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# PALYNOLOGY OF THE VICTORIAN MINES DEPARTMENT LATROBE 1 BORE, OTWAY BASIN, VICTORIA

by

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ILLUSTRATIONS.

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## ABSTRACT.

The palyonology of the Victorian Mines Department latrobe 1 bore, Otway Basin was studied. Three spore-pollen zones from Middle Paleocene to late Eocene are recognized. The Middle Paleocene and Upper Paleocene to Eocene zones can be related to th *G. edwardsii* Zonule and the *C. orthoteichus* Zonule ( Harris 1971 ) respectively. When these zones are compared with the biostratigraphic zones of the Gippsland Basin, it is found that there are many similarities in the pollen assemblages of the two basins. A total of eighty-one species identified from the core have been described.

The prolific production and wide distribution of pollen makes it well suited to biostratigraphic analysis. Dispersed pollen may be incorporated into a wide variety of sediments both marine and continental. Changes in vegetation either from natural succession or a variety of environmental factors are reflected in the content and abundance of pollen produced. Palynology is concerned with recording and interpreting these changes in pollen assemblages. If the spore-pollen assemblages present in dated microfaunal sequences can be recorded, then these assemblages may prove to be useful biostratigraphic indicators for sediments not containing or deficient in microfauna.

Throughout south-eastern Australia, non marine and marginal marine sediments of Tertiary age are to be found. In the larger sedimentary basins marginal to the present coastline ( fig. 2 ) these sediments are intercalated with sediments carrying marine faunas. This is particularly so in the Otway Basin,where Tertiary palynology in south-eastern Australia was first instigated. At Castle Cove, Princetown and Pebble Point in the Otway Basin the stratigraphic positions of marine faunal sequences are well established , and palynological analysis of sediments within these sequences may establish the position of south-eastern Australian pollen assemblages within the accepted time scale.

The Victorian Mines Department Latrobe 1 core comes from the Princetown area of the Otway Basin. (fig. 1 ). The purpose of this thesis is to examine the palynology of the core with regard to the spore-pollen assemblage and their stratigraphic implications.

Tertiary palynology in south-eastern Australia actually began in 1946 with Cookson's article on fossil *Nothofagus* pollen (Southern

Beech ), and this was followed by a number of articles which identified and described new pollen species found in various locations of southern Australia.

In 1954, Cookson published an article on the Victorian Mines Department No.1 bore, Birregurra, in the Otway Basin ( fig. 1 ). This was the first attempt in south-eastern Australia to use Tertiary spore-pollen assemblages as a means of correlating surface and subsurface sections. She recognized three distinct spore-pollen assemblages in Birregurra 1 bore, which she designated Microflora A ( Cretaceous ), Microflora B ( Paleocene-early Eocene ), and Microflora C ( Eocene ), and showed that these species occurred in similar assemblages in the nearby Otway Basin surface sections.

The next major work came in 1965, with Harris's article on the sequence of spore-pollen assemblages in the Princetown area of the Otway Basin. He recognized three spore-pollen zones, from middle Paleocene to late Paleocene, which were partly related to Cookson's Microfloras.

In 1971 Harris further clarified the characteristics of spore-pollen assemblages in the Otway Basin, with information obtained from about 19 bores and outcrops. By correlating marine sequences, a succession of biostrategraphic zones was established for the Tertiary. The lower Tertiary zones have been recognized throughout southern Australia, giving them more than local correlative value. Middle and upper Tertiary microfloral successions however, are not well known in the Otway Basin, and Palynological data for these assemblages came from sediments in the nearby Murray Basin where Eocene and younger sedimentary sequences exist. Seven biostrategraphic zones from middle Paleocene to upper Eocene were recognized, ( fig. 3 ). One Oligocene, two Miocene and one Pliocene zones were also recognized, but not formally constructed.

In 1973 Stover and Partridge published the spore-pollen zonation for the onshore and offshore portions of the Gippsland Basin. It represented the culmination of information derived from several sources, including offshore petroleum exploration wells, and resulted from the examination of about 800 offshore and 130 onshore samples. They recognized 10 biostratigraphic zones from late Cretaceous to late Miocene ( fig. 3 ). The Gippsland Basin zones from mid Paleocene to late Eocene are partially equivalent to those known in the Otway Basin.

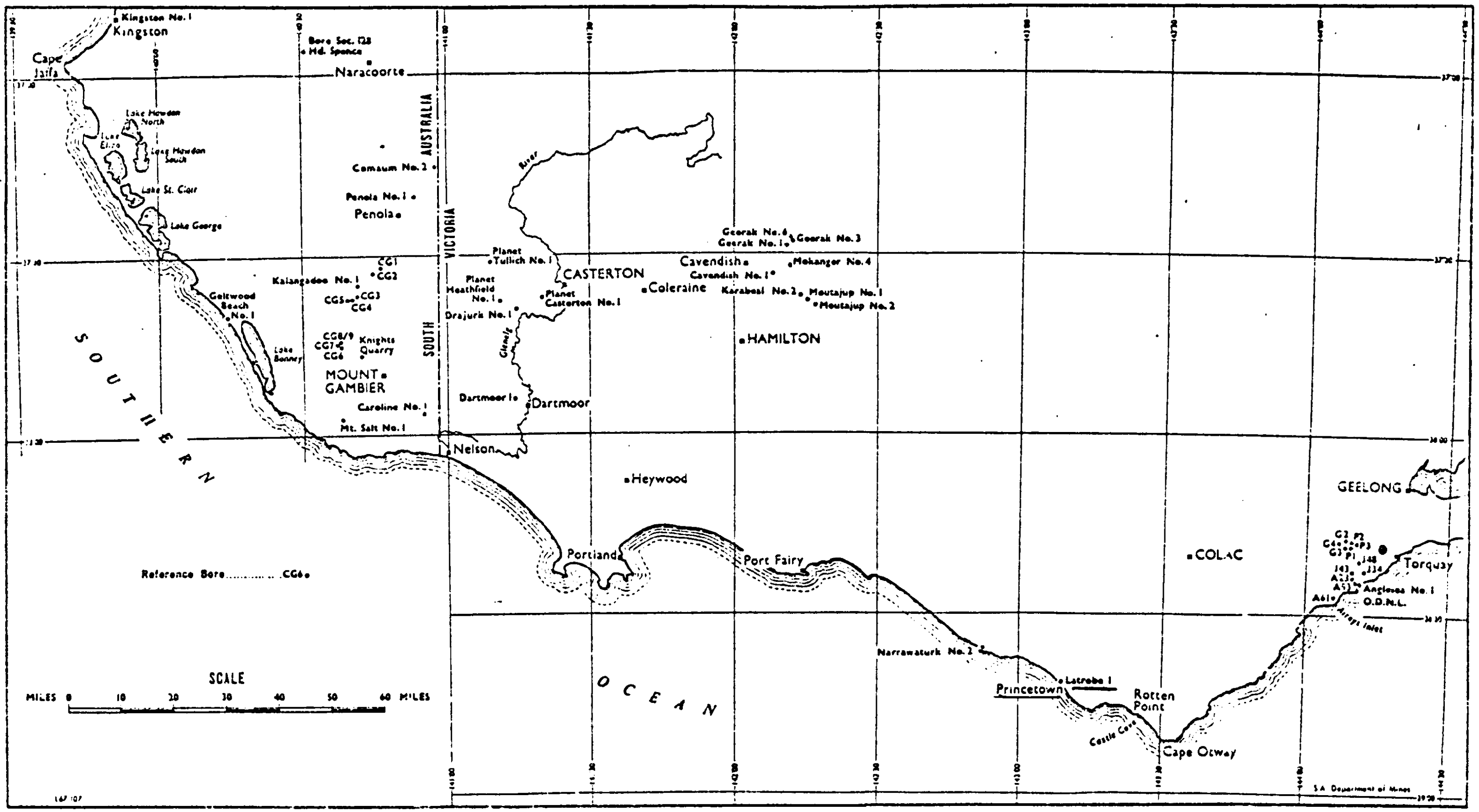


FIG. ·1. Locality plan of wells and outcrop sections, Otway Basin ( After

GEOLOGY

Chapter 2

The Otway Basin is a trough containing a thick sequence of Mesozoic and Cainozoic sedimentary and volcanic rocks, which extends in a west-northwesterly direction across southwestern Victoria from the eastern side of Port Phillip Bay, to Lacepede Bay, South Australia ( fig. 2 ) To the north the margin of the basin is defined by the Palaeozoic rocks of the Western Highlands of Victoria which separate the Otway Basin from the Murray Basin in the north. ( C.Abele et al 1976 ). The southern limit of the basin beneath Tasmanian waters is uncertain.

The evolution of the Otway Basin apparently began in Upper Jurassic time when a narrow east-west depression developed between Robe ( South Australia ) and Casterton ( Victoria ). Continued subsidence along largely east-west direction had produced a major trough by the early Lower Cretaceous, which was separated from the open ocean by a basement ridge. For the remainder of the Lower Cretaceous, sedimentation was accompanied by contemporaneous volcanic activity. By the end of the Lower Cretaceous, the progressive downwarping had reduced the effectivness of the southern basement ridge, allowing the sea to gain limited access to the basin, and by the early Tertiary complete foundering of the basin had occurred. ( D. Spencer-Jones et al 1971 ).

Subsidence continued during the Tertiary, and paralic sedimentation ( Wangerrip Group ), representing the first of two major Tertiary transgressive-regressive depositional cycles,prevailed during the Paleocene and early Eocene (Abele et al 1976 ). At some time during the early and middle Eocene there occurred a hiatus characterized by widespread nondeposition and erosion of the sediments, but the extent of the hiatus is not known ( Abele et al 19'76 ).

The Victorian Mines Department Latrobe 1 core comes from a marginal part of the Port Campbell Embayment, one of several tectonic units recognized onshore in the Otway Basin. The Port Campbell Embayment remained an essentially negative tetonic unit during the Lower Cretaceous to Tertiary, and contains a relatively thick developement of these sediments,particularly near Port Campbell. The marine transgressions of the early Upper Cretaceous and Upper Eocene had their first and probably best development in this embayment. ( D. Spencer-Jones et al 1971 ). Upper Cretaceous and early Tertiary marine sediments are restricted to the coastal belt of the embayment.

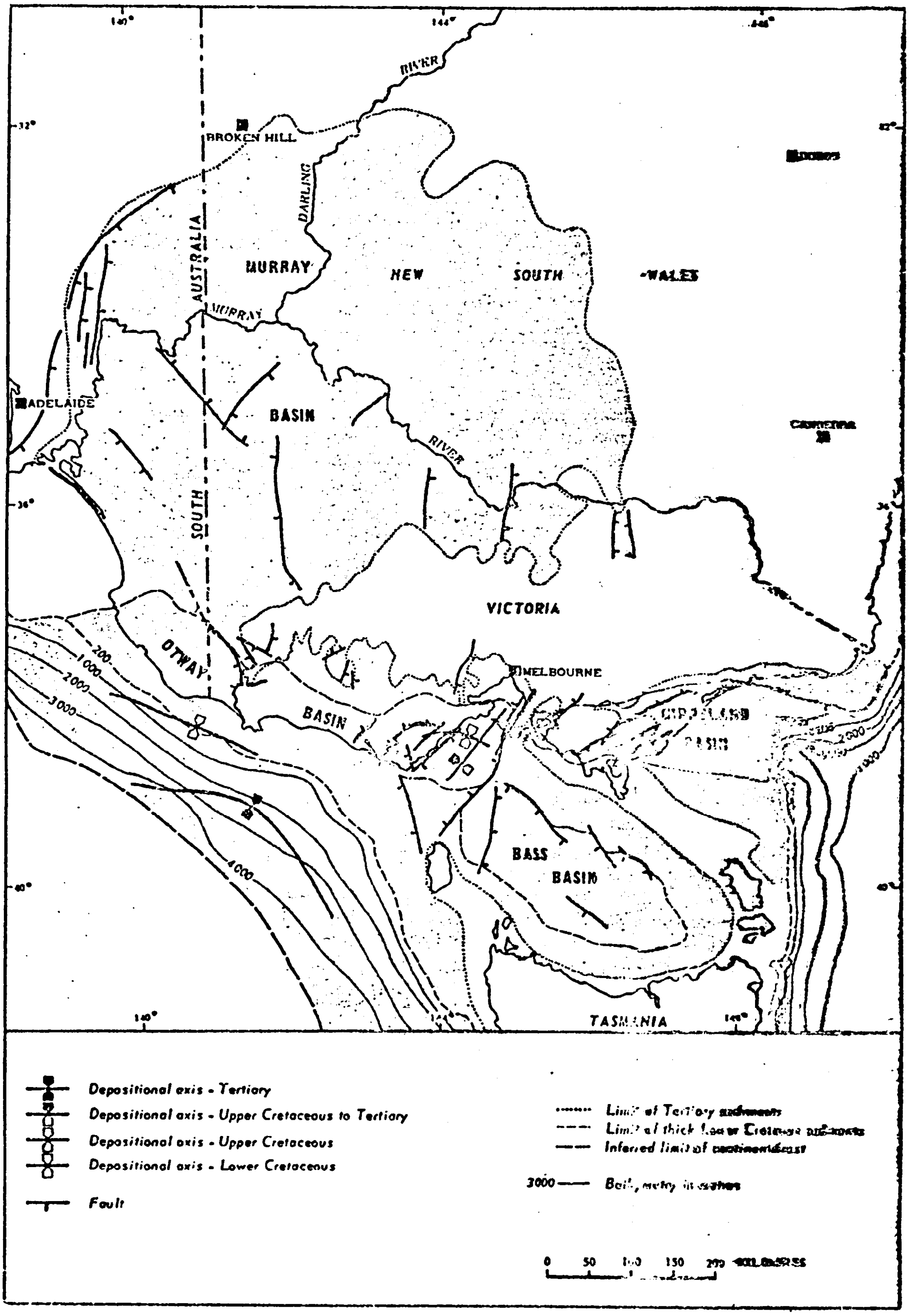


Figure 2 - Tertiary Basins of Southeastern Australia.

(After

STRATIGRAPHY. Chapter 3

The Latrobe 1 well was drilled to a depth of 620 m. with good core recovery above 350m., but poor below this depth. The stratigraphy is shown at fig. 4.

Two marine transgressive-regressive cycles are represented in the core, the Wangerrip Group and the Heytesbury Group. The Wangerrip Group comprises the lower Pebble Point Formation and the upper Dilwyn Formation, and represents a transition from shallow marine to largely continental deposits following the marine transgression of the Upper Cretaceous, From the base of the core, to a depth of about 344m., is the Pebble Point Formation, which represents the initial marine transgressive unit of the upper part of the Wangerrip Group. It consists predominently of limonitic quartz sandstone or sand which is commonly pebbly, silty or clayey, and partly dolomitic and glauconitic.

From a depth of about 344m. to 71m. is the Dilwyn Group which conformably overlies the Pebble Point Formation. There is uncertainty as to the exact limit of the Dilwyn Formation. There is a possibility that the Dilwyn Formation - Narrawaturk Marl boundary actually occurs below 71m. ( R. Blake pers. comm. ). This group is the main paralic regressive unit of the upper Wangerrip Group, and comprises the Pember Mudstone Member, the Rivernook Member and the Princetown Member. The Dilwyn Group consists mainly of quartz sand , commonly silty or clayey, sandy silt and clay, mudstone and shale. The fine grained sediments are usually dark carbonaceous, micaceous and pyritic. The basal Pember Mudstone Member consists largely of carbonaceous, micaceous, sandy siltstone, mudstone and shale, and is the main marine member of the Dilwyn Formation.

Above this between a depth of about 310m. and 287m. is a thick glauconitic clay bed, the Rivernook Member, which contains a distinctive faunal assemblage. It occurs immediately beneath a series of dolomitic sandstone beds, and is believed to represent a minor marine transgression. Glauconites are indicative of a more marine environment,while shallower marginal marine environments tend to deposit dolomite. ( D. Ripper pers. comm. ).

Towards the top of the Dilwyn Formation the sediments become less clayey, coarser grained and more carbonaceous as the marine influence decreased and a salt marsh, lagoonal and tidal flat environment prevailed.

The Dilwyn Formation is overlain unconformably by sediments which are predominantly marine marl and sandy,limonitic quartz limestone. These sediments are known as the Narrawaturk Marl, a sub group of the Nirranda subgroup of the Heytesbury Group . These sediments represent the upper Eocene marine transgression.

THE FORAMINIFERAL ZONATION OF LATROBE 1.

The foraminiferal zonation as proposed by Taylor ( 1964 ) is shown at fig. 4.

Between a depth of 59m. and 76m. the late Eocene ( Johannian ) fauna is recognized, which puts possibly a late Eocene age on the top of the Princetown Member. Below this depth the sediments become barren of microfauna.

Late Paleocene sediments are recognized at a depth of 207m. with the "Princetown Fauna" , containing the species Globorotalia pseudomenardii which is indicative of a definite late Paleocene age. This species is first noted at 217m.

Below this , between 256m. and 290m. , the late Paleocene "<u>Trochocyathus</u> fauna" is recognized, and this section is the youngest occurrence of a rich Paleocene fauna.

Between 290m. and 306m. ,the late Paleocene "Rivernook fauna" occurs. This sequence is richest in Paleocene faunas.

Below this, between 315m. and 345m., the middle Paleocene "Pebble Point fauna" occurs. These sediments are poor in fauna, and below this the sediments become berren of fauna. The middle Paleocene-late Paleocene boundary is placed at the top of the "Pebble Point fauna".

At a depth of about 488m. Late Cretaceous arenaceous foraminifers are recognized. ( Stough 1969 )

PREPARATION AND PROCEDURES Chapter 4

The samples consisted mainly of siltstones and mudstones with varying proportions of sand, clay and carbonaceous material. The method used to extract the pollen is as follows:

1. About25g of the sample is crushed, then dissolved in dilute HCL to remove carbonates..

2. After washing, the sample is left in concentrated HF for at least 48 hrs, usually longer, to dissolve inorganic material. The residue is then washed.

3. The residue is then boiled in Shultze's solution ( 2 parts conc. $HNO_3$ :1 part KCL ) for approximately 2 minutes, then washed. This procedure is repeated several times until most of the organic material is dissooved. At this stage care must be taken to prevent over oxidation, which would damage the pollen itself.

4. The residue is then treated with an alkali ( $NH_3$ ) briefly, then washed until solution is clear.

5. Finally the residue was centrifuged with warm glycerine jelly to remove water and then stored in glycerine jelly to which a little saffranin stain had been added.

6. The slides were mounted in glycerine jelly and sealed with nail polish.

The slides were of variable quality. Some samples tended to flocculate at step 3 which affected the clarity of the slide. Use of a sonic vibrator can avert this difficulty. Centrifuging with a heavy liquid would help to remove the finer particles which remained after the preparation of the samples.

In most of the samples the pollen was reasonably abundant, particularly in the mudstones. The sandier samples contained the least abundant and least well preserved grains. A sample from the Rivernook Member yielded scarce pollen and could not be used.

In order to identify the pollen , particularly for the initial count in which every grain should be identified, the slides had to be melted to allow rotation of the grains. This procedure had the added disadvantage of making photography more difficult since the grains kept moving. As a result some of the photos either did not work or were blurred.

THE POLLEN ZONES- METHODS Chapter 5

When establishing pollen zones , consideration is given to both the relative abundance and the vertical distribution of species.

To determine the relative abundance of species, a count of an equal number of grains is made in each sample. The optimum number is considered to be about 200, although in samples deficient in pollen this is not always possible. The percentage of each species within the total is then calculated.

The information is then plotted on a pollen diagram, which is a graphical representation of the relative abundance of species with depth. Only those species present in amounts greater than 1% are used to construct the pollen diagram. The data on the diagram is then reduced by uniting neighbouring samples into groups, creating "zones", so that the variance within zones is less than that between zones.

The pollen diagram represents the abundance of one species relative to another only, and not necessarily the abundance of species in the vegetation at the time the pollen was incorporated into the sediments. The amount of pollen released varies not only between species but also within species, according to environmental conditions. So it is the relative fluctuations in species abundance which is considered when determining pollen zones.

After the initial count is made, further grains are counted to ascertain the presence of as many species as possible in order to determine the vertical distributation of the species. The total number counted depends on the species diversity and the abundance of pollen in the sample. The greater the species diversity then the greater the number to be counted. This information in conjunction with the information on the pollen diagram , provides the basis for determining the pollen zones.

The resultant pollen diagram is at fig 4 .

Table 1 shows the percentage of the various species. The ' + ' sign indicates species of less than 1% abundance, and includes the data for the vertical distribution. of the species.

DESCRIPTIVE PALYNOLOGY Chapter 6

The terminology used in describing the exine structure and ornament is largely taken from the glossary of Faegri and Iverson(1964), with additions from Erdtman (1943). The fossil species are placed in organ and form genera according to the nature,position and number of the apertures the pollen and spores contain. This produces an artificial classification, and it is considered preferable to use this even when the fossil species can be related to extant genera with a reasonable degree of confidence. (Potonie 1959, Harris 1965).

## TRILETE SPORES

| | | |
|---|---|---|
| Aneturma | SPORITES | Potonie 1893 |
| Turma | TRILETES | Reinsch emend. Dettmann 1963 |
| Suprasubturma | ACAMERATITRILETES | Neves and Owens 1966 |
| Subturma | AZONOTRILETES | Luber emend. Dettmann 1963 |
| Infraturma | Laevigati | Bennie & Kidston emend. Potonie 1956 |

Genus CYATHIDITES Couper emend. Partridge 1973

1. *Cyathidites australis* Couper 1953

Plate 1, fig. 1

Description: Microspores trilete, spore wall two layered, inner layer thin, attached proximally and equatorially separated distally from thick outer wall layer Amb triangular, sides straight to concave. Laesurae straight extending nearly to amb, exine 2-3u thick, smooth to faintly ornate. Equatorial diameter 43(52)60 u

2. *Cyathidites minor* Couper 1953

Plate 1, fig 10

Descript: Differs from C. australis in being smaller 25(33)45u eq. diam., and having a thinner exine, 1u thick, smooth to faintly scabrate. In compressed specimens laesarae accompanied by lips 1.5 u wide.

3. Infraturma APICALATI Bennie & Kidston emend. Potinie 1956

Genus <u>CERATOSPORITES</u> Cookson & Dettmann 1958

<u>Ceratosporites equalis</u> Cookson & Dettmann 1958

Plate 1, fig. 16

Descript: Microspores trilete, tetrahedral, distal surface convex proximal surface pyramidal. Amb Convexely subtriangular, laesurae straight extending almost to amb, with raised lips (2 μ high). Exine 1-1.5 μ thick, smooth to faintly scabrate. Distal surface sculptured with baculae (2-3μ high), having broad bases (1.5-2u wide) and flattened tips. Elements spaced 2.5-4u apart. Eq. diam. including sculpture 32(38)45u

4. Genus <u>BACULATOSPORITES</u> Thompson & Pflug 1953

<u>Baculatosporites comaumensis</u> (Cookson) Potonie 1956

Plate 1, fig. 7

Descript: Microspores trilete, biconvex, amb circular. Laesurae straight length 3/4 spore radius. Exine 1u thick, sculptured with short baculae 1-1.5u high and 1-1.5u in diam., randomly disposed 1-3u apart. Eq. diam. 30(40)50 u excluding baculae.

5. Genus <u>KUYLISPORITES</u> Potonie 1956

<u>Kuylisporites waterbolkii</u> Potonie 1956

Plate 1, fig 13

Descript: Microspores trilete, amb triangular. Laesurae straight with lips 1.5u wide, 3/4 spore radius. Exine 1.5u thick, with foveolae on the distal surface and an aperture (7u) diam. located midway between apices in the equatorial region. Exine slightly thickened around apertures.

6 Genus CAMAROZONOSPOTITES (Pont) Potonie, 1956

Camarozonosporites sp. cf C. bullatus. Harris 1965

Plate 1, Fig. 12.

Description: Microres trilete, zonate, biconvex, amb nearly circular. Spore body subtriangular with straight to convex sides and rounded angles. Laesurae curved with slightly raised lips (1u), length $\frac{3}{4}$ spore radius. Exine 1-3u thick, ornate. Eq. diam 32u.

7. Genus. PILOSISPORITES Delecourt & Sprumont, 1955

Pilosporites notensis Cookson & Dettmann, 1958

Plate 1, Fig. 17

Description: Microspores trilete, biconvex : amb triangular with concave sides and broadly rounded angules. Laesurae straight, length $\frac{3}{4}$ spore radius, enclosed within membraneous, elevated (2-3u high) lips which have serrated crests. Exine 2u thick and spinulose, with the sculptural elements densely disposed about equatorial, radial regions and sparsely distributed over polar regions, closely spaced and linearly arranged at laesurate margins. Spinulae 2-3u high, 1-2u wide at base. Eq diam. 108u

Subturma ZONOTRILETES Waltz 1935

Infraturma TRICRASSATI Dettmann 1963

Genus GLEICHENIIDITES Ross ex Delcourt & Sprumont emend. Dettmann 1963

8. Gleicheniidites circinidites ( Cookson ) Dettmann 1963

Plate 1, Figs. 4, 5

Description: Microspores trilete, biconvex, distal surface strongly arched or with three, arcuate, interradial folds about the poles. Amb triangular, sides straight or concave and acutely rounded angles. Laesurae straight, extending to amb, and with narrow elevated lips. (1-2u) high. Exine smooth, 1-1.5u thick, thicker at equator in inter-radial regions (3-6u) thick). Eq diam. 24(32)40u.

9. Genus <u>CLAVIFERA</u> Bolkovitina 1966

<u>Clavifera</u> <u>triplex</u> (Belkovitina ) Bolkovitina 1966

Plate 1, Fig 2

Description: Microspores trilete, biconvex. Amb triangular,sides straight to convex. Laesurae straight extending to amb, with elevated lips (2-3u wide). Exine smooth, 1.5-4u thick, thicker in inter-radial regions(6-7) thick) with bulbous thickenings at apices.

Infraturma MURONATI Potonie & Kremp, 1954

10. Genus <u>LYCOPODIUMSPORITES</u> Thiergart ex Delcourt & Sprumont 1955

<u>Lycopodiumsporites</u> <u>austroclavatidites</u> (Cookson) Potonie 1956

Plate1, Fig. 6.

Description: Microspores trilete, amb subcircular to convexly subtriangular. Laesurae straight, length greater than $\frac{3}{4}$ spore radius, enclosed within membraneous, elevated lips (2-3u high). Exine 1.5-2u thick, with reticulum composed of narrow (1u wide), projection muri (2-3u high),lumina hexagonal to pentagonal in outline, 7-12u diameter, Eq. diam. 34(43)58u.

11. Genus. <u>ROUSEISPORITES</u> Pocock 1967

<u>Rouesisporites</u> <u>reticulatis</u> Pocock 1962

Plate 1, Fig. 14

Description: Microspores inaperturate, amb convexly triangular to circular. Exine two layered consisting of inner layer 1-1.5u thick and an enveloping, membraneous outer layer which is reticulate. Reticulum composed of muriod ridges (2-3u high) which encloses hexagonal lumina 15-30u diam. Faint tetrad mark visible on proximal surface. Eq. diam. 54u overall.

Genus VERRUCOSISPORITES Potonie & Kemp 1955

12. Verrucosisporites kopukuensis (Couper ) Stover 1973

Plate 1, Fig. 3

Description: Microspores trilete, amb circular. Lasurae straight, extending to amb. Exine consisting of discrete verrucae, varying from circular to polygonal in shape, 3-4u high, 3-7u diam.. Eq. diam. 55u overall.

## MONOLETE SPORES.

TURMA MONOLETES Ibrahim 1933

| | | |
|---|---|---|
| Suprasubturma | ACAVATOMOLETES | Dettmann 1963 |
| Subturma | AZONOMONOLETES | Luber 1955 |
| Infraturma | LAEVIGATOMONOLETI | Dybova & Jachowicz 1957 |

Genus. LAEVIGATOSPORITES Ibrahim 1933

13. Laevigatosporites ovatus Wilson & Webster 1946

Plate 1, Figs 8,9.

Description: Microspores monolete, laesurae nearly full length of spore. Shape elliptical. Exine 1u thick, smooth. Eq. diam. length 31(40)50u, breadth 20(27)36u. Polar diam. 20(26)34U.

14. Laevigatosporites major ( Cookson )Krutzsch 1959

Plate 1, Fig. 15

Description: Microspores monolete,colpae $\frac{1}{2}$ to $\frac{3}{4}$ length spore. Shape elliptical. Exine 1-2u thick, smooth, spores often crushed. Eq. diam. length 50(62)74, 38(44)50u breadth. Polar diam diam 30(34)49u.

Suprasubturma PERINOMONOLITES

Genus PEROMONOLITES (Erdtman) Couper 1953

15. Peromonolites densus Harris 1965

Plate 2, Figs. 1,2.

Description. Spores monolete, laesurae $\frac{3}{4}$ spore length, shape elliptical in polar view, biconvex in lateral view, exine 1,5-2u thick, sub-verrucate to scabrate, surrounded by dense, hyaline perispore, 2-5u thick, rugulate . Eq. diam.length 33(40)45u, breadth25(30)33u. Polar diam. 24(32)33u.

Infraturma SCULPTATOMONOLETI

Genus. VERRUCATOSPORITES Thompson & Pflug 1953

16. Verrucatosporites specious Harris 1965

Plate 2, Figs 3,4.

Description: Mycrospores Monolete, laesurae two lipped, about $\frac{2}{3}$ spore length, shape elliptical in polar view, aprox. plano-convex in lateral view. Exine 2-3u thick, verrucate: verrucae 2-7u wide at base, 1.5-2u high.

Genus RETICULOIDOSPORITES Pflug 1953

17. Reticuloidosporites arcus

Plate 1, Fig 11

Description: Microspores monolete, bilateral, amb broadly elliptical to subcircular. Laesurae straight, length $\frac{2}{3}$ spore length Exine 2-3u thick, with narrow, low muri, forming reticulate structure enclosing polygonal lumina 1-3u diam. Eq. diam. length 42(44)48u, breadth 39(40)42u. Polar diam. 31(33)34u.

FUNGAL BRYOPHYTE SPORES.

Germinlings of mycrothyriaceous fungi

Plate 2, Figs. 8,9

Remarks; The fossil fungi is present in various growth stages. Previously recorded from the Eocene ( Kemp 1974), and recorded here from the Middle Paleocene, ranging in size from 15-60u. eq. diam.

A wide variety of fungal and bryophyte spores occurs throughout the sequence, some of which are illustrated plate 2 Figs. 11-13. They are particularly abundant in one sample , S2. The spores are generally mono-porate or inaperturate.

18. Genus COPTOSPORA gen. nov.

Coptospora sp.

Plate 2, Fig. 10

Description: Microspores inaperturate, amb circular. A wide variety of exine structures exist. Persistent, concentric layers, usually two, of varying thickness,exist on some specimens, while on others, layers are persistent. There is sometimes a radially fractured circular area at one pole, formed by a breakdown of the exine. The spore is enveloped in an irregular hyaline sheath. Eq. diam.35(52)50u overall.

Remarks: Polar features comparable to certain modern hepatic spores which germinate by means of a rupture in,and after a breakdown of , their polar (distal) exine. (Dettmann 1963). Known from the Upper Mesozoic, Otway Basin.

DISACCATE POLLEN

| | | |
|---|---|---|
| Anteturma | POLLENITES | Potonie 1931 |
| Turma | SACCITES | Erdtman 1947 |
| Subturma | DISACCITES | Cookson 1947 |

Genus PHYLLOCLADIDITES. Cookson 1947

Phyllocladidites mawsonii (Cookson) 1947.

19. Plate 3, Figs. 1,2.

Description: Body circular to oval, with two smallbladders inserted laterally Cap convex, faintly granular, aperture smooth, wide, clearly defined. Exine 2.5-4u thick. Reticulations of air bladders poorly developed, proximal tubercles prominent.

Body Dimensions: 21(33)45u length, 24(34)45u width, bladders 21(22)24u x 5(9)13u.

20. Phyllocladidites reticulosaccatus Harris 1965

Plate 2, Fig. 5

Description: Body subcircular, bisaccate, bilateral. Bladders small, usually infolded on to the aperture, finely reticulate with a prominent basal tubercle at the root of each bladder.

Dimensions: body 37(40)45u width, 42(45)50u length. Bladders 22(28)30u.

21. Genus <u>LYGISTEPOLLENITES</u> Stover & Evans 1973

<u>Lygistepollenites Florinii</u> (Cookson & Pike) Stover & Evans 1973

Plate 2, Fig. 21

Description: Body more or less spherical. Usually two bladders, sometimes three, relatively small, free or united in a frill around the region of the aperture, the internal thickenings forming well defined, radially arranged loops on the margins. Exine two layered, 2-4u thick, finely rugulate merging into the coarser texture of the wings.

Dimensions: Body 22(27)31u length, 19(25)31u width, Bladders 6(9)12u.

22 Genus <u>PODOCARPIDITES</u> Cookson ex Couper 1953

<u>Podocarpidites ellipticus</u> Cookson 1947

Plate 2, Figs. 17.18.

Description: Body subcircular to elliptical, bisaccate, bilateral. Cap psilate to finely scabrate, exine 1-1.5u thick. Bladders large, approx. same diam. as body; reticulum complete and distinct, branched sexinous elements protruding into cavity.

Dimensions: body, 18(34)50u length, 13(29)45u width, overall 35(55)75u length.

23. <u>Podocarpidites exiguus</u> Harris 1965

Plate 2, Figs. 19,20

Description: Body of grain subcircular to elliptical, cap psilate to finely scabrate, exine 1-1.5u thick,aperture broad, well defined. Bladders large,strongly inclined distally, breadth greater than depth of corpus; reticulum, wide, indistinct, incomplete.

Dimensions: Body 26(28)32u width, 28(31)34u length.Overall 42(46)50u.

Subturma <u>POLYSACCITES</u> Cookson 1947

24 Genus <u>PODOSPORITES</u> Rao 1943

<u>Podosporites</u> <u>microsaccatus</u> (Couper) Dettmann 1962

Plate 2, Fig.16

Description: body, convexly triangular to subcircular. Exine 1-1.5u thick . Three small bladders are commonly infolded onto corpus, finely reticulate.

Dimensions: body 30(35)40u, bladders 10(15)20u width, 25(30)35 length.

25. <u>Podosporites</u> <u>antarticus</u> (Cookson & Couper) Stover & Evans 1973

Plate 3, Figs 3,4.

Description: body subcircular to elliptical, with two or three small bladders inserted laterally. Exine 1-1.5u thick, finely reticulate on body, reticulate on bladders.

Dimensions: body, 22(32)42u length, 18(26)35u width, bladders 21(22)24u length, 5(9)13u width.

Turma ALETES Ibrahim 1933

Subturma AZONALETES (Luber) Potonie & Kremp 1954

Infraturma GRANULONAPITI Cookson 1947

Genus <u>ARAUCARIACITES</u> Cookson ex Couper 1953

26 <u>Araucariacites</u> <u>australis</u> Cooksen 1947

Plate 2, Fig. 15

Description: Grains, spherical, non-aperturate, exine granular, usually flattened and crumpled. Exine, thin, finely and closely granular. Eq. diam. 35(42)50u.

MONOCOLPATE POLLEN

Turma PLICATES (Naumova) Potonie 1960

Subturma MONOCOLPATES Iverson & Troels-Smith 1950

Genus LILIACIDITES Couper,1953 a

27 Liliacidites spp.

Plate 2, Figs 5-7,14.

Remarks: A variety of species are represented. The smaller species tend to be more elliptical in shape and have a finer mesh reticulum than the larger varieties. Eroded specimens, such as Fig. 14, are more common than specimens with exine structure intact.

28 Genus MONOSULCITES (Cookson) ex Couper 1953 a

Monosulcites spp.

Remarks: Monosulcate spp. occur throughout the sequence. All such species, other than lilicidites spp. have been included here.

TRICOLPATE POLLEN

Subturma TRIPTYCHES

Genus BEAUPREACIDITES (Cookson) Couper 1953

29. Beaupreacidites elegansiformis Cookson 1950

Plate 3, Fig. 6

Description: amb triangular with straight sides, rounded angle s, and deep colpoid apetures (7-10u). Exine0.5u wide tapers towards apertures, with sexine and nexine of equal thickness; sexine baculate, reticulate with mesh of reticulum reduced towards the aperture areas.

Genus TRICOLPITES (Cookson ex Couper) Potonie 1960

30 Tricolpites sp. A

Plate 3, Fig. 12

Description: Pollen grains tricolpate, amd subcircular to convexely sub-triangular in polar view, spherical in equatorial view. Exine 1u thick, psilate.. Colpae 4u long. Eq. diam10(12)15u

Remarks: This species is abundant throughout the sequence. It is equivalent to the small dicotyledenous Type 3, recorded from the Victorian brown coals. (Baragwanath & Kiss 1974 )

31 <u>Tricolpites</u> spp. B

Plate 3, Fig 13.

Description: pollen grains tricolpate, prolate, exine psilate, 1u thick. Colpae simple, extending full length of grain.

Dimensions: length 10(13)15u x 8(10)13u

Remarks: Abundant throughout; less common than sp. A: equivalent to small type 1, as above

32. <u>Tricolpites</u> <u>fissilis</u> Couper 1960

Plate 3, Fig.8

Description: Grains tricolpate, prolate to oblate spheroidal. Amb subcircular to convexly subtriangular. Exine 1u thick, sexine and nexine equal, sexine scabrate. Colpi wide open, 10u deep, with indefinite margins.

33 <u>Tricolpites</u> <u>phillipsi</u> Stover 1973

Plate 3, Fig. 9.

Description: Pollen tricolpate, amb convexly triangular, oblate in polar view. Exine 1u thick. Sexine and nexine approx. equal, with nexine thickening at apertures. Colpi short 3-4u long, with margins either uneven, or smooth and thickened. Exine finely scabrate 25(30)36u

34. <u>Tricolpites</u> <u>pannosus</u> sp. nov. Dettmann & Playford 1968

Plate 3, Fig. 10

Description: Grains tricolpate, prolate to oblatespheroidal. Amb subcircular to convexly subtriangular. Exine 1u thick, nexine thicker than sexine, finely and faintly scabrate. Colpi shallow, with ragged margins, 5-10u long. Eq. diam.27u

Genus MYRTACEIDITES Cookson & Pike ex Potonie 1960

35. Myrtaceidites eugeniioides Cookson & Pike 1954 b

Plate 3, Figs 15-18

Description: Grains triangular with straight to slightly concave sides and truncate angles which are usually notched. They are syncolpate and parasyncolpate. Exine is 0.5-1u thick and psilate or faintly granular.. Eq. diam. 9(12)13u.

36. Myrtaceidites mesonesus Cookson & Pike 1954 b

Plate 3, Fig 23.

Description: Grains triangular with straight to concave sides; parasyncolpate with a polar island 2-6u wide - sides of polar island may be concave or straight. The pore has a vestibule 0.5-1.5u wide. Exine faintly granular. 0.5-1u thick. Eq. diam. 12(16)19u.

37. Myrtaceidites parvus. Cookson & Pike 1954 b

Plate 3, Figs 19-22

Description: Grains subtriangular, with convex sides. Syncolpate to parasyncolpate, with or without polar islands. Exine 1u or less, a fine faint pattern sometimes visible. Eq. diam. 11(14)17u

Remarks: The distinction between the species is not always clear. There is a wide variability in the morphological features , and overlap between the species. The more extreme types in each species can be related to Cookson and Pikes species, but the distinction is not always satisfactory, nor obvious.

The known range of M. parvus and M. mesonesus is Eocene to Pliocene, but they occur within Latrobe I bore from the mid- Paleocene sediments.

38. <u>Tetracolpites</u> Sp.

Plate3, Fig. 7

Description: Grains tetracolpate, amb subcircular, colpiwith straight to slightly ragged margins. Exine two layered 1u thick, finely scabrate, nexine and sexine equal. Eq. diam. 10(17)25u.

Remarks: This species is most like <u>T. fissilis</u> and may be a four-colpate variety of this species. Grains of this type occur randomly through the sequence.

<u>TRICOLPORATE POLLEN</u>

Subturma PTYCHOTRIPORINES · Potonie 1960

Infraturma PROLATI

Genus <u>TRICOLPORITES</u> Cookson 1947

39. <u>Tricolporites</u> <u>prolata</u> Cookson 1947

Plate 3, Fig. 26

Description: Grains small, prolate, tricolporate, colpi long and tapering, each with an equatorial pore. Exine1.5-2.5u thick, psilate.

Dimensions: 25(29)34u x 17(24)32u

40 <u>Tricolporites</u> <u>microreticulatus</u> Harris 1965

Plate 3, Figs. 5,28,29

Description: Grains tricolporate, prolate: amb elliptical in lateral view. Apertures complex, colpi less than 1u wide, bordered by thickened lips 2u wide, spreading around the pore. Pore diam. 4-6u. Exine 2u thick, finely reticulate, lumina and mesh 1u wide. Size 23(24)27u. width x 32(37)40u length.

41. <u>Tricolporites</u> <u>sphaerica</u> Cookson 1947

Plate 3, Fig. 27

Description; Grains tricolpate,suboblate to prolate, amb subtriangular with broadly rounded apices. Colpi long, pores 6-8uwide. Exine 1-1.5u thick, thicker atpoles, nexine thicker than sexine, finely reticulate, lumina circular to polygonal, mesh smallest at equator. Columellae distinct, of uniform height, single, underlie muri of reticulum, Eq. diam., polar diam 22u.

Infraturma OBLATI

Genus <u>CUPANIEIDITES</u> Cookson & Pike 1954

42 <u>Cupanieidites orthoteichus</u> Cookson & Pike 1954

Plate 3, Fig. 25.

Description: Grains tricolporate, amb sharply triangular, sides straight to concave, arci prominent with distinct polar islands, exine 1-1.5u thick, sexine as thick as nexine with faint mesh reticulum. Size 20(23)25u

43 <u>Cupanieidites reticularis</u> Cookson & Pike 1954

Plate 3, Fig. 24

Description: Grains tricolporate, amb triangular with slightly convex sides, arci which may or maynot enclos polar islands, are prominent. Sexine reticulate mesh clearly defined. Eq. diam. 24u

<u>POLYCOLPATE POLLEN</u>

Subturma POLYPTYCHES Potonie 1960

Genus <u>NOTHOFAGIDITES</u> (Erdtman) Potonie 1960

(A) <u>BRASSI</u> type is characterized by uniform thickness of exine, angular amb, small to medium size.

44 <u>Nothofagidites emarcidus</u> (Cookson )

Plate 3, Figs 32,33

Description: Grain flattened, sides straight to concave, pores 4-7, mostly 5 and 6 ; exine 1u thick, spinules numerous, less crowded at equator. Eq. diam. 19(25)30u

45. <u>Nothofagidites</u> <u>falcatus</u> (Cookson) Stover & Evans 1973

Plate 3, Fig. 35

Description; Grains biconvex, amb angular. Exine 2u, often embayed between pores ; spinules short ,shorter at equator, widely spaced (1.5-2u. Pores 4-7, mostly 5 and 6. Eq. diam. 20(25)30u.

46 <u>Nothofagidites</u> <u>heterus</u> (Cookson) Stover& Evans.

Plate 3, Fig. 37

Description: Grain flattened, amb slightly angular. Pores 6-9, mostly 7-8. Exine 1u, forming narrow rims to pores which are wide open. Spinules moderately fine and dense, coarser and closer at poles. Eq. diam. 20(28)37u

47. <u>Nothofagidites</u> <u>incrassatus</u> Cookson 1958

Plate 3, Fig. 36

Description: Grain slightly biconvex, amb circular to slightly angular. Pores 6-9, mostly 7. Exine 2u, spinules short, moderately dense. Eq. diam. 23(34)45u

(B) <u>FUSCA</u> type characterized by medium size, biconvexity, thickeningof exine around pore.

48 <u>Nothofagidites</u> <u>brachyspinulosus</u> (Cookson) Harris 1965

plate 3, Fig.34

Description: Grain biconvex, circular amb ; pores 5-9, mostly 6 amd 7. Exine 1,5u thick between pores, 2-2.5u at pores. Spinules short, moderately dense. Eq. diam. 20(27)35u.

49. <u>Nothofagidites</u> <u>cinctus</u> Cookson 1958

Plate 3, Fig. 38.

Description : Grain large, circular amb, pores6. Exine 1u thick, 3-4u at pores; spinules fine and short. Eq. diam. 30u

50 Genus <u>QUINTINIA</u> A. DC.

<u>Quintinia</u> sp.

Plate 3, fig. 11

Description: Grain subspheroidal to prolate, amb circular. Colpi 5, simple. Exine psilate 1u thick. Eq. diam. 12(13)14u, Polar diam 12(13)15u

51. Turma POROSES

Subturma MONOPORINES

<u>Monoporites</u> sp.

Plate 3, fig. 14

Descpiption: Grains small, monoaperturate, less than 5u eq. diam; exine 0.5u thick, finely scabrate. Pore diam. 1u

Subturma DIPORINES

Genus <u>BANKSIEAEIDITES</u>Cookson 1950

<u>Banksieaeidites</u> <u>elongatus</u> Cookson 1950

Plate 3, fig. 31

Description: Grains bilateral, biaperturate; exine 1.5u thick, nexine same thickness as sexine, but thickens around apertures to 3-4u; faint sculpture visible on sexine , scabrate. Pore diam. 1-2u, eq. diam. 10(13)15u, polar diam. 20(22)24u.

53. Genus <u>DIPORITES</u> Van der Hammen

<u>Diporites</u> sp.

Plate 3, fig 30

Description: Grains small, bilateral, biaperturate. Exine thin, 0.5u, nexine slightly thicker than sexine and tapers at apertures; faint reticulate pattern visible. Pore diam. 3u, polar diam. 14u, eq. diam. 11u.

<u>TRIPORATE POLLEN</u>

Subturma TRIPORINES

Genus <u>GAMBIERINA</u> Harris 1972

54. *Gambierina edwardsii* (Cookson & Pike) Harris 1972

Plate 4, figs 8,9

Description: Grain flattened, triangular, sides concave, angulaperturate, apertures sunk and surrounded by exinous rim which over reaches apertures with two superimposed collars; apertural cavity very deep.Exine three layered,sexinethin, finely patterned, nexine thicker than sexine, particularly at apertures. Exine 2-4u thick, eq. diam 45(50)55u.

55. *Gambierina rudata* Stover 1973

Plate 4, fig 10,11

Description: Grains triangular, apices moderately rounded, exine 1.5-2.5u thick, nexine thicker than sexine. Sexine psilate or faintly sculptured, exine thicker at apertures, eq. diam. 14(22)30u

Genus PROTEACIDITES Cookson 1950

56. *Proteacidites adenthoides* Cookson 1950

Plate 4 fig 7

Description: Grains triangular. sides concave, exine 2-3u, thinning at apertures; sexine thinner than nexine, wider at apertures, reticulate. Reticulum baculate, mesh fine,finer at apertures. Pore diam 3u, eq. diam 35(41)52u

57. *Proteacidites* sp. cf. *P. angulatus*

Plate 4 fig 4

Description: Grain triangular, sides concave, protruding at apices. Exine 3u, thinner at apertures, nexine and sexine equal, sexine reticulate finer at apertures, pore diam. 1u, eq. diam. 35u

58 *Proteacidites annularis* Cookson 1950

Plate 4 figs. 1,2 Plate 3 figs 43,44

Description: Grains triangular with prominent apertural areas, sides straight to concave. Exine three layered, at base of aperture ectonexine thins, then thickens, forming a collar around aperture. Often the thinner portion beyond collar is not preserved. Sexine thinner than nexine, finely reticulate. Pore diam. 5-6u, eq. diam. 8(19)30u

59. <u>Proteacidites crassus</u> Cookson 1950

Plate 4 fig 6

Description: Grains triangular, sides concave. Exine 3u, sexine thinner than nexine, reticulate, widest between apertures. Mesh of reticulum moderately large, finer at pores, muri thick, baculae clearly defined. Eq. diam. 39(42)45u

60. <u>Proteacidites dilwynensis</u> Harris 1965

Plate 4 fig 5

Description: Grains peroblate, amb triangular, sides concave; exine 2-3u , thicker at apertures(4-5u diam.),sexine equals nexine. Sexine coarsely reticulate, lumina 2-4u wide, smaller near apertures, eq. diam. 55-60u

61 <u>Proteacidites pachypolus</u> Cookson & Pike

Not illustrated

Description: Grain oblate, amb triangular, sides concave, with a prominent circular thickening in polar area. Exine 2u, 6u in polar area, finely reticulate, eq. diam. 27u.

62 <u>Proteacidites formosus</u> Stough 1969

Plate 4 fig 3

Description: Grain triangular, sides concave, exine 3u, nexine twice as thick as sexine , thinner at apertures; sexine consists of coarse, flattened baculae, finer at apertures (4u diam. ), eq, diam. 37u

63 Proteacidites latrobensis Harris 1966

Plate 3 fig 41

Description: grains oblate, amb triangular, sides concave to straight

Exine 1-1.5u,thicker at apertures, psilate, apertures 1.5u,eq. diam 20(24)27u

64. Proteacidites parvus Cookson 1950

Plate 5 fig 1

Description: Grain triangular, , sides straight finely reticulate baculate, nexine thins slightly towards apertures. Pore diam 4-5u. Eq diam 35(40)45u.

65 Proteacidites sp. cf. P. rectomarginus Cookson 1950

Plate 3, Fig 65

Description: Grains triangular, sides straight. Exine 2-3u, nexine equal width to sexine, but thickens slightly at apertures. Sexine finely scabrate. Eq. diam. 25(32)40 u

66. Proteacidites scaboratus Couper 1960

Plate 3, Fig. 42

Description: Grains triangular, sides slightly concave to straight. Exine relatively thick 2-3u, nexine equal to sexine, thicker at apertures, pore margins slightly ragged, exine psilate to scabrate. Eq. diam. 19(22)25u.

67. Proteacidites subscabratus. Couper 1960

Plate 3, Figs. 39, 40.

Description: Grains triangular, sides straight to slightly concave, exine 1-2u, psilate to faintly scabrate, nexine equal to sexine, pore diam. 25u. Eq. diam.15(26)37u.

68. Triorites sp. cf. T. minor Couper 1960

( not illustrated ).

Description: Grains small, triangular amb , triaperaturate, sides to slightly concave. Exine thin, psilate tending to be slightly raised and incurved at apertures. Eq. diam. 10(11)12u.

70. HEXAPORATE POLLEN

Plate 5, Fig. 3.

Genus Anacolosidites ( Cookson & Pike ) Potone 1960

Anacolosidites actullus Cookson & Pike 1956

Description: Grains triangular, 6 porate with 3 pores with 3 pores towards angles of each face. Sides straight or slightly convex with acute angles. Exine 2-3u, sexine slightly thinner than nexine, rugulate, more finely towards apices. Sculpture prominent 37(39)42u.

71 STEPHANOPORATE POLLEN

Infratum Stephanoporiti

Genus Australopollis Krutzsch 1966

Anacolosidites obscurus ( Harris ) Krutzsch 1966

Plate 5, Fig. 2

Description : Amb circular, exine 2-2.5u thick. Sexine equal width to nexine, with fine mesh reticulum, lumine polygonal to elongate. Apertures 5-7 porate, margin ragged on some species, covered by sexinous membrane. Eq. diam. 27(36)45u.

72. Genus HALORAGACIDITES Couper 1953

Haloragacidites harissii ( Couper ) Harris 1971

Plate 5, Figs. 5,6,7.

Description: Grains triadially symmetric, triorate subtriangular with convex sides, angulaapeturate, pore rim slightly bulging, pores equatorial, circular, 2.5-3u, exine 1-1.5u thick, exine tectate, sexine about as thick as nexine, faintly scabrate, psilate. Eq diam. 29(34)48u.

N. B. Item 69 placed at end of Chapter.

73. Genus MALVACIPOLLIS Harris 1965

Malvacipollis diversus Harris

Plate 5, Figs. 12,14

Description: Pollen oblate,stephanoporate , amb circular. Exine with sexine thicker than nexine, collumellae small, singular dense. Ectosexine psilate, containing conate projections whose bases are equal or wider than their heights. Apertures mostly equatorial, porate, 5-8. Eq. diam, exclusive if spines, 18(22)27u.

74. Malvacipollis subtilis Storer 1973

Plate 5, Fig. 13.

Description: Pollen stephanoaperturate, oblate to subspherical, amb circular. Exine with thin nexine, thick sexine 1-2.5u thick, extosexine psilate, surface with spinules or spines 2-4u long, length greater than basal diam., tips pointed, sides tapered. Apertures mainly equatorial. Eq. diam. 23(30)34u, not including spines.

Remarks: The distinction between the Malvacipollis sp., is, as proposed by Stover & Partridge, 1973 not always clear, and there appears to be overlap between the species. They also appear together with the section studied in this core.

PERIPORATE POLLEN

Genus Periporopollenites Pflug, Thompson

75 Periporopollenites polyoratus ( Couper ) Stover 1973

Plate 5, Fig. 11

Description : Grains subspherical , amb circular. Exine 2u thick, psilate to finely scabrate. Pores 15-40u,diam. 3-4u. Eq. diam. 25(32)40u

76. Periporopollenites demarcatus Stover 1973

Plate 5, Fig. 15

Description: Grains subspherical, amb circular, exine 1.5-2u thick, nexine thinner than sexine, ectosexine scabrate to puncto-reticulate. Pore circular, 6-8u diam., with or without membraneous covering. Pore number 12. Eq. diam. 20(26)32u.

77. Periporopollenites vesicus Parteidge 1973

Plate 5, Fig. 16.

Description: Grains spherical, amb circular, exine 1.5-3u, sexine thicker than nexine, puncto-reticulate, pores circular 3-10u, usually with domed , faintly granular membrane across pores. Pore number 14-25. Eq. diam. 25(31)3(

78 POLLEN RETAINED IN TETRADS

Genus Ericipites Wodehouse 1933

Ericipites scabratus Harris 1965

Plate 5, Fig. 9

Description: Pollen in tetrads sub-spheroidal to oblate,tricolporate. Amb subcircular in polar view. Apertures complex, extending $\frac{3}{4}$ the length of polar diam. Colpi 1-2u wide, pores 2u wide. Exine 2u thick finely scabrate. Eq. diam. 15(20)25u.

Genus SIMPLICEPOLLIS Harris 1965

79. Simplicepollis meridianus Harris 1965

Plate 5, Fig. 8

Description: Pollen in tetrads, sub-spheroidal, triporate, amb sub-circular polar view. Pores simple, exine 1-1.5u thick, psilate. Eq. diam. 30(36)40u.

80 INAPERTURATE POLLEN

Infraturma Subpilonopiti

Genus DILWYNITES Harris 1965

Dilwynites granulatus Harris 1965

Plate 5, Fig 5

Description: Pollen non-aperturate, spheroid , usually folded, exine 1.5-2.5µthick, scabrate. Eq. diam. 30(36)43u.

81. <u>Dilwynites tuberculatus</u> Harris 1965

Plate 5, Fig. 4

Description: Pollen nonaperturate, spherical, often folded. Exine 2-2.5u thick, verrucate scabrate , verrucae 1-2u high,2-4u apart, and scabrate to psilate between verrucae. Eq. diam. 30(36)43u.

<u>Ommitted In Sequence</u> :

69. '<u>Triorites</u>' <u>psilatus</u> Harris 1972

Plate 5, Fig 10

Description: Pollen oblate, amb sub triangular, sides straight to slighty convex, apertures sunken 2-4u wide, circular. . Exine 3u may be slightly thicker at apertures, psilate. Eq. diam. 25(26)28u.

THE POLLEN ZONES Chapter 7

## Zone I

Between 431m (S11) and 314m (S8), the characteristic species Gambierina edwardsii is recognized. Gambierina rudata is relatively abundant, and Dilwynites granulatus, Proteacidites annularis, Proteacidites subscabratus and P. scaboratus are also abundant. Cupanieidites orthoteichus appears at the top of the zone.

Fern spores are abundant, particularly Cyathidites australis, Cyathidites minor, Gleichinidites circiniidites, Laevigatosporites ovatus, L. major, Peromonolites densus and Verrucatosporites speciosus. Their abundance generally decreases towards the top of the zone. L. ovatus is notably extremely abundant at the base of this zone.

Gymnosperms are also abundant within this zone, notably Lygistepollenites florinii, Phyllocladidites mawsonii, P. reticulosaccatus, Podocarpidites ellipticus, P. exiguus, Podosporites antarcticus and Podosporites microsaccatus. Two species, P. ellipticus and P. antarcticus are particularly abundant at the base of this zone. There is an overall decrease in gymnosperms towards the top of the zone.

In contrast, there is an overall increase in angiosperms towards the top of the zone. Tricolpites spp., Haloragacidites harrisii increase to the top, and Peripollenites spp., Simplicepollis meridians and Nothofagidites brachyspinulosus occur consistently throughout the zone. Nothofagidites heterus appears throughout the zone.

## Zone II

This zone is recognized between 275m (S7) and 122m (S2). Species which make their appearance in this zone are Myrteocidites spp. Malvacipollis diversis, Malvacipollis subtilis, Banksiedites elongatus, Anacolosidites acutullis, Beaupreacidites elegansiformis and N. emarcidus. Cupanieidites orthoteichus occurs in moderate abundance in this zone.

Myrteacidites spp. occur abundantly throughout, and their abundance decreases toward the top of the zone, although in one sample (214m) are extremely abundant. Species which are abundant in this zone include Malvacipollis spp., Peripollenites spp., Simplicepollis meridians, Tricolporites prolata and Tricolporites microreticulatus. Dilwynites granulatus, Dilwynites tuberculatus, Haloragacidites harrisii, Proteacidites annularis and P. subscabratus are all more abundant at the base of the zone.

Gambierina rudata is present at the base of the zone only. Nothofagidites emarcidus and N. brachyspinulosus increase in abundance towards the top of the zone.

There is an overall increase in angiosperms towards the top of the zone, whereas gymnosperms and pteridophytes decrease. Phyllocladidites reticulosaccatus occurs only at the base of this zone. In S2 (122m) there is a marked increase in bryophyte spores in contrast to their minimal occurrence in other samples throughout the section.

## ZONE II A

On the basis of the abundance of Myrtaceadites eugeniioides, Zone II can be subdived into a Zone IIA, which extends from the base of Zone II (275m.) to 183m. ( S4 ). Within this zone, the abundance of the species, Tricolpites sp. A, Peripollenites polyoratus, Tricolpaites prolata is also high.

The terminology of subzone is used because this unit is contained within the vertical distribution of the species Cupanieidites orthoteichus and retains the characteristics of zone II, but with an increase in the abundance of certain species. For later reference, to the established pollen zones, this terminology is also more useful.

## ZONE III

This zone occurs at 61m. It is marked by an increase in the abundance and diversity of *Myrteacidites* spp. Both *M. parvus* and *M. mesonesus* increase in abundance in this zone. *Nothofagidites* spp. show a marked increase in abundance. *N. emarcidus* in particular is very abundant here. *N. cinctus* is first noted at this depth, and *N. falcatus*, which was first recognized at 122m, is more abundant at this depth. *Proteacidites pachypolus* is first noted at this depth. *Dilwynites* spp., *A. acutullus*, *A. obscurus* and *Beaupreacidites elegansiformis* are not recognized in this sample.

Gymnosperm and pteridophyte species are not common at this depth.

Harris ( 1965 ) recognized his Triorites edwardsii Assemblage Zone within the Pebble Point Formation and the lower portion of the Dilwyn Clay.A new genus name Gambierina has now been given to the species, which has been divided into two species, Gambierina edwardsii and Gambierina rudata . ( Stover & Evans 1973 ). Of these, Gambierina rudata is by far the most abundant species. Harris ( 1971 ) recognized that Gambierina edwardsii extended into the Cupanieidites orthoteichus zone. Zone 1, the equivalent of the T. edwardsii zone is recognized in the Pebble Point Formation and the basal Pember Mudstone Member of the Dilwyn Formation. The foraminiferal distribution indicates that this zone has a late Paleocene age. It would appear that only Gambierina rudata extends into the above zone, Zone II, and that Gambierina edwardsii is restricted to the late Paleocene. Since G. edwardsii was of rare occurence in the samples studied, it may in fact have the same vertical distribution as G. rudata. Harris ( 1971 ) noted Gambierina edwardsii to a depth of between 432m and 460m. in the Latrobe 1 bore, after which Late Cretaceous palynomorphs are recognized. Stough ( 1969 ) in the same bore, recognizes the Triorites edwardsii zone to a depth of 497m. Zone I which extends to a depth of 431m, represents the upper part of the Triorites edwardsii Assemblage Zone. The base of this zone extends beyond the limit of the samples studied.

Zone II is recognized in the Dilwyn Formation above the Rivernook Member and includes the Princetown Member. The foraminiferal zones place a late Paleocene age on these sediments. Zone II is equivalent to the Duplopollis orthoteichus Assemblage Zone ( now Cupanieidites orthoteichus ) of Harris ( 1971 ), recognized by the occurrence of the nominate species. At the base of the zone, several new species appear in some abundance.

Stough ( 1969 ) recognized the C. orthoteichus zone between 279m. and 86m. in the Latrobe I bore. Harris ( 1971 ) notes this zone at a depth of 179m. in the same bore, but he does not place an upper limit on the zone. Zone II is recognized at 122m, and the top of the zone could therefore be higher than this.

Cupanieidites orthteichus is first noted at 314m. ( S8 ), at the top of Zone I. However, since only one specimen was observed, and this rather eroded, its presence does not provide a sound basis for assuming that C. orthoteichus first appeared in the late Paleocene. More grains would have to be found to establish this. Mixing of sediments at the interface of the mid-Paleocene- late Paleocene boundary could account for the presence of the younger species within older sediments. The River-nook Member marine transgression occurred at this boundary, which would have resulted in a turbulent enviroment of deposition.

At the base of the C. orthoteichus zone, Harris ( 1971 ) places a subzone, the Myrteacidites eugeniioides Subzone, on the basis of an abundance of the nominate species. Zone II A appears to be equivalent to this subzonule, having a relatively high abundance of M. eugeniioides. Both phyllocladidities reticulosaccatus Harris and G. rudata extend into the base of this zone, as noted by Harris ( 1971 ) for the M. eugeniioides Subzonule. ( Harris actually noted G. edwardsii, not G. rudata. )

Zone II A is recognized to a depth of 183m., which is higher than the upper boundary of the late Paleocene "Princetown Fauna" (207m.) at fig. 4 . On the basis of the samples studied there does not appear to be a change in the pollen assemblage at this depth ( 207m )

The extreme abundance of bryophyte spores in S2 ( 120m. ) at the top of Zone II, in comparison to their low occurance in other samples, suggests that these spores possibly resulted from localized deposition , and are not representative of the regional spore-pollen flora.

The base of Harris's Middle Eocene Proteacidites Pachypolus Zonule ( fig. 3 ) is marked by the first occurrence of Nothofagidites aspera and N. falcatus.( Harris 1971 ). This zone is characterized by the common occurrence of P. pachypolus, a rich Nothofagidites flora, and is rich in Proteacidites spp. Stough ( 1969 ) recognized this zone between 61m and 62.5m in the Latrobe I core. In S1, at 61M, both P.pachy-polus and N. falcatus are recognized, but P. pachypolus has only rare occurrence in this sample.

As mentioned in Chapter 1, Harris derived his Eocene Zones from a sub-surface section in the middle of the Murray Basin, which had an Eocene sequence and a paleocene sequence in superposition. This does not occur in the Otway Basin, which, as mentioned in Chapter 2, experienced a hiatus in deposition of unknown extent during the Eocene. The sedimentary sequence was thus disrupted, making it difficult to find a complete pollen zone, comparable to Harris' at this level of the core.

There is a certain degree of inaccuracy involved in estimating the depths of the chosen samples, and two different samples at "61m" are unlikely to come from exactly the same depth. So within a small range,the pollen assemblages differ, notably P. pachypolus. P. pachypolus was only recognized in S1, but this species is known to range from the Upper Paleocene to at least the Upper Eocene, ( Harris 1971 ) and its occurrence in this sample does not necessarily impose any time restrict-ions.

However, the abundant Nothofagidites spp.and particularly the large increase in N. emarcidus, and the increase in M parvus and M. mesonesus seem to indicate at least a Middle Eocene age for the sediments, when related to the P. pachypolus Zone. The occurrence of N. falcatus in Zone II possibly indicates that this species is not a suitable indicator for the base of the P. pachypolus Zone. There is also the possibility that the Middle Eocene zone occurs at a lower depth than Zone III, but is not well represented in these sediments. The Foraminiferal Distribution indicates a Late Eocene age for these sediments, but the pollen assemblage cannot be related to the Upper Eocene zones of Harris. Further samples both below and above this would need to be examined before reaching any conclusions on the relationship between the pollen zones and the Foraminiferal Zones at this depth.

The occurrence of Tricolpites pannosus at this depth is of interest because this species was recorded from the late Upper Cretaceous by Dettmann and Playford (1968 ), but has not been recorded as yet from the Tertiary. Its presence in this sample may therefore indicate that it is derived from a reworked older sediment.

## COMPARISON WITH THE GIPPSLAND BASIN BIOSTRATIGRAPHIC ZONES

The Lygistepollenites balmei Zone of Stover and Partridge (1973) ranges from the middle to late Paleocene. The base of the zone is defined by the appearance of species which include H. harrisii, N. brachyspinulosus, P. densus, P. reticulosaccatus, T. phillipsi. The top of the zone is marked by the last appearance of species including A. obscurus, C. equalis, G. rudata and P. reticulosaccatus. In the upper part of the zone particularly, new species are introduced, including B. elongatus, M. mesonesus/ parvus, P. adenthoides, P. annularis and P. incurvatus. Species which terminate within the zone include G. edwardsii. M. diversus and M. subtilis bith appear at the top of this zone.

Their Malvacipollis diversus zone ( Early Eocene )is defined by the first appearance of species including C. orthoteichus, and V. kopukuensis.

Other species appearing within the zone include A. acutullus, B. elegansiformis, P. latrobensis, P. demarcatus and N. heterus.

All of the species listed in the above two zones are common to both the Otway and Gippsland Basins.

A comparison of the species which are recognized in both basins shows that a similarity between the L. balmei Zone and Zone I, and the M. diversus Zone and Zone II.

The M. diversus Zone has an early Eocene age and the base is defined by the appearance of C. orthoteichus. While this species appears the base of the late Paleocene Zone II ( C. orthoteichus Zone ). The pollen assemblage which characterizes the M. diversus Zone is also charastic of Zone I (the C. orthoteichus Zone) . In the Gippsland Basin this assemblage ranges from the Early Eocene, but is recognized from the Late Paleocene sediments within this core.

The assemblage which characterizes the Middle to Late Paleocene L, balmei Zone is also recognized within the Latrobe 1 bore, in Zone I, the middle Paleocene zone, and extending into the late Paleocene zone, Zone IIA.

At the top of the L. balmei Zone, G. rudata and P. reticulosaccatus disappear, but these species disappear earlier in the Late Paleocene in this section.

The distribution of Myrtaceadites spp. and Malvacipollis spp. appears to be similar in both basins, appearing in the Late Paleocene in each basin. G. rudata has a longer vertical distribution than G edwardsii in both basins. The use of G. rudata to mark the top of the Late Paleocene, as used in the Gippsland Basin is not applicable in this section.

The species A. obscurus, which disappears at the top of the L. balmei Zone, extends well into Zone II, beyond the Late Paleocene 'Princetown Fauna' upper boundary.

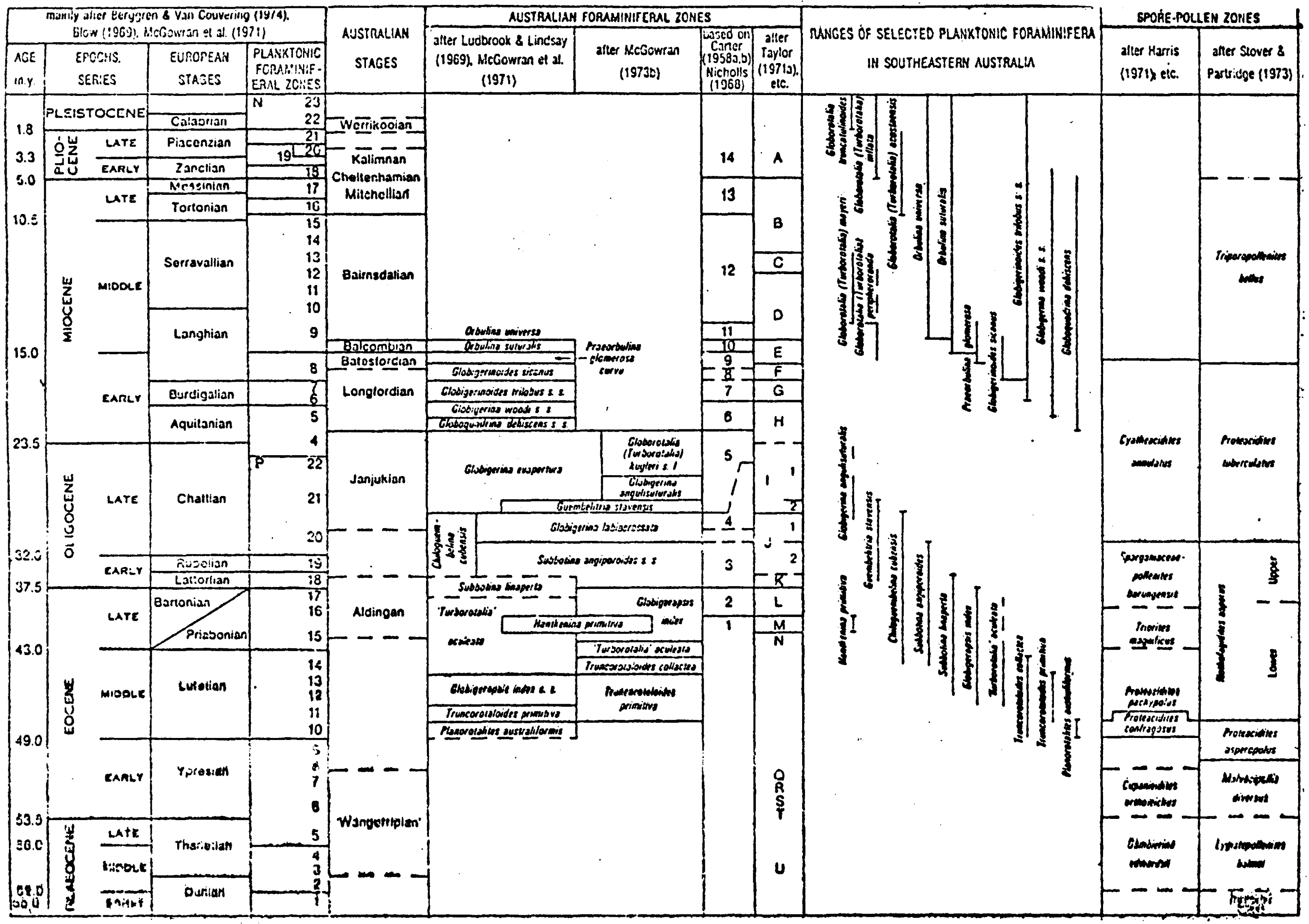


Figure 3 - Tertiary spore - pollen Zones

TABLE 1 - MICROFLORAL DISTRIBUTION AND PERCENTAGE OCCURRENCE IN EACH SAMPLE

| | ZONE III | ZONE II | | ZONE IIA | | | | ZONE I | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 | S11 |
| TRILETE SPORES | | | | | | | | | | | |
| Baculatisporites comaumensis | | | + | | | | | + | + | | |
| Camarozonosporites sp. cf. C. bullatus | | | | | | | | | | + | |
| Ceratosporites equalis | | | | | | | + | | | | + |
| Clavifera triplex | | | + | | + | + | | 1.0 | | + | |
| Cyathidites australis | + | + | | 1.5 | 1.0 | 1.0 | + | 1.0 | 1.5 | 2.0 | 2.0 |
| " minor | + | + | + | 1.0 | 1.5 | 1.5 | 1.0 | 3.0 | 2.0 | 3.0 | 2.0 |
| Gleicheniidites circinidites | + | 1.0 | 1.5 | 1.5 | 1.5 | 3.0 | 3.0 | 4.0 | 3.5 | 4.5 | 3.0 |
| Lycopodiumsporites austroclavatidites | | | | | | + | | + | | | + |
| Pilosisporites notensis | | | | | | | | | + | | |
| Kuylisporites waterbolkii | | | + | | | | | | | | |
| Rouseisporites reticulatus | | | | | | | + | | | | |
| Verrucosisporites kopukensis | + | | | | | | | | | | |
| MONOLETE SPORES | | | | | | | | | | | |
| Laevigatosporites major | + | + | 1.5 | 2.5 | 2.5 | 3.0 | 3.0 | 4.5 | 4.5 | 3.5 | 2.0 |
| " ovatus | 2.5 | 4.0 | 4.5 | 2.0 | 1.5 | 4.5 | 5.0 | 7.0 | 6.0 | 6.0 | 10.0 |
| Peromonoletes densus | | | + | + | | | + | 1.0 | + | 1.5 | 4.5 |
| Reticuloidosporites arcus | | | | | | | + | | | + | + |
| Verrocatosporites speciosus | + | | | | | + | | 1.0 | + | + | 1.5 |
| OTHER SPORES (INCL. BRYOPHYTE, FUNGAL) | | | | | | | | | | | |
| Coptospora sp. | + | | | + | + | | | 1.5 | | | |
| Microthryriaceous fungi | | | + | | + | | | | | | |
| Other spores | | 10.5 | | + | + | | + | | + | + | + |
| GYMNOSPERMS | | | | | | | | | | | |
| Araucariacites australis | + | | | + | ± | 1.0 | 1.0 | + | 3.0 | 1.0 | 1.0 |
| Lygistepollenites florinii | 2.0 | 1.0 | 2.0 | 2.5 | 4.0 | 2.0 | 4.5 | 3.0 | 4.0 | 3.0 | + |
| Phyllocladidites mawsonii | 1.0 | + | 1.0 | + | | + | + | 4.0 | 1.0 | 3.0 | 3.5 |
| " reticulosaccatus | | | | | | | + | 2.0 | 1.0 | 3.0 | 3.5 |
| Podicarpidites ellipticus | 1.0 | + | 2.0 | 2.5 | 3.0 | 4.5 | 3.5 | 2.0 | 4.0 | 5.0 | 11.0 |
| " exiguus | + | | 1.0 | + | 2.0 | 3.0 | 1.5 | 1.0 | 3.0 | 2.0 | 4.5 |
| Podosporites antarcticus | + | | | 2.0 | + | 3.5 | 2.5 | 3.0 | 4.0 | 7.0 | 10.0 |
| " microsaccatus | | | | + | + | 2.0 | 1.5 | 1.0 | 1.5 | 3.0 | 1.0 |

TABLE 1 - CONT.

| | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 | S11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MONOCOLPATE POLLEN | | | | | | | | | | | |
| Liliacidites spp. | + | | | + | | | + | | + | | |
| Monosulcites spp. | 1.0 | 2.0 | 2.0 | 1.5 | + | 1.0 | 1.0 | 1.5 | 1.0 | 1.0 | + |
| TRICOLPATE POLLEN | | | | | | | | | | | |
| Beaupreacidites elegansiformis | | + | | | + | + | | | | | |
| Myrteacidites eugeniioides | 5.5 | 3.5 | 5.0 | 10.5 | 24.5 | 9.0 | 12.0 | | | | |
| " mesonesus | 2.5 | + | | + | | | | | | | |
| " parvus | 4.5 | 1.5 | 1.0 | + | 1.0 | + | + | | | | |
| Tricolpites sp. A | 9.0 | 1.0 | 4.5 | 8.5 | 10.0 | 5.5 | 13.0 | 5.0 | 3.5 | 4.5 | 2.0 |
| " sp. B | 5.5 | 6.5 | 5.5 | 6.0 | 7.5 | 1.0 | 3.0 | 4.0 | 5.5 | 3.0 | 2.5 |
| " fissilis | | | | | + | | | | | | |
| " phillipsi | | | | | + | | + | | + | + | |
| " pannosus | + | | | | | | | | | | |
| TETRACOLPATE POLLEN | | | | | | | | | | | |
| Tetracolpites sp. | + | | | | + | | | | | + | |
| TRICOLPORATE POLLEN | | | | | | | | | | | |
| Cupanieidites orthoteichus | | + | + | 1.0 | + | | + | + | | | |
| " reticularis | + | | | | | | | | | | |
| Tricolporites microreticulatus | 2.0 | 2.0 | 3.0 | 1.0 | + | 1.0 | + | + | 1.0 | | + |
| * " sphaerica | | | | | | | | + | | | |
| POLYCOLPATE POLLEN | | | | | | | | | | | |
| Nothofagidites brachyspinulosus | 7.5 | 5.5 | 4.0 | 3.0 | 2.5 | 2.0 | 3.0 | 2.5 | 2.0 | 3.0 | 3.0 |
| " cinctus | + | | | | | | | | | | |
| " emarcidus | 15.5 | 9.0 | 7.5 | 1.5 | + | | | | | | |
| " falcatus | 1.0 | + | | | | | | | | | |
| " heterus | + | + | | + | 1.5 | 1.0 | + | + | 1.0 | 1.0 | + |
| " incrassatus | + | | + | + | | | | | | | |
| Quintinia sp. | 1.5 | | | | | | | | | | |
| MONOPORATE POLLEN | | | | | | | | | | | |
| Monoporites sp. | + | | | + | | | + | | + | | |
| DIPORATE POLLEN | | | | | | | | | | | |
| Banksiedites elongatus | + | | | + | | + | | | | | |
| Diporates sp. | + | | | | | | | | | | |
| *Tricolporites prolata | 5.0 | 3.0 | 2.0 | 5.0 | 3.0 | 4.5 | 5.0 | 3.0 | 1.0 | 3.5 | 2.0 |

TABLE 1 - CONT.

| | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 | S11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TRIPORATE POLLEN | | | | | | | | | | | |
| Gambierina edwardsii | | | | | | | | + | + | | + |
| " rudata | | | | | | | 1.0 | 5.0 | 3.0 | 4.0 | 3.0 |
| Proteacidites adenanthoides | + | | + | | + | + | | + | | | |
| " sp. cf. P.angulatus | | | | | | | | | + | | |
| " annularis | + | | | + | + | 2.0 | 1.5 | 2.5 | 3.0 | 2.0 | 1.0 |
| " crassus | + | | + | | | | + | | | | |
| " dilwynsis | | | | + | | + | | | | | |
| " formosus | | | | | | + | | | | | |
| " latrobensis | + | | | | + | | | | | | |
| " pachypolus | + | | | | | | | | | | |
| " parvus | + | + | 1.5 | | + | + | | | 2.0 | + | |
| " sp. cf. P. rectomarginus | + | + | 1.0 | | + | + | 1.0 | + | 1.0 | | + |
| " scaboratus | + | | + | + | | + | + | 1.0 | 1.0 | + | + |
| " subscabratus | 5.0 | 5.0 | 5.5 | 7.0 | 8.5 | 7.0 | 6.5 | 7.5 | 5.0 | 6.0 | 6.0 |
| Triorites sp. cf. T. minor | + | | + | + | + | | + | | + | | |
| " 'psilatus | | + | | + | | | | | | | |
| HEXAPORATE POLLEN | | | | | | | | | | | |
| Anacolosidites acutullis | | | | + | | | + | | | | |
| STEPHANOPORATE POLLEN | | | | | | | | | | | |
| Australopollis obscurus | | | + | | 1.5 | 1.5 | + | 1.5 | + | + | |
| Haloragacidites harrisii | 8.5 | 6.0 | 10.5 | 5.0 | 4.0 | 5.0 | 4.5 | 3.5 | 1.5 | 1.0 | + |
| Malvacipollis divers s | 1.0 | + | 2.0 | 3.0 | 2.0 | 2.0 | | | | | |
| " subtilis | 1.0 | 1.5 | + | 1.0 | + | + | 1.0 | | | | |
| PERIPORATE POLLEN | | | | | | | | | | | |
| Periporopollenites demarcatus | | | | + | | + | | | | | |
| " polyoratus | + | + | 1.0 | 2.5 | 2.5 | 3.5 | 1.5 | + | + | 1.0 | + |
| " vesicus | + | + | | + | 2.5 | + | + | + | 2.0 | + | |
| TETRAD POLLEN | | | | | | | | | | | |
| Ericipites scabratus | + | | | | + | + | | | + | | |
| Simplicepollis meridians | + | 1.5 | + | 1.5 | 1.5 | 2.5 | + | | + | 2.5 | + |
| INAPERTURATE POLLEN | | | | | | | | | | | |
| Dilwynites granulatus | | | + | 2.0 | 2.0 | 6.0 | 7.0 | 3.0 | 3.0 | 3.5 | 2.0 |
| " tuberculatus | | | | | 1.0 | + | 1.5 | 2.0 | + | 1.0 | |
| Eroded grains | 2.0 | 2.5 | 2.0 | 4.0 | 1.5 | 1.5 | 1.5 | 3.0 | 2.5 | 4.0 | 4.0 |

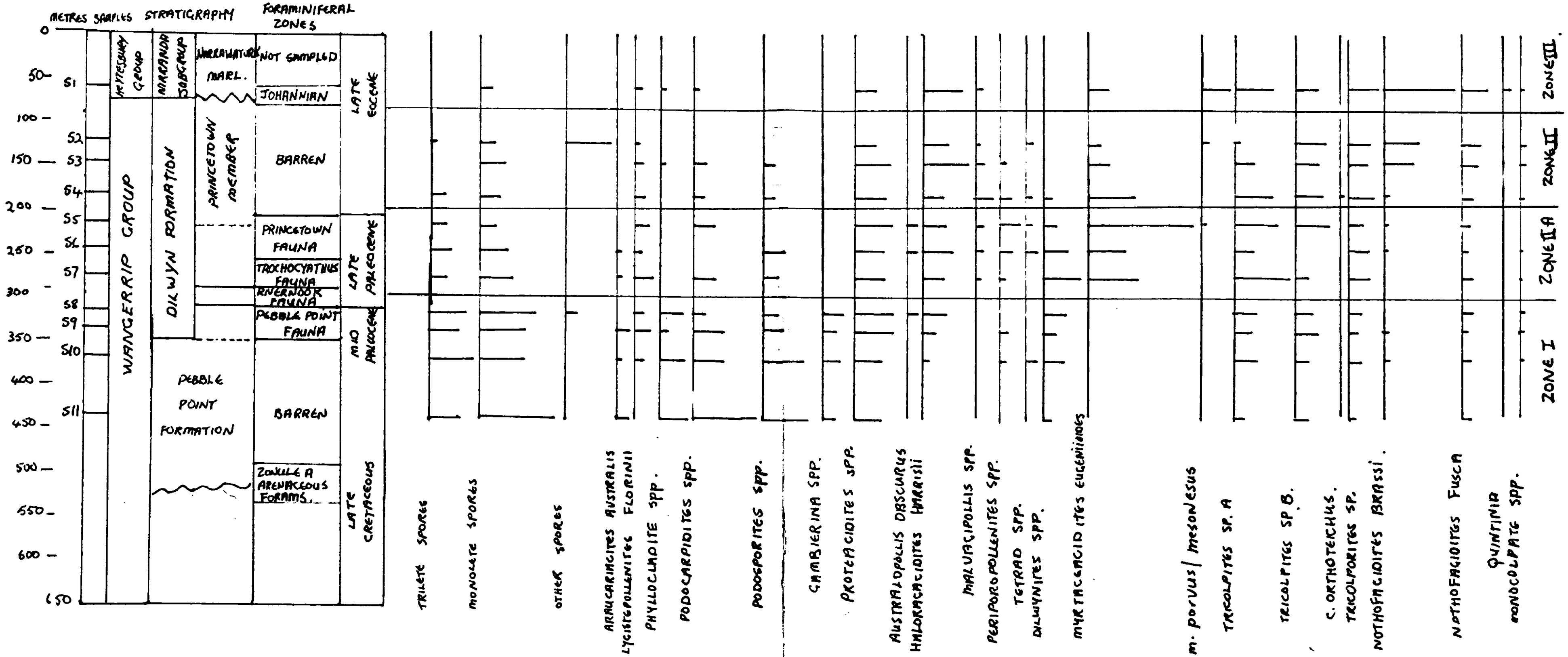


Figure 4 -The Pollen Diagram

CONCLUSION Chapter 9

On the basis of the limited samples studied , any conclusions reached on the spore-pollen zonation can only be inference.

The top of Zone I , the Middle Paleocene zone is marked by the appearance of the C. oriboteichus assemblage, rather than the disappearance of the G. rudata and P. reticulosaccatus, as are used in the Gippsland Basin.

Zone II, ranges from Late Paleocene, on the basis of the Foraminiferal evidence. An assemblage similiar to this zone , which is characterized by the appearance of C. orthoteichus, is recognized in the Gippsland Basin for the Early Eocene. It is therefore possible that ZoneII ranges from the Late Paleocene to the Early Eocene. The top of the Late Paleocene could not be defined from the samples studied.

On the basis of an abundance of M. eugeniioides, a subzone,Zone IIA, established at the base of Zone II. The top of this subzone does not, however correspond to the top of the "Princetown Fauna, and on the basis of the pollen assemblages so far recognized,there does not appear to be a change in the microflora at this level.

At the Middle- Late Paleocene boundary, a concurrent assemblage zone is recognized, where the C. orthoteichus Zone (Zone II ), and the G. rudata Zone (Zone I) overlap.

Species recognized from Late Eocene (Johannian) Faunal sediments could not be related to any of the established pollen zones.

This report has formed only a basis for investigating the bio-stratigraphy of the Latrobe 1 bore. While the pollen assemblages can be related to the established zones to some degree, the range of the zones is undetermined within this section. Only by the examination of further samples, from this and other cores can any definite zones be established, or the relationship of assemblages to the established zones be given with any degree of certainty.

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PLATE 1

All photos approximately (x 850) unless otherwise indicated.

Figures

| | | |
|---|---|---|
| 1 | Cyathidites australis | Couper |
| 2 | Clavifera triplex | (Bolkhovitina) Bolkhovitina |
| 3 | Verrucosisporites kopukuensis | (Couper) |
| 4,5 | Gleicheniidites circinidites | (Cookson) Dettmann |
| 6 | Lycopodiumsporites austroclavatidites | (Cookson) Dettmann |
| 7 | Baculatisporites comaumensis | (Cookson) Potonie |
| 8,9 | Laevigatosporites ovatus | Wilson & Webster |
| 10 | Cyathidites minor | Couper |
| 11 | Reticuloidosporites arcus | (Balme) Dettmann |
| 12 | Camarozonosporites bullatus | Harris |
| 13 | Kuylisporites waterbolkii | Potonie |
| 14 | Rouseisporites reticulatus | Pocock |
| 15 | Laevigatosporites major | (Cookson) Krutzsch |
| 16 | Ceratosporites equalis | Cookson & Dettmann |
| 17 | Pilosporites notensis | Cookson & Dettmann (x 425) |

PLATE I

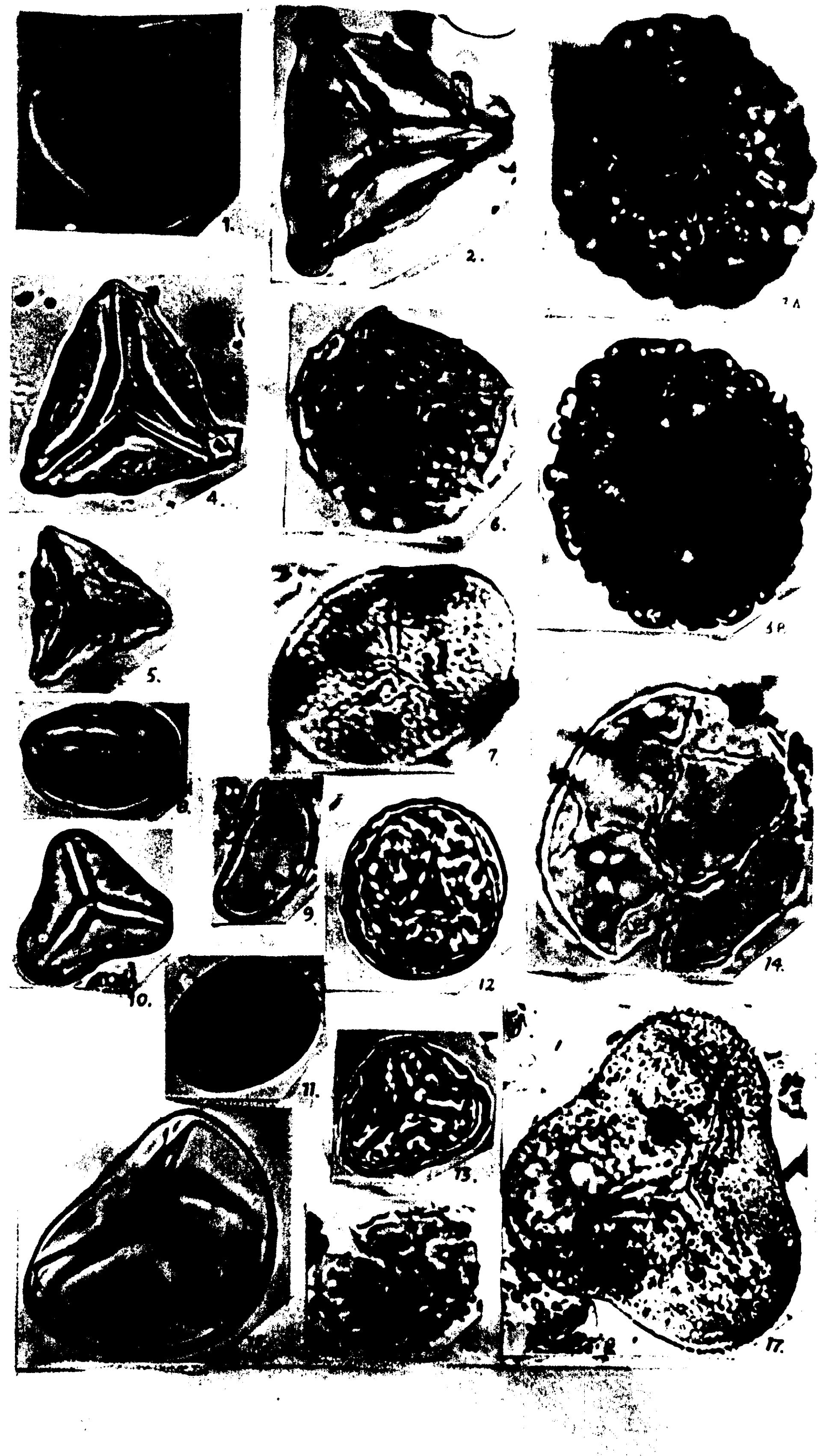

PLATE 2

All photos (x 850) approx.

Figures

| | |
|---|---|
| 1,2 | Peromonoletes densus Harris |
| 3,4 | Verrucatosporites speciosus Harris |
| 5-7 | Liliacidites spp. Coupre |
| 8,9 | Microthyriaceous fungi |
| 10 | Coptospora sp. |
| 11-13 | Bryophyte spores |
| 15 | Araucariacites australis Cookson |
| 16 | Podosporites microsaccatus (Couper) Dettmann |
| 17.18 | Podocarpidites ellipticus Cookson ex Couper |
| 19,20 | Podocarpidites exiguus Harris |
| 21 | Lygistepollenites florinii (Cookson & Pike)Stover & Evans |

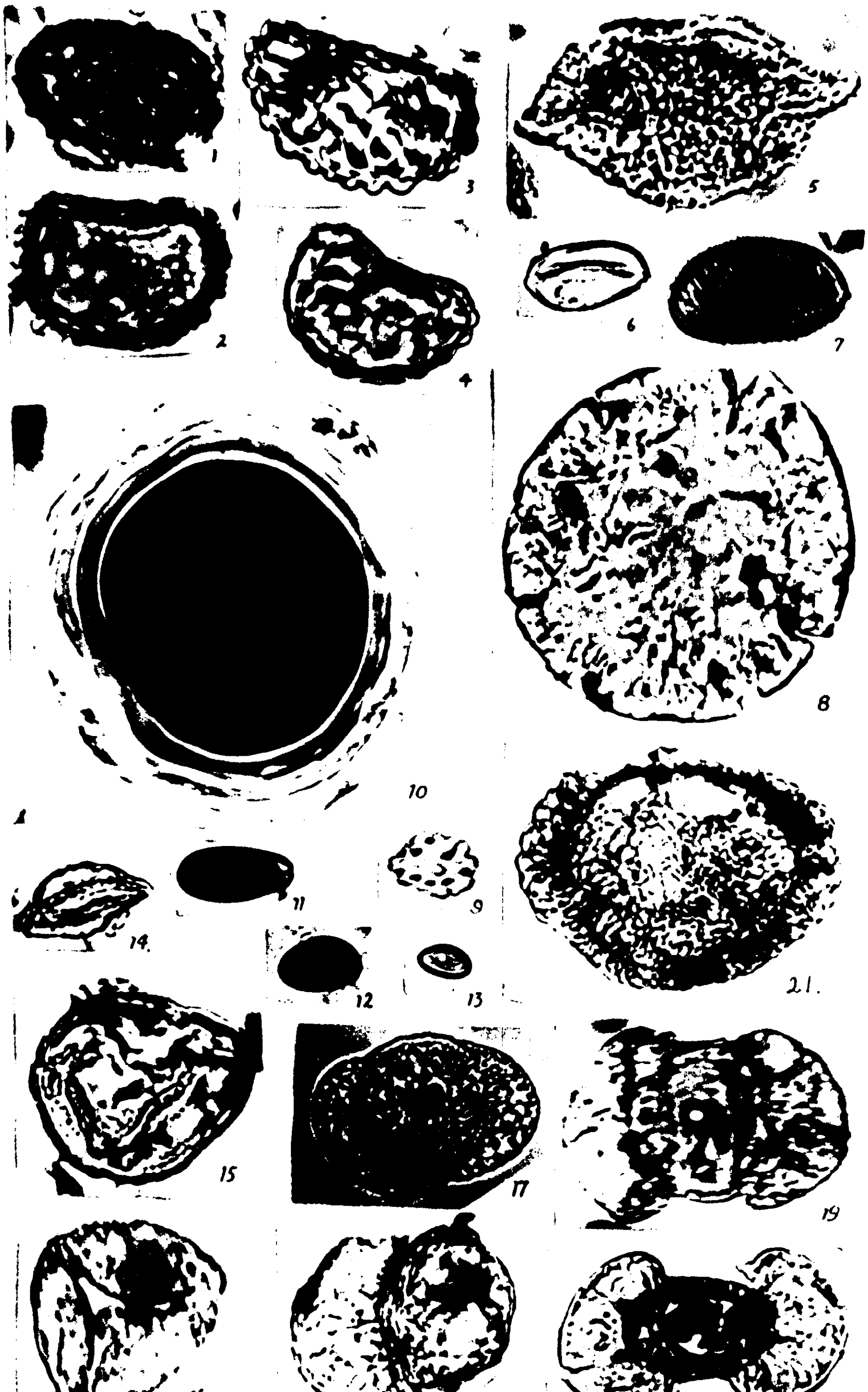
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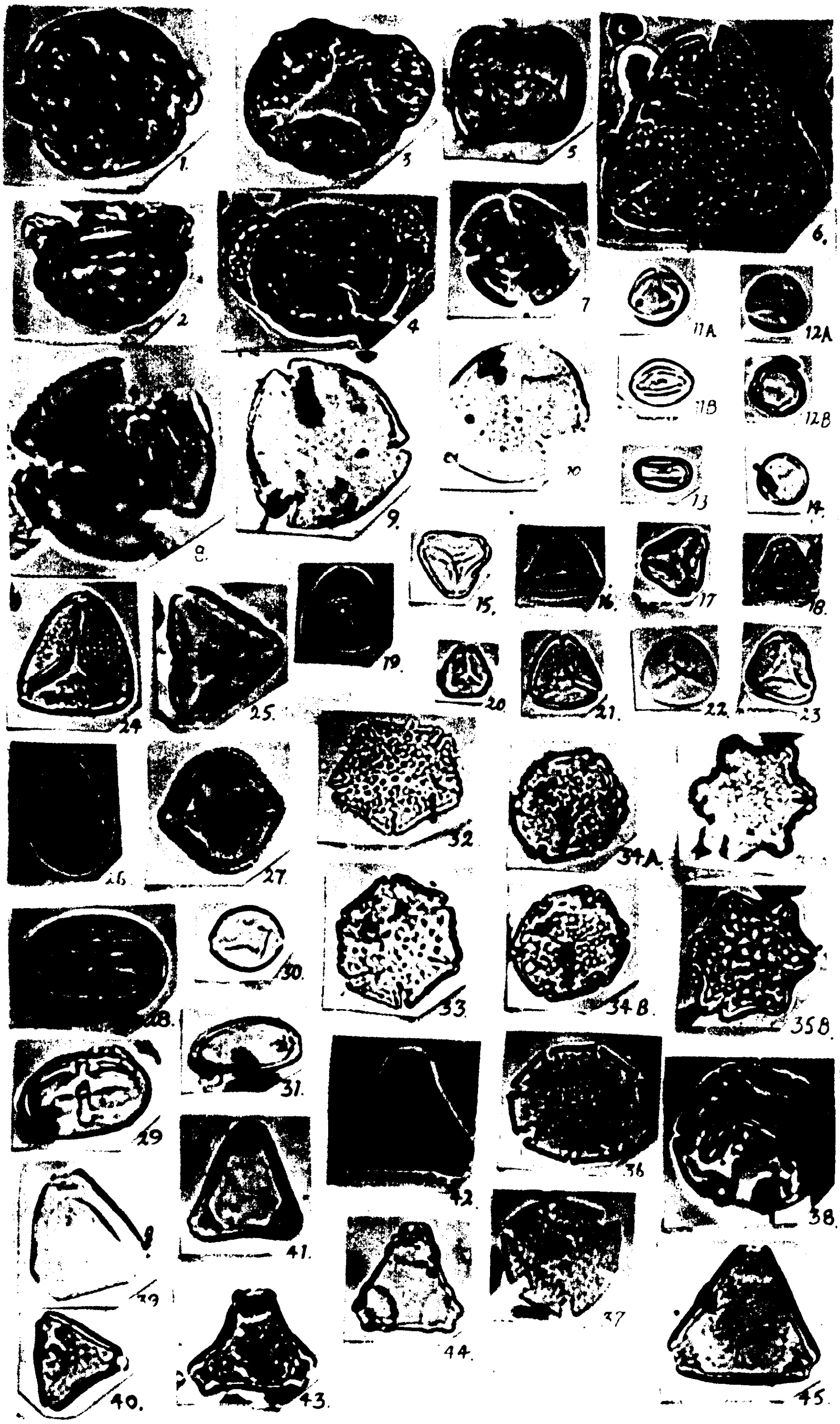
PLATE 3 CONTINUED

| | |
|---|---|
| 37 | *Nothofagidites heterus* (Cookson) Stover & Evans |
| 38 | *Nothofagidites cinctus* (Cookson) |
| 39,40 | *Proteacidites subscabratus* Couper |
| 41 | *Proteacidites latrobensis* Harris |
| 42 | *Proteacidites scabratus* Couper |
| 43,44 | *Proteacidites annularis* Cookson |
| 45 | *Proteacidites* sp. cf. *P. rectomarginus* Cookson |

PLATE 3

All photos (x 850)

| Figures | |
|---|---|
| 1,2 | Phyllocladidites mawsonii Cookson ex Couper |
| 3,4 | Podosporites antarcticus (Cookson ex Couper)Stover & Evans |
| 5 | Phyllocladidites reticulosaccatus Harris |
| 6 | Beaupreacidites elegansiformis Cookson |
| 7 | Tetracolpites sp. |
| 8 | Tricolpites fissilis Couper |
| 9 | Tricolpites phillipsi Stover |
| 10 | Tricolpites pannosus Dettmann & Playford |
| 11 | Quintinia sp. |
| 12 | Tricolpites sp. A |
| 13 | Tricolpites sp. B |
| 14 | Monoporites sp. |
| 15-18 | Myrtaceidites eugeniioides Cookson & Pike |
| 19-20 | Myrtaceidites parvus Cookson & Pike |
| 23 | Myrtaceidites mesonesus Cookson & Pike |
| 24 | Cupanieidites reticularis Cookson & Pike |
| 25 | Cupanieidites orthoteichus Cookson & Pike |
| 26 | Tricolporites prolata Cookson |
| 27 | Tricolporites sphaerica Cookson |
| 28,29 | Tricolporites microreticulatus Harris |
| 30 | Diporites sp. |
| 31 | Banksieaeidites elongatus Cookson |
| 32,33 | Nothofagidites emarcidus (Cookson) Harris |
| 34 | Nothofagidites brachyspinulosus (Cookson)Harris |
| 35 | Nothofagidites falcatus (Cookson)Stover & Evans |
| 36 | Nothofagidites incrassatus (Cookson) |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## PLATE 4

All photos approximately ( x 850 ).

| Figures | |
|---|---|
| 1,2 | *Proteacidites annularis* Cookson |
| 3 | *Proteacidites formosus* Stough |
| 4 | *Proteacidites* sp. cf. *P. angulatus* Stover |
| 5 | *Proteacidites dilwynensis* Harris |
| 6 | *Proteacidites crassus* Cookson |
| 7 | *Proteacidites adenthoides* Cookson |
| 8,9 | *Gambierina edwardsii* (Cookson & Pike) Harris |
| 10,11 | *Gambierina rudata* Stover |

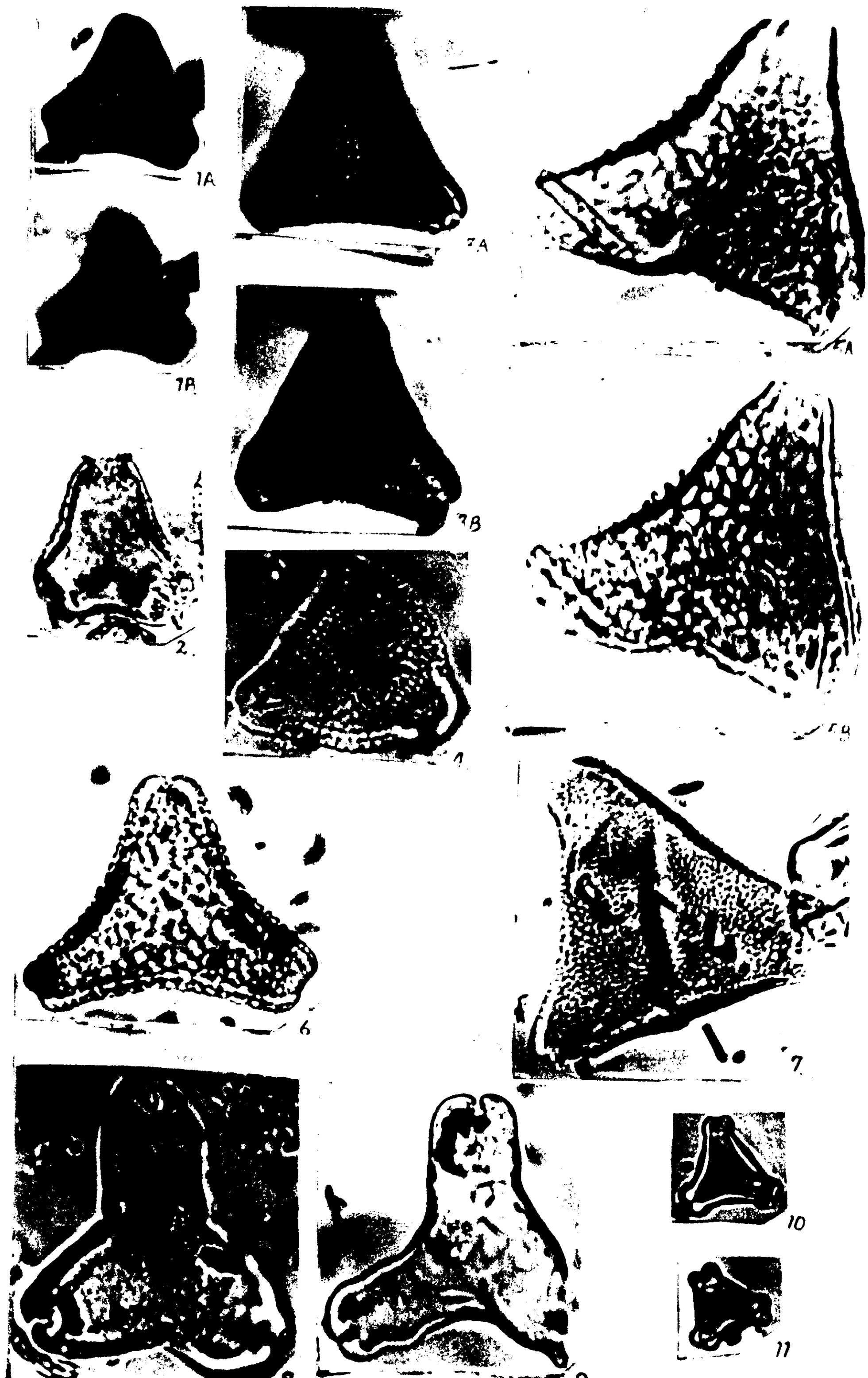
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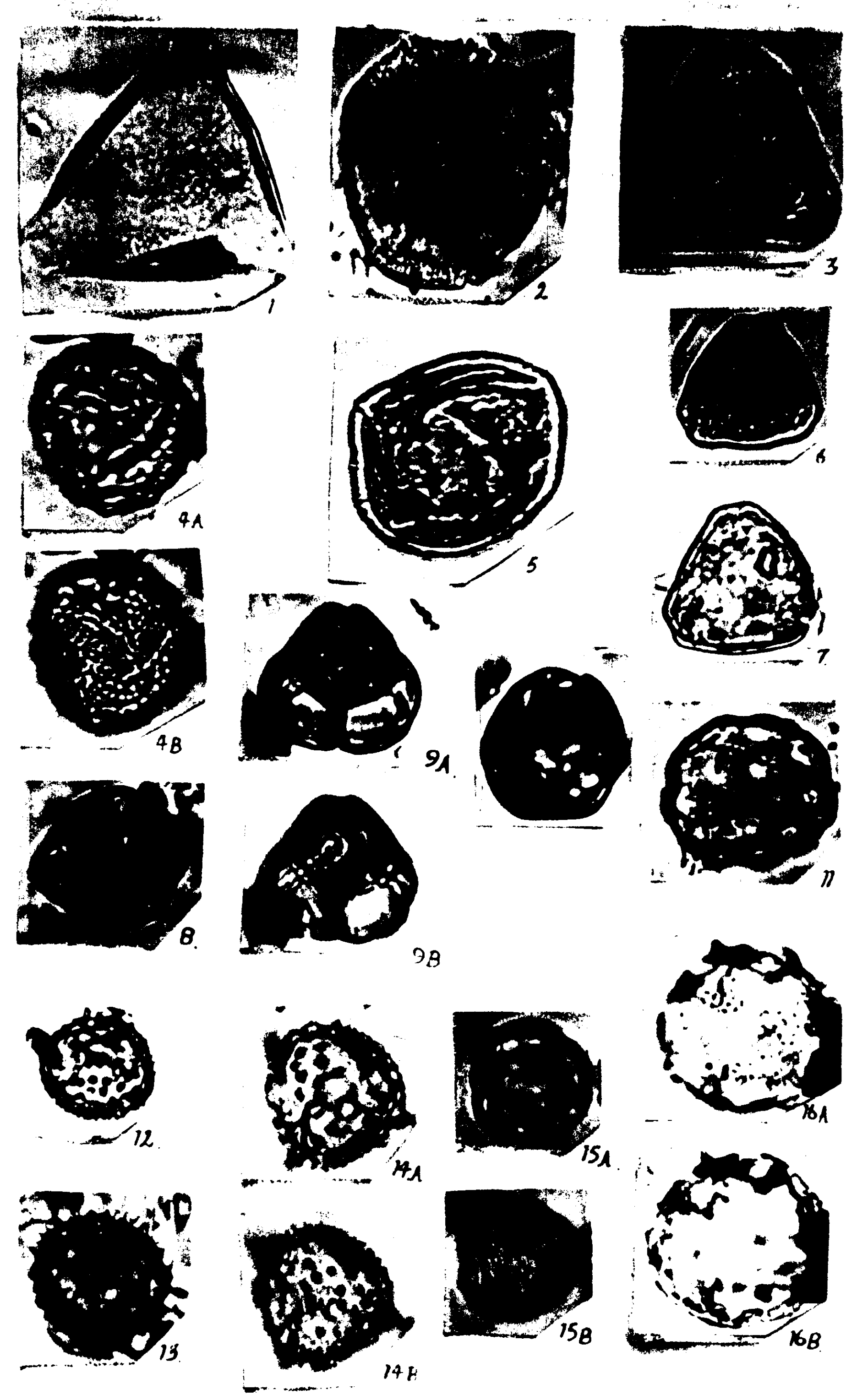
PLATE 5

All photos approx. ( x 850 )

| Figures | |
|---|---|
| 1 | Proteacidites parvus Cookson |
| 2 | Australopollis obscurus (Harris) Krutzsch |
| 3 | Anacolosidites acutullus Cookson & Pike |
| 4 | Dilwynites tuberculatus Harris |
| 5 | Dilwynites granulatus Harris |
| 6,7 | Haloragacidites harrisii (Couper) Harris |
| 8 | Simplicepollis meridianis Harris |
| 9 | Ericipites scabratus Harris |
| 10 | "Triorites" psilatus Harris |
| 11 | Periporopollenites polyoratatus (Couper) Stover |
| 12, 14 | Malvacipollis diversus Harris |
| 13 | Malvacipollis subtilis Stover |
| 15 | Periporopollenites demarcatus Stover |
| 16 | Periporopollenites vesicus Partridge |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