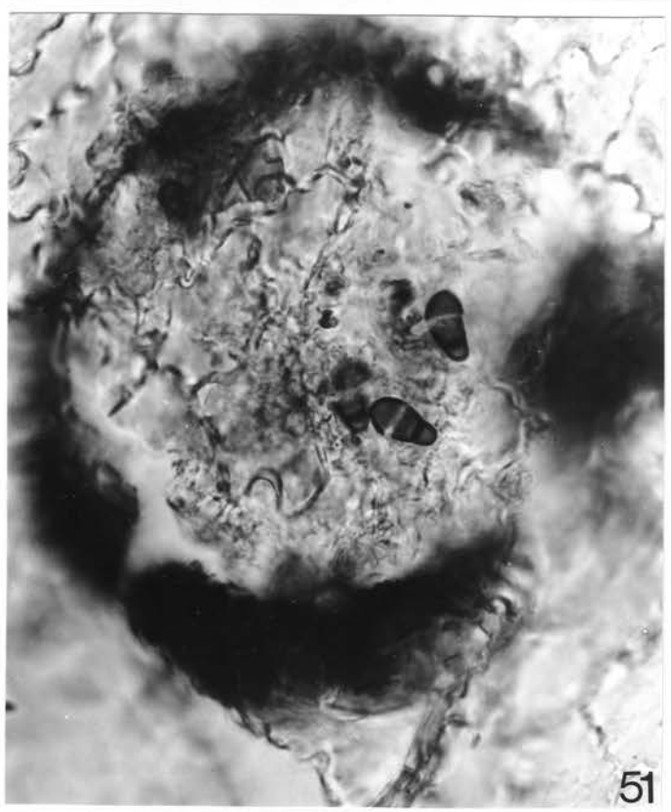
Fig. 52. Ascospores in perithecium. Herb.DAR 17204(a). x800.



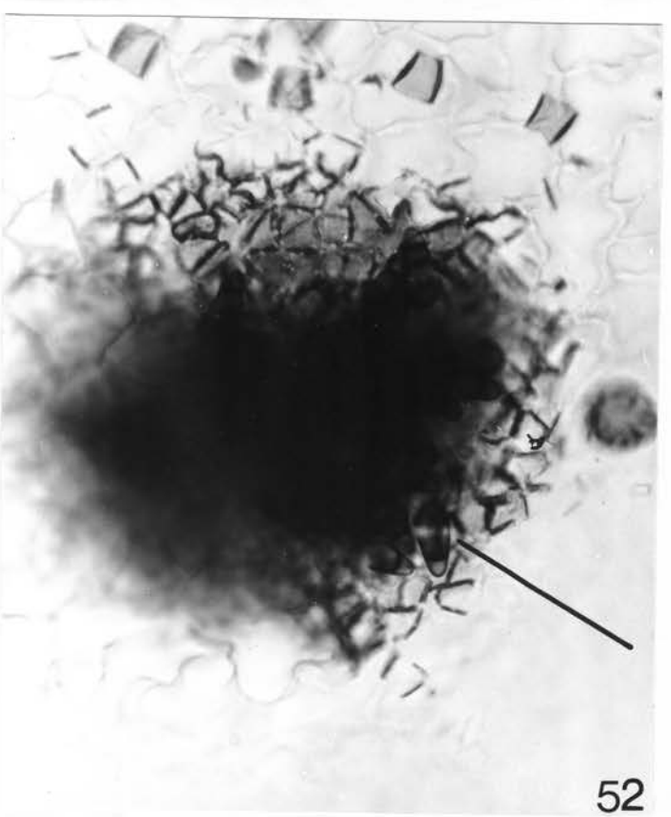
49



50



51



52

FIGURES 53 - 57

Vizella discontinua sp. nov.

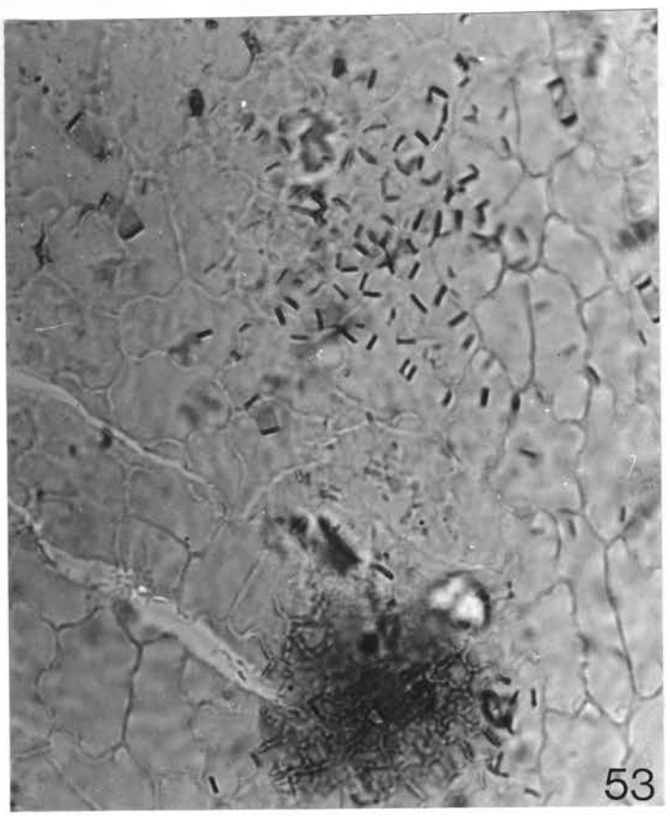
Fig. 53. Irregular cross-septa in young perithecium. Herb.DAR 17205(a). x680.

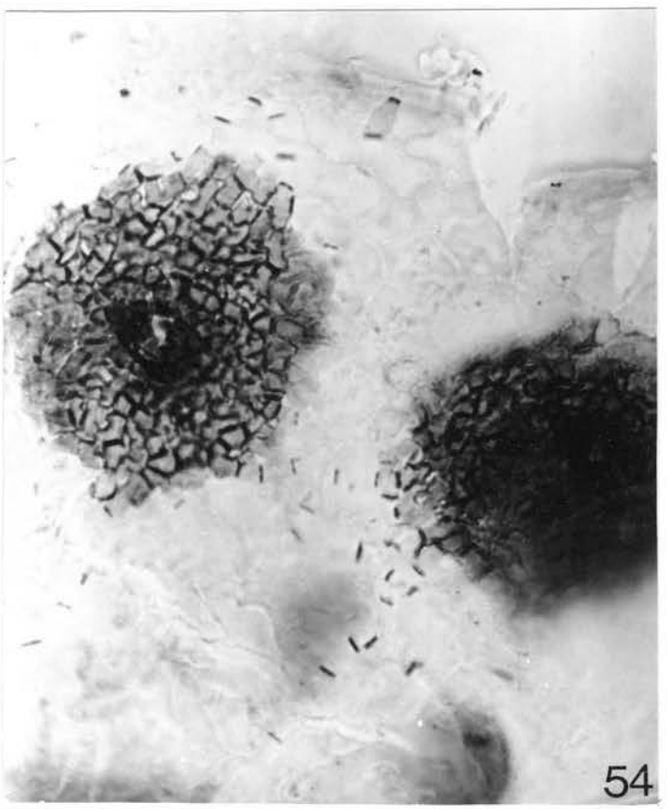
Fig. 54. Perithecia, and cross-septa of hyphae. Herb.DAR 17205(a). x680.

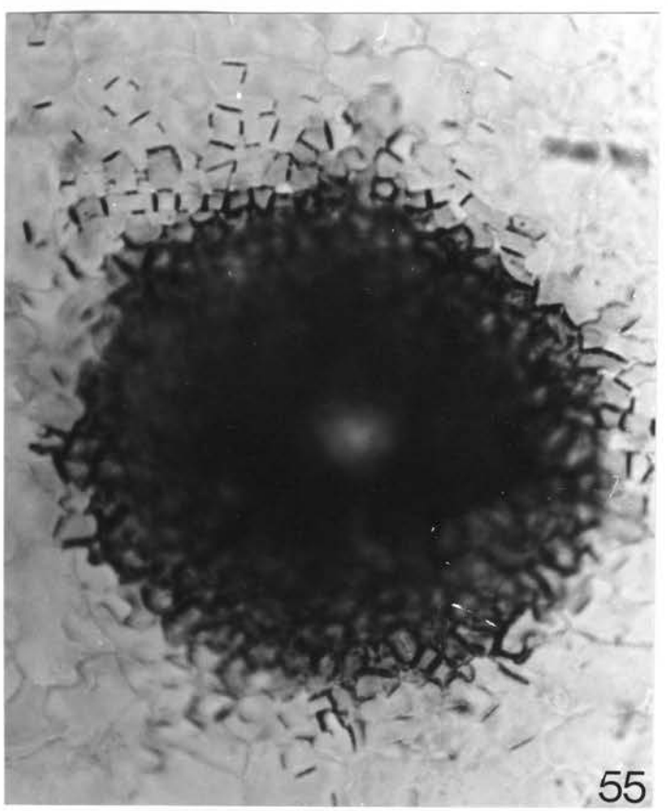
Fig. 55. Perithecium with hyphae radiating from margin. Herb.DAR 17205(a). x680.

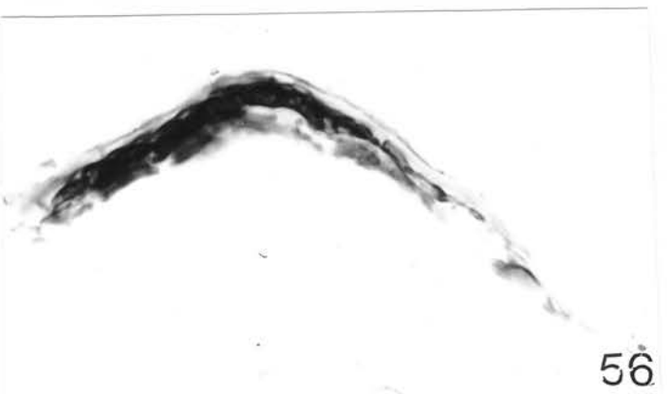
Fig. 56. Section through perithecium. Note cuticle covering wall and hyphae. Herb.DAR 17263. x680.

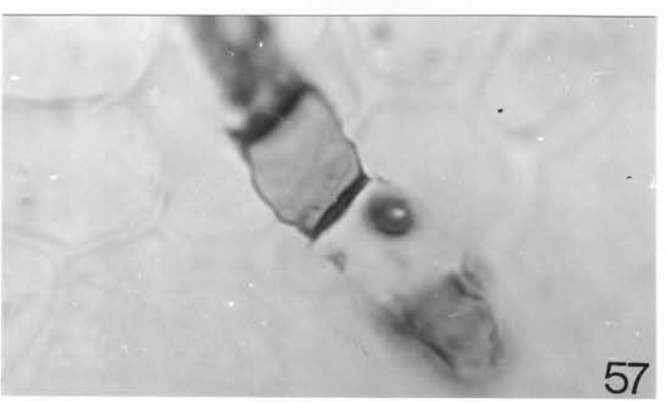
Fig. 57. Pore in upper face of long cell. Herb.DAR 17203. x2000.


53


54


55


56


57

FIGURES 58 - 62.

Vizella discontinua sp. nov.

Fig. 58. Centre of colony showing long cells with thick lateral walls and possible remnants of ascospore. Herb.DAR 17205(a). x240.

Fig. 59. Ostiole of perithecium. Herb.DAR 17205(a). x500.

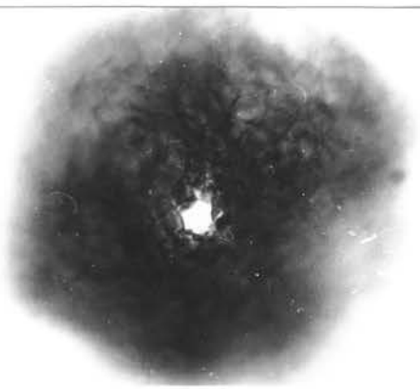
Entopeltacites attenuatus sp. nov. on Lauraceae.

Fig. 60. Colony showing branching pattern. Herb.DAR 17248. x36.

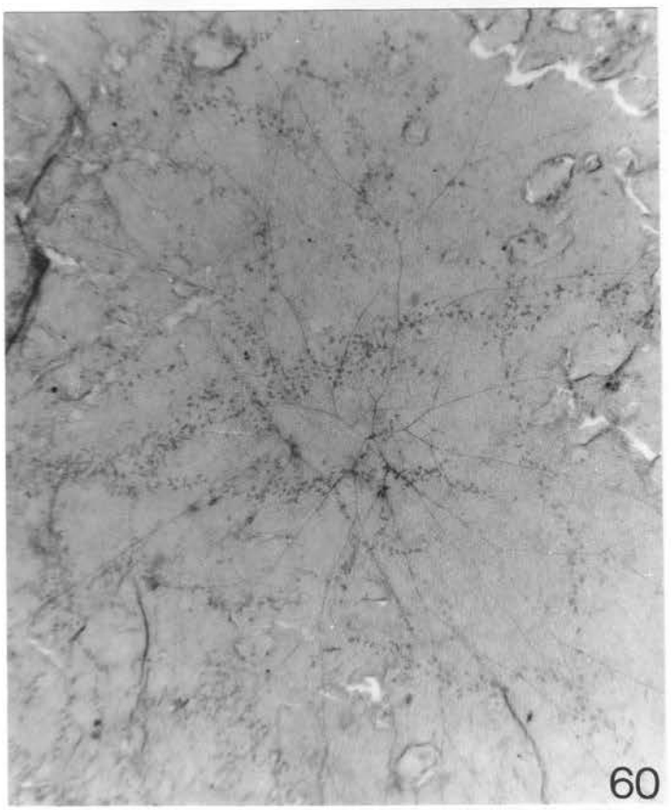
Fig. 61. Colony with fructification (f). Herb.DAR 17249. x36.

Fig. 62. Portion of colony. Note dichotomously branched main hyphae with lateral branches. Slide 307. x180.

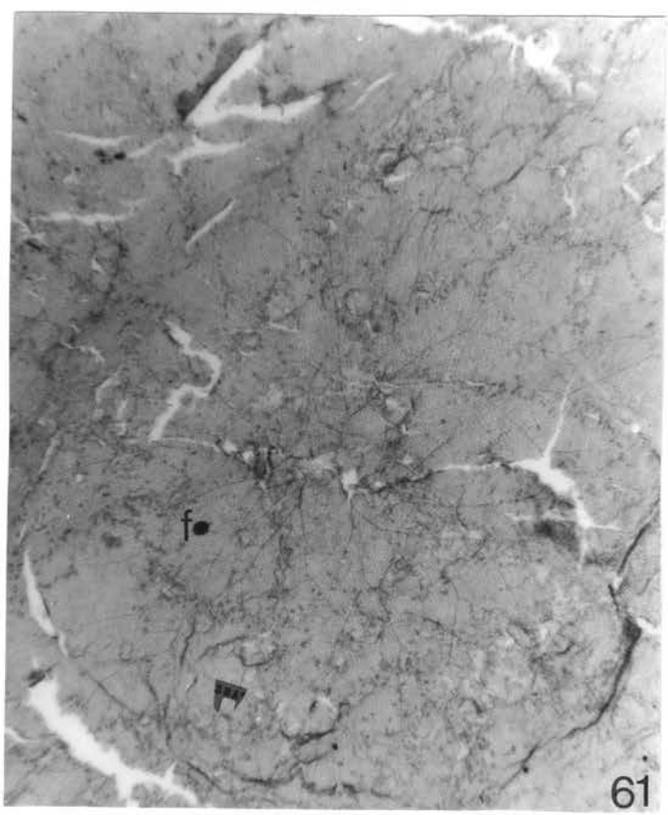
58



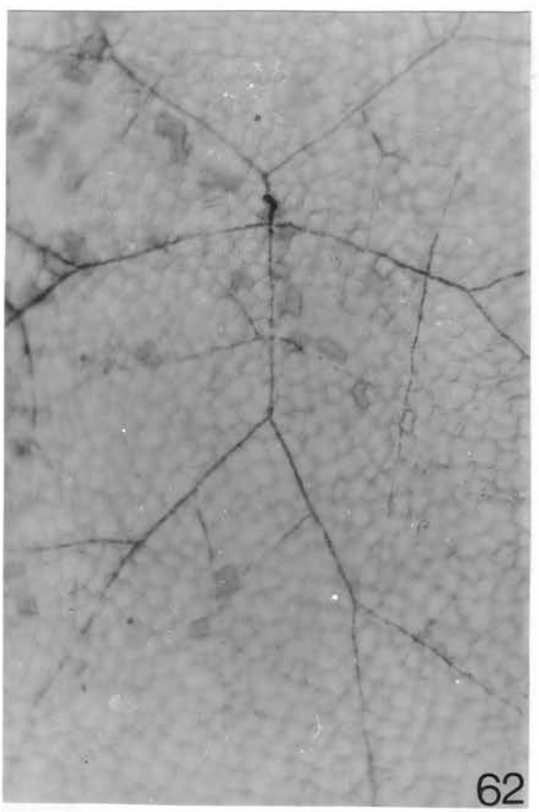
59



60



61



62

FIGURES 63 - 68.

Entopeltacites attenuatus sp. nov.

Fig. 63. Main hyphal branch with lateral branches. Herb.DAR 17248. x900.

Fig. 64. Spore? in centre of colony. Herb.DAR 17265. x1500.

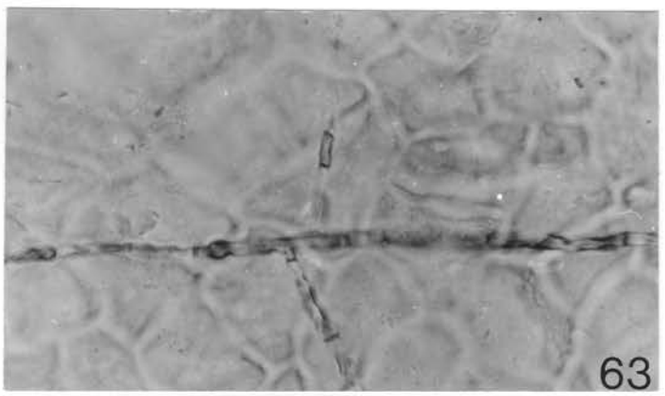
Fig. 65. Spore? in centre of colony. Herb.DAR 17248. x1500.

Fig. 66. Fructification showing pseudoparenchymatous wall and ostiole. Herb. DAR 17265. x300.

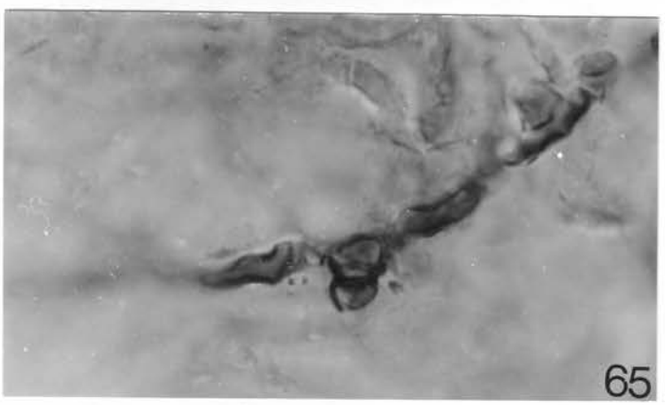
Fig. 67. Very thin layer of cuticle covering hyphae. Herb.DAR 17249. x900.

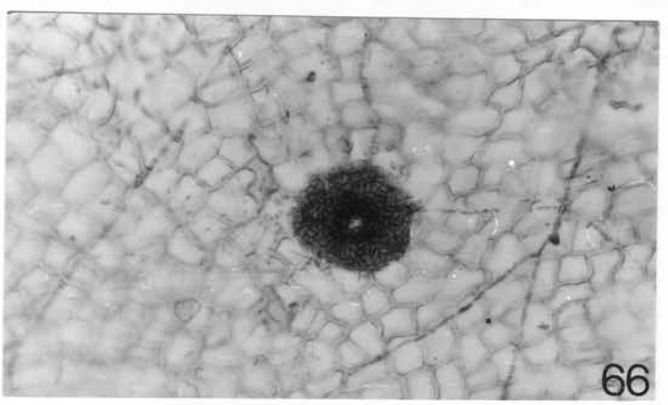
Entopeltacites irregulare sp. nov. on Lauraceae.

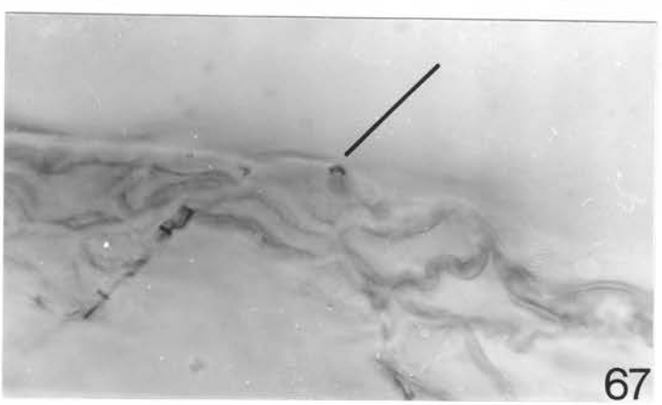
Fig. 68. Hyphae and fructifications. Herb.DAR 17213. x150.

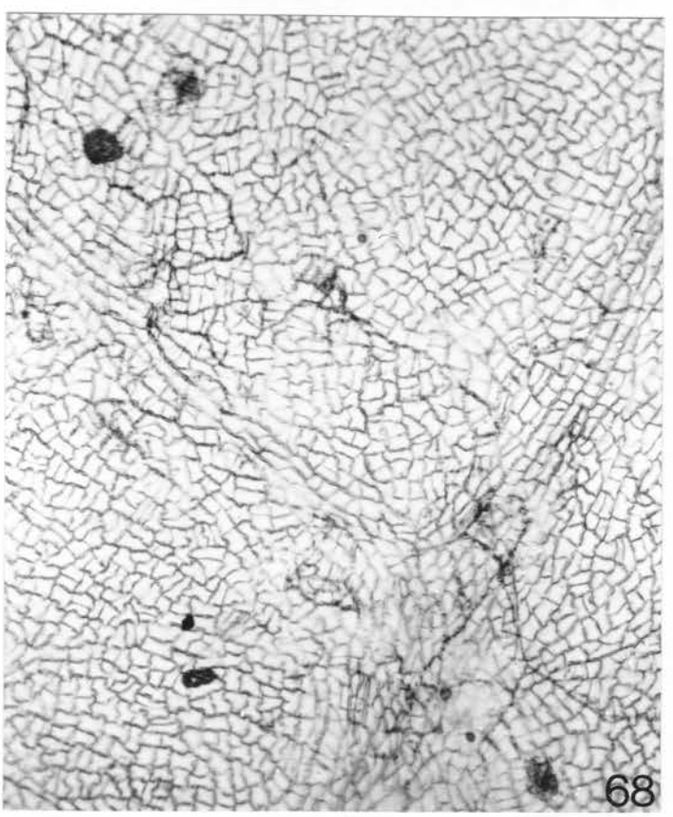

63


64


65


66


67


68

FIGURES 69 - 72.

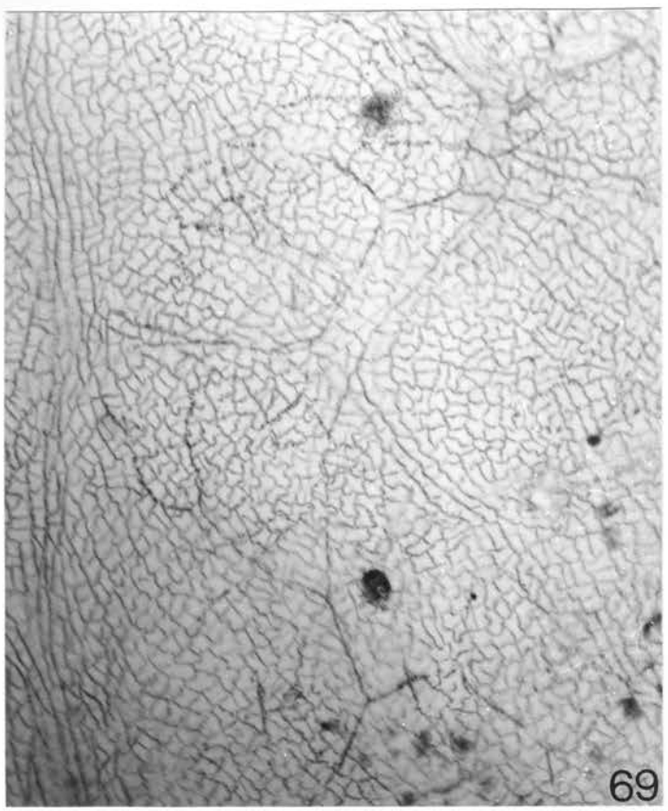
Entopeltacites irregulare sp. nov.

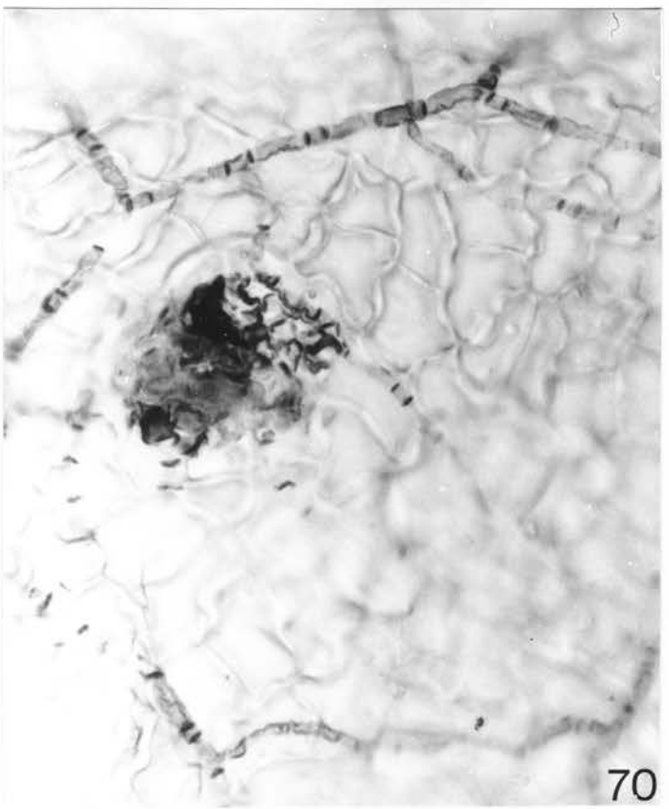
Fig. 69. Colonies showing hyphal branching. Herb.DAR 17213. x150.

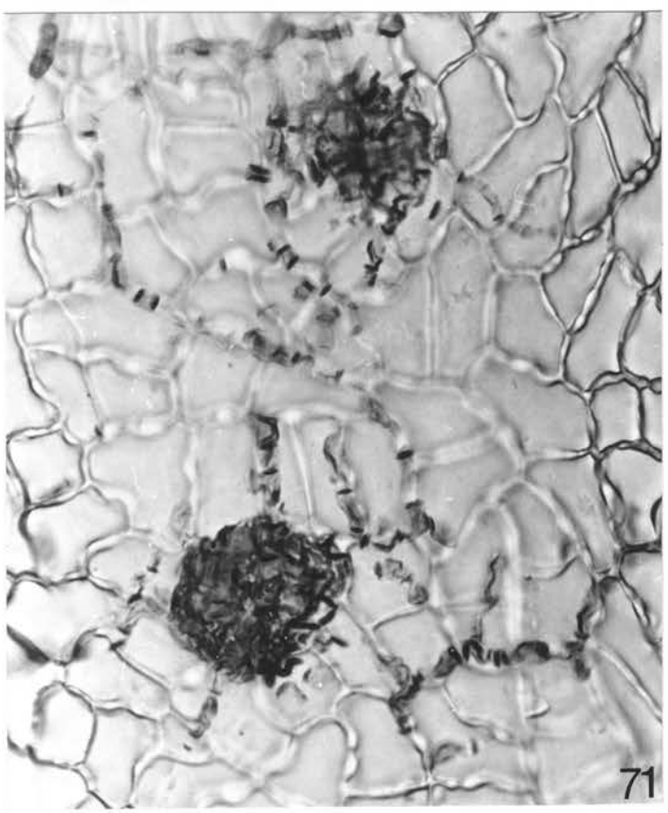
Fig. 70. Detail hyphae and small fructification. Note alternating long and short cells in some parts of the hyphae. Herb.DAR 17213. x680.

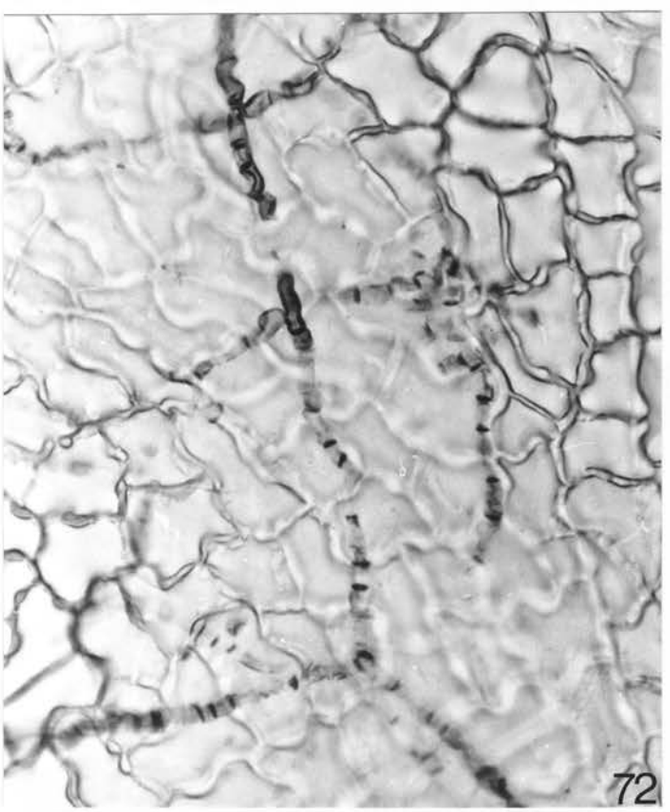
Fig. 71. Fructifications. Herb.DAR 17213. x680.

Fig. 72. Hyphae with irregular cells and opposite lateral branches. Herb.DAR 17213. x680.


69


70


71


72

FIGURES 73 - 77.

Entopeltacites irregulare sp. nov.

Fig. 73. Hyphae on surface of cuticle. Herb.DAR 17213. x800.

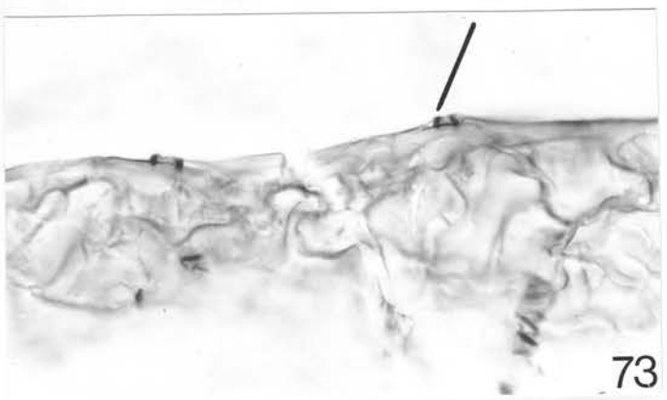
Fig. 74. Very thin layer of cuticle covering hyphae. Herb.DAR 17213. x1500.

Entopeltacites cooksoni sp. nov. on unidentified host.

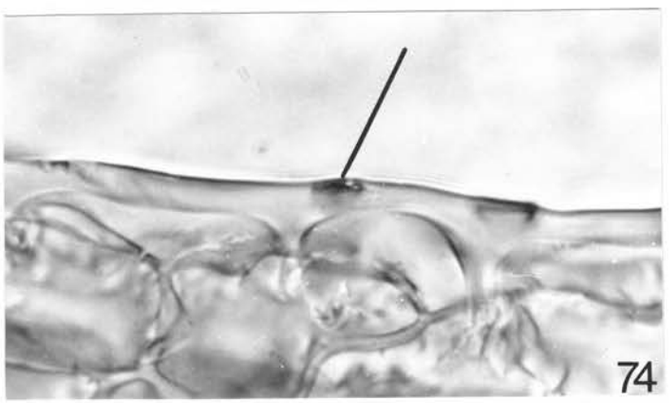
Fig. 75. Colony with fructification. Herb.DAR 17258. x100.

Fig. 76. Colonies showing dichotomous hyphal branching. Herb.DAR 17258. x100.

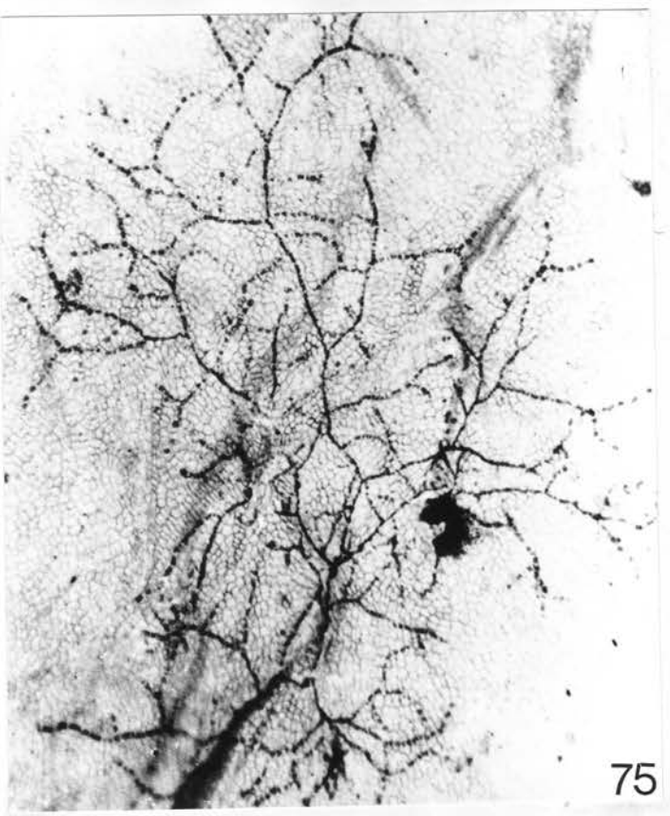
Fig. 77. Central portion of colony showing lateral "stigmopodia" and mixed dark and hyaline cells of lateral branches. Herb.DAR. 17258. x540.



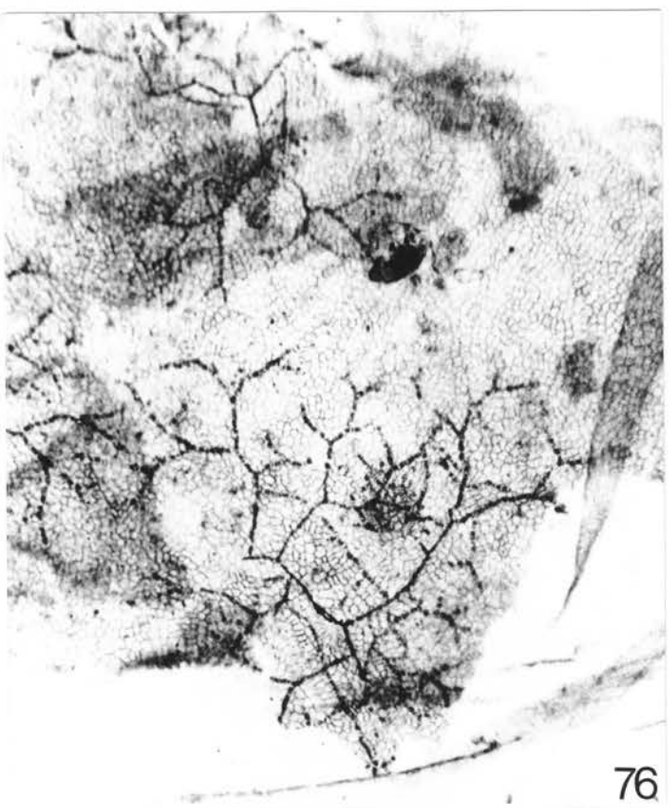
73



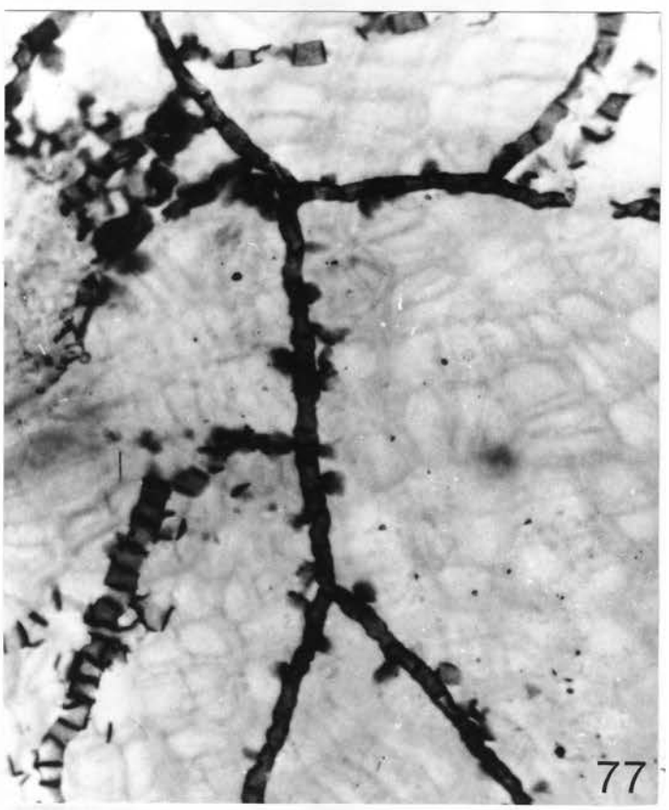
74



75



76



77

FIGURES 78 - 81

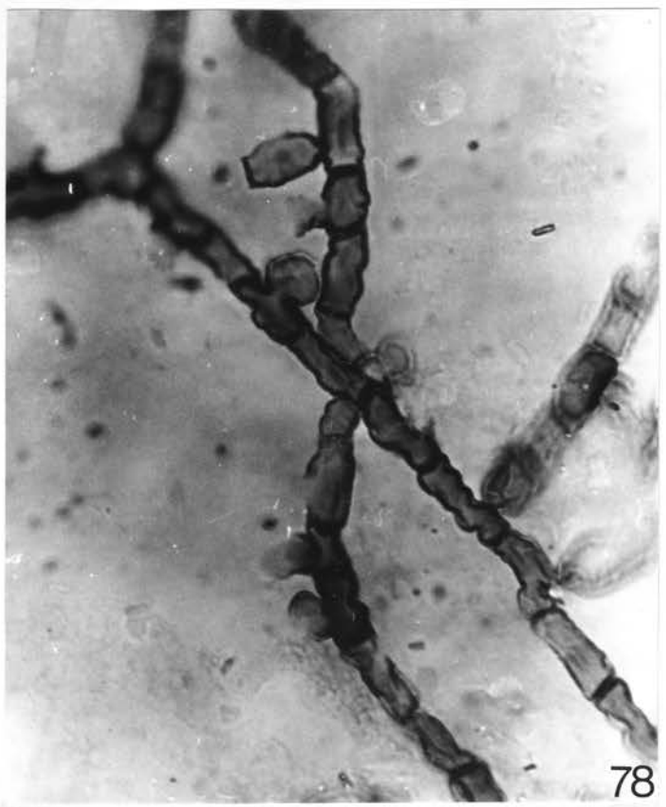
Entopeltacites cooksoni sp. nov.

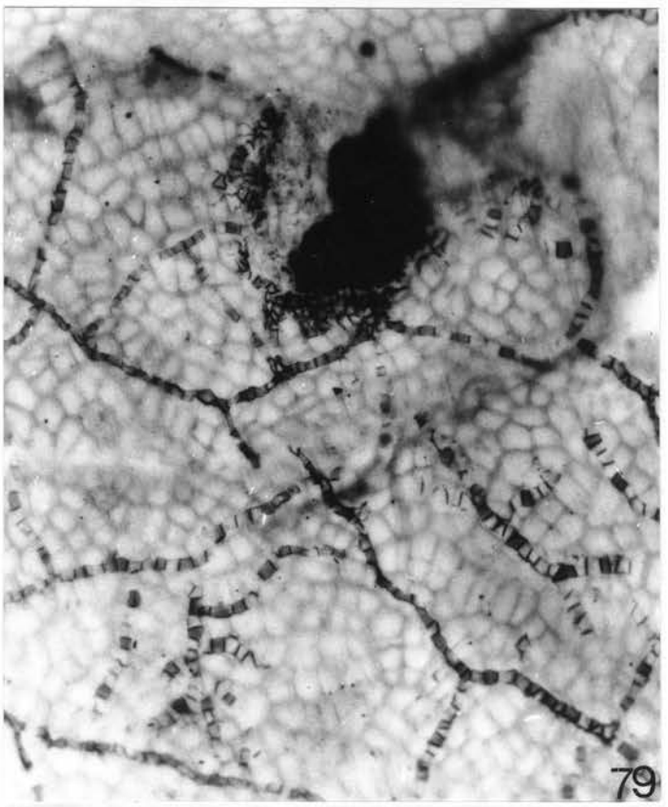
Fig. 78. Detail hyphae with lateral "stigmopodia". Herb.DAR 17258. x1350.

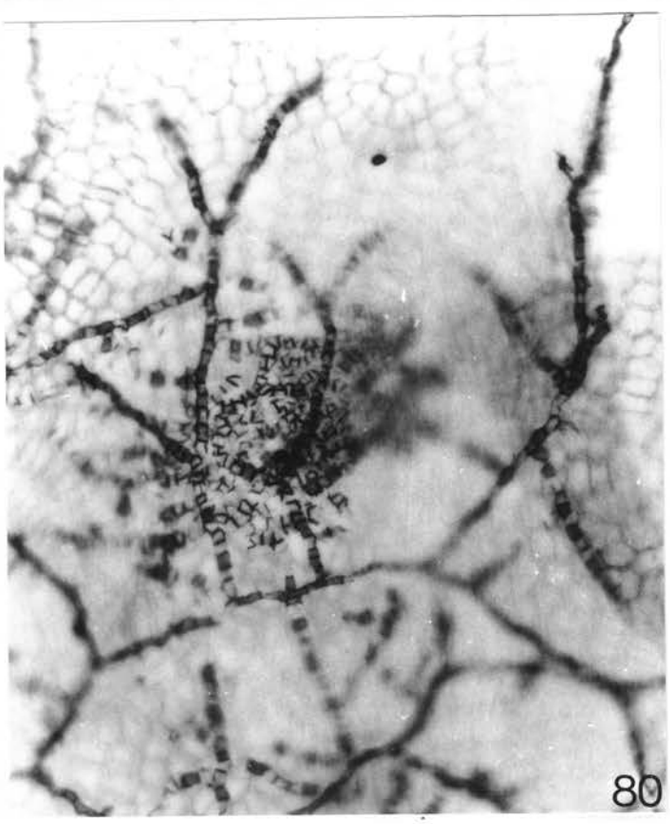
Fig. 79. Portion of colony showing structure of hyphae and fragmentary old fructification. Herb.DAR 17258. x270.

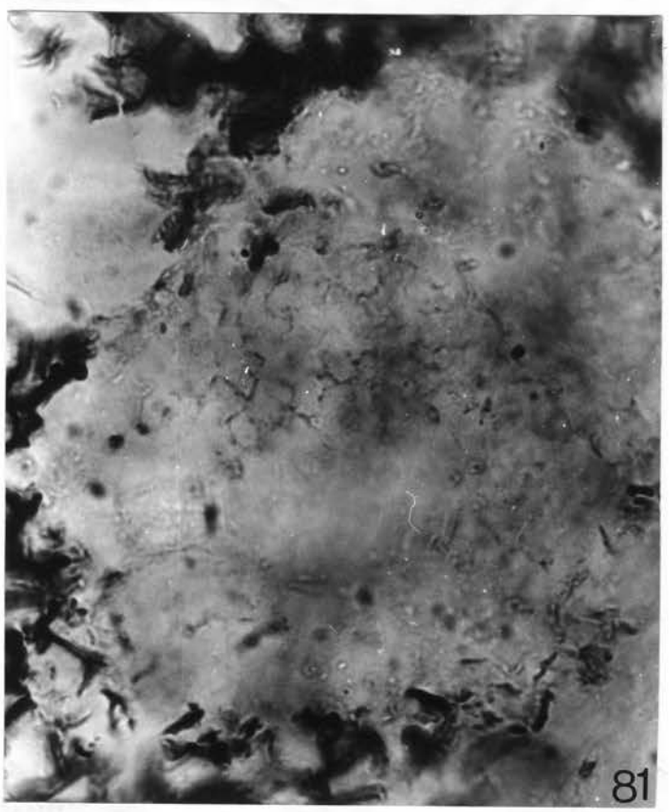
Fig. 80. Portion of colony showing irregular cross-septa in young fructification. Herb.DAR 17258. x270.

Fig. 81. Fragmentary basal layer of fructification. Herb.DAR. 17258. x1350.


78


79


80


81

FIGURES 82 - 87

Vizella memorabilis comb. nov.

Fig. 82. Cuticular layer covering hyphae in side view. x 1200.

Fig. 83. Cuticular striations continuous across some portions of hyphae. x 1200

Fig. 84. Layer of cuticle covering pycnidium wall. x 1200.

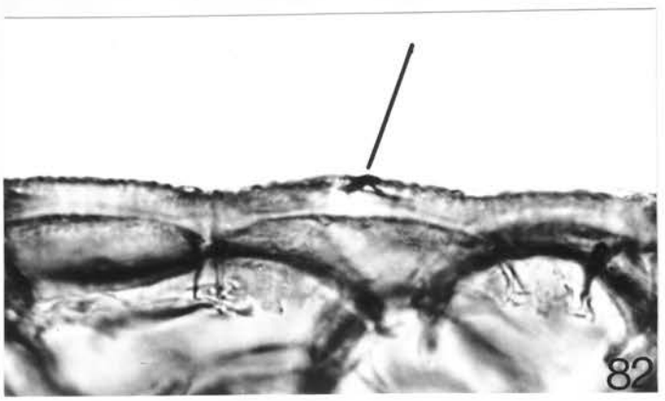
Vizella hendrickxii (Hansf.) Hughes.

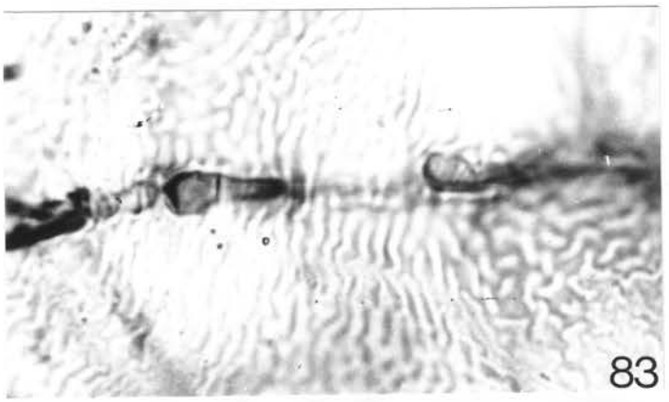
Fig. 85. Ascospore. Herb. IMI. 47458. x 1500.

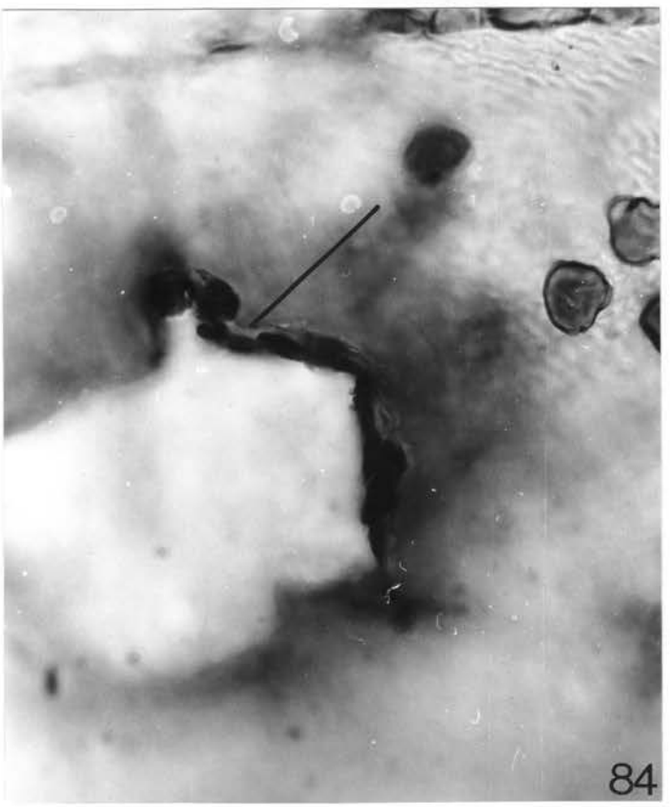
Fig. 86. Hyphae. Note dichotomous branching and alternating long and short cells. Herb. IMI. 47458. x90.

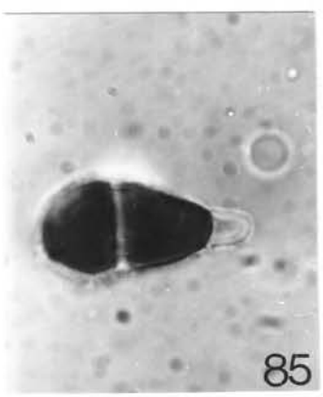
Vizella sp. on *Acmena smithii*

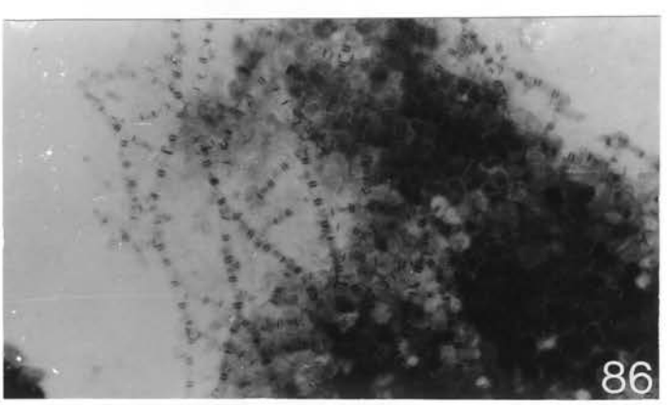
Fig. 87 Ascospores. Epidermal strip, treated ca. ten minutes 70% Jeffrey's solution. x 900.

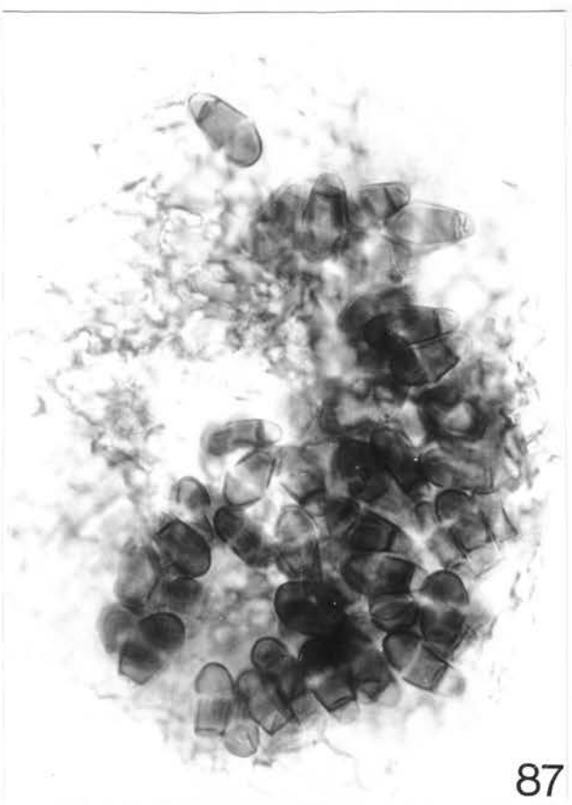

82


83


84


85


86


87

FIGURES 88 - 92.

Vizella sp. (modern) on Acmena smithii

Fig. 88. Section through sub-cuticular perithecium showing 2-celled ascospore with hyaline band. x 900.

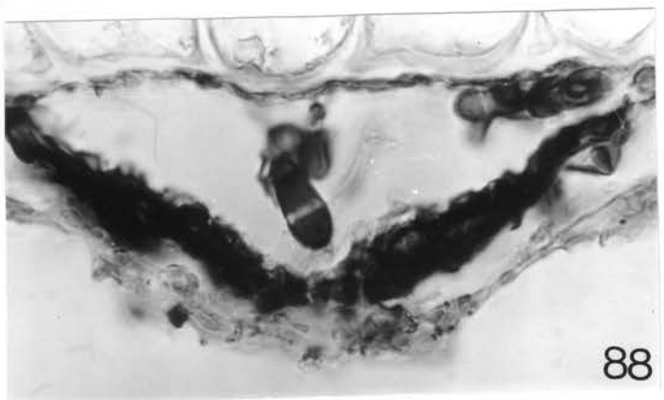
Fig. 89. Section through perithecium showing immature spores within ascus. x 900

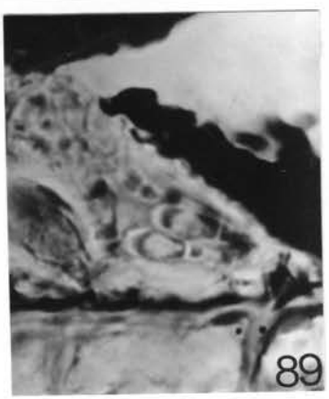
Fig. 90. Vizella interrupta hyphae on leaf surface of Tieghemopanax elegans. Herb.DAR. 4413. x 300.

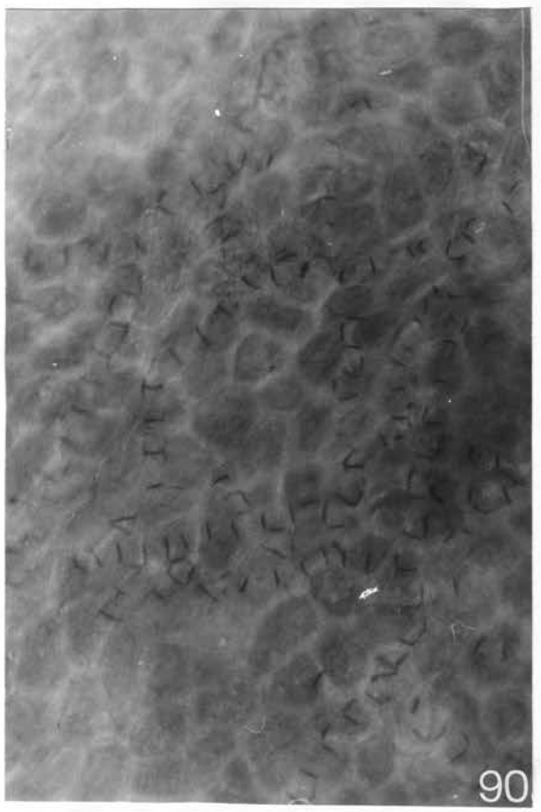
Notothyrites kiandrensis sp. nov. on Lauraceae.

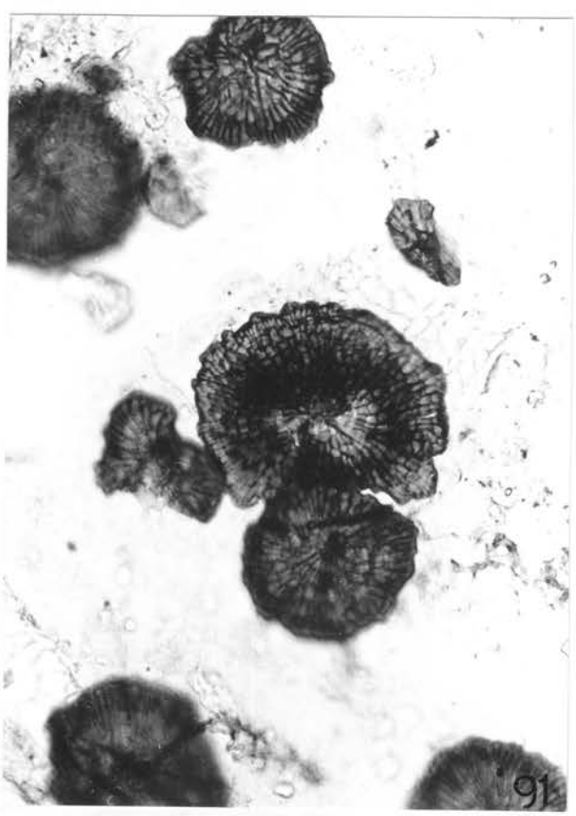
Fig. 91. Young ascoma without ostiole on cuticle. Herb.DAR. 17222. x225.

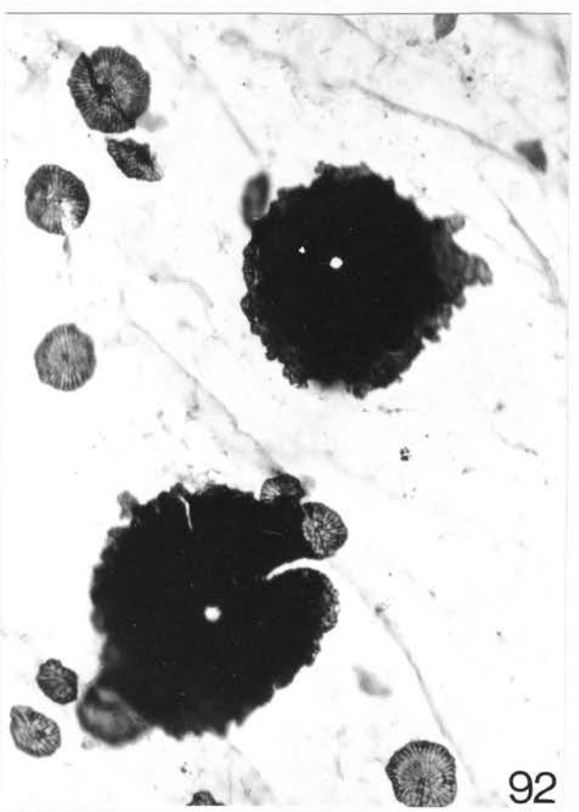
Fig. 92. Ascomata with ostioles on cuticles. Note dark walls of ascoma. Herb.DAR. 17222. x115.


88


89


90


91


92

FIGURES 93 - 97

Notothyrites kiandrensis sp. nov. on Lauraceae.

Fig. 93. Isolated ascoma. Note dark ring of cells around ostiole. Herb.DAR 17266. x300.

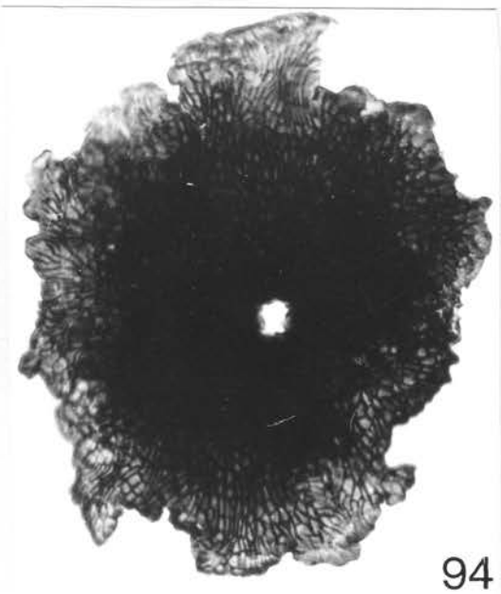
Fig. 94. Isolated ascoma showing hyphal structure at the margin. Herb.DAR 17266. x300.

Fig. 95. Ascoma with associated *Callimothallus*. Herb.DAR 17222. x300.

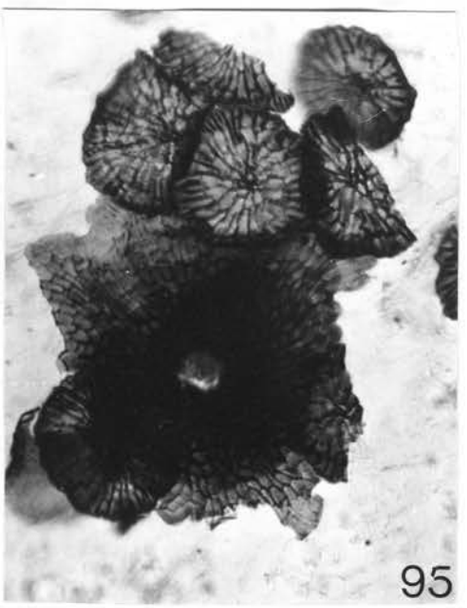
Fig. 96. Detail portion fig.94 above. Herb.DAR 17266. x680.

Fig. 97. Collar of dark cells surrounding the ostiole (portion of fig.93 above). Herb.DAR.17266. x680.

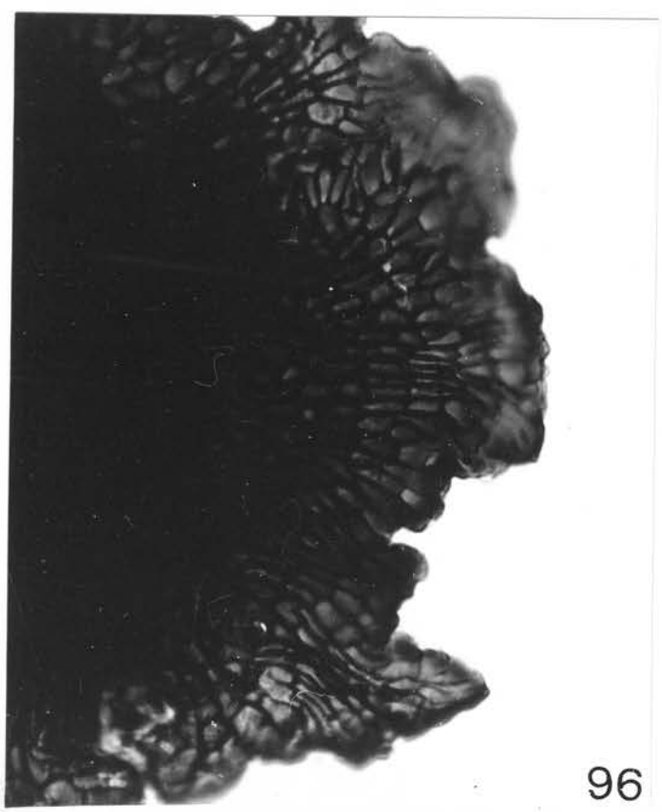
93



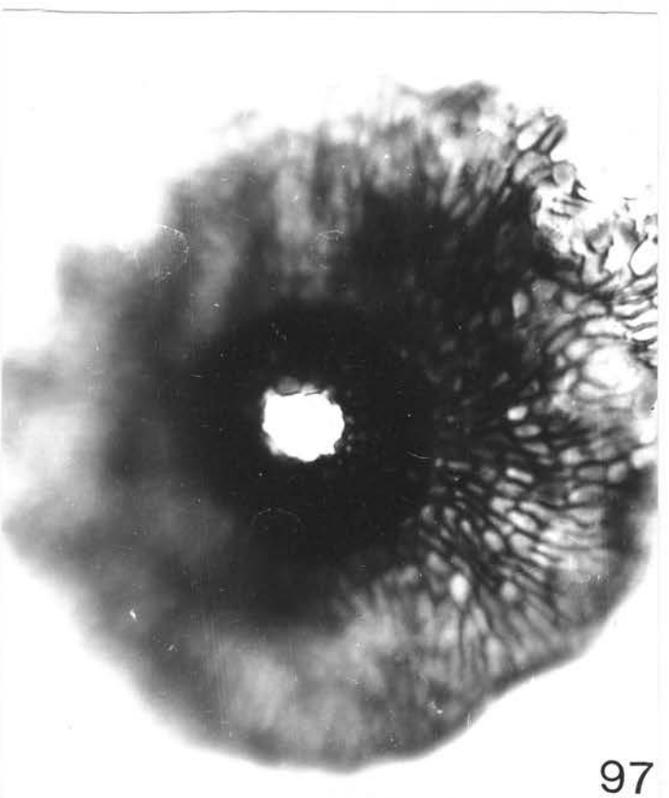
94



95



96



97

FIGURES 98 - 104

Notothyrites kiandrensis sp. nov.

Fig. 98. Detail of ostiole. Herb.DAR 17266. x600.

Fig. 99. Detail of portion of fig.95 above. Apparent organic continuity with ascoma of Callimothallus. Herb. DAR 17222. x800.

Fig.100. As above, lower focus, showing distinct margin of Callimothallus ascoma. Herb.DAR 17222. x800.

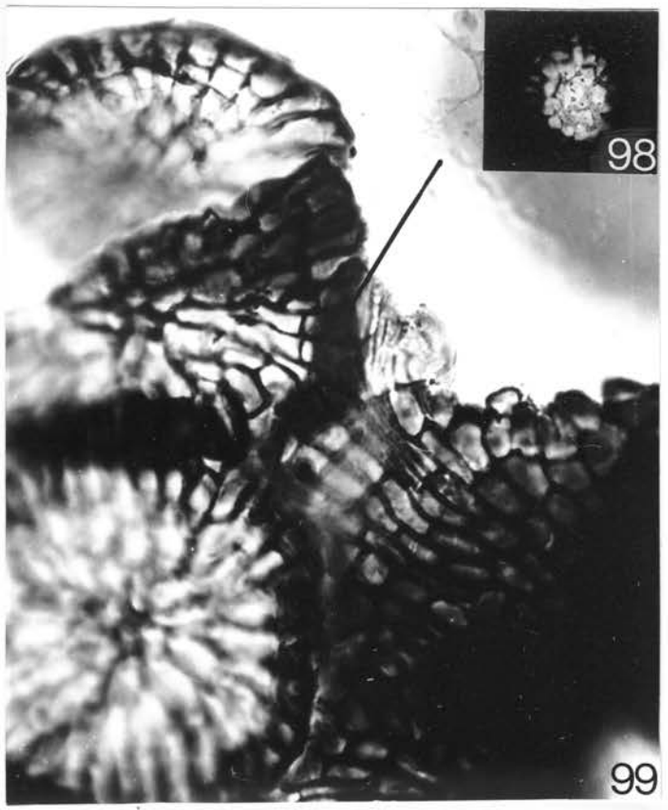
Microthyriacites kiandrensis sp. nov. on Myrtaceae.

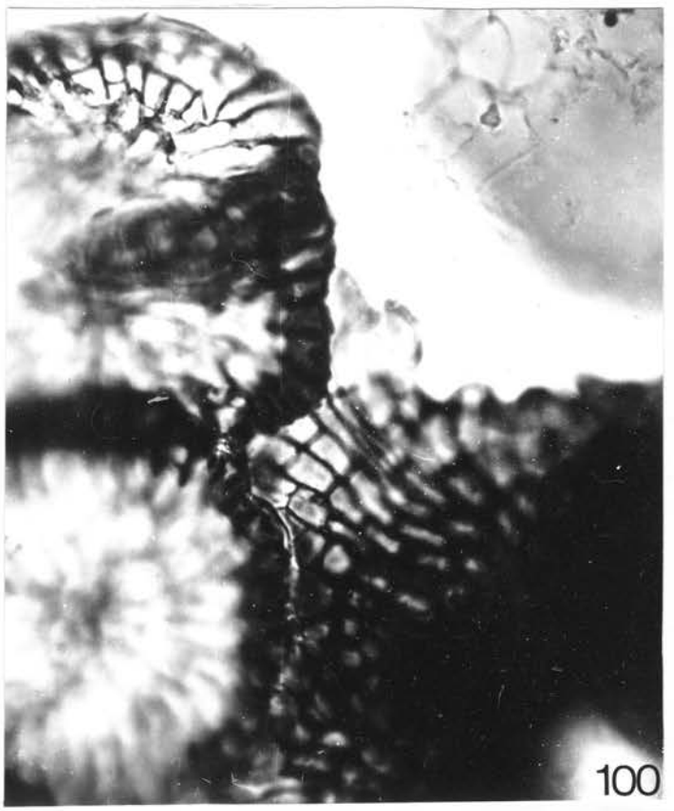
Fig.101. Small ascoma showing dichotomous branching of wall hyphae. Note absence of cross-septa. Herb.DAR 17227. x600.

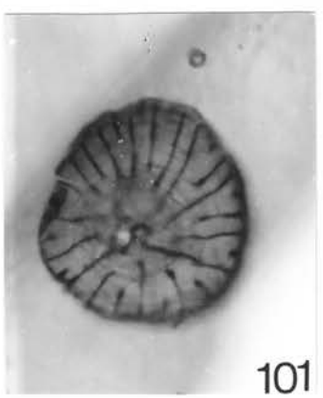
Fig. 102. Small ascoma. Note indistinct cross-septa towards centre. Herb.DAR 17243. x600.

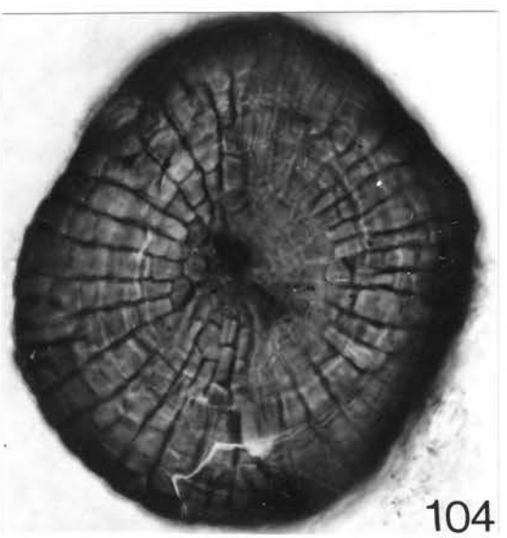
Fig. 103. Older ascoma with dark central cell. Herb.DAR 17207. x600.

Fig. 104. Large ascoma. Herb.DAR 17220. x600.









103

FIGURES 105 - 112

Microthyriacites kiandrensis sp. nov. on Myrtaceae.

Fig. 105. Pale hyphae of basal layer of ascoma. Herb.DAR 17225. x600.

Fig. 106. Pale hyphae of basal layer with indistinct cross-septa. Herb.DAR 17214. x600.

Fig. 107. Slightly inflated hyphal extremities at margin of ascoma. Herb.DAR 17207. x900.

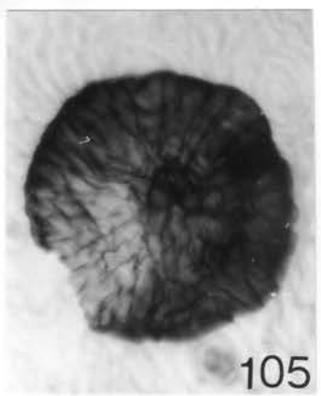
Fig. 108. Bordered pore in outer wall of ascoma. Herb.DAR 17252. x1500.

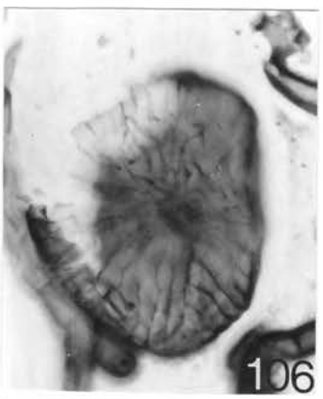
Fig. 109. Detail of central portion of fig. 103 above. Herb.DAR 17207. x1500.

Fig. 110. Central portion of ascoma. Herb.DAR 17239(a). x1500.

Fig. 111. Hyphae associated with ascoma. Herb.DAR 17252. x900.

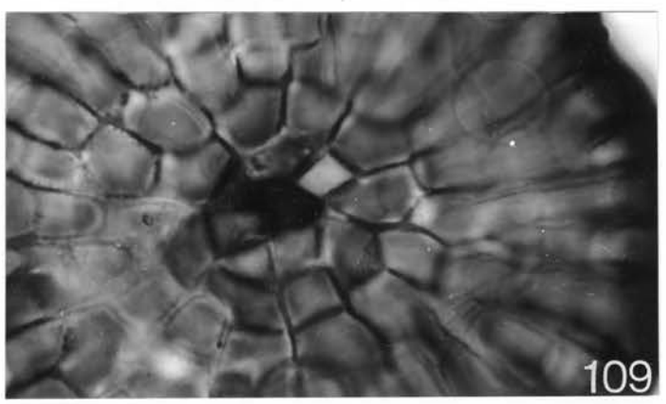
Fig. 112. Hyphae associated with ascoma. Herb.DAR.17252. x900.

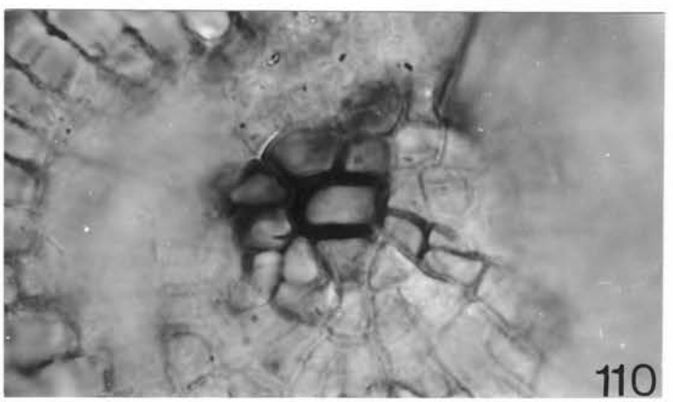

105

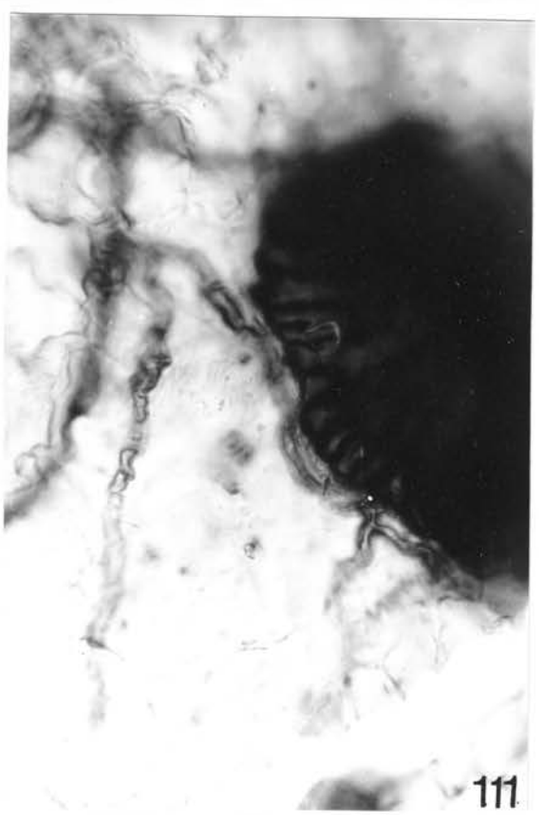

106

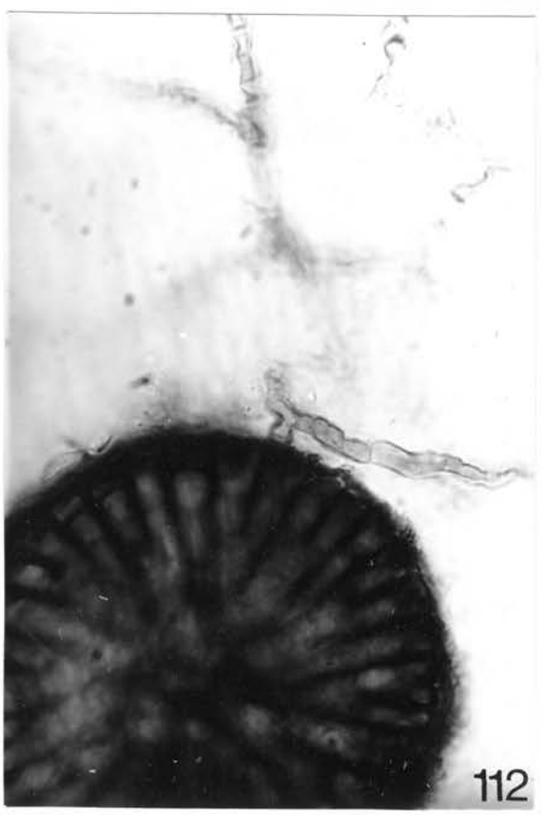

107


108


109


110


111


112

FIGURES 113 - 116

Microthyriacites kiandrensis sp. nov.

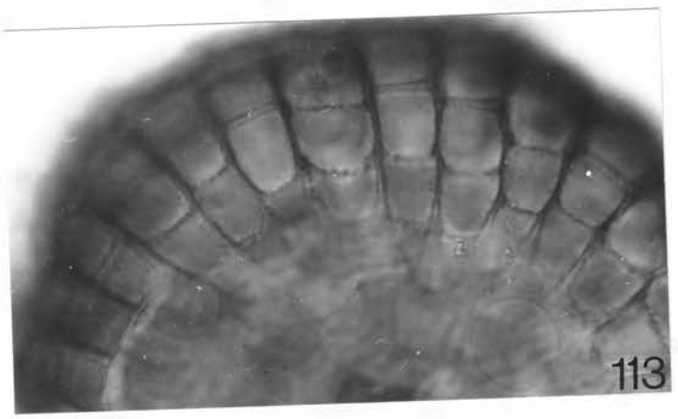
Fig. 113. Detail of portion of ascomal wall. Note cross-septa less distinct than longitudinal walls. Herb.DAR 17207. x1500.

Microthyriacites obscurus sp. nov. on Myrtaceae.

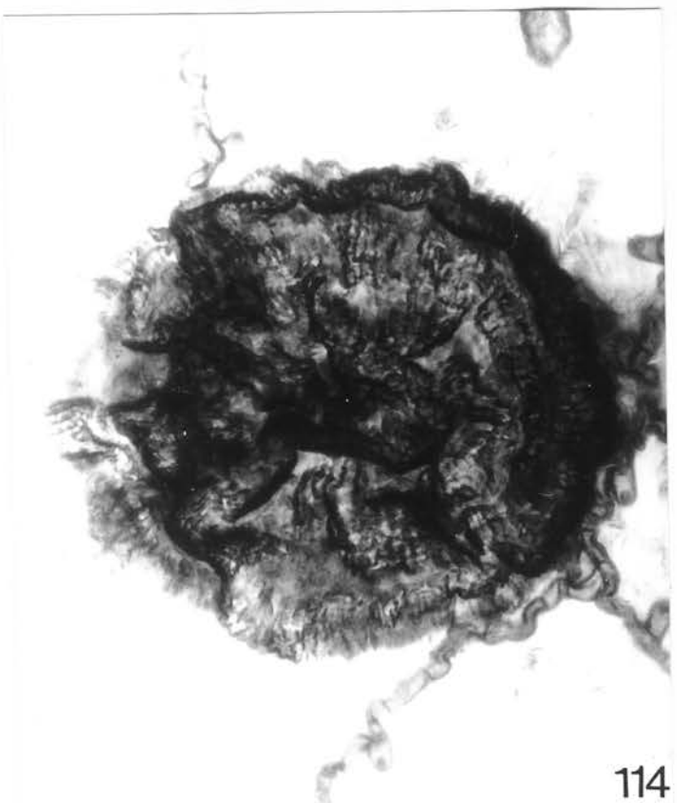
Fig. 114. Large ascoma with folded wall. Herb.DAR 17235. x400.

Fig. 115. Ascoma. Herb.DAR 17212. x400.

Fig. 116. Ascoma. Note paler "frilled" marginal area. Herb.DAR 17255. x400.

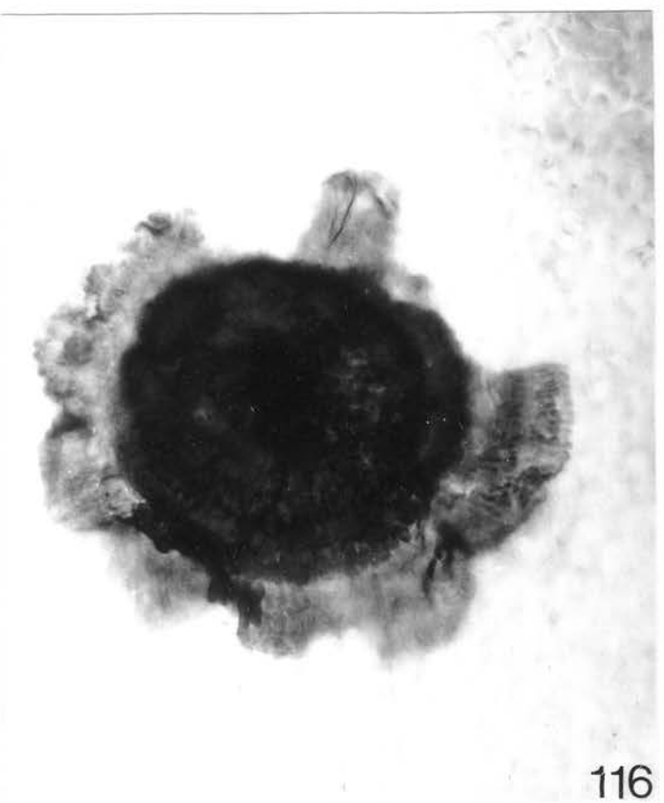


113



114

115



116

FIGURES 117 - 120

Microthyriacites obscurus sp. nov.

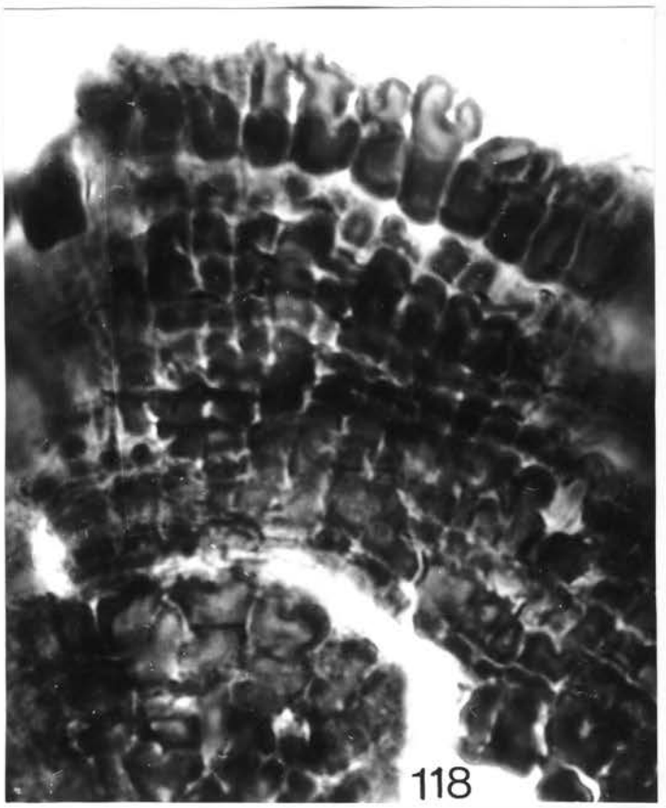
Fig. 117. Central portion of ascoma. Note pale and dark hyphal walls. Herb. DAR 17250. x1200.

Fig. 118. Margin of ascoma with lobed hyphal extremities. Herb.DAR 17212. x2000.

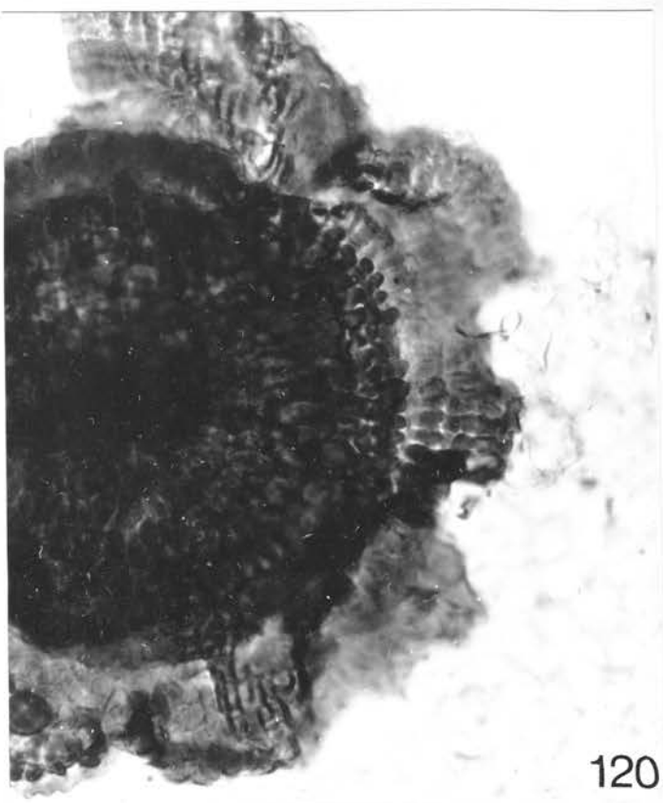
Fig. 119. Fimbriate margin of ascoma. Herb.DAR 17250. x1200.

Fig. 120 Portion of ascoma (see fig.116 above). Note growth of pale marginal area from beneath dark hyphae of central area. Herb.DAR 17255.x680


117


118


119


120

FIGURES 121- 126

Microthyriacites delicatus sp. nov. on Myrtaceae.

Fig. 121. Ascoma with free hyphae radiating over cuticle. Herb.DAR 17224.x240.

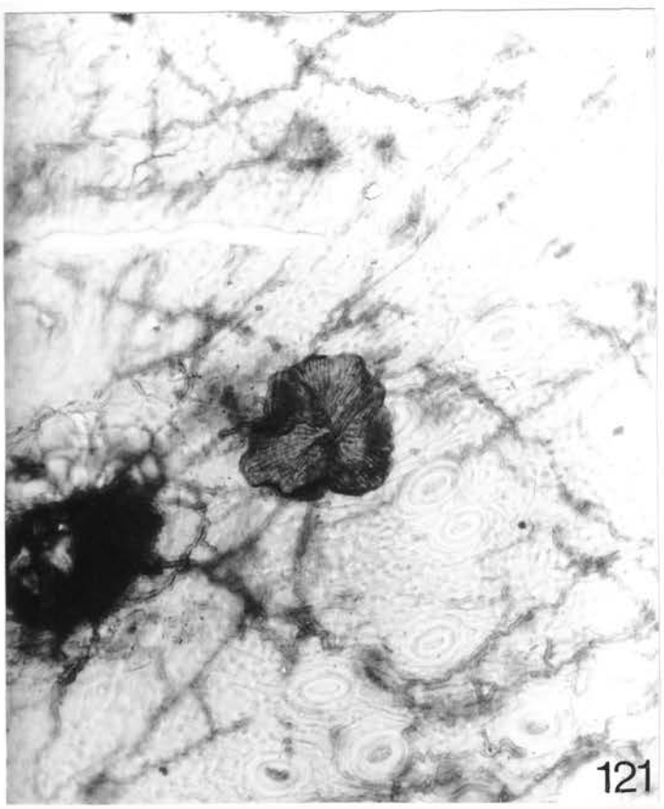
Fig. 122. Ascoma with attached free hyphae and thick-walled central cells. Herb.DAR. 17234. x480.

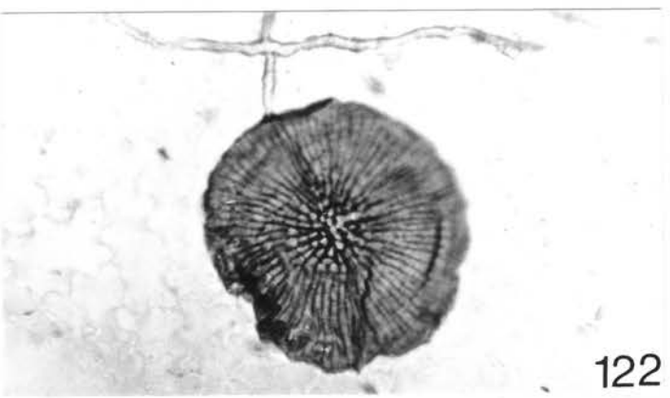
Fig. 123. Ascoma with hyphae. Herb.DAR.17224. x480.

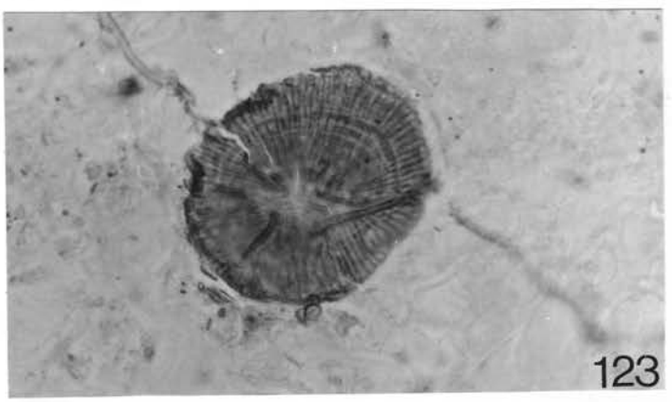
Fig. 124. Ascoma without hyphae. Herb.DAR 17228. x480.

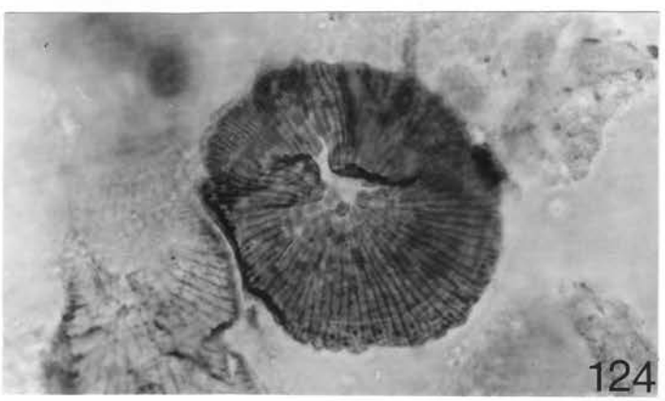
Fig. 125. Ascoma with hyphae. Note indistinct cross-septa. Herb.DAR 17224. x 480.

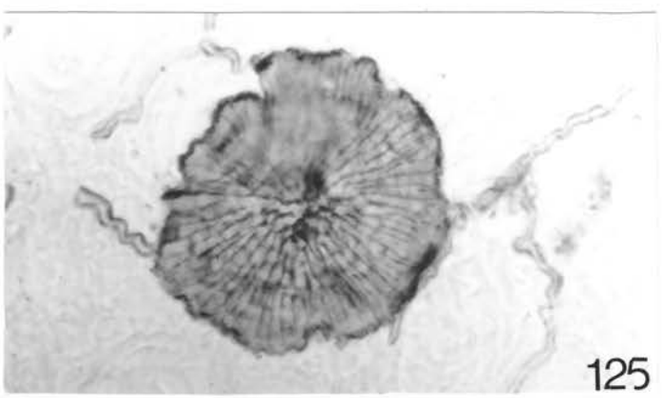
Fig. 126. Portion of ascoma showing attachment of hyphae at margin. Herb.DAR 17228. x1200.


121


122


123


124


125


126

FIGURES 127 - 132.

Microthyriacites delicatus sp. nov.

Fig. 127. Portion of ascoma showing cross-septa and lobed hyphal extremities Herb.DAR 17224. x1300.

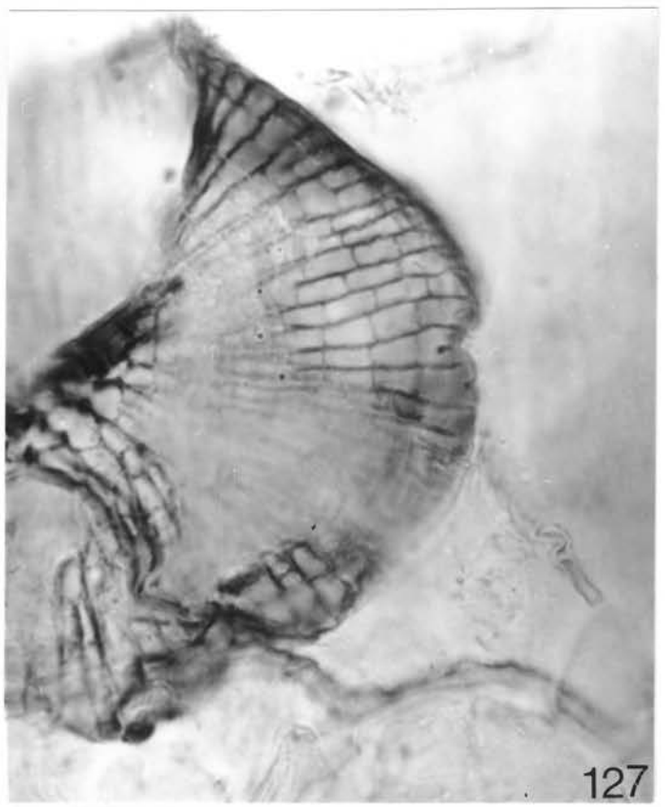
Fig. 128. Portion of fig.122 above. Note thick walled central cells and pore in branched hyphae. Herb.DAR 17234. x1200.

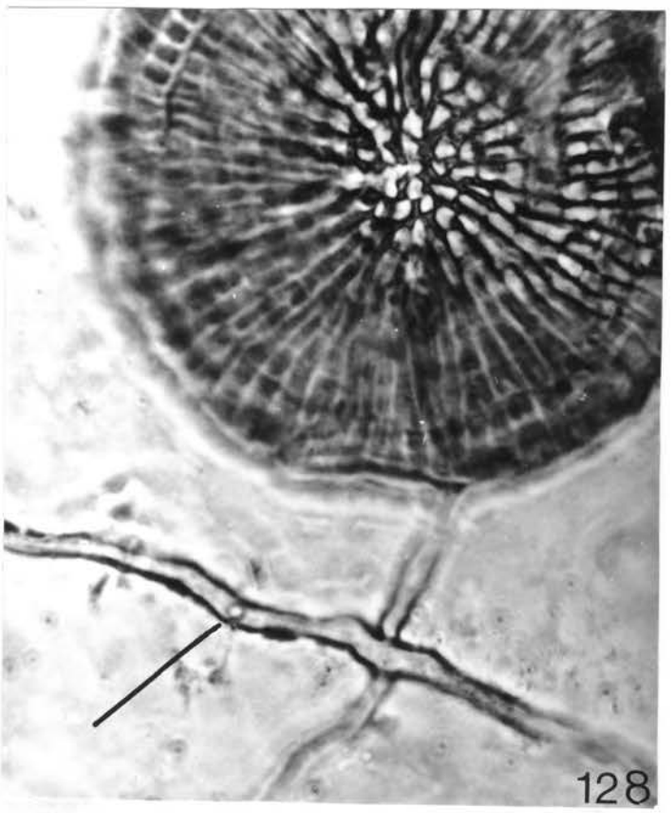
Fig. 129. Very young ascoma beneath hyphae. Note pore in upper face. Herb. DAR 17234. x1200.

Fig. 130. Young ascoma showing dichotomous hyphae of the wall. Herb.DAR 17234. x1200.

Fig. 131. Hyphal cell with pore. Herb.DAR 17234. x1200.

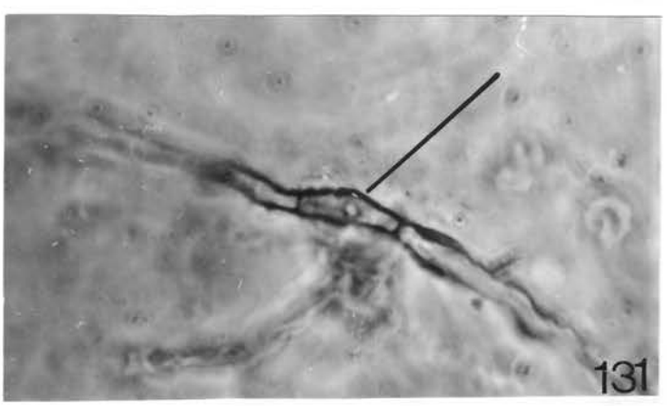
Fig. 132. Pore in aseptate hypha. Herb.DAR 17234. x1200.

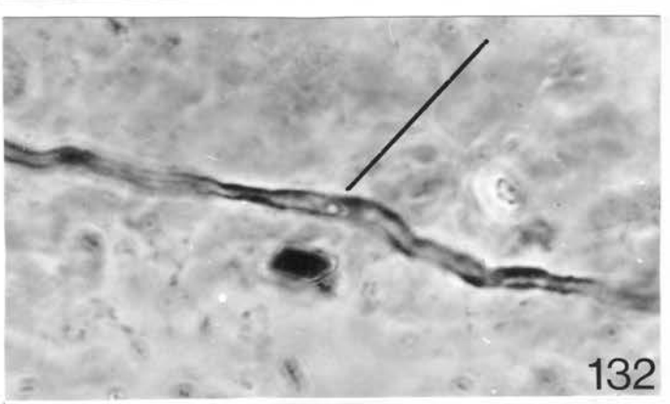

127


128


129


130


131


132

FIGURES 133 - 143

Microthyriacites sp. 1 on Myrtaceae and Lauraceae.

Figs.133-136. Ascomata showing structure of upper wall. x750. Fig.133. Herb. DAR 17242. Figs.134-136. Herb.DAR 17247(a).

Fig. 137. Pore in central cell (see fig.134 above). Herb.DAR 17247. x1500.

Fig. 138. Margin of ascoma showing projections of ends of hyphae. Herb.DAR 17247(a). x1500.

Fig. 139. Structure on cuticle after ascoma has flaked off. Herb.DAR 17240 x750.

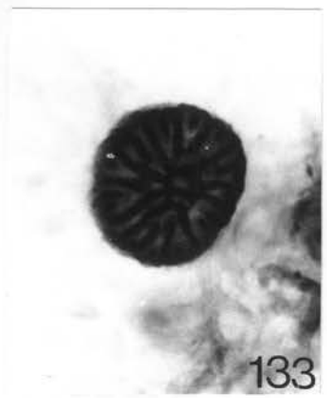
Fig. 140. Margin of ascoma. Herb.DAR 17240. x1500.

Fig. 141. Possible basal layer of ascoma. Note pale hyphae and cross-septa. Herb.DAR 17247(a). x1500.

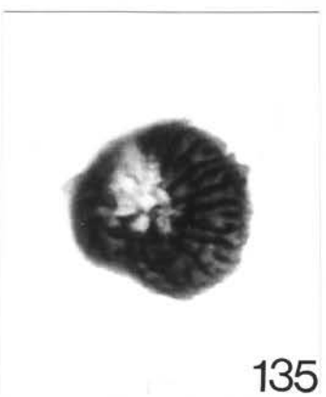
Microthyriacites sp. 2.

Fig. 142. Fragmentary ascoma. Herb. DAR 17261. x36.

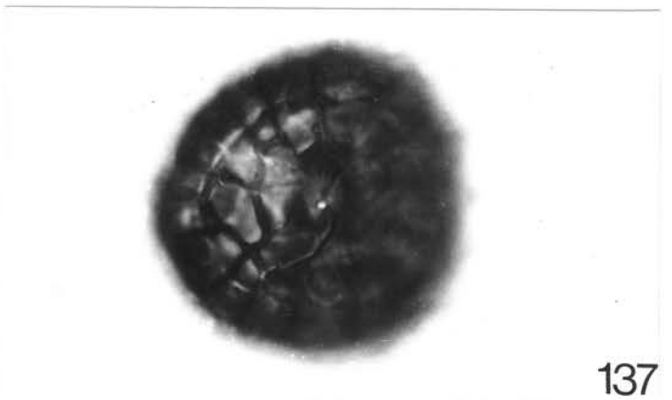
Fig. 143. Fragment of an ascoma. Herb.DAR 17260. x90.

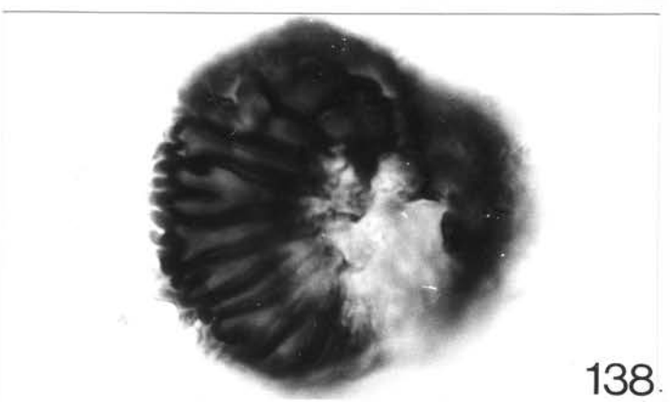

133

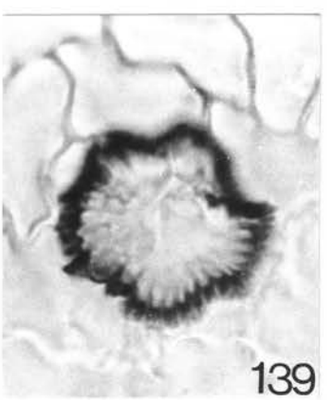

134


135


136


137

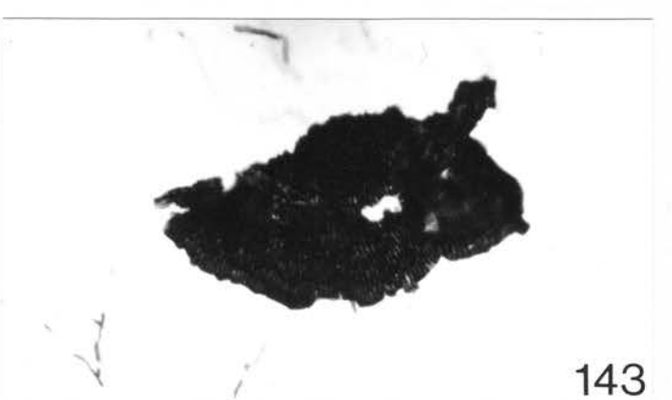

138


139


140


141


142


143

FIGURES 144- 147

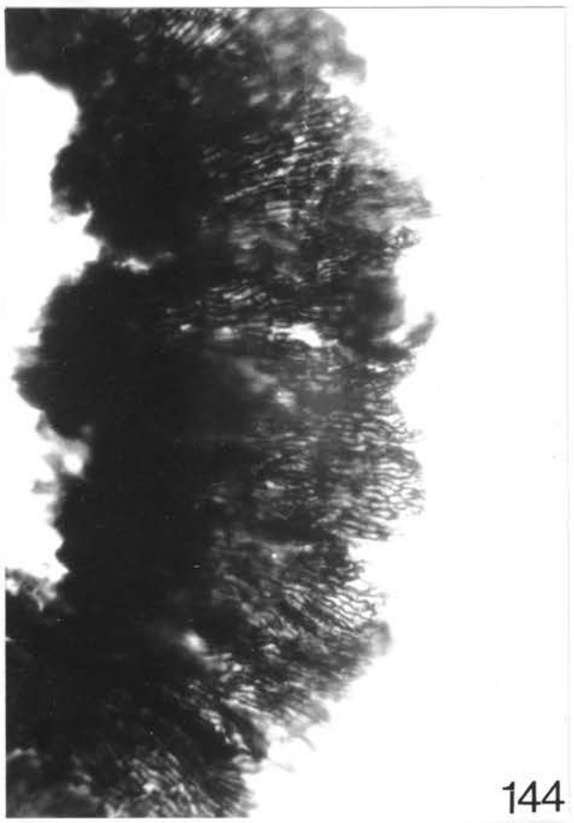
Microthyriacites sp. 2. on Lauraceae.

Fig. 144. Portion of ascoma (see fig.142 above) with hyphae free for short distance at margin. Herb.DAR 17261. x180.

Fig. 145. Margin of ascoma (see fig. 143). Herb. DAR 17260. x900.

Fig. 146. Hyphae protruding at margin of ascoma. Herb.DAR 17260. x900.

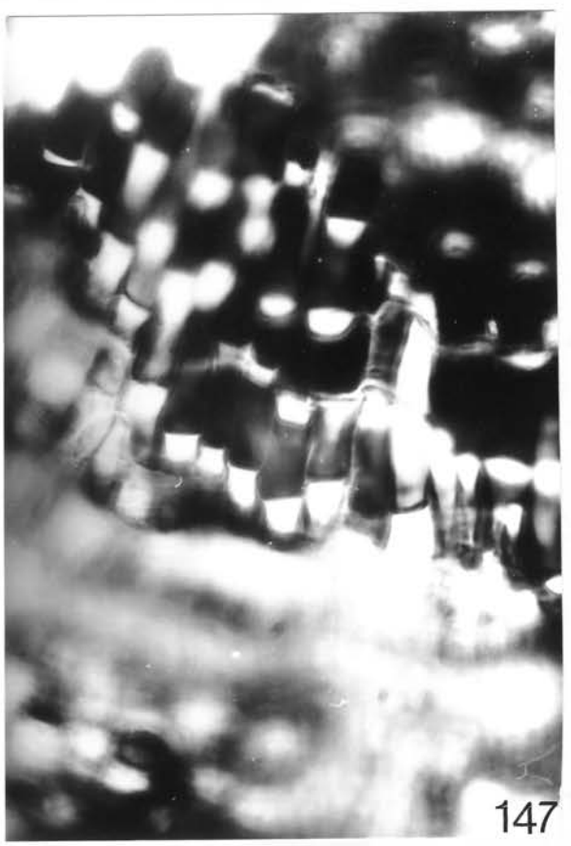
Fig. 147. Hyphae towards centre of ascoma with pale areas at proximal ends of cells. Herb.DAR 17260. x900.



144

145

146



147

FIGURES 148 - 151

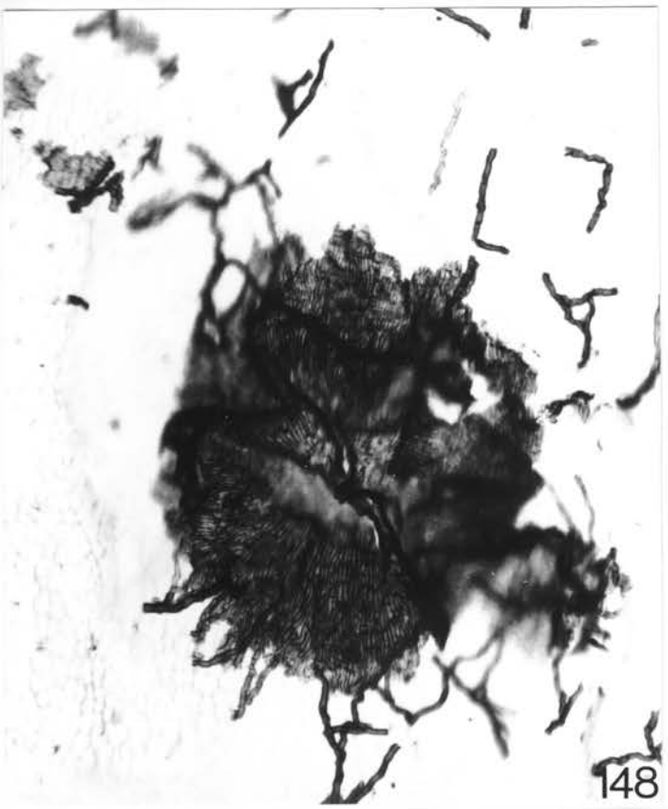
Asterothyrites kiandrensis sp. nov. on Lauraceae.

Fig. 148. Ascoma showing free hyphae produced from margin, and fragmentary free hyphae. Herb.DAR 17221. x150.

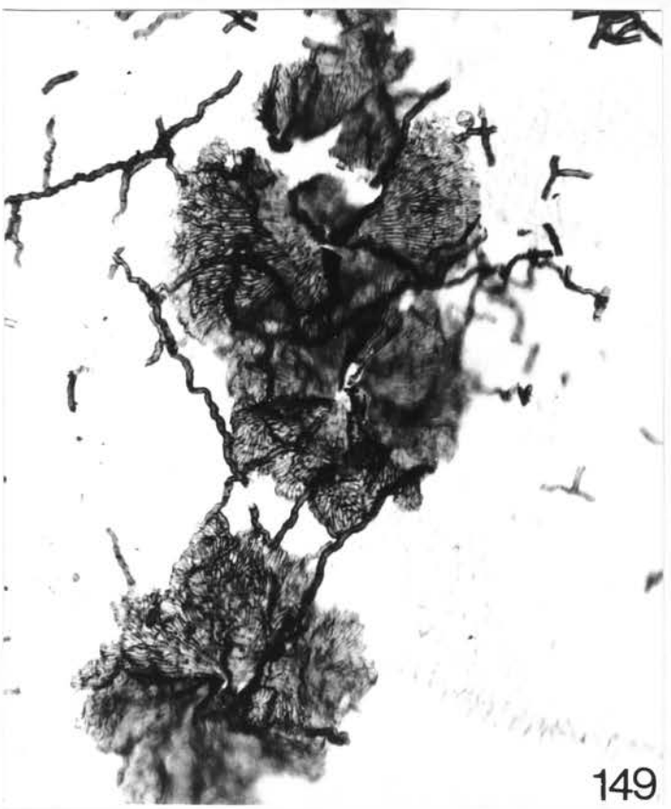
Fig. 149. Group of ascomata. Herb. DAR 17221. x150.

Fig. 150. Detail of wall of ascoma. Herb.DAR 17221. x680.

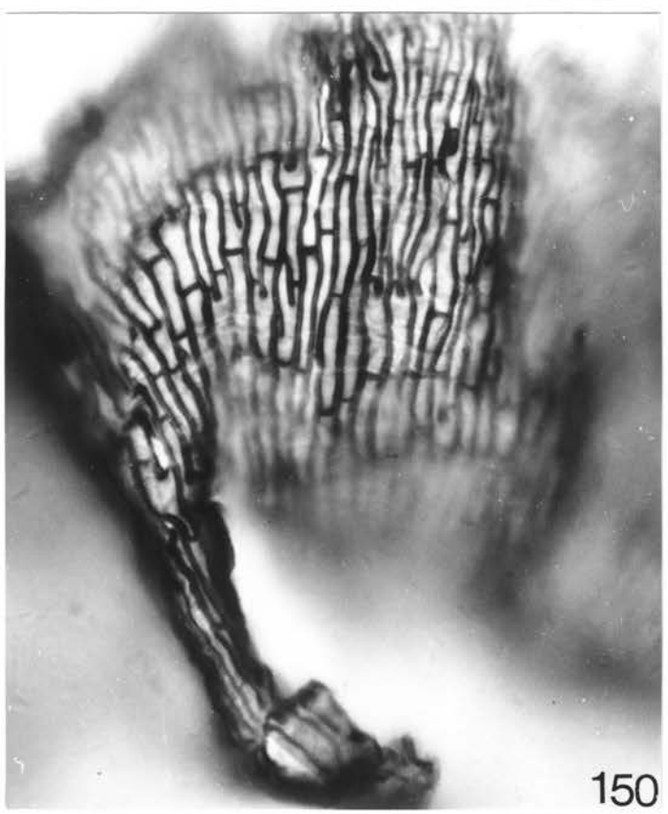
Fig. 151. Free hyphae produced from margin of ascoma. Herb.DAR 17221. x680.



148



149



150

151

FIGURES 152- 156

Asterothyrites kiandrensis sp. nov.

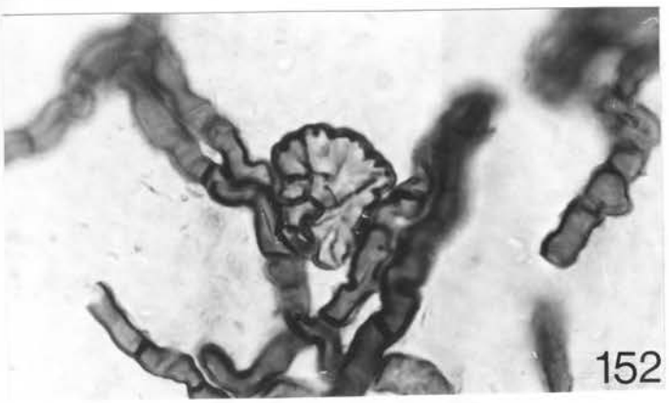
Figs. 152-153. Young fructifications produced from free hyphae. Herb.DAR 17221. x680.

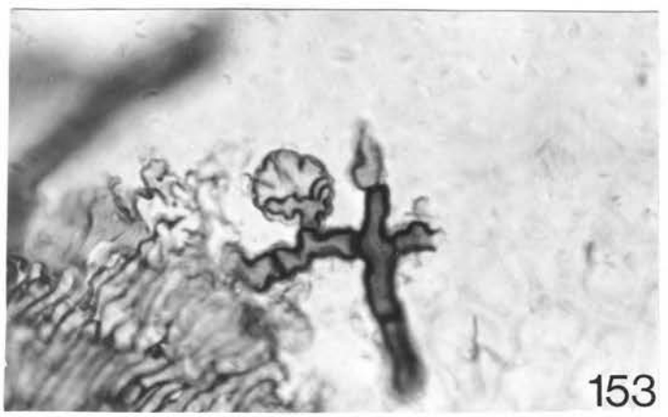
Fig. 154. Pore in hyphal cell. Herb.DAR 17221. x900.

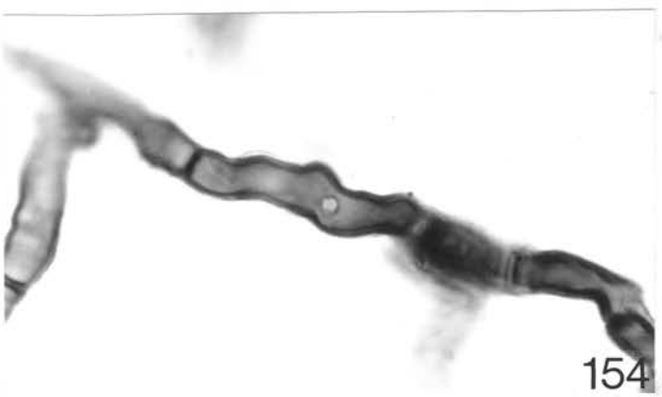
Asterothyrites hyphopodiatus sp. nov. on Myrtaceae.

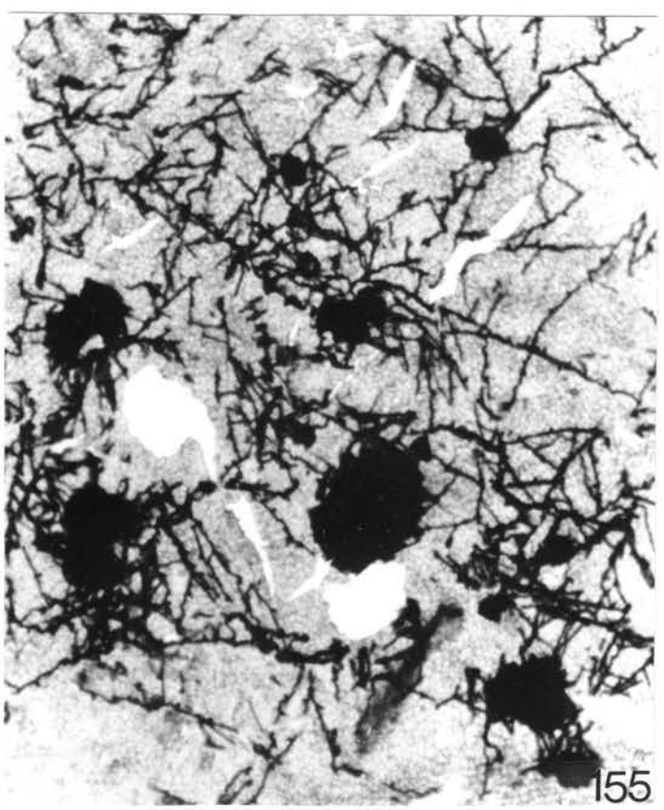
Fig. 155. Fragmentary colonies. Herb. DAR 17226. x54

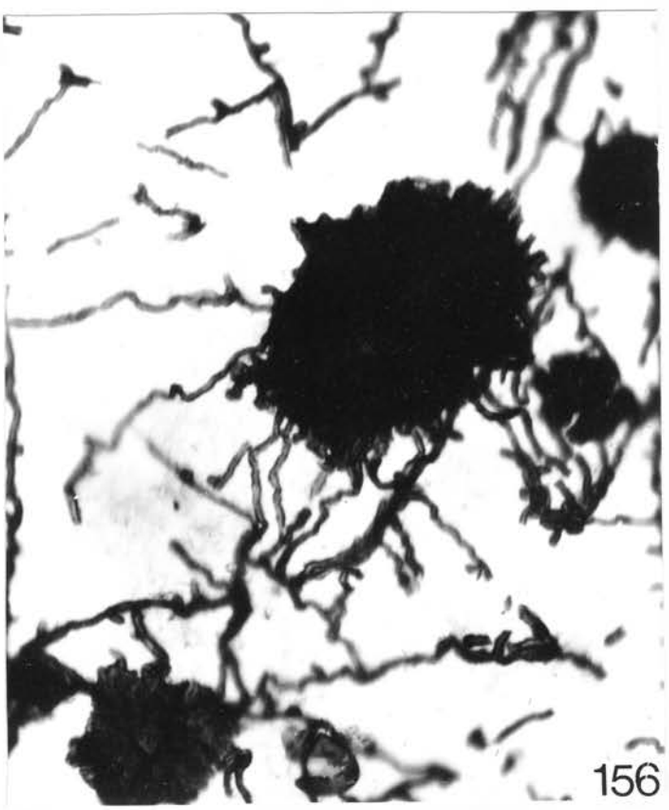
Fig. 156. Fructification with free hyphae produced from wall. Herb.DAR 17226. x155.


152


153


154


155


156

FIGURES 157 - 161

Asterothyrites hyphopodiatus sp. nov.

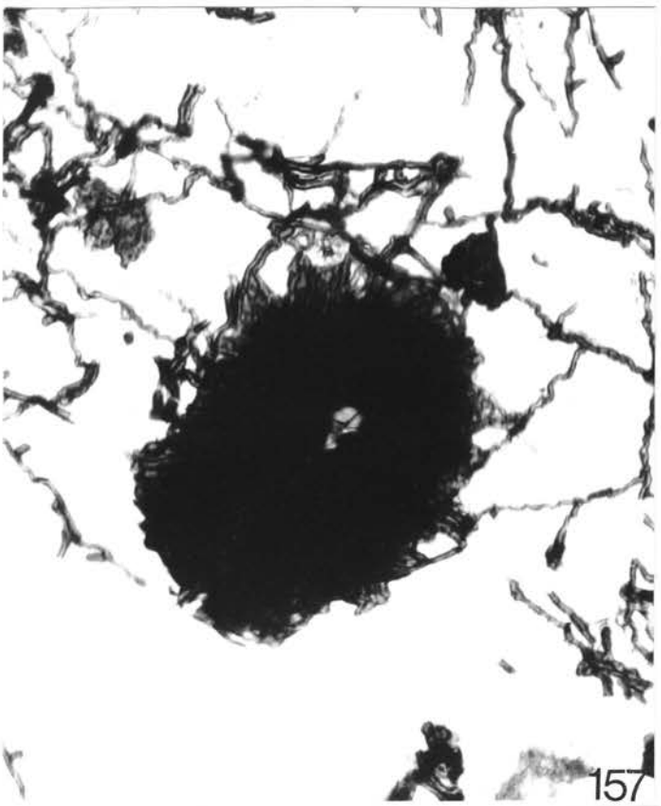
Fig. 157. Fructification. Herb.DAR 17226. x155.

Fig. 158. ?Ascospore associated with fructification. Herb.DAR 17226. x800.

Fig. 159. Hyperparasite? associated with hyphae. Herb.DAR 17217. x680.

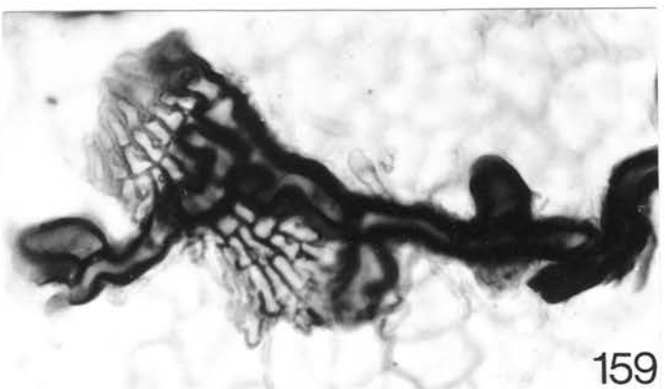
Fig. 160. Pore in hyphopodium. Herb.DAR 17217. x800.

Fig. 161. Young fructification beneath hypha. Herb.DAR 17226. x680

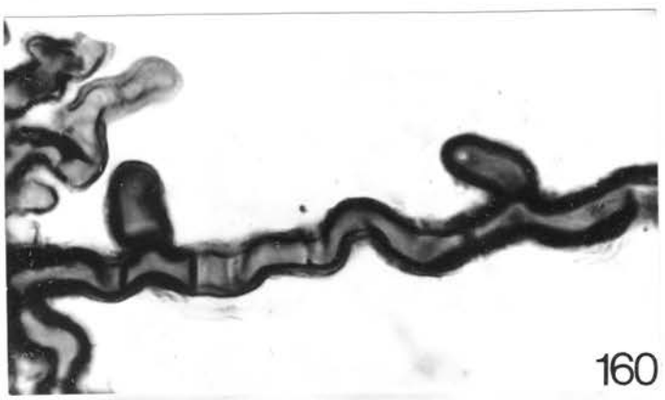


157

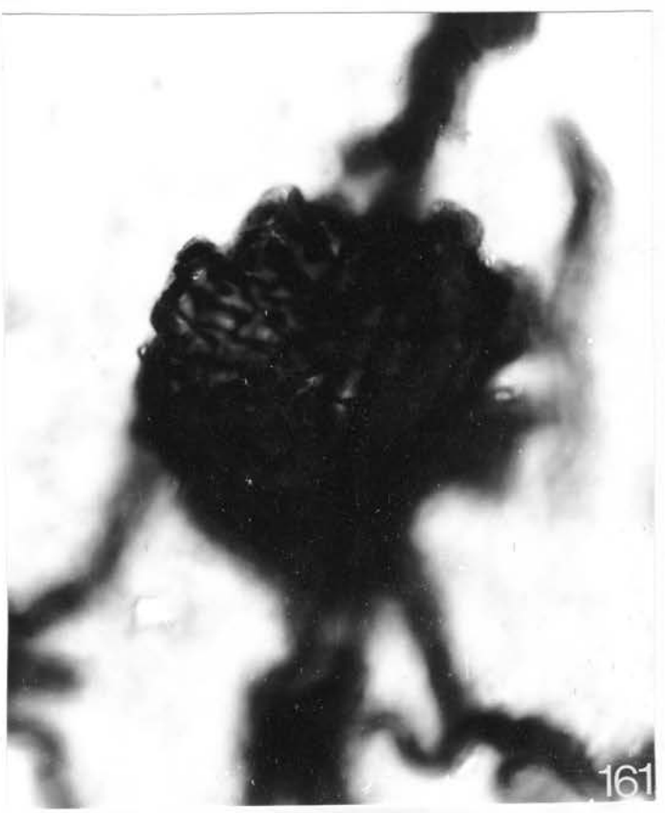
158



159



160



161

FIGURES 162 - 165

Asterothyrites hyphopodiatus sp. nov.

Fig. 162. Young fructification. Herb.DAR 17226. x680.

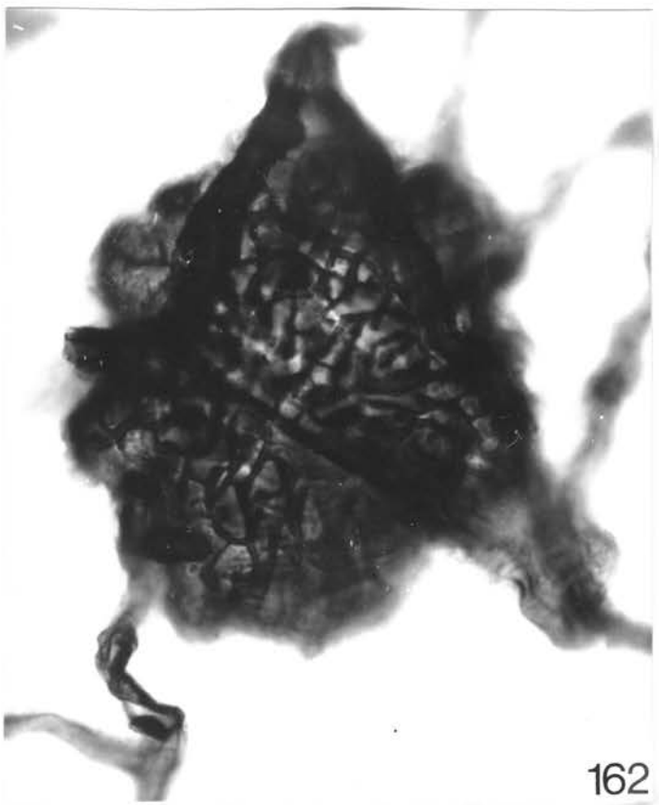
Asterothyrites sp.

Fig. 163. Older fructification with free hyphae developed from the margin. Herb.DAR 17204(b). x 480.

Fig. 164. Young fructification beneath hypha. Herb.DAR 17204(b). x 480.

Callimothallus pertusus (Dilcher) emend. on Lauraceae.

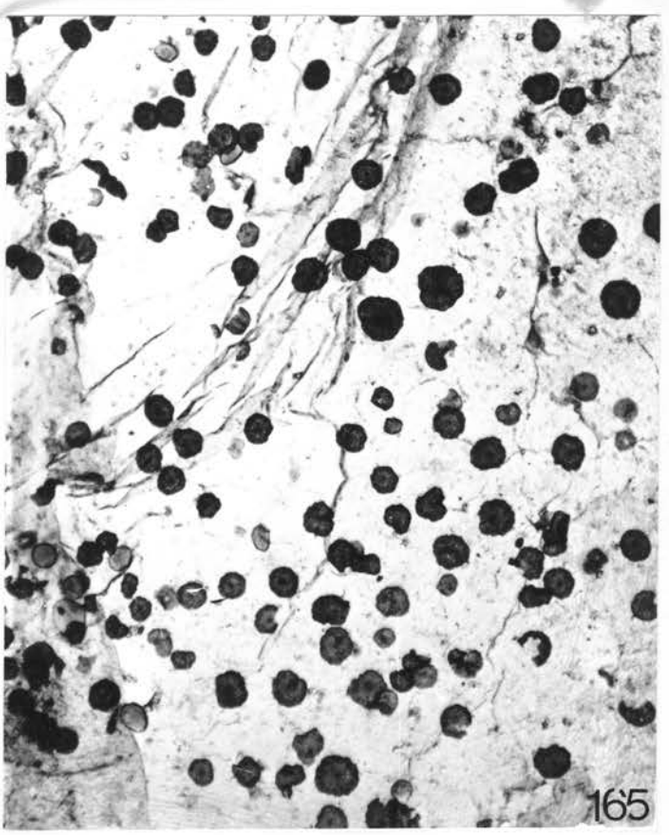
Fig. 165. Ascomata on surface of cuticle. Herb.DAR 17222. x55



162

163

164



165

FIGURES 166 - 171

Callimothallus pertusus (Dilcher) emend.

Fig. 166. Small ascoma. Herb.DAR 17223. x500.

Fig. 167. Ascoma. Herb.DAR 17223. x500.

Fig. 168. Ascoma. Herb. DAR 17222. x500.

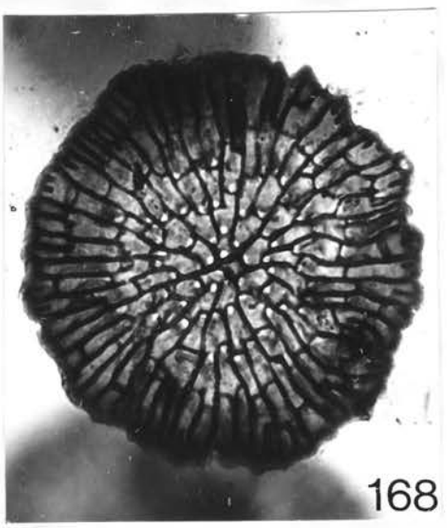
Fig. 169. Ascoma without pores. Herb.DAR 17222. x500.

Fig. 170. Ascoma. Herb.DAR 17222. x500.

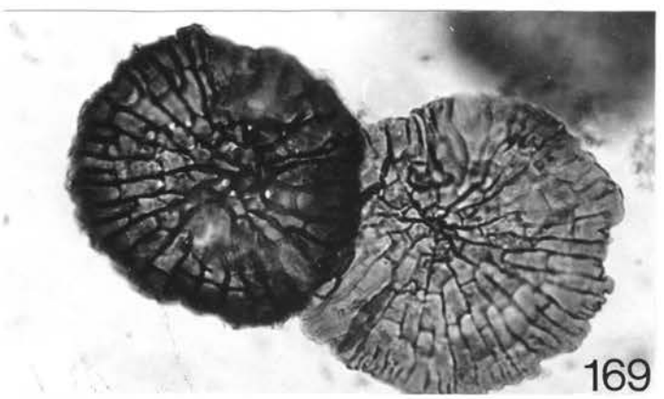
Fig. 171. Pale basal layer? of ascoma on cuticle. Herb.DAR 17222. x500.

166

167

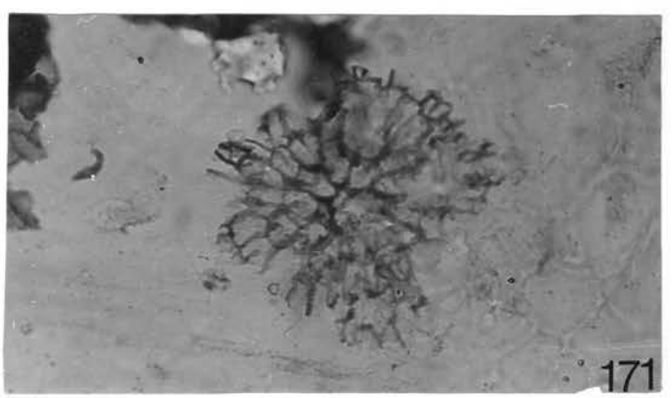


168



169

170



171

FIGURES 172 - 175.

Callimothallus pertusus (Dilcher) emend.

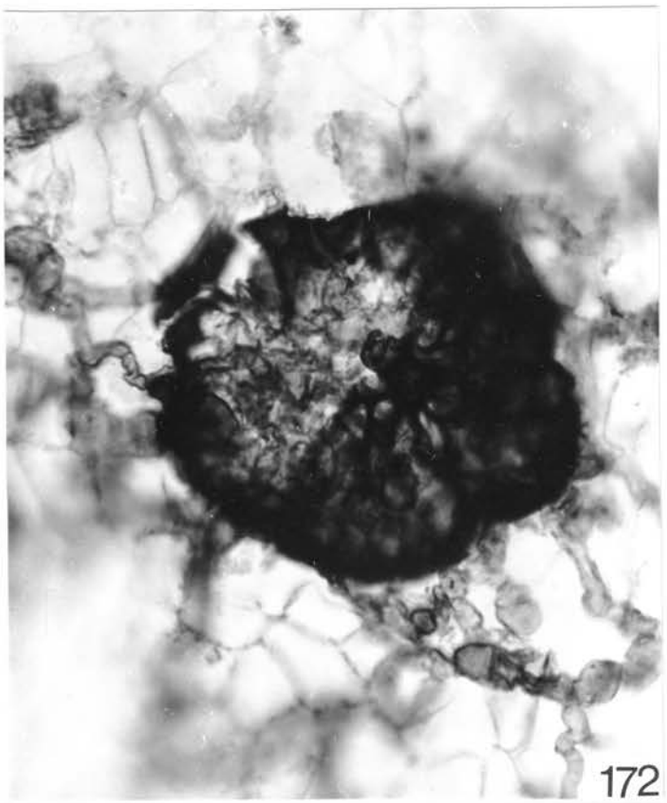
Fig. 172. Fragmentary ascoma with free hyphae attached to basal layer, stained in methylene blue. Herb.DAR 17233. x800.

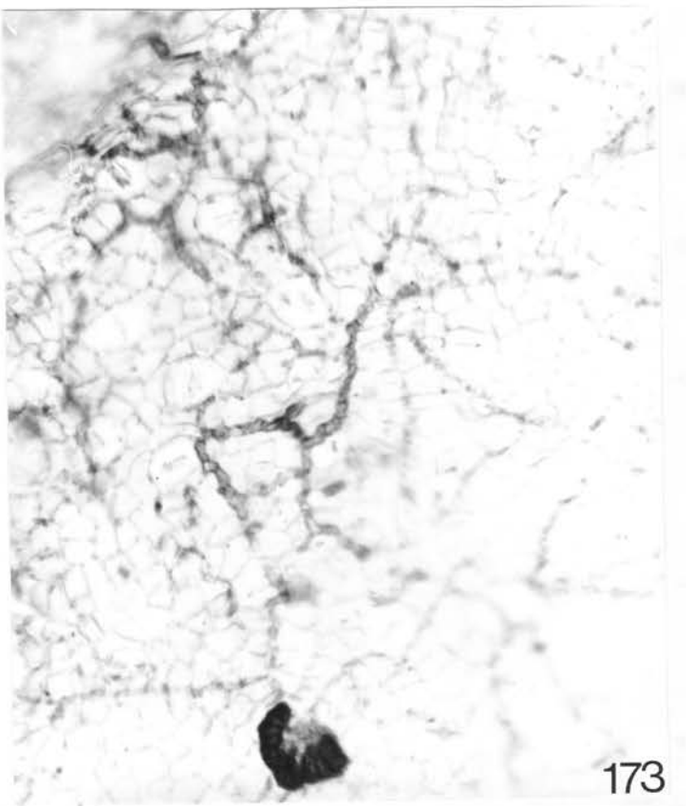
Fig. 173. Septate free hyphae on cuticle surface, and portion of an ascoma. Herb.DAR 17229. x300.

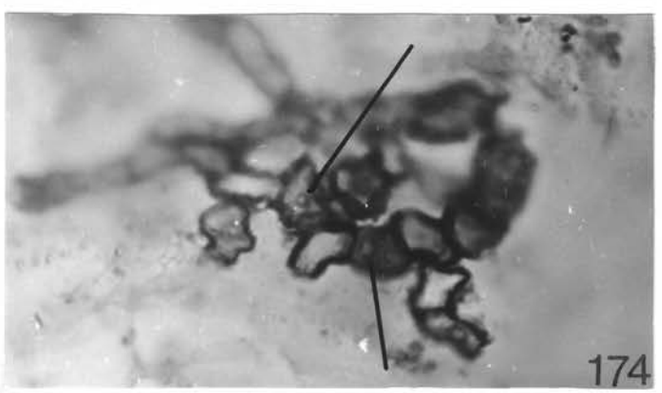
Fig. 174. Pore in hypha. Herb.DAR 17229.x1000.

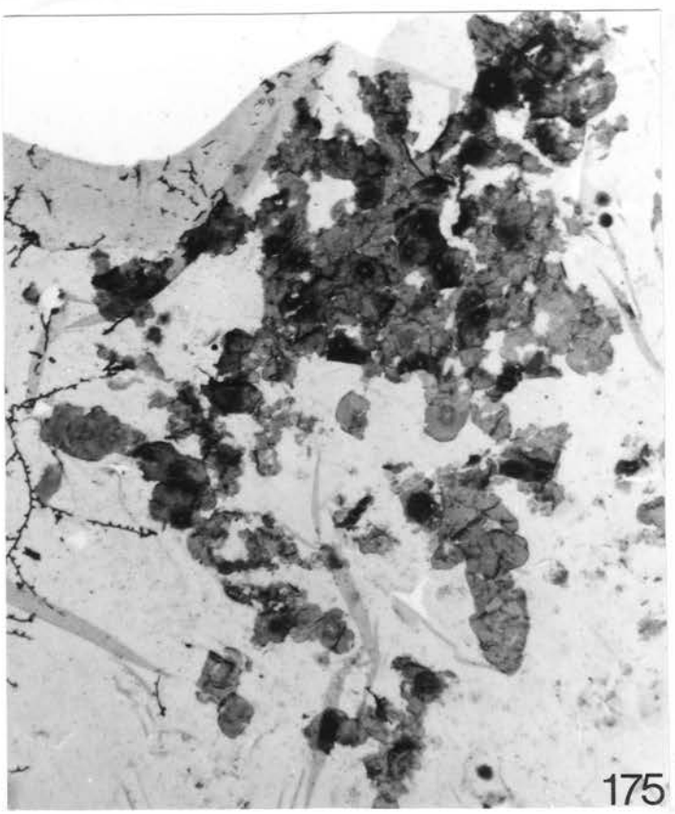
Trichopeltinites kiandrensis sp. nov. on Myrtaceae.

Fig. 175. Crowded thalli showing irregular shape. Herb.DAR.17205(b). x40.


172


173


174


175

FIGURES 176 - 179

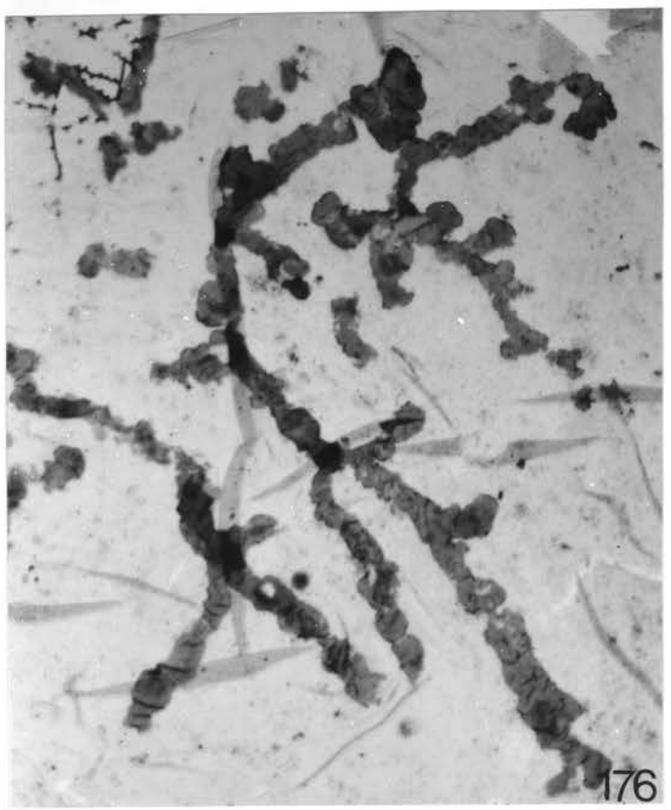
Trichopeltinites kiandrensis sp. nov.

Fig. 176. Branched ribbon-like thalli. Herb.DAR 17205(b). x40.

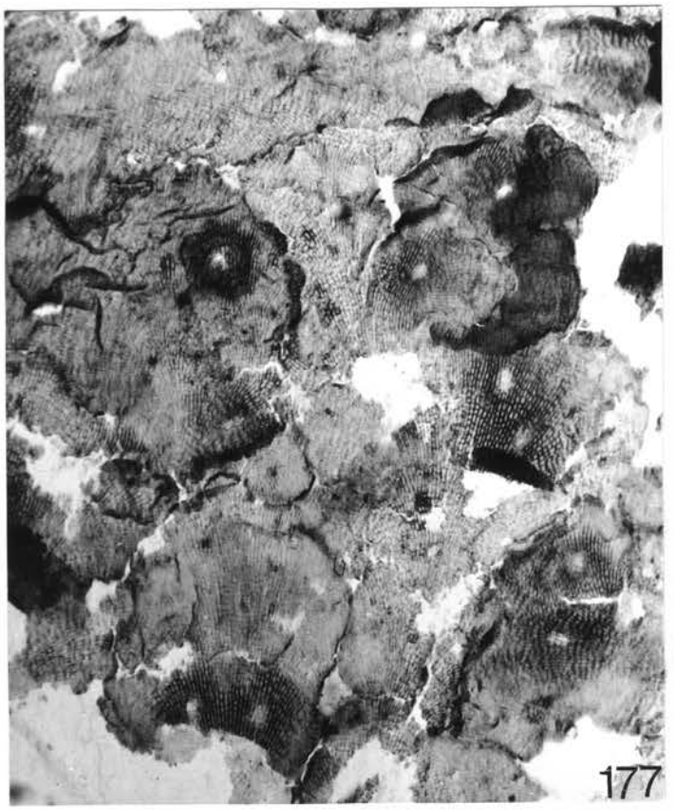
Fig. 177. Crowded colonies with dark-celled areas over the fructifications. Herb.DAR 17205(b). x150.

Fig. 178. Pseudo-ostiole of fructifications. Herb.DAR 17205(b). x680.

Fig. 179. Basal layer? of fructification. Herb.DAR 17205(b). x680.



176



177

178

179

FIGURES. 180 - 184

Trichopeltinites kiandrensis sp. nov.

Fig. 180. Dichotomously branched hyphae beneath mycelial membrane. Herb.DAR 17204(c). x1200.

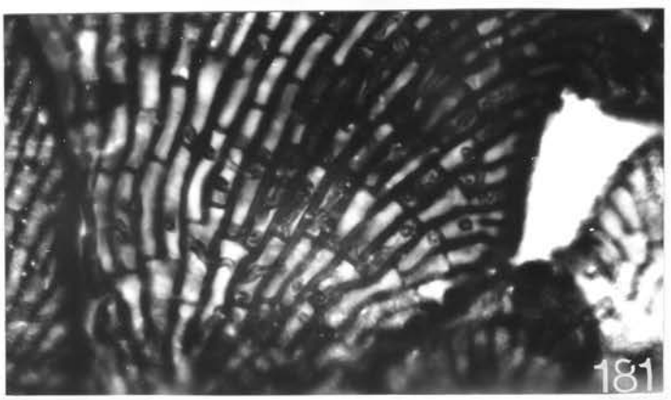
Fig. 181. Parasitic hyphae in mycelial membrane. Herb.DAR 17254. x800.

Fig. 182. Pores in upper walls of cells containing parasitic hyphae. Herb.DAR 17254. x800.

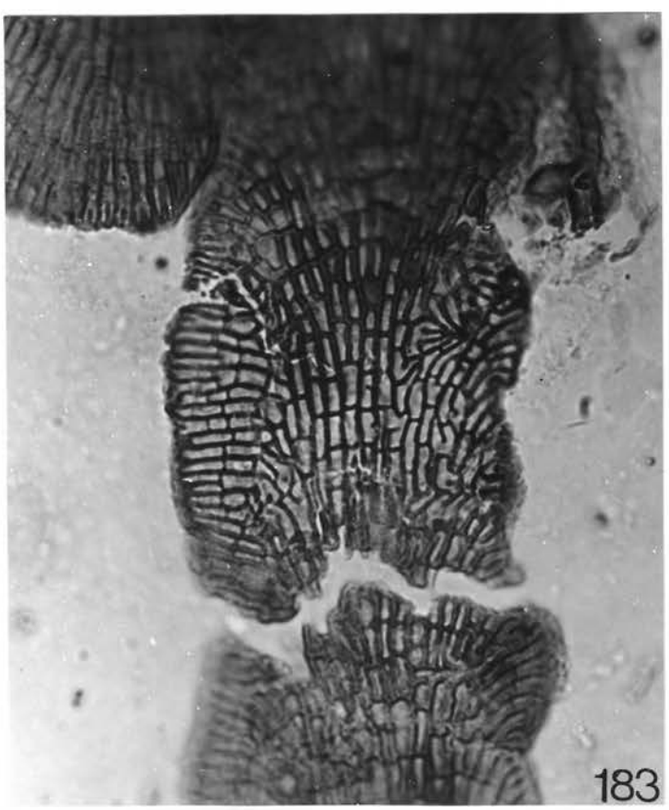
Fig. 183. Ribbon-shaped mycelial membrane with fringing lateral growth. Herb. DAR 17211. x680.

Fig. 184. Mycelial membrane. Herb.DAR 17211. x480.


180


181


182


183


184

FIGURES 185 - 188

Trichopeltinites kiandrensis sp. nov.

Fig. 185(a). Very young thallus. Herb.DAR 17205(b) x1200.

Fig. 185(b). Very young thallus. Herb.DAR 17254. x1200. phase contrast.

Fig. 186. *Trichopeltum* sp. on *Acmena smithii*. Mycelial membrane with fringing lateral growth. x240.

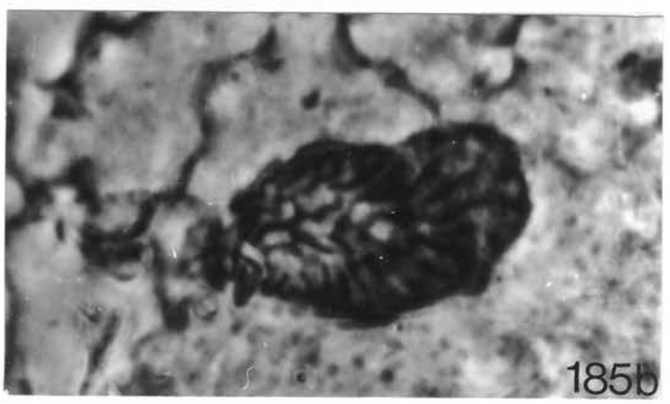
Microthyriacites cf. *fimbriatus* Cookson on Lauraceae.

Fig. 187. Confluent ascomata. Herb.DAR 17240. x750.

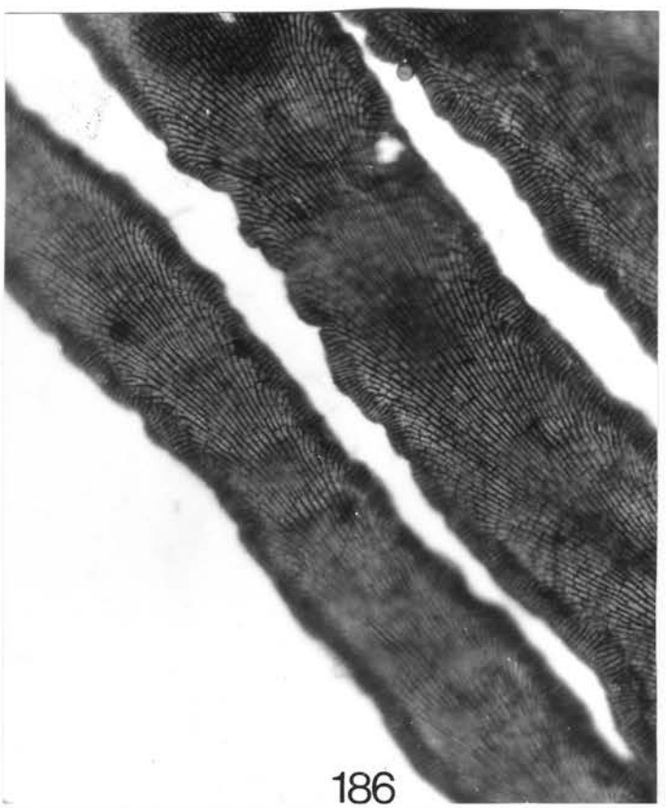
Plochmopeltinites masoni (Cookson) emend. on Lauraceae.

Fig. 188. Colonies showing fructifications and extensive free hyphae. Herb.DAR 17238. x48.

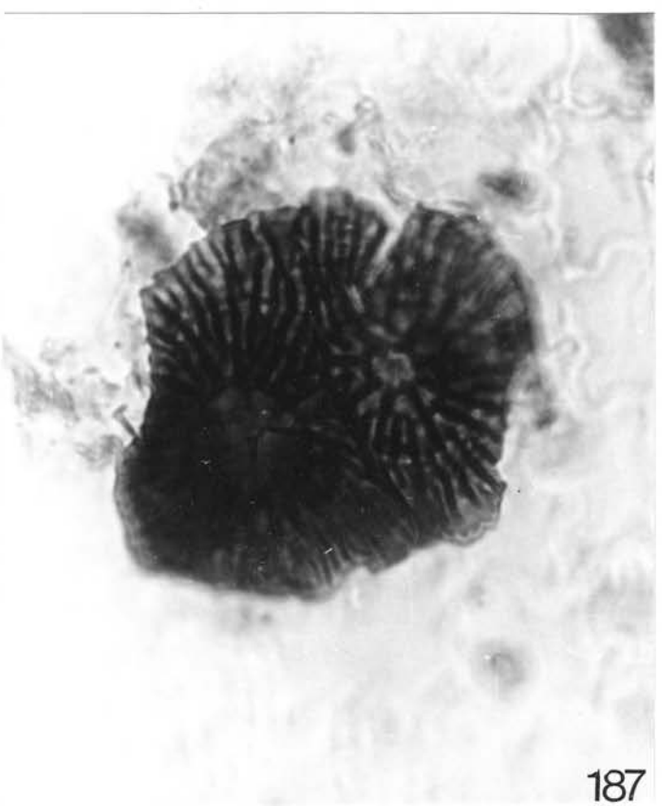
185a



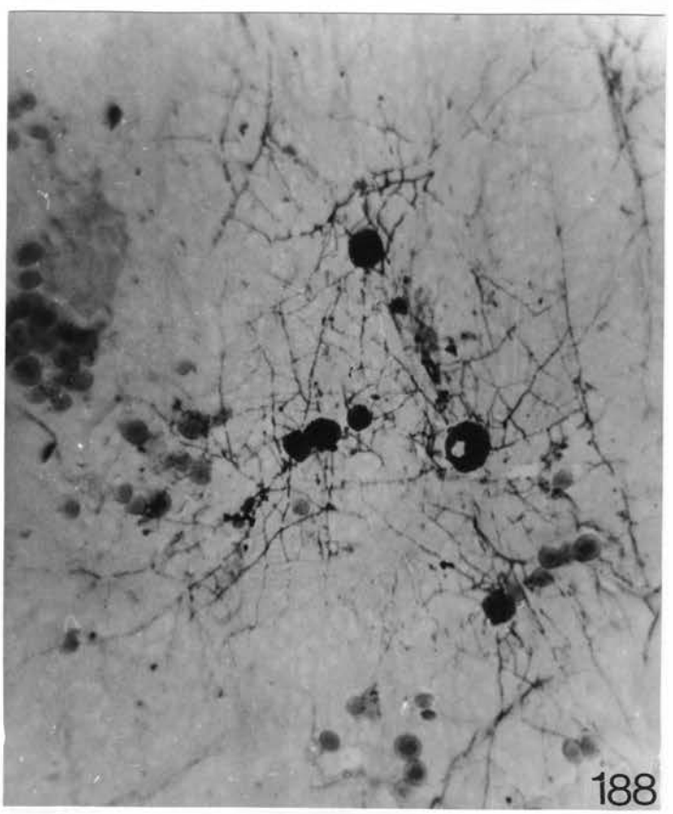
185b



186



187



188

FIGURES 189 - 192

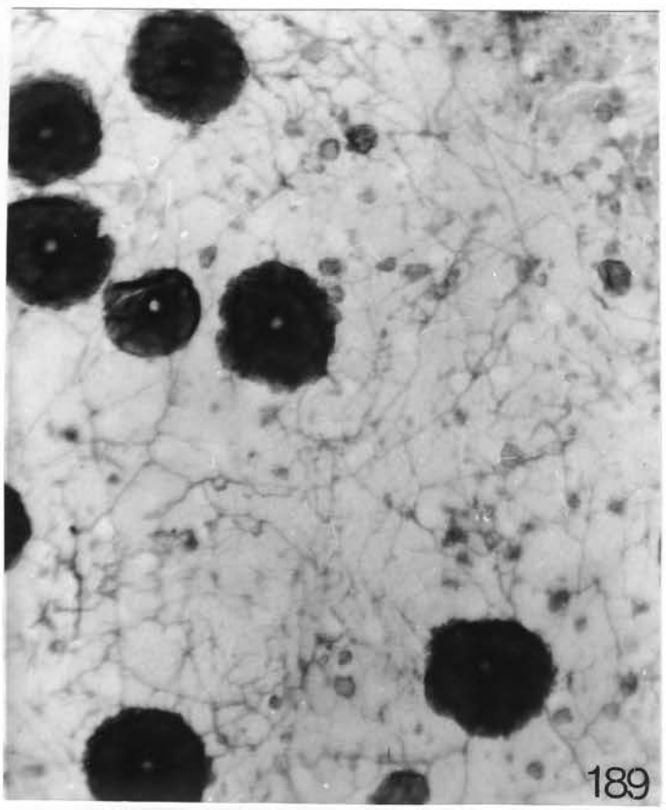
Plochmopeltinites masoni (Cookson) emend.

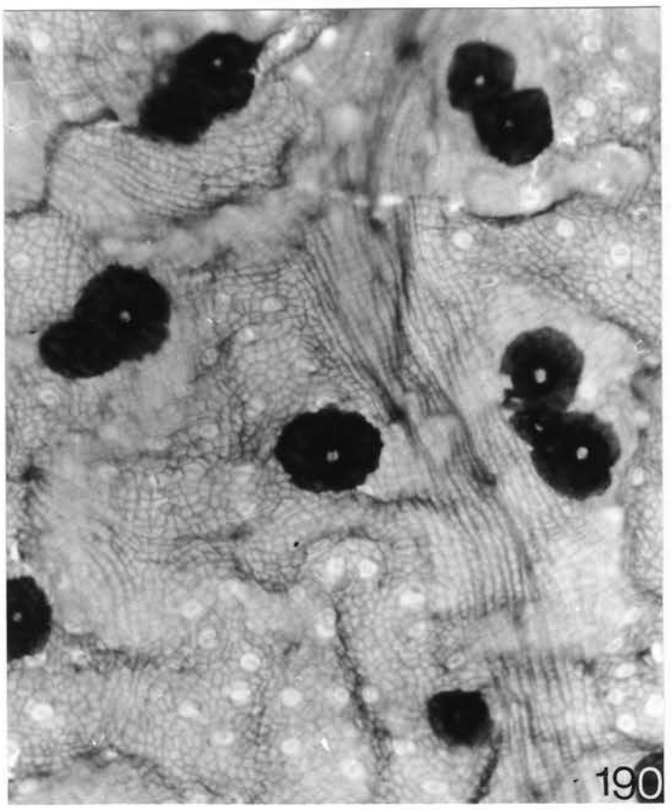
Fig. 189. Mature fructifications and hyphae bearing young fructifications. Herb.DAR 17236. x120.

Fig. 190. Fructifications lacking free hyphae (stain methylene blue). Herb.DAR 17232. x120.

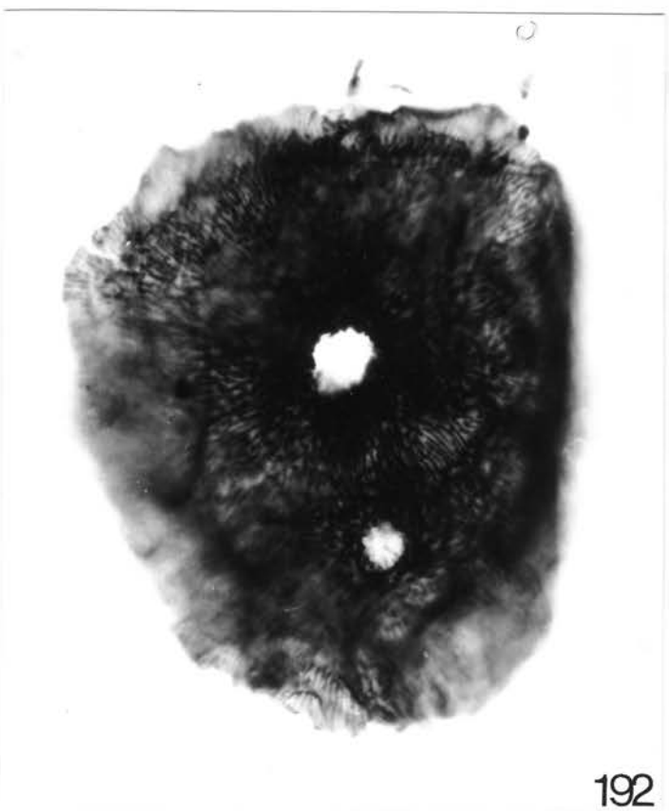
Fig. 191. Central portion of fructification showing sinuous plectenchyma of wall. Herb.DAR 17237. x1200. phase contrast.

Fig. 192. Confluent ascomata. Herb.DAR 17238. x480.


189


190


191


192

FIGURES 193 - 197

Plochmopeltinites masoni (Cookson) emend.

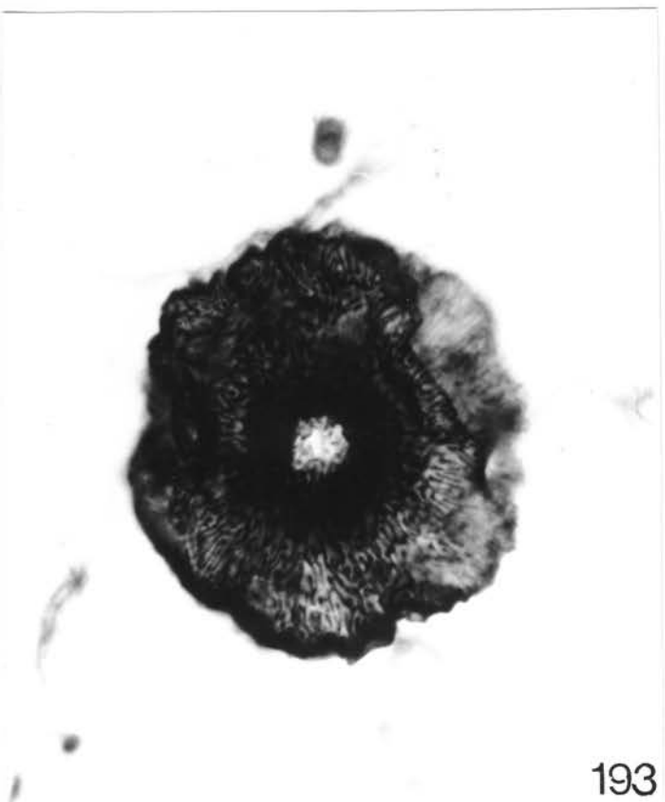
Fig. 193. Fructification with delicate cells in ostiole. Herb.DAR 17237. x480.

Fig. 194. 2-celled spore associated with fructifications. Herb.DAR 17237. x1200.

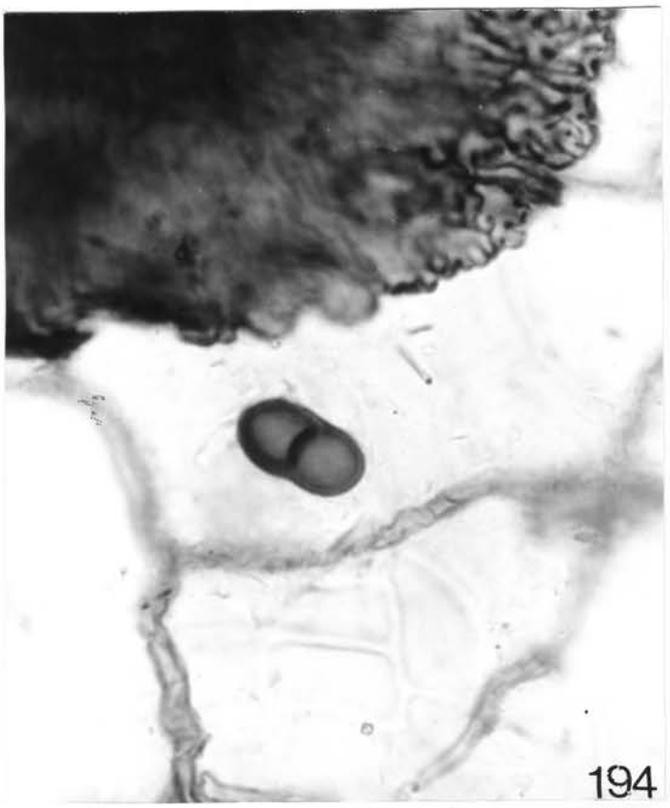
Fig. 195. TYPE SPECIMEN. Plochmopeltinites masoni Cookson. National Museum, Melbourne, P26034. x 550.

Fig. 196. Young fructification. Herb.DAR 17237. x1200.

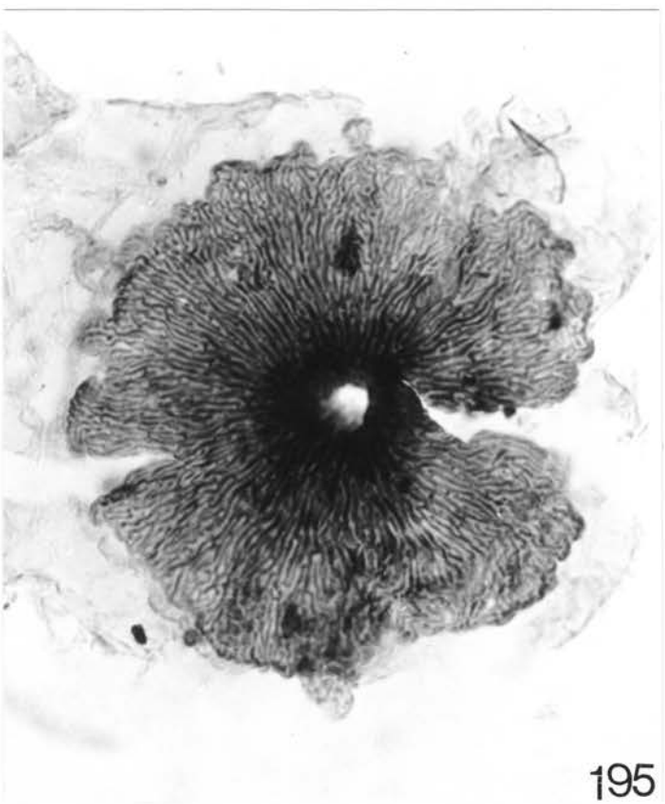
Fig. 197. Young fructifications on hyphae. Herb.DAR 17262. x1200.



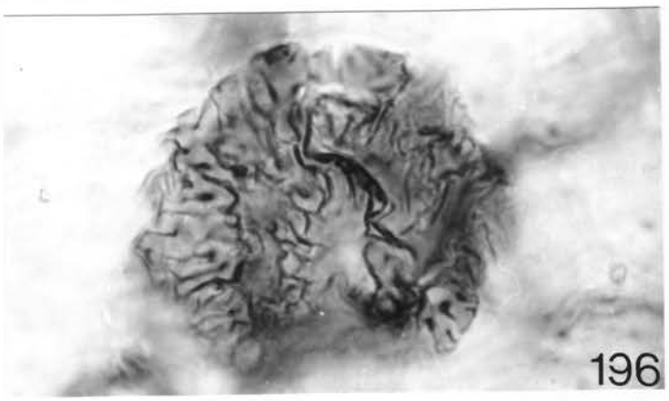
193



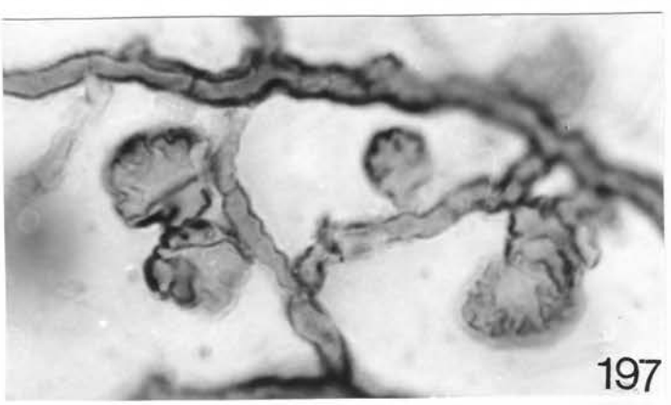
194



195



196



197

FIGURES 198 - 202

Plochmopeltinites masoni (Cookson) emend.

Fig. 198. Cells in ostiole. Herb.DAR 17237. x1200.

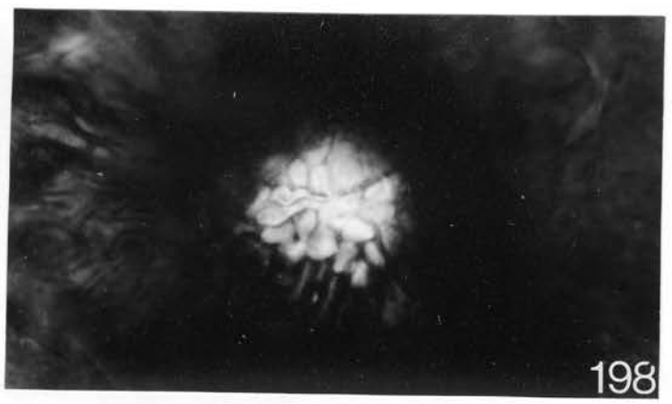
Fig. 199. Pores in hyphal cells. Herb. DAR 17262. x 1000.

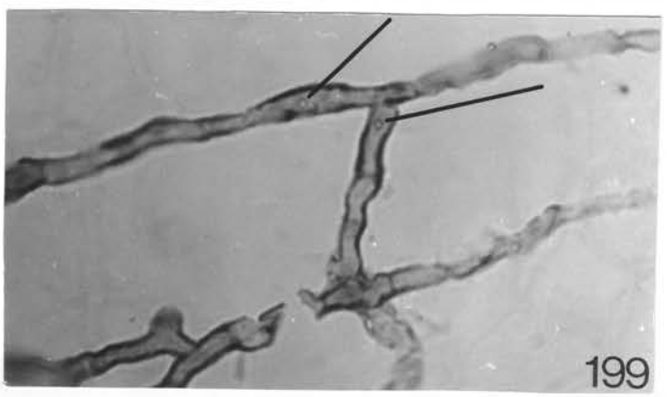
Dictyopileos sp. on Lauraceae.

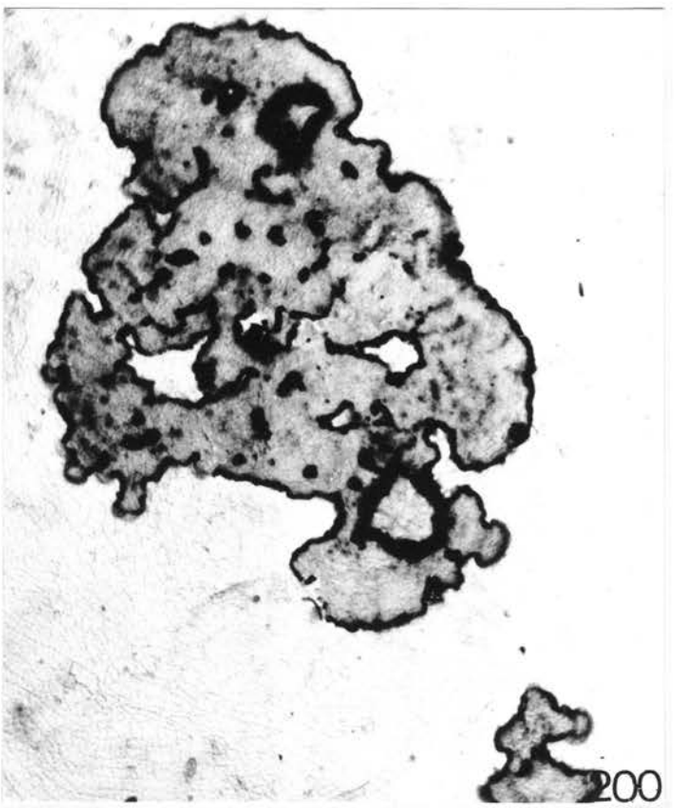
Fig. 200. Large rounded stroma with dark margin and ring-like areas of superficial hyphae. Herb.DAR 17244. x75.

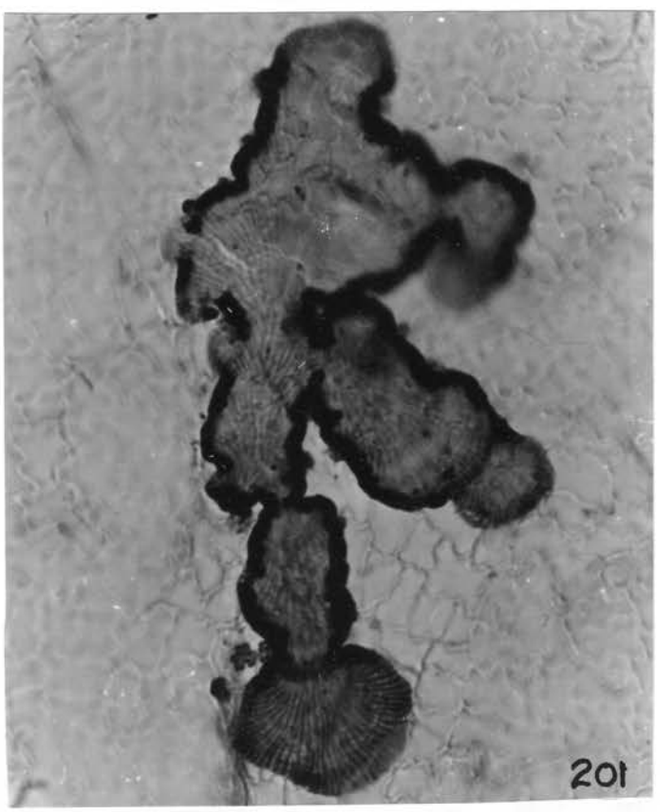
Fig. 201. Branched linear stroma. Herb.DAR 17244. x300.

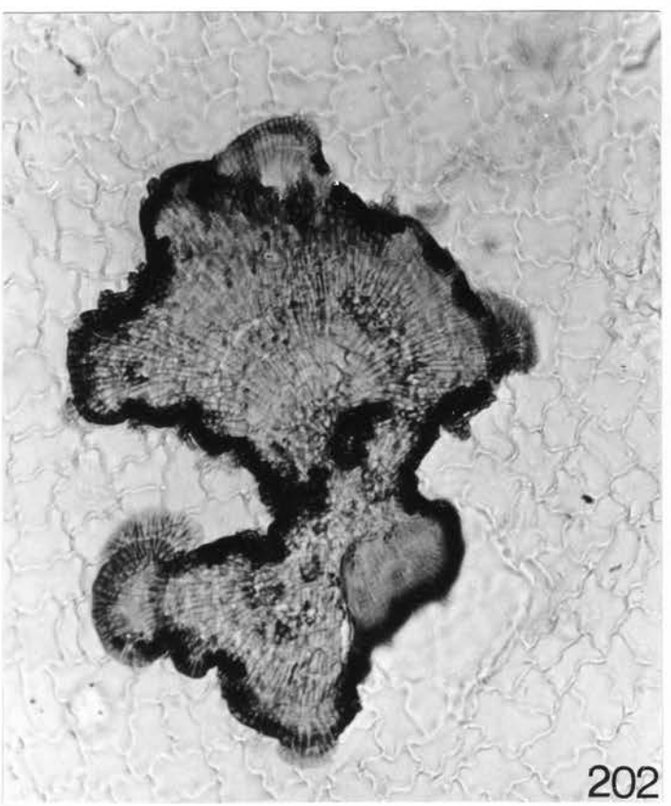
Fig. 202. Small rounded stroma showing radiate structure of the subiculum. Herb.DAR 17244. x300.


198


199


200


201


202

FIGURES 203 - 207

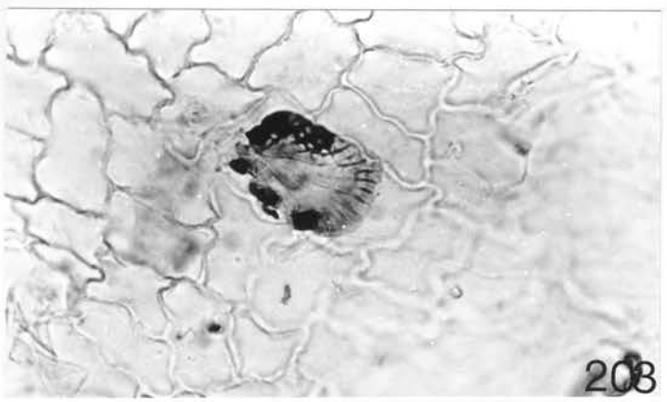
Dictyopileos sp.

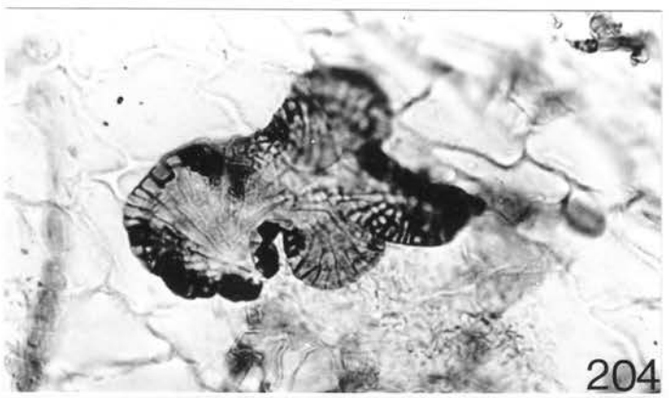
Figs. 203, 204. Young stromata. Herb.DAR 17242. x500.

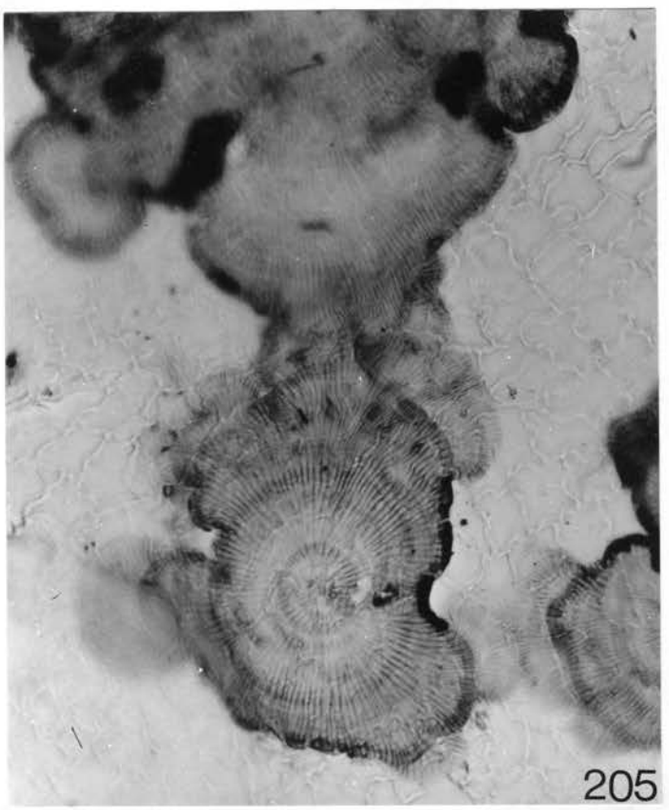
Fig. 205. Stroma showing radiate nature of subiculum. Herb.DAR 17244. x300.

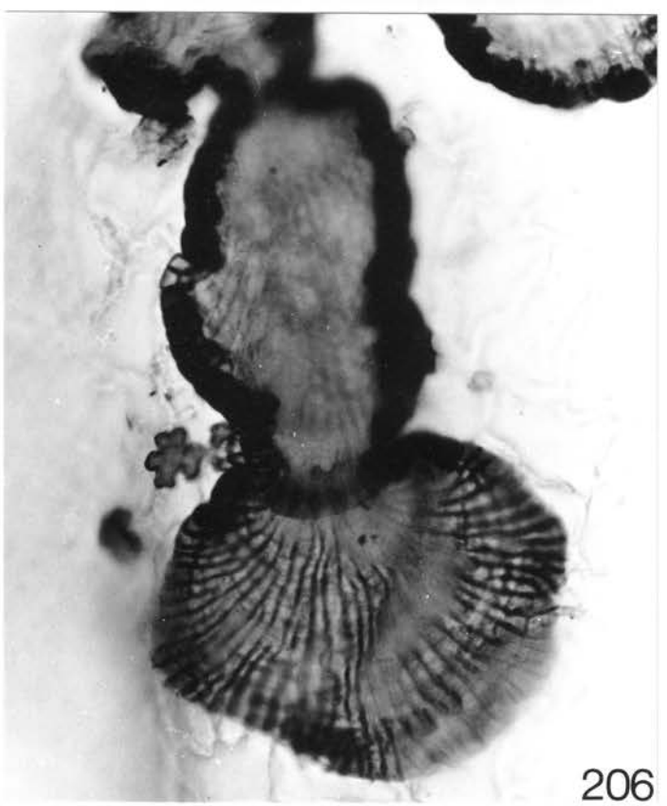
Fig. 206. Portion of stroma showing growth of a lobe from beneath thick-walled marginal cells. Herb.DAR 17244. x700.

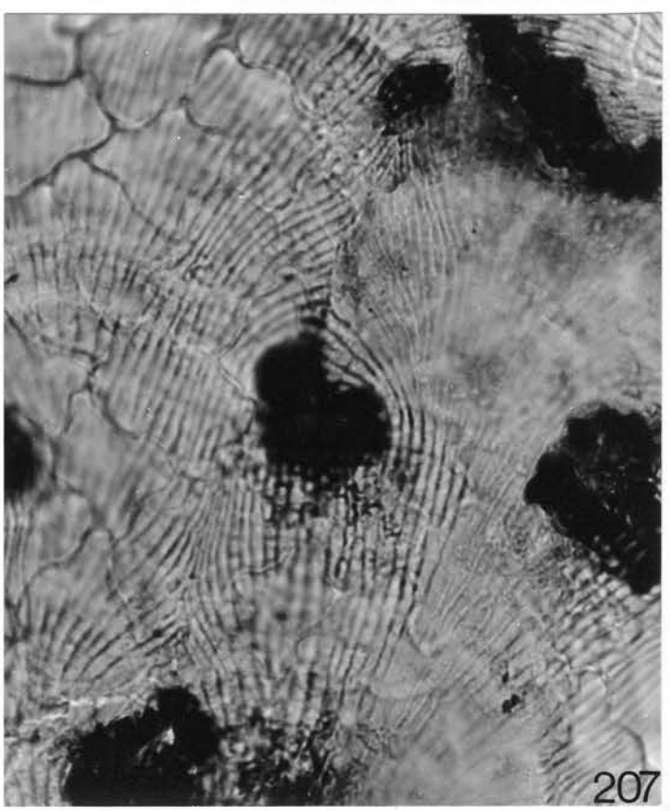
Fig. 207. Line of contact between different lobes of stroma. Herb.DAR 17244.


203


204


205


206


207

FIGURES 208 - 212

Dictyopileos sp.

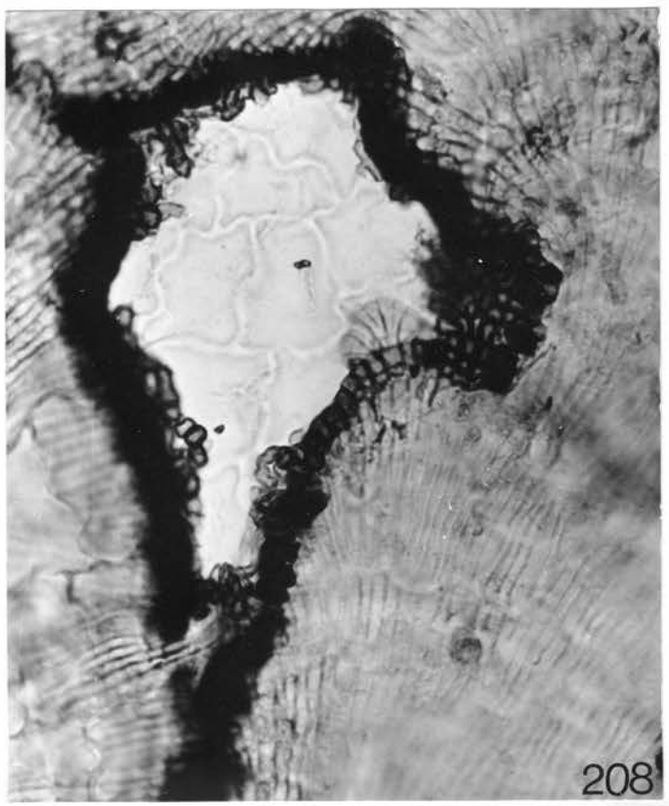
Fig. 208. Free hyphae and lobe developed around hole in subiculum. Herb.DAR 17244. x700.

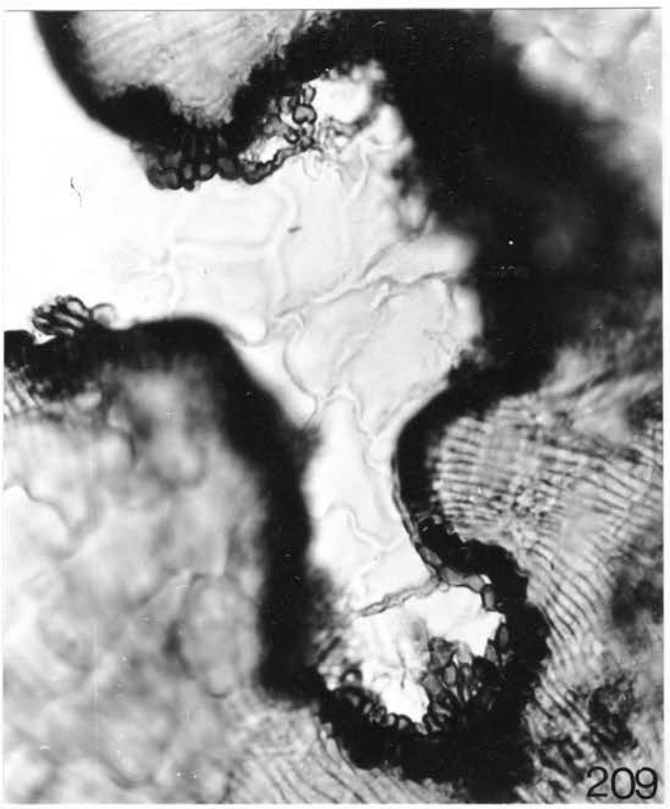
Fig. 209. Free hyphae at margin of stroma. Herb.DAR 17244. x700.

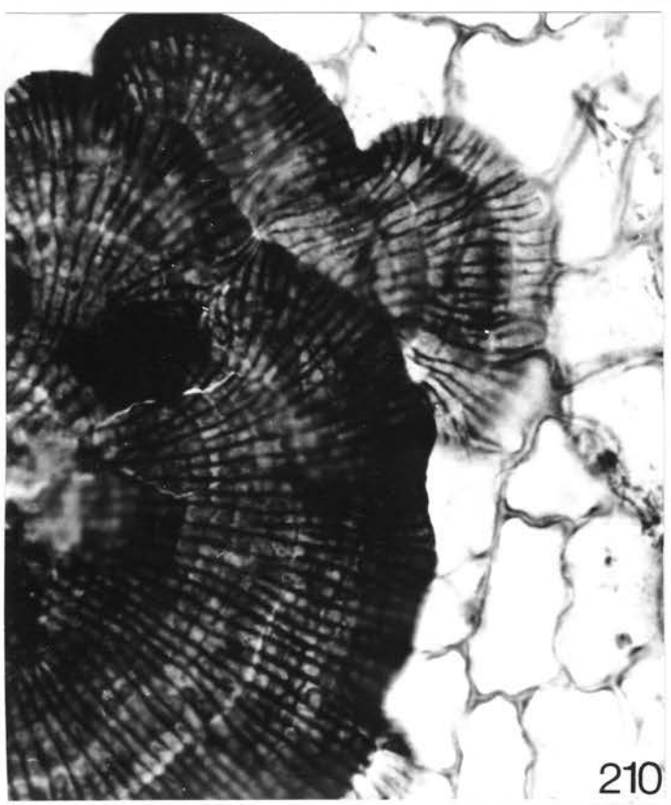
Fig. 210. Growing lobe of stroma showing indistinct cross-septa in older portions. Stained methylene blue. Herb.DAR 17241. x700.

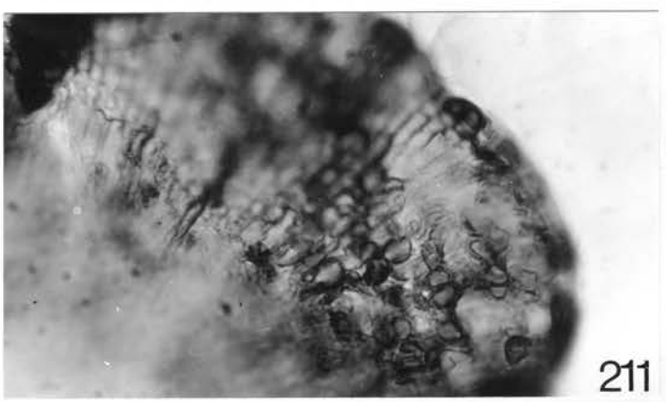
Fig. 211. Hyphae developed above subiculum. Herb.DAR. 17244. x700.

Fig. 212. Portion of ring of hyphae above subiculum. Herb.DAR17244. x700.


208


209


210


211


212

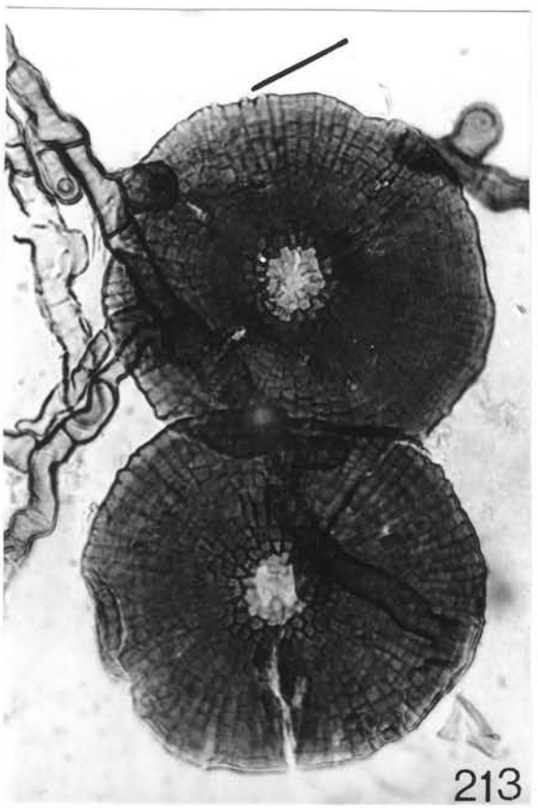
FIGURES 213 - 216

?Trichothyriaceae on Myrtaceae

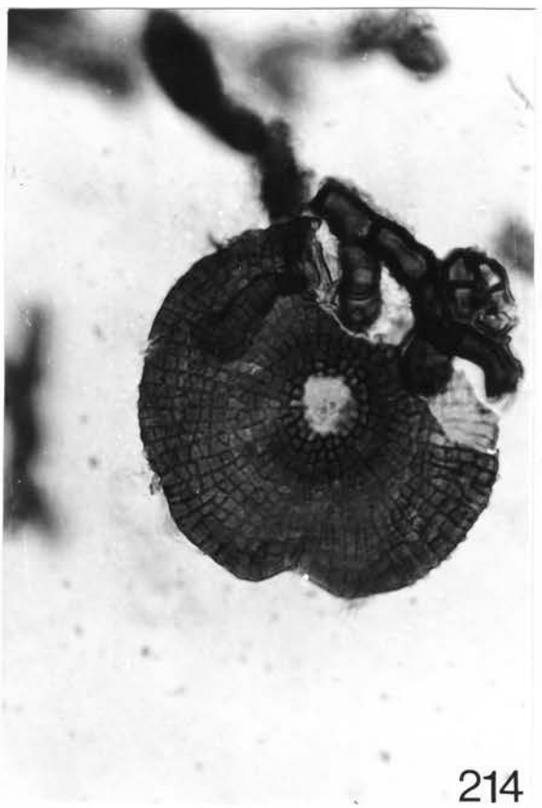
Fig. 213. Ascomata showing radiate construction of the wall and ostioles. Note small papillate projections of some marginal cells. Herb.DAR 17253(b). x570.

Figs.214,215. Ascomata with upper wall broken showing paler basal wall. Herb. DAR 17253(b). Fig. 214; x570: Fig. 215; x660.

Fig. 216. Isolated basal wall of ascoma. Note dichotomously branched hyphae with indistinct cross-septa. Herb.DAR 17253(b). x 660.

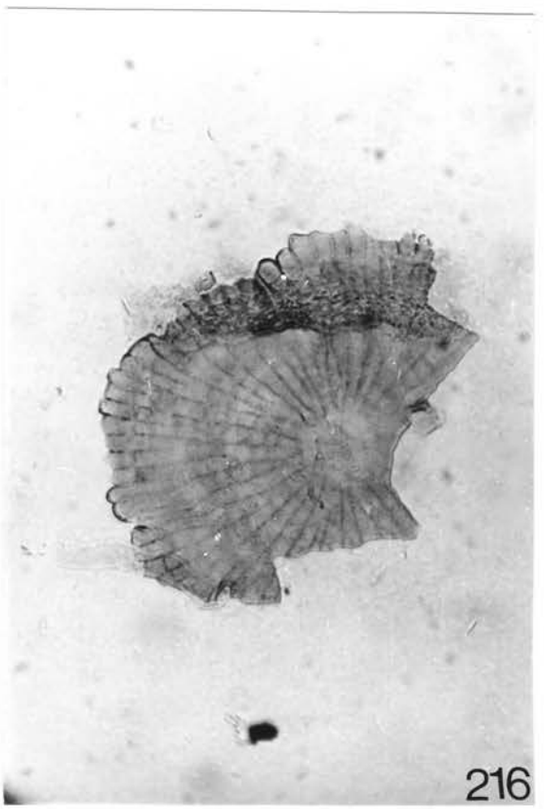


213



214

215



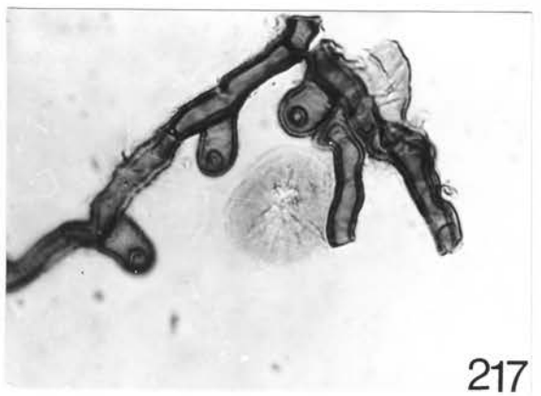
216

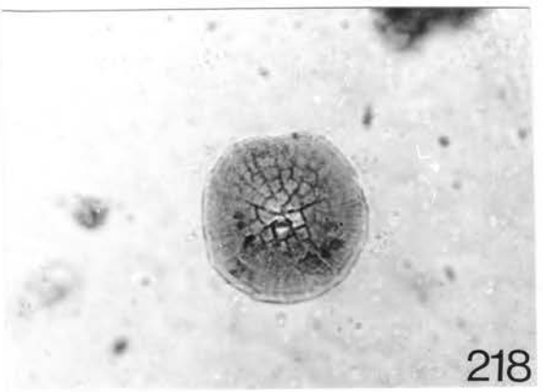
FIGURES 217 - 221

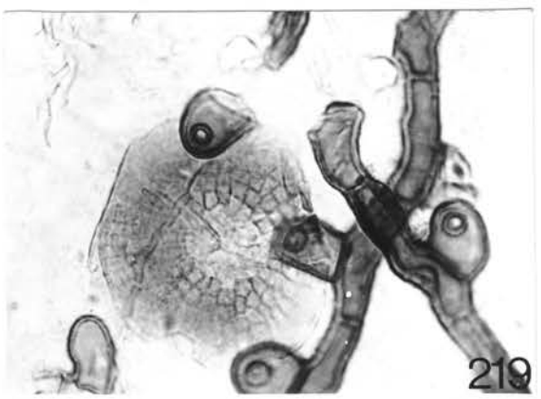
?Trichothyriaceae.

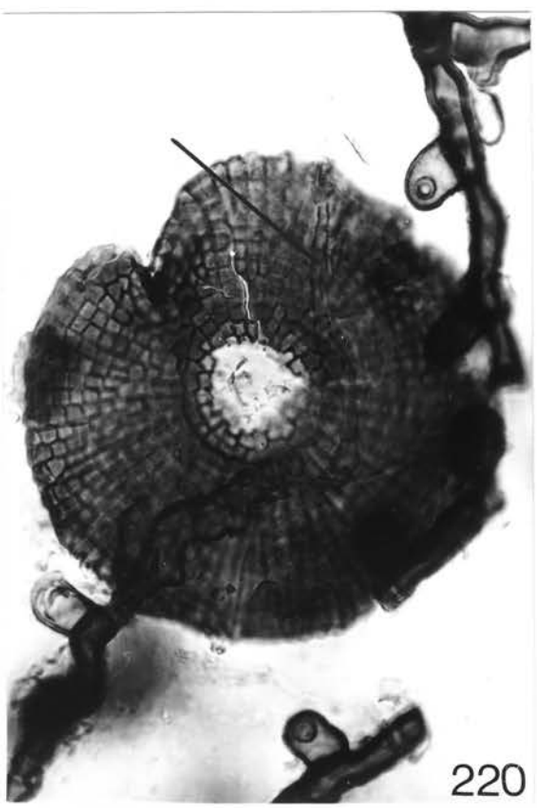
Figs. 217-219. Young ascomata. Note dark cells in centre of wall (fig.218) and early development of the ostiole (fig.219). Herb.DAR 17253(b). x 660.

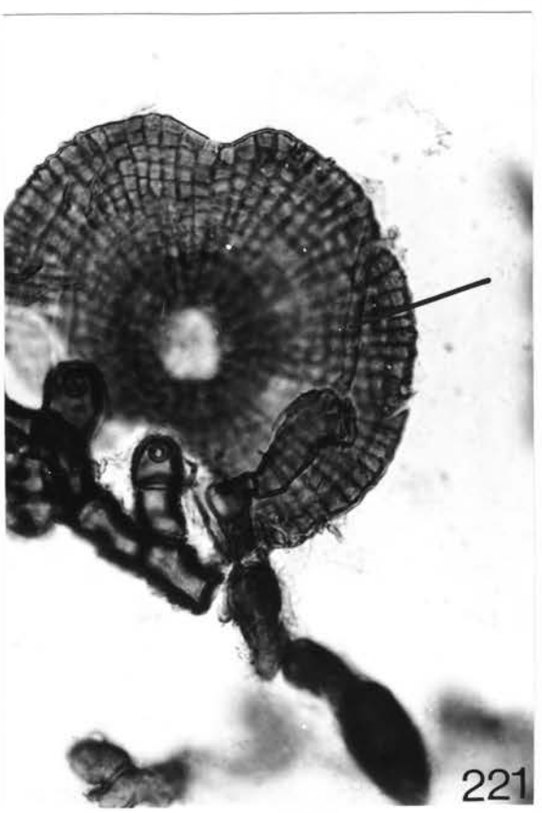
Figs. 220, 221. Hyphae associated with basal layer of ascoma. Large dark hyphae of Asterina kiandrensis. Herb.DAR.17253(b). x 660.


217


218


219


220


221

FIGURES 222 - 228

Fig. 222. Setae and seta bases, modern Chaetothyriaceae on Bosistoa, Mt.Boss, nr. Wauchope, N.S.W. for comparison with fossil form cf. Vitalia. Treated with 70% Jeffreys solution 10 minutes. x680.

Fossil setae and seta bases cf. Vitalia, on Myrtaceae.

Fig. 223. Seta and base. Herb.DAR 17239(b). x680.

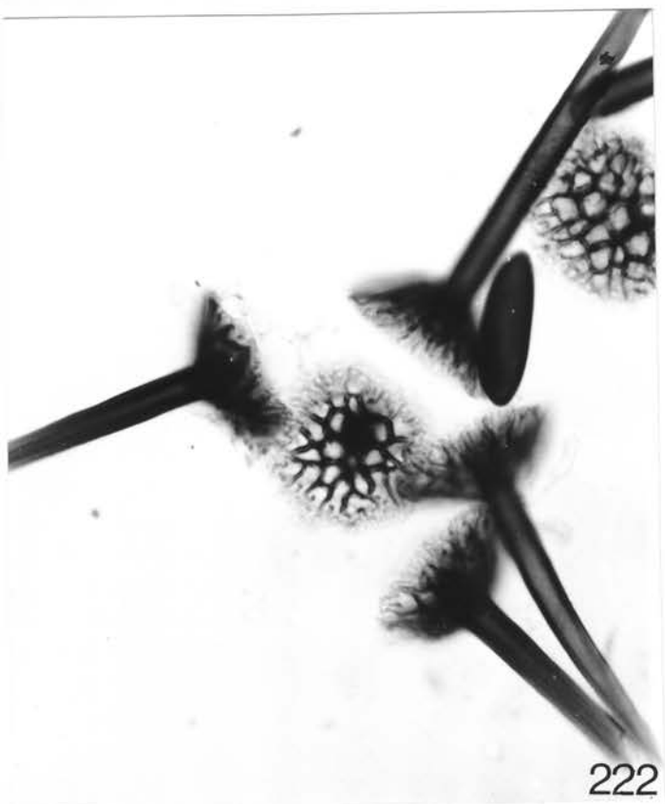
Fig. 224. Seta and base. Herb.DAR 17239(b). x680.

Fig. 225. Seta bases showing fimbriate margin. Herb.DAR 17239(b). x680.

Fig. 226. Septate seta. Herb.DAR 17239(b). x680.

Fig. 227. Very young seta base. Herb.DAR 17239(b). x680.

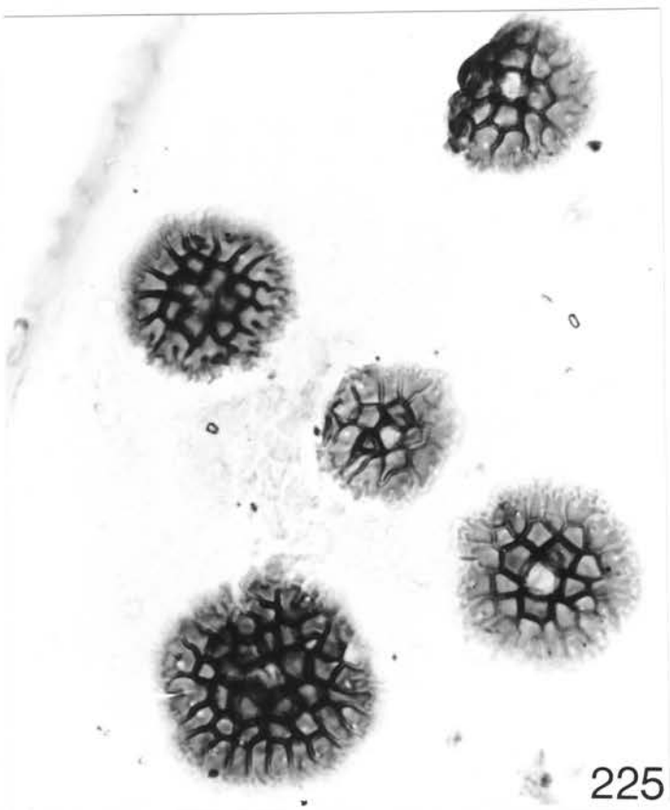
Fig. 228. Thick-walled base of seta in surface view. Herb.DAR 17239(b). x680.



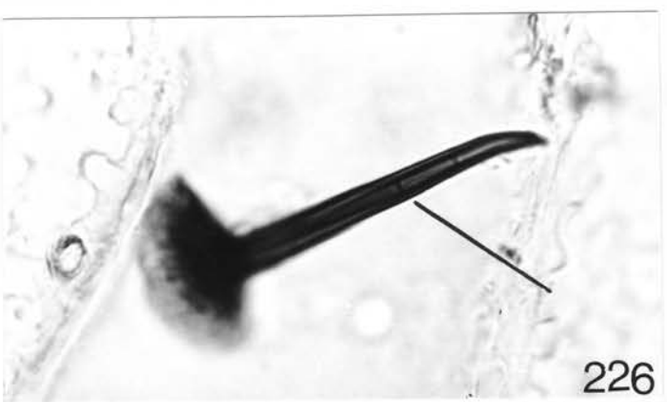
222

223

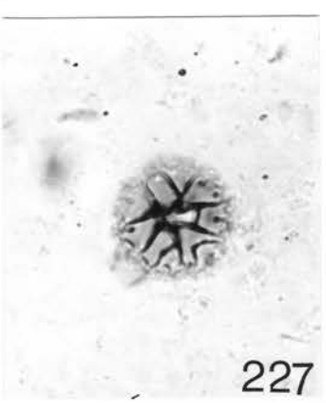
224



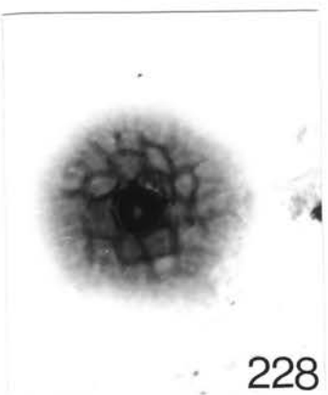
225



226



227



228

FIGURES 229 - 240

Fossil setae and seta bases cf. Vitalia.

Fig. 229. Seta base, side view. Herb.DAR 17239(b). x680.

Fig. 230. Pores in peripheral cells of seta base. Herb.DAR 17239(b). x1500.

Seta bases, Type 2, on Myrtaceae

Fig. 231. Seta. Herb.DAR 17251. x680.

Figs.232-235. Seta bases, surface view. Herb.DAR 17251. x1000.

Fig. 236. Seta base in side view showing finger-like extensions of the margin. Herb.DAR 17251. x1000.

Fig. 237. Seta base, side view. Herb.DAR 17251. x1000.

cf. Ephemeropsis on Myrtaceae

Fig. 238. Paired haptera on protonemal filament. x425.

Fig. 239. Haptera without secondary basal cells. x425.

Fig. 240. Haptera and protonemal filament.

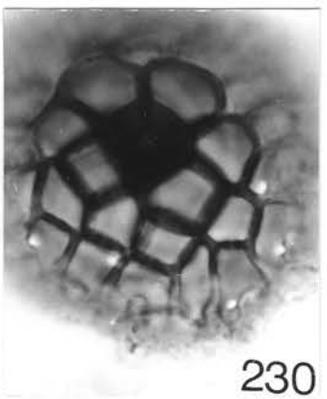
b.....basal cell

sb.....secondary basal cell

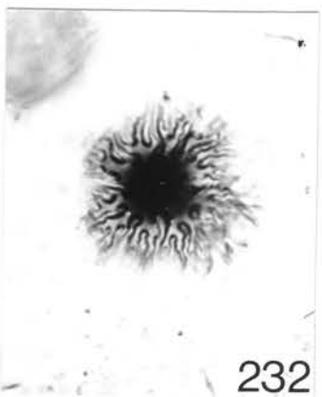
A.....terminal conical cell

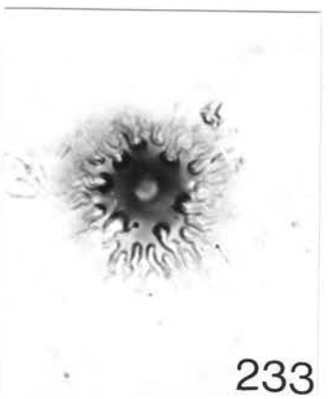
x425.


229

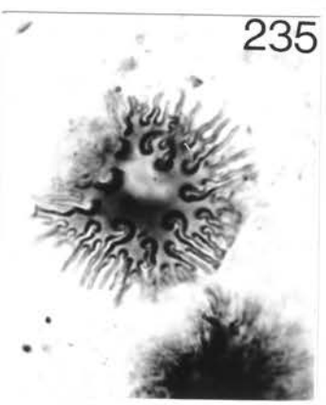

230


231


232

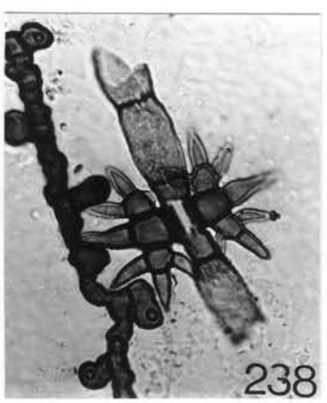

233

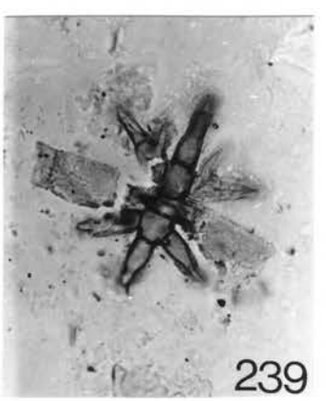

234

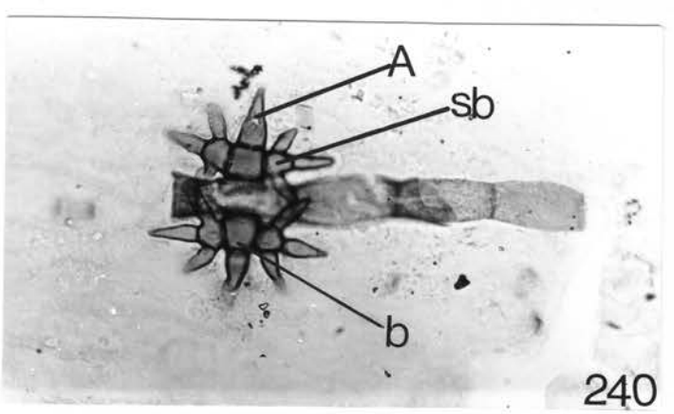

235


236


237


238


239


A
sb
b
240

FIGURES 241 - 245

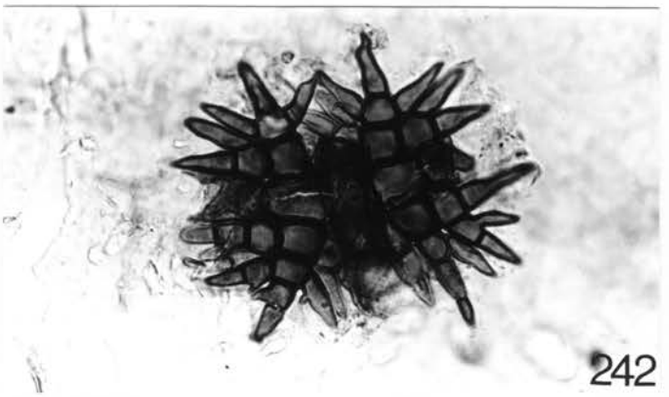
cf. Ephemeropsis.

Figs. 241-243. Haptera in opposite pairs at protonemal branches. X425.

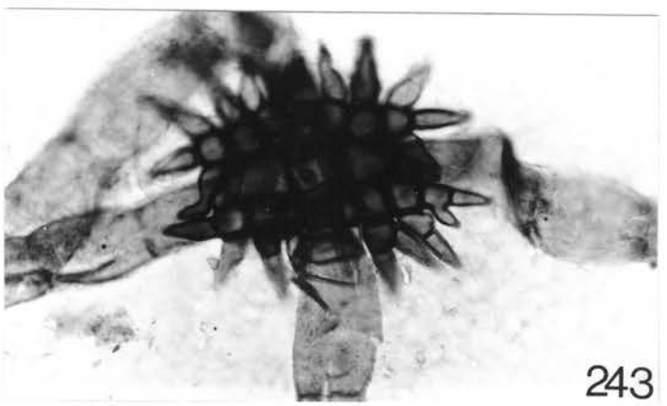
sterile mycelium, cf. Trichopeltheca, on Myrtaceae.

Figs. 244,245. Hyphae aggregated into thallus. Note darker, septate aerial filaments. Herb.DAR 17205(c). x240.

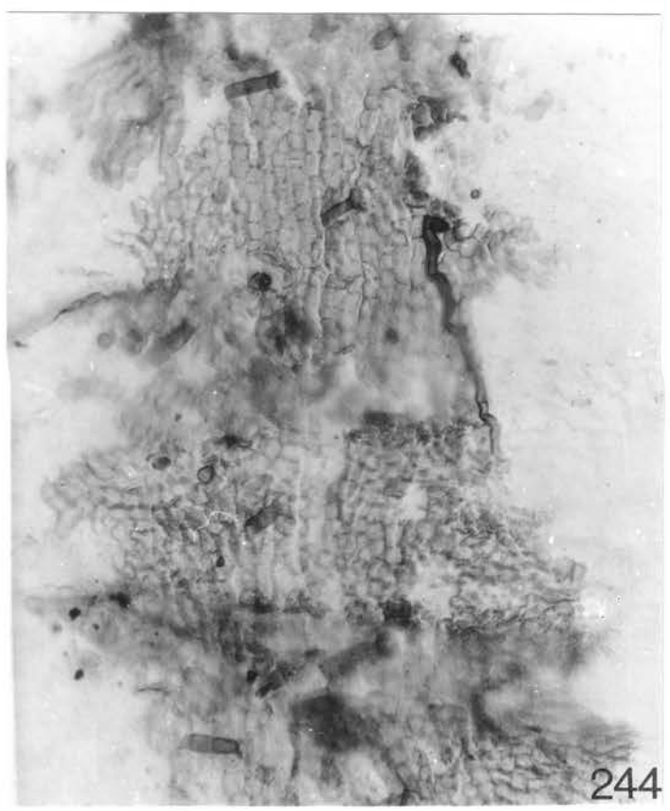
241



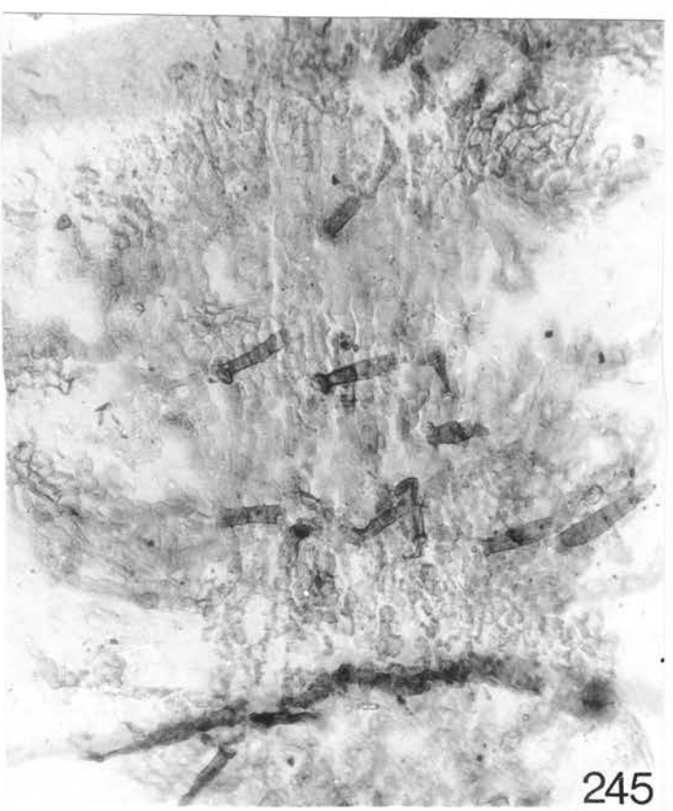
242



243



244



245

FIGURES 246 - 254

Sterile mycelium cf. Trichopeltheca.

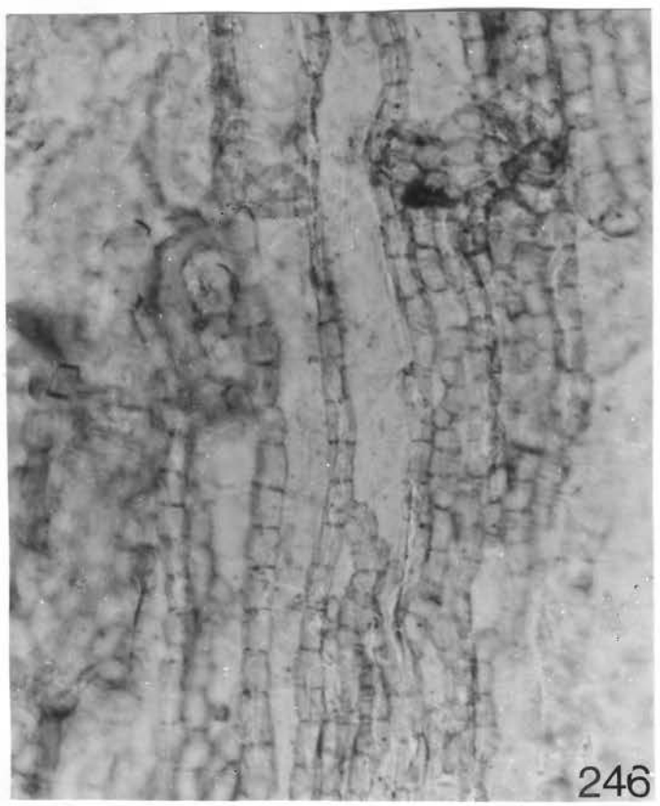
Fig. 246. Hyphae growing as separate strands. Herb.DAR 17205(c). x480.

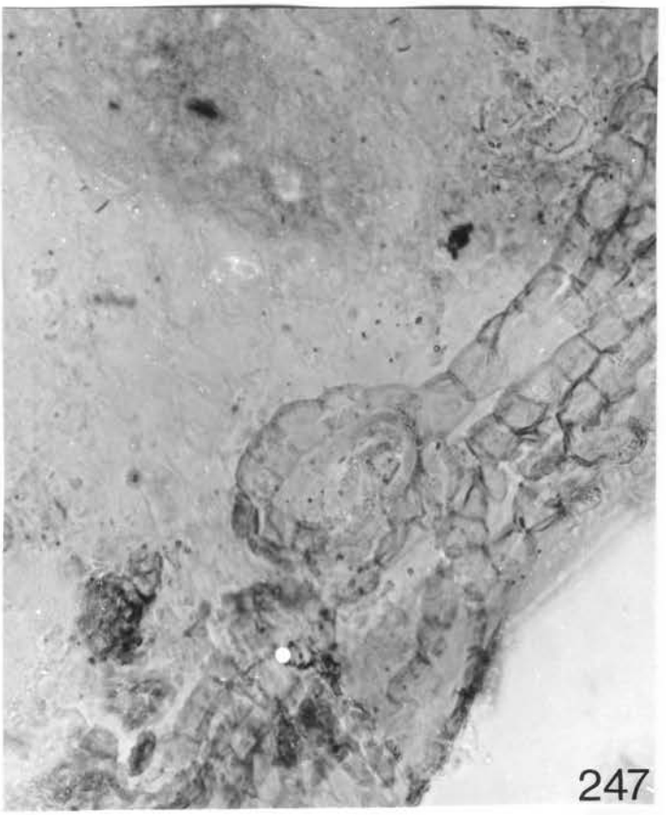
Fig. 247. Hypha growing around hair base of Myrtaceae. Herb.DAR 17205(c). x480.

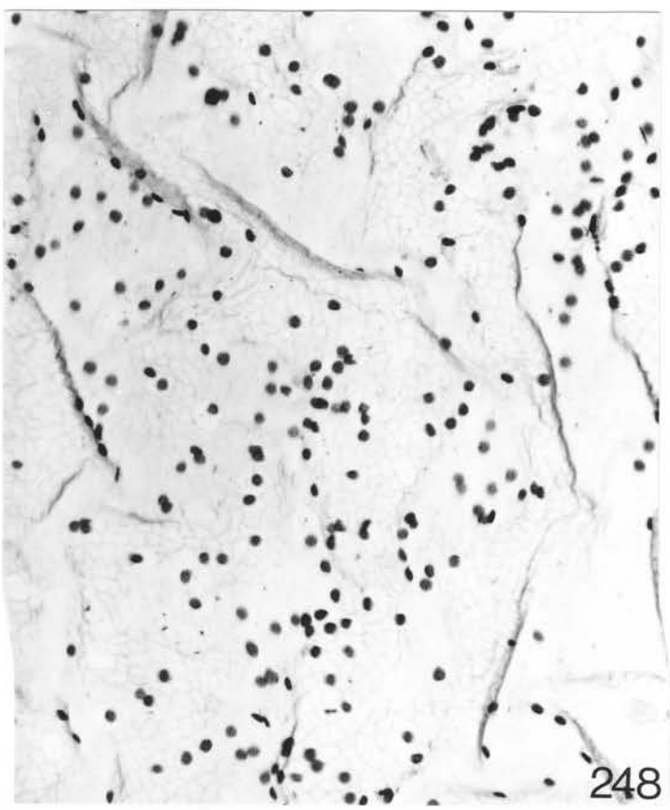
?Appressoria on Myrtaceae & Lauraceae

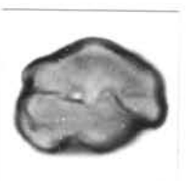
Fig. 248. Group of "thalli" on cuticle. Herb.DAR 17264. x155.

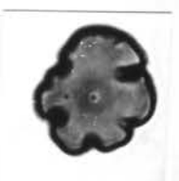
Fig. 249-254. Specimens to show possible mode of origin from a spore. x1500.

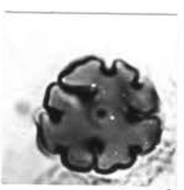

246


247


248


249


250


251


252


253


254

FIGURES 255 - 268

?Appressoria.

Figs. 255-260. Specimens to show range of variation. x1500.

Figs. 261, 262 Specimens to show possible further development of fossil ?appressoria. x1500.

Modern specimens for comparison.

Fig. 263. Thickened junction between ?appressorium and hypha on Bosistoa. x1500.

Fig. 264. Spore and hypha attached to ?appressorium. x1500.

Figs. 265-266. Young stages of Phycopeltis on Acmena. x1500.

Fig. 267. Young stage of Microthyriaceous fungus on Acmena. x1500.

Fig. 268. Modern ?appressorium with pore in lower face on Bosistoa. x1500.


255

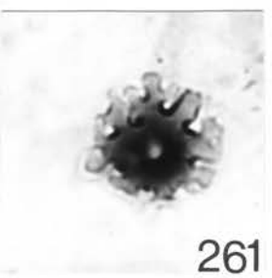

256

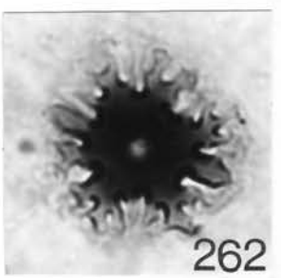

257

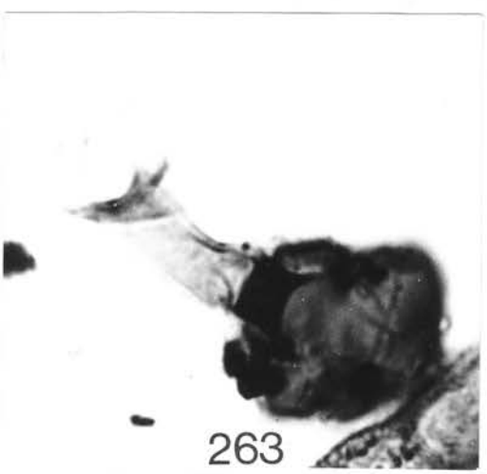

258

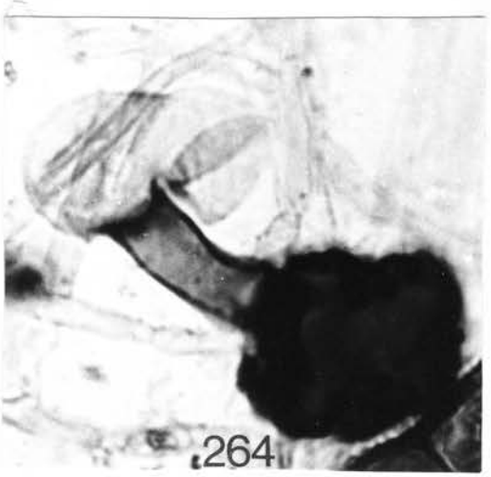

259

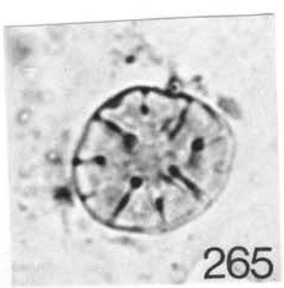

260

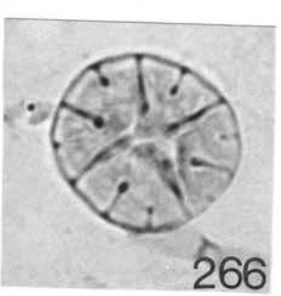

261


262


263


264


265


266


267


268

FIGURES 269 - 277

Modern ?appressoria.

Figs.269,270. Specimens showing absence of pore in upper wall. x2000.

Fig. 271. Small pore in apex of invagination, x1500.

Fig. 272. Double ?appressorium with rounded papilla. x1500.

Fig. 273. Thickened junction of hypha and ?appressorium. x1200.

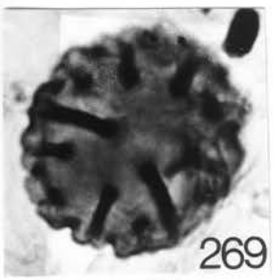
Fig. 274. Fossil ?appressorium with associated hypha. X 1500.

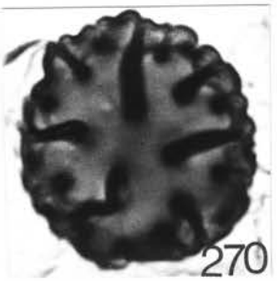
Podocarpus praecupressinus Ett.

Fig. 275. Distichous shoot. x 4.

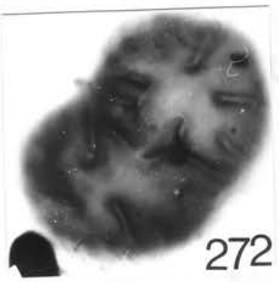
Fig. 276. Stomata with common polar subsidiary cells. x500.

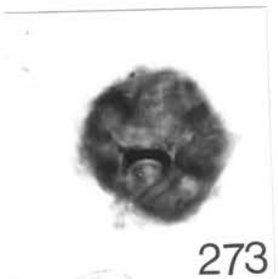
Fig. 277. Portion of cuticle showing stomata in longitudinal rows. x120.

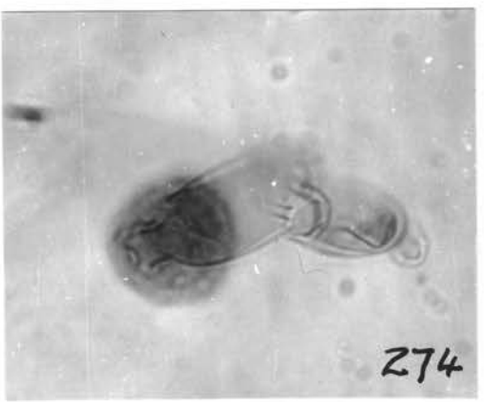

269


270

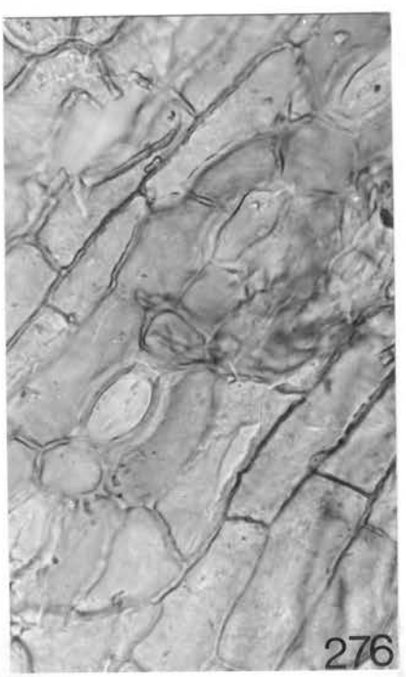

271


272


273


274


275


276


277

FIGURES 278 - 282

LAURACEAE.

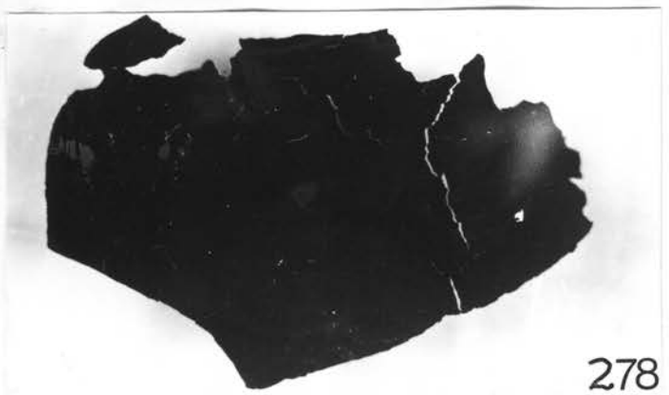
Fig. 278. Upper surface of leaf. x 2.

Fig. 279. Lower surface of leaf. x 2.

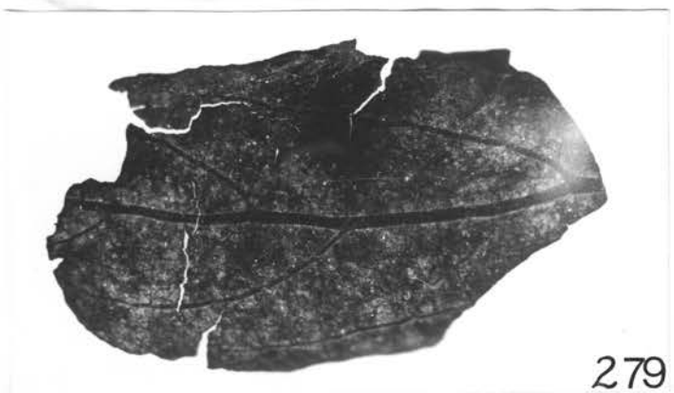
Fig. 280. Upper cuticle showing vein reticulum. x55.

Fig. 281. Lower cuticle showing vein reticulum. x55.

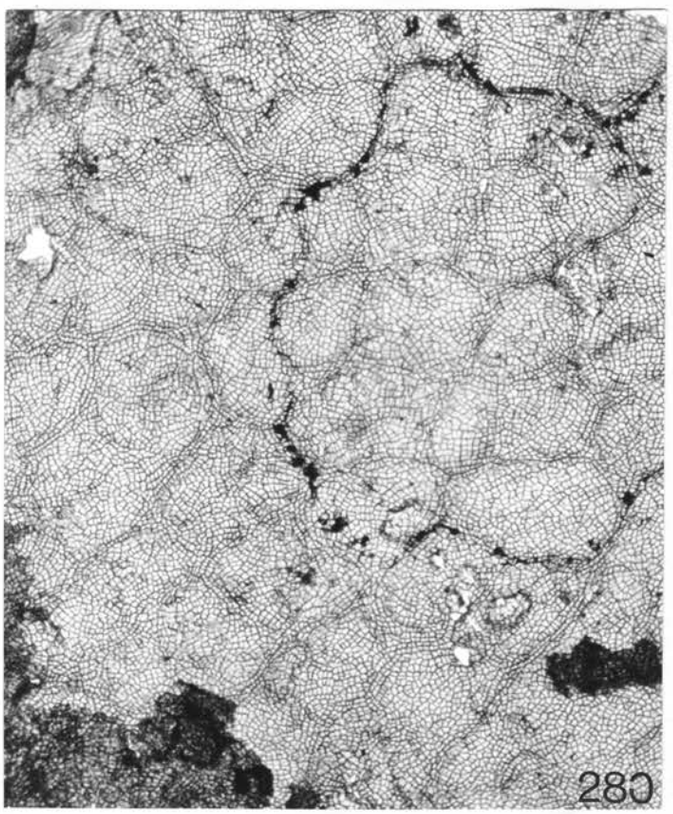
Fig. 282. Lower cuticle showing stomata in intervein areas. x150.



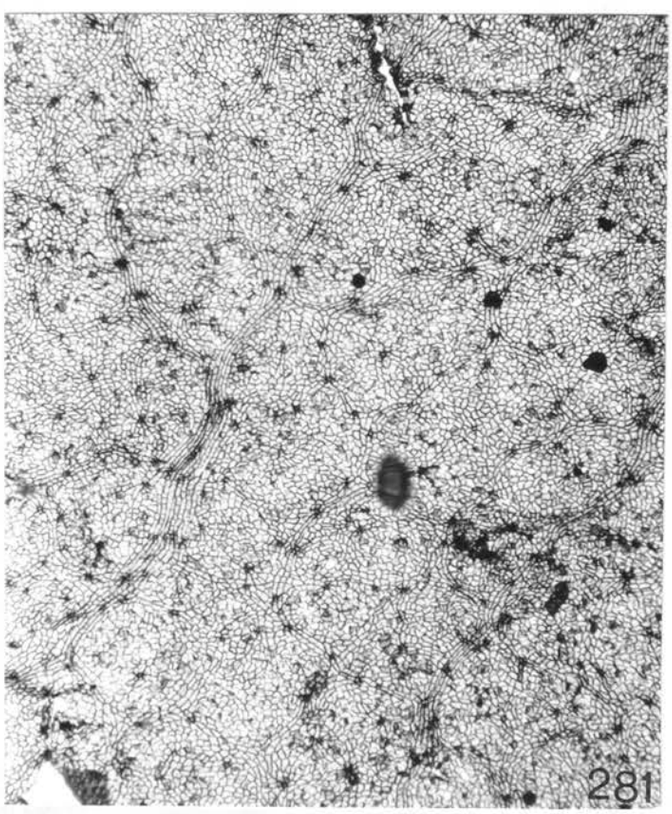
278



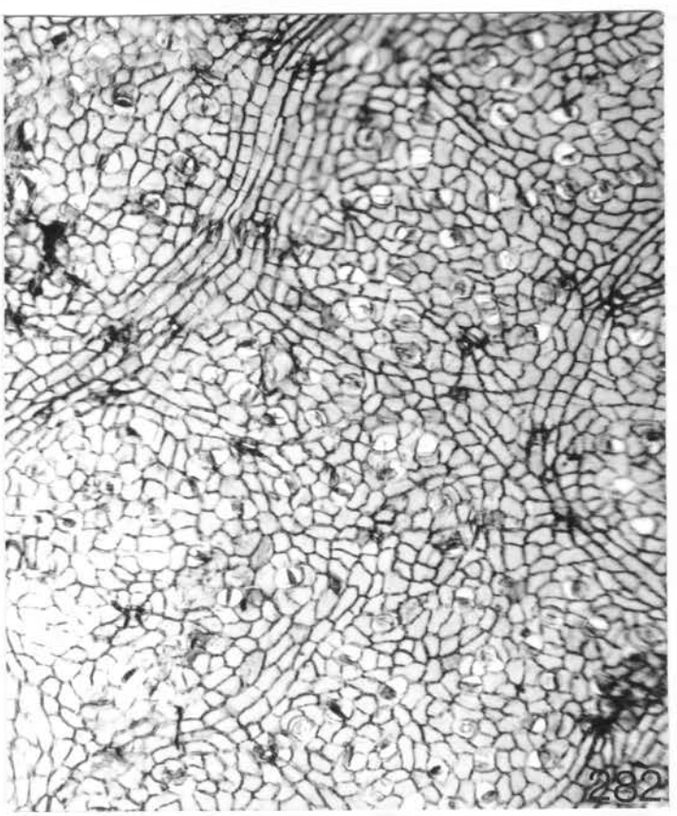
279



280



281



282

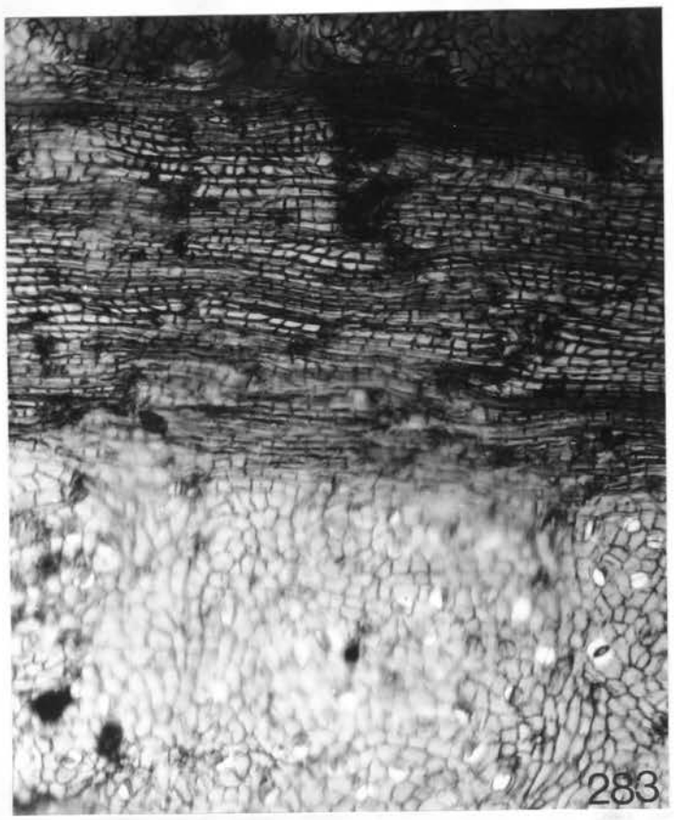
FIGURES 283 - 285

Lauraceae.

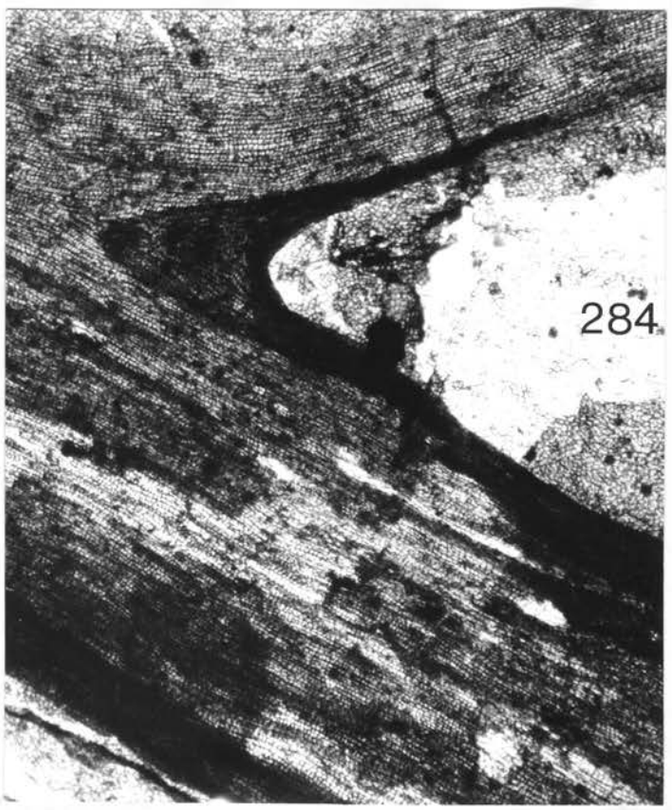
Fig. 283. Lower cuticle with portion of midrib. x155.

Fig. 284. Marsupiform domatium at junction of midrib and lateral vein. x55

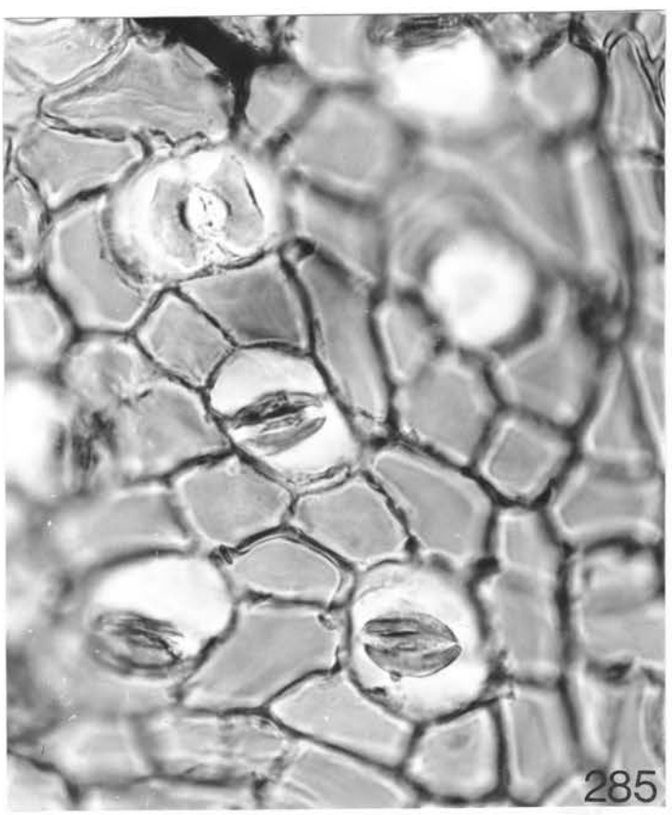
Fig. 285. Stomata with deeply staining cuticle scales. x800.



283



284



285

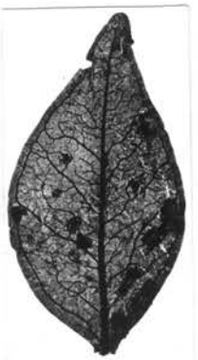
FIGURES 286 - 293.

Myrtaceae.

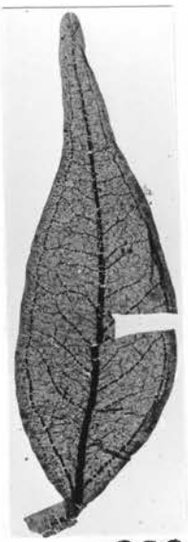
Figs. 286 - 293. Unmacerated leaves mounted in canada balsam showing venation and range of form. All x3.

286

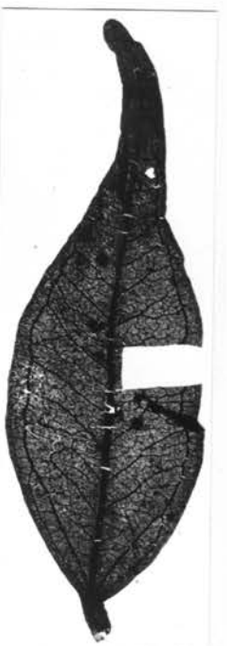
287



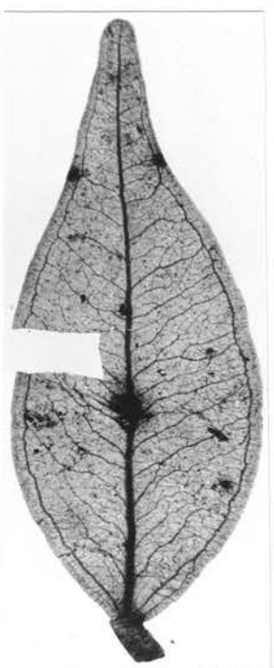
288



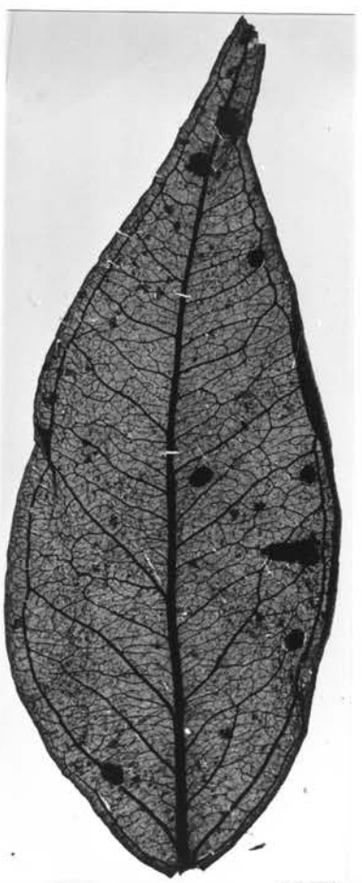
289



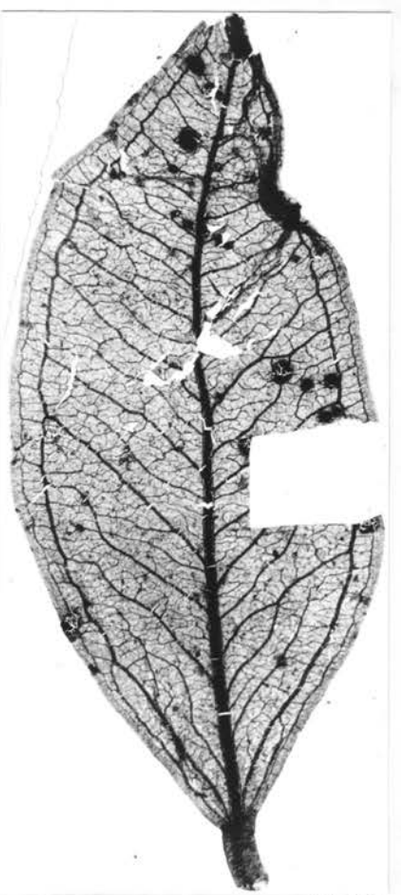
290



291



292



293

FIGURES 294 - 301.

Myrtaceae

Fig. 294. T.S. lamina at margin showing poorly preserved mesophyll. x500.

Fig. 295. Upper cuticle: midrib. Note longitudinal rows of cells and hair bases. x55.

Fig. 296. Upper cuticle: detail of midrib showing hair bases and longitudinal cuticle ridges. x500.

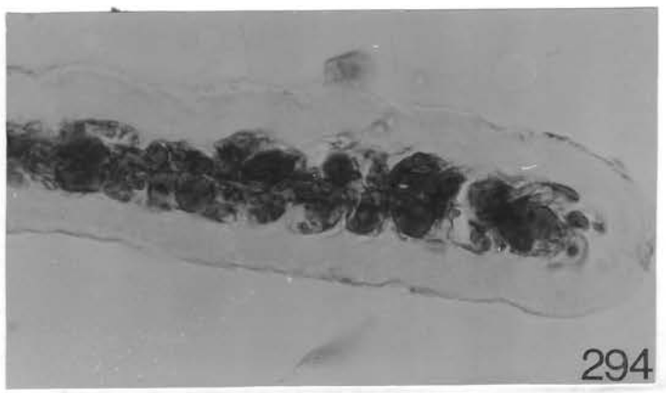
Fig. 297. Upper cuticle: lamina epidermal cells with straight walls. x500.

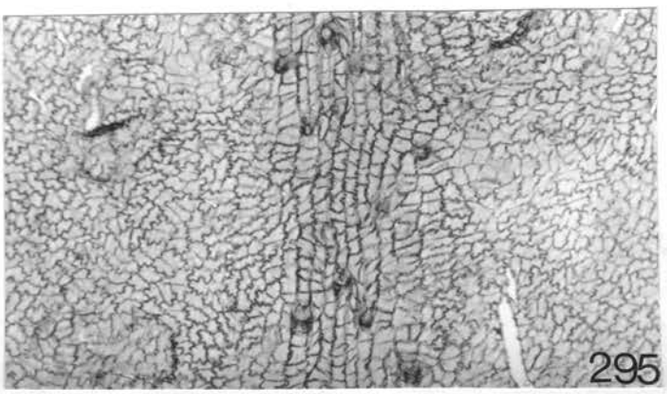
Fig. 298. Upper cuticle: lamina epidermal cells with sinuous walls. x500.

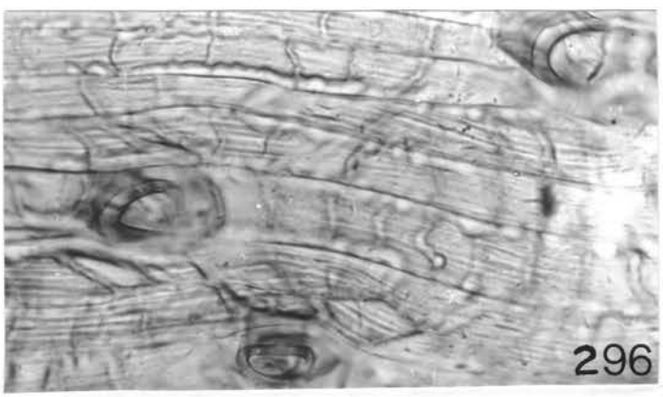
Fig. 299. Upper cuticle: lamina epidermal cells with walls of intermediate type. x500.

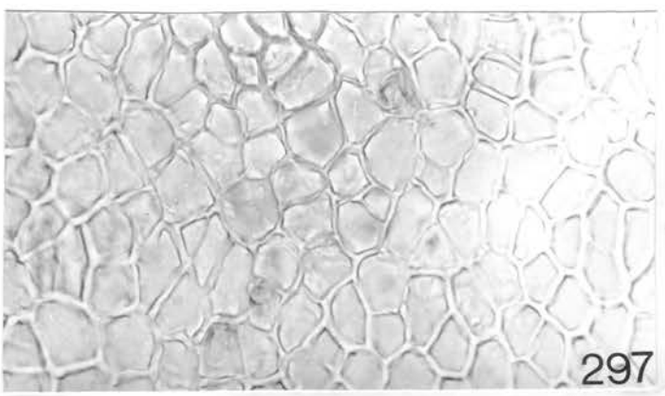
Fig. 300. Lower cuticle: midrib. Note longitudinal rows of cells and hair bases. x40.

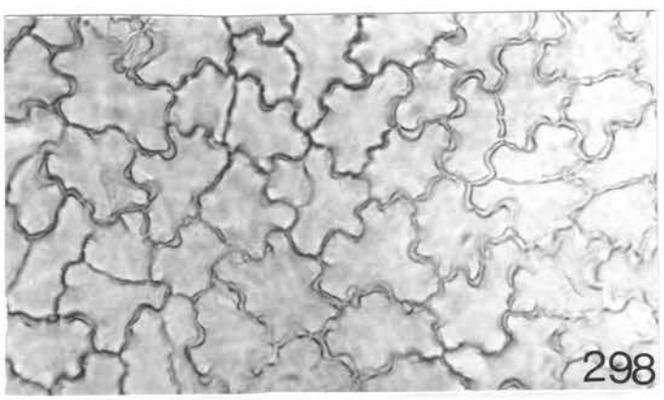
Fig. 301. Lower cuticle: detail of midrib showing longitudinal cuticle ridges. Note individual striations and grooves. Stained in basic fuchsin. x500.

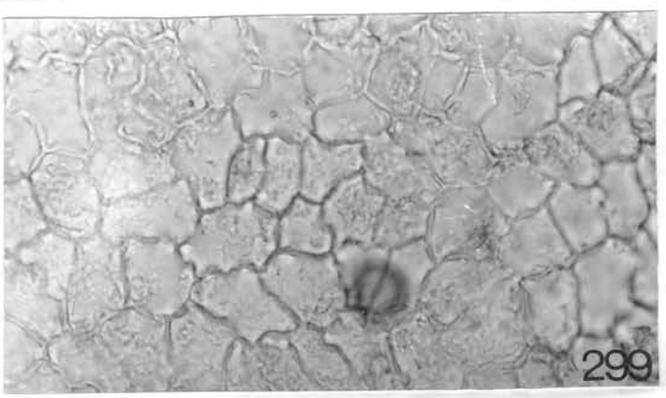

294

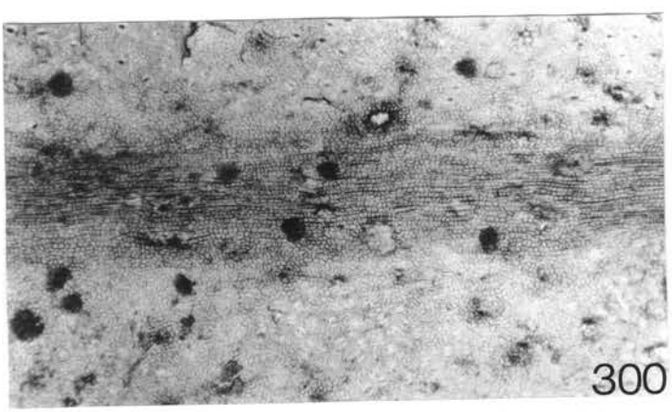

295

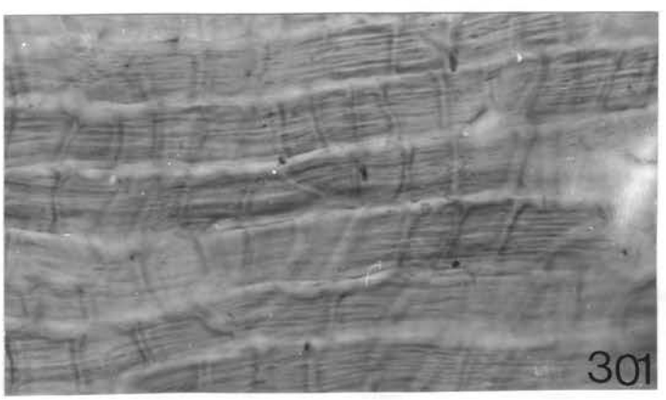

296


297


298


299


300


301

FIGURES 302 - 309.

Myrtaceae

Fig. 302. Lower cuticle: lamina. Note scattered stomata, cork warts and hair bases. x 40

Fig. 303. Lower cuticle: lamina. Note stomata in loose clusters, scattered cork warts and hair bases. x 40

Fig. 304. Lower cuticle: lamina epidermal cells. x500.

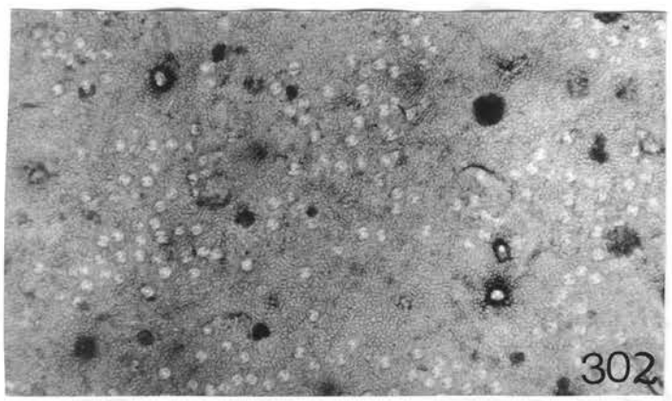
Fig. 305. Lower cuticle: hair base. Note radiating cuticle striations. x500.

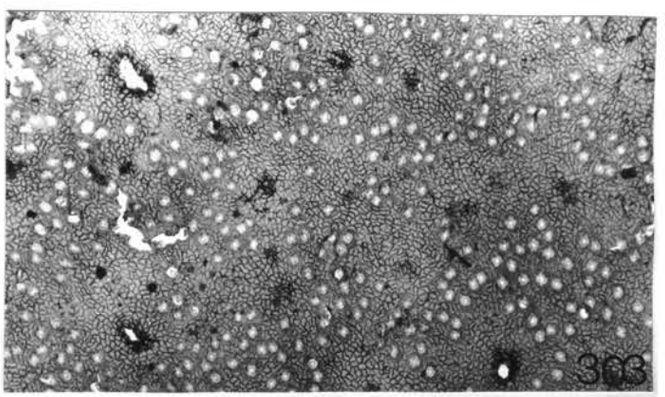
Fig. 306. Lower cuticle: 2-celled gland cover. x500.

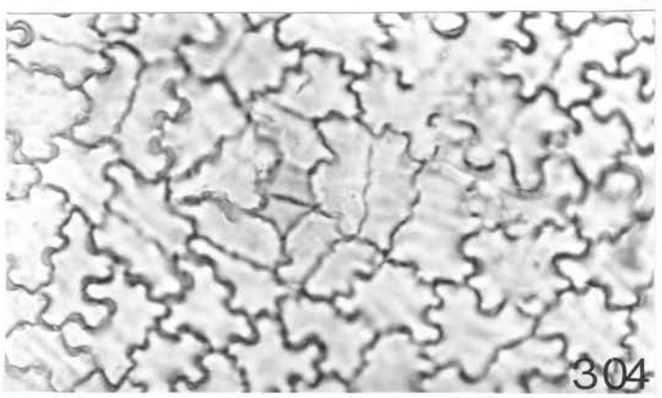
Fig. 307. Syzygium oleosa. 2-celled gland cover on lower cuticle. x500.

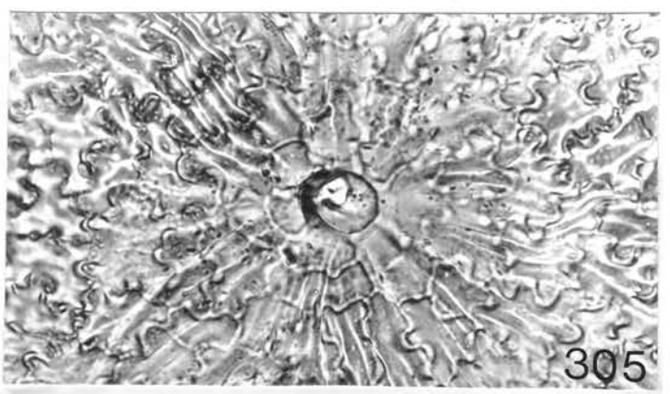
Fig. 308. Syzygium oleosa. T.S. leaf showing oil gland. x500.

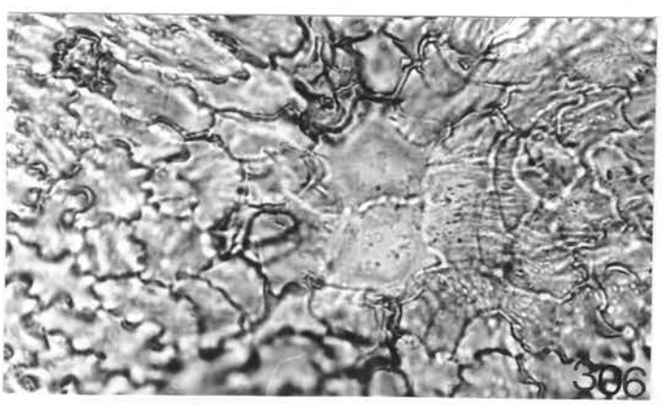
Fig. 309. Lower cuticle: mature stomata in high focus (see fig.315A). Note distinct outer stomatal ledges forming ring, and cuticle striations. x 500.

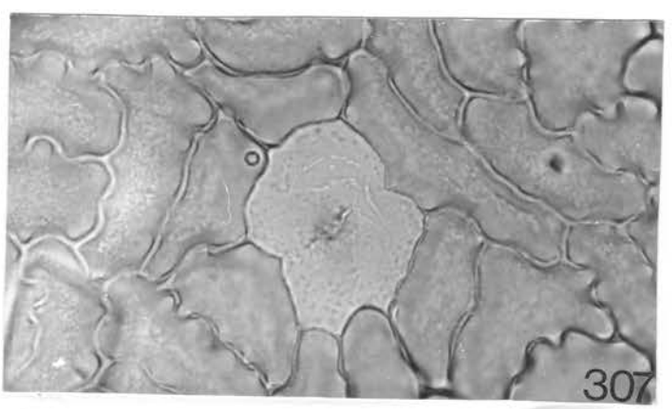

302

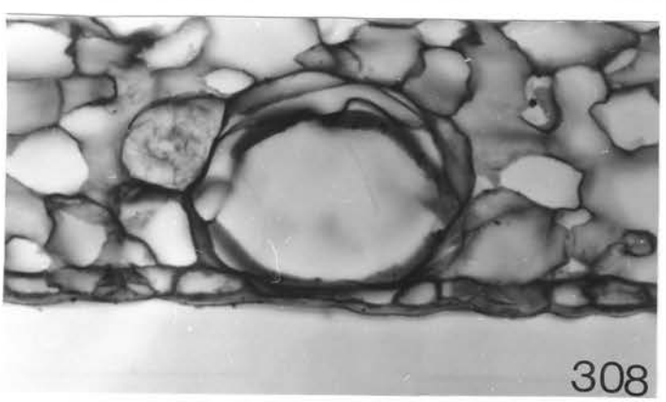

303

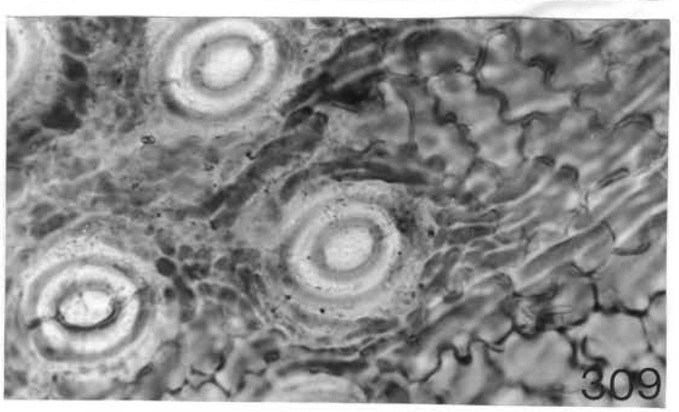

304


305


306


307


308


309

FIGURES 310 - 315.

Myrtaceae

Fig. 310. Lower cuticle: mature stomata surrounded by rings of epidermal cells. x500.

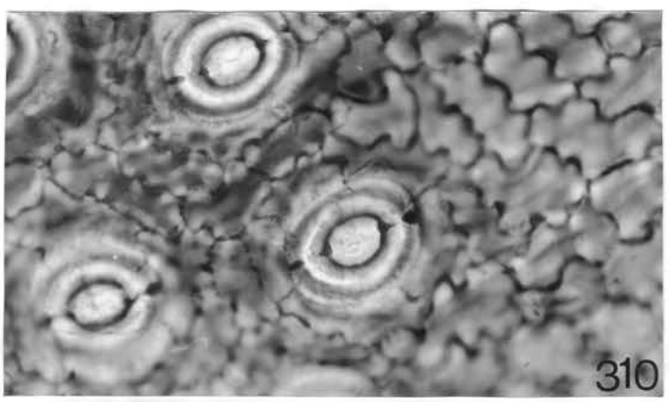
Fig. 311. Lower cuticle: developing stoma. x500.

Fig. 312. Lower cuticle: developing stomata. x500.

Fig. 313. Giant stoma on lower cuticle. Note radiating cuticle striations. x500.

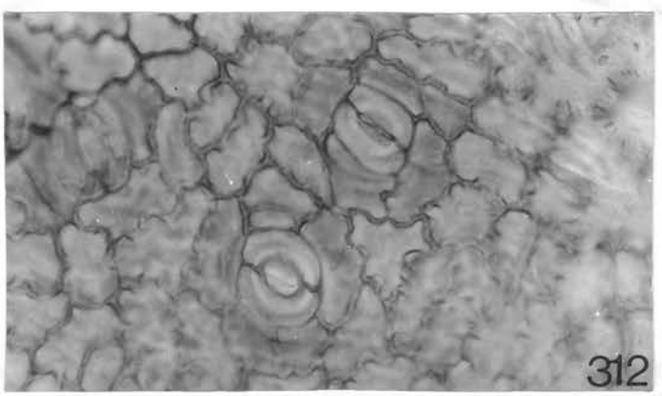
Fig. 314. Lower cuticle: cork wart. x500.

Fig. 315. T.S. stoma, diagrammatic reconstruction. Stippling indicates structure preserved. Dotted lines represent probable structure.



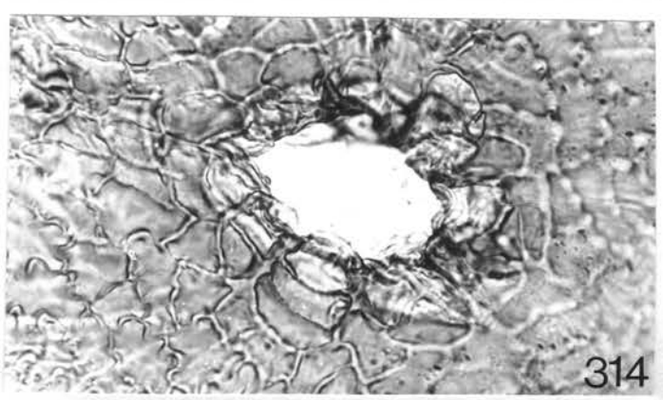
310

311



312

313



314

315