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PALYNOLOGY OF THE
PERMO-CARBONIFEROUS
IN TASMANIA:
AN INTERIM REPORT

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PREFACE

Dr E.M. Truswell (formerly Kemp), a graduate of the Universities of Western Australia and Cambridge, who is now a palaeontologist with the Bureau of Mineral Resources, Canberra, is a leading authority on Late Palaeozoic microfloras, more especially those of the Gondwanan countries (South America, South Africa, Peninsular India, Australia and Antarctica). In this bulletin, Dr Truswell collates her own recent studies with a revision of all the previously known palynological information from the Permo-Carboniferous rocks of Tasmania.

The essentially flat-lying Tasmanian sequence is now known in some detail on a lithostratigraphic and marine macrofaunal biostratigraphic basis, and although much thinner, is as complete as any sequence in Australia. It thus offers an ideal opportunity for equating the marine macrofaunal and palynological criteria.

Although by no means complete, the results obtained so far are extremely encouraging, and indicate the probability of a close synthesis of the macrofaunal and microfloral data in the not too distant future. This synthesis should prove invaluable in the detailed correlation of the Tasmanian sequence with sequences elsewhere in Australia and throughout the world.

J.G. SYMONS, Director of Mines

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ABSTRACT

This report brings together the results of recent palynological studies on the older parts of the Lower Parmeener Supergroup of Tasmania. Core material from a bore hole drilled in the Masseys Creek Group at Andersons Creek, near Beaconsfield, has been examined and the sequence correlated with the Quamby Mudstone and Golden Valley Group at Golden Valley. Suites of samples from Strahan, Hellyer Gorge, Sassafras and the Fisher Tunnel also form part of this survey.

The microfloral assemblages recovered from these rocks have been assigned to biostratigraphic stage and substage units which are modifications of those instituted by Evans (1969) and which are widely applied in eastern Australia. The Tasmanian sequence has provided a useful opportunity to study the emerging relation between these units and faunal units based on marine invertebrates. From the present study, it becomes apparent that Faunizone 1 of Clarke & Banks (1975) is generally associated with microfloras referable to Substage 3a; this relation is clear at Golden Valley and Beaconsfield. The oldest parts of this faunal unit, however, probably overlap with Stage 2 at Latrobe.

Among those lithological units which as a general rule lack invertebrate fossils, the following correlations with microfloral units have been determined: the glacial sediments at the base of the Parmeener Supergroup are associated with both Stage 1 and Stage 2 microfloras; tasmanite oil shale, where sampled, contains Stage 2 assemblages; the Mersey Coal Measures yield assemblages identifiable with Substage 3b.

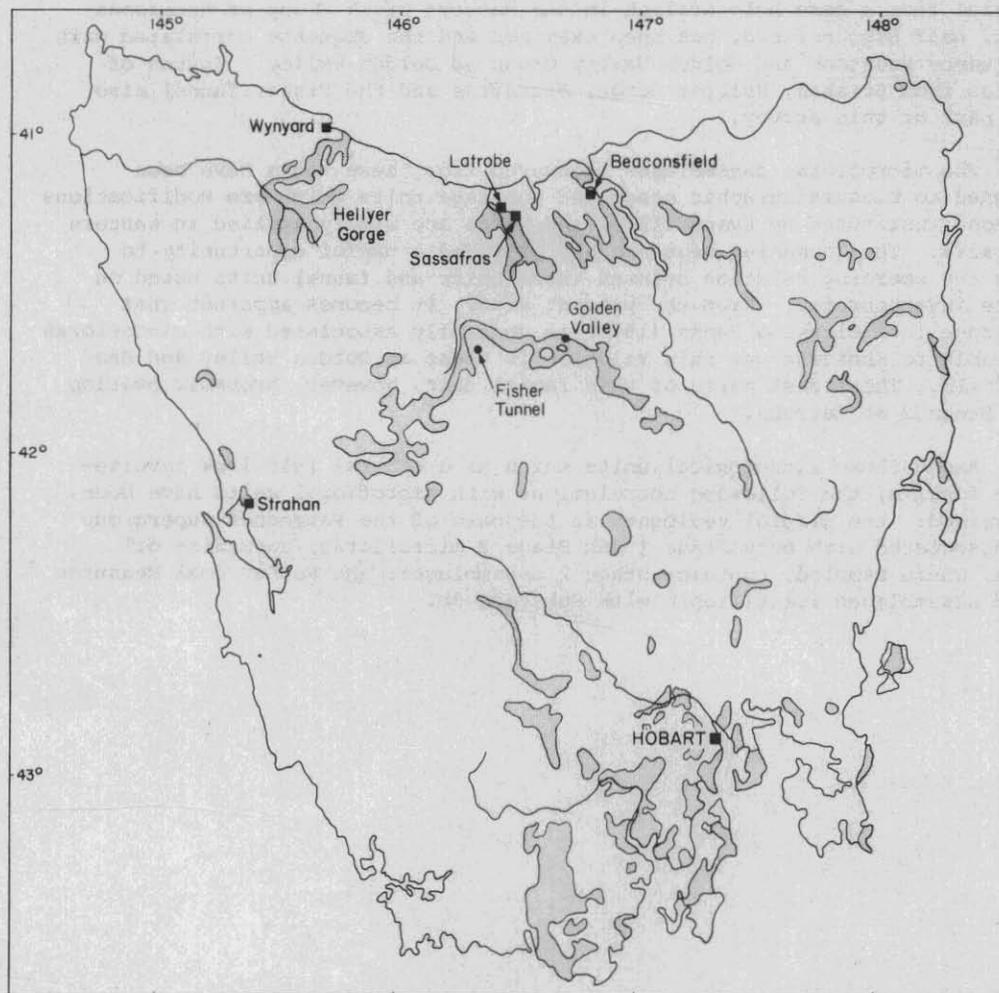
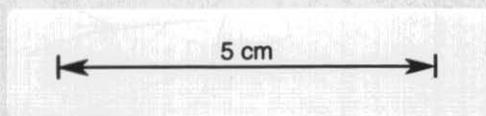


Figure 1. Map showing localities studied and areas of outcrop of Permo-Carboniferous rocks (stippled).



INTRODUCTION

The palynological study of the latest Palaeozoic rocks in Tasmania began as long ago as 1875, when Newton described the algal fossil *Tasmanites punctatus* from shale outcrops on the north side of the Mersey River. The algal nature of the microscopic bodies in the oil shale had been recognised earlier (Ralph, 1965), but it was Newton who extracted them from the rock matrix by methods closely akin to those that are now standard palynological preparation techniques, and who furnished full descriptions and clear illustrations of these acid-insoluble microfossils. His paper, therefore, has strong claims to be considered the first piece of palynological research in Australia.

Apart from a cursory re-examination of *Tasmanites* by Singh in 1932, no further palynological study of Tasmanian rocks was undertaken until 1949, when Dulhunty and Dulhunty presented their study of miospore types in Permian coals. Microspores described in that study were given letter designations, rather than formal binomial nomenclature, following the style of earlier descriptions of New South Wales coals (Dulhunty, 1946). The Tasmanian coal samples examined (Dulhunty and Dulhunty, 1949) came from both the upper and lower coal measure sequences of what is now referred to as the Lower Parmeener Supergroup (Banks, 1973; Clarke and Banks, 1975). In addition to samples from the Mersey and Cygnet Coal Measures, a sample of tasmanite from Latrobe was examined in that study, but the yield of spores other than *Tasmanites* was reported to be poor.

Subsequently, Balme and Hennelly (1955, 1956a,b) used coals from the Mersey Coal Measures in their taxonomic studies of microspores from a variety of Australian Permian coals. Balme (*in* Spry and Banks, 1962) gave brief reports on the palynology of samples from a number of localities: he assigned a probable Sakmarian age to samples of tasmanite from Oonah and Dulverton; a probable lower Artinskian age to coal and carbonaceous shale samples from the Mersey Group at Nook, Quamby Bluff, Illamatha and Elephant Pass; and a Kungurian to Upper Permian age to material from the Cygnet Coal Measures at Cygnet, the Henty River, Pelion Range and Sky Farm near Hobart. Samples from the Jackey Shale at Western Bluff were described as probably Tatarian (Balme, *in* Jennings, 1963; Balme, 1969); the distribution of form-species in the Cygnet Coal Measures was summarised in Banks and Naqvi (1967). Species listed in the latter publication indicated the correlation of coal measures at Cradoc, Mount Pelion, Mole Creek and Western Bluff, and the general correlation of these with the Newcastle Coal Measures of New South Wales. Additional brief references to the palynology of the Mersey and Cygnet Coal Measures are contained in Balme (1962 and 1964).

More recently, spore assemblages from the Quamby Mudstone and Golden Valley Group, penetrated in a bore hole at Golden Valley, near Poatina, were described in an unpublished report by Helby (1972). A sample from varved shales in the Wynyard Tillite in Hellyer Gorge was briefly reported on (Evans, *in* Banks and Clarke, 1973). Core material from a bore hole at Andersons Creek, near Beaconsfield, was examined by R.J. Helby (unpublished) and by the present author. The writer has also examined suites of samples from Strahan, Hellyer Gorge, Sassafras and the Fisher Tunnel, and has re-examined slides from the Balme and Hennelly collection of the Mersey Coal Measures. This report brings together all of this recent palynological research, and, where possible, shows the emerging relation between the microfloral assemblages and the informal faunal zones recently delineated by Clarke and Banks (1975). It expands the brief summary of recent information given in Kemp *et al.* (1977).

Taxonomic notes describing forms of stratigraphic and, or, palaeo-

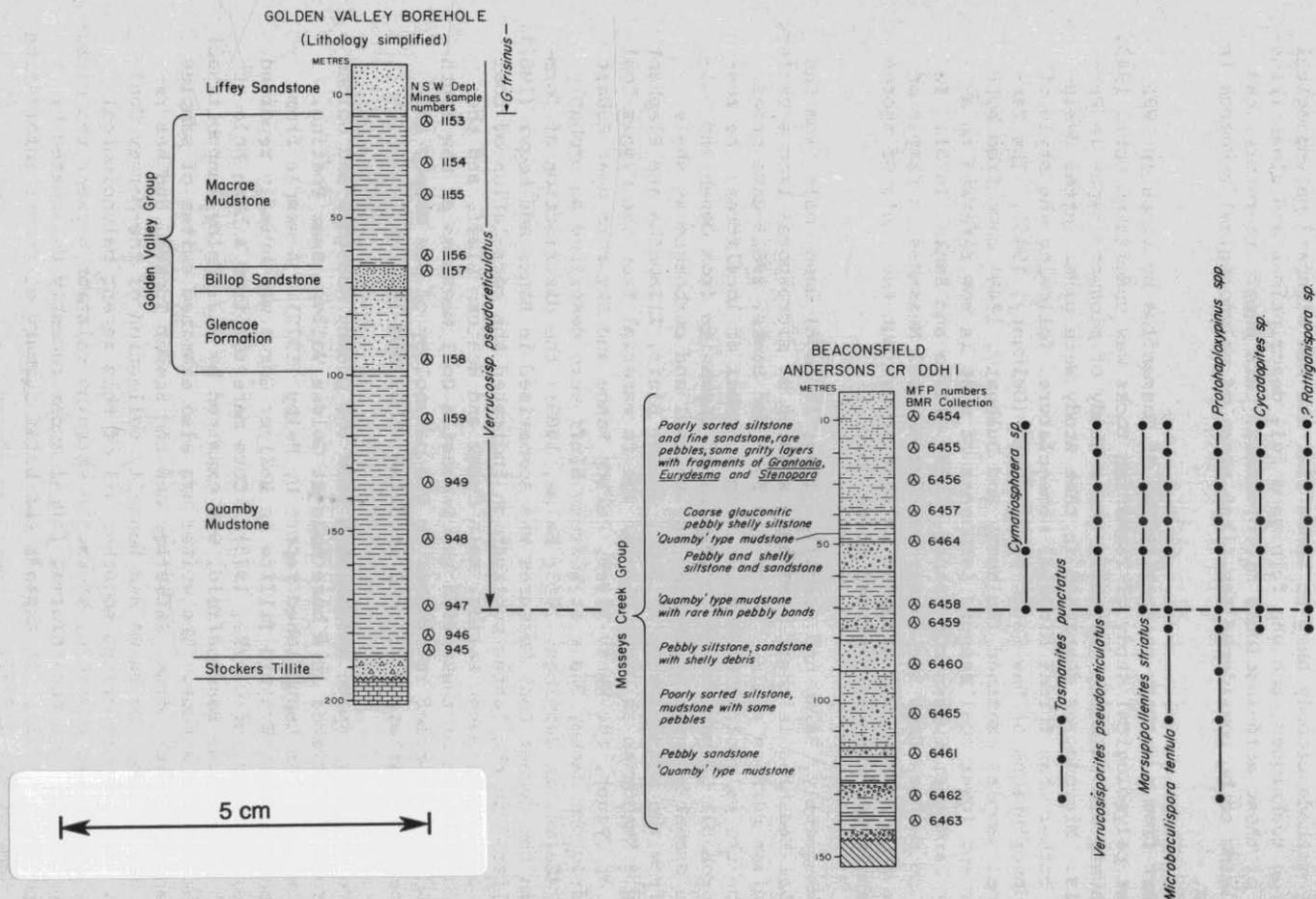


Figure 2. Suggested correlation between Golden Valley bore hole sequence (data from Helby, 1972) and section in Andersons Creek DDH 1, Beaconsfield. Datum line drawn at the first appearance of *Verrucosporites pseudoreticulatus* at each site. Ranges of selected form-species at Andersons Creek shown on right.

environmental interest are appended. The localities on which the recent work is based are shown in Figure 1. The distribution of species in all samples is shown in Table 1.

BEACONSFIELD

In the Beaconsfield area (fig. 1), the oldest part of the Permian sequence has been referred to the Masseys Creek Group (Gee and Legge, 1974), and rests unconformably on folded early Palaeozoic rocks. Diamond-drill holes in the Andersons Creek area have penetrated the lower part of the group (Clarke, *in* Gee and Legge, 1974) and have yielded a poorly diversified fauna which has been broadly identified as equivalent to the Allandale fauna of the Sydney Basin. Clarke (*in* Gee and Legge, 1974, p.117) has noted the presence of three subdivisions of this broad fauna within the exposed sequence of the Masseys Creek Group in Andersons Creek, and has noted further that the assemblages identified in the bore hole probably equate with the oldest of these assemblages - Faunizone 1 of Clarke and Banks (1975) is probably represented.

Samples at approximately 9 m intervals throughout the cored sequence in Andersons Creek DDH 1 (fig. 2) were processed for palynological study and were examined at reconnaissance level by Helby (quoted in Gee and Legge, 1974) and subsequently by the present writer. Microfloral assemblages consisting of spores, pollen and acritarchs were recovered from all samples, and generally showed fair preservation.

Composition of assemblages

A general uniformity in composition of the assemblages was evident throughout the sequence, although some changes occur at about the level of Sample 6458, and are discussed below. The composition of the samples, expressed in terms of the frequencies of five major morphological groups, viz., monosaccate pollens, taeniate and non-taeniate disaccate pollens, monocolpate pollens and trilete spores, is shown as a series of bar-graphs in Figure 3. Overall, the microflora is characterised by the dominance of monosaccate pollens, including *Parasaccites* spp., *Plicatipollenites* sp., and, more rarely, *Potonieisporites* spp. Also characteristic is the presence of a group of non-taeniate disaccate pollens: these have been referred to the form-genera *Limitisporites* (Leschik), *Vestigisporites* (Balme & Hennelly), and *Jugasporites* Leschik, depending on the form of the proximal scar and the lateral union or otherwise of the sacchi. Taeniate disaccate pollens are a constant component, but are always present in frequencies of less than 5%; most forms within the group are referable to *Protohaploxylinus* Samoilovitch, but the group also includes rare specimens in which the sacchi are rudimentary, and which have been assigned to *Striatoabieites* Zoricheva & Sedova. Some of the latter (plate 2, fig. 1) show a distinct longitudinal thickening on the distal face, resembling the northern hemisphere form *Vittatina costabilis* Wilson, 1962.

Trilete spores of probable pteridophytic origin are prominent in all samples, and include some recognised and some potential stratigraphic markers. The form-species *Verrucosisporites pseudoreticulatus* Balme & Hennelly, 1956 was observed in all samples down to and including Sample 6458. Other forms of possible stratigraphic value include *Microbaculispora tentula* Tiwari, 1965, which is present in all but the oldest samples; an apiculate verrucate form comparable to *Lophotriletes scotinus* Segroves, 1970 (plate 1, fig. 4-6); a small spore with pronounced distal thickening and proximal verrucae, tentatively referred to *Rattiganispora* Playford & Helby (plate 1, fig. 1-3); and forms similar to *Granulatisporites micronodosus* Balme & Hennelly, 1956.

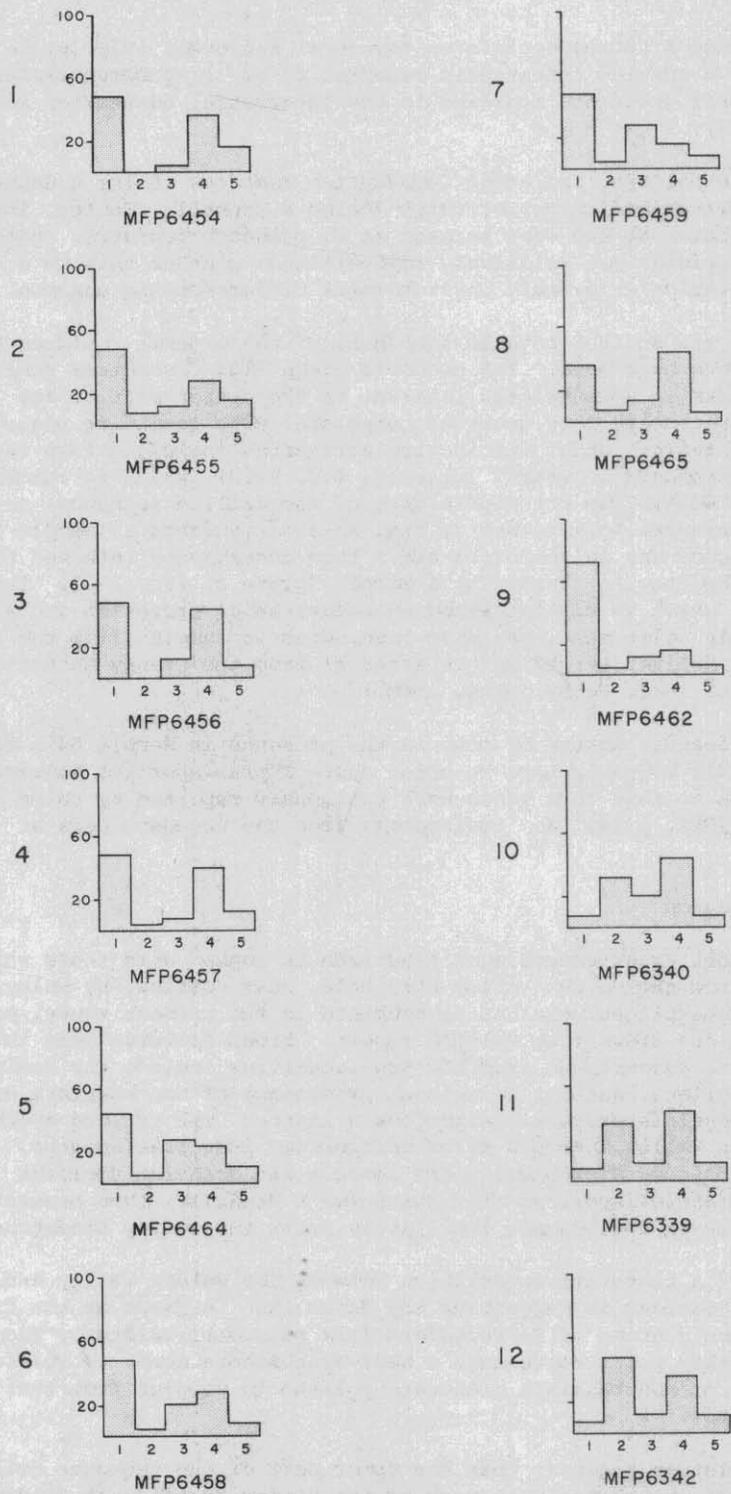
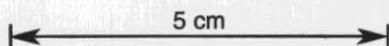


Figure 3. Bar-graphs showing percentages of morphological types in samples from Andersons Creek DDH 1 (graphs 1-9) and from Mersey Coal Measures at Sassafras (graphs 10-12). Columns represent: 1 - monosaccate pollens, 2 - taeniate disaccate pollens, 3 - non-taeniate disaccate pollens, 4 - trilete spores, 5 - monosulcate pollens.



Rarer forms include *Diatomozonotriletes townrovii* Segroves, 1970 (plate 1, fig. 9, 10), and a species tentatively referred to as '*Diatomozonotriletes*' sp. in which distal grana are modified in the interradian equatorial region (plate 1, fig. 23).

Monosulcate pollens, including *Cycadopites cymbatus* (Balme & Hennelly) Hart, 1965 and *Marsupipollenites striatus* (Balme & Hennelly) Foster, 1975 appear in the section at the same horizon as *V. pseudoreticulatus*. Below this level, microfloras are relatively impoverished; whether this is a result of preservation or primary environmental differences is unknown.

Acritarchs are another notable component of the organic residues from the Andersons Creek bore hole. The probable green alga *Tasmanites punctatus* Newton, 1875 occurs in a restricted interval in the deeper part of the section; just how closely this interval correlates with tasmanite shale elsewhere is uncertain. Other distinctive acritarchs include a form referred to *Cymatiosphaera* O. Wetzel (plate 3, fig. 9-12), which is common in Samples 6464 and 6458, from the middle part of the drilled sequence; an alete, rugulo-verrucate form (plate 3, fig. 13-15), confined to Sample 6458, where it is the dominant palynomorph; and a form tentatively referred to *Gorgonisphaeridium* Staplin, Jansonius & Pocock (plate 3, fig. 1-6). The last-named form, which is distinguished by square-ended processes and a characteristically split test, has also been noted in samples from the Inglis Siltstone in the Hellyer Gorge, and in material from the Cranky Corner Basin in New South Wales (R.J. Helby, pers. comm.).

One other feature worthy of note is the presence in Sample 6456 of the recycled Middle to early Late Devonian spore *Emphanisporites* McGregor. Species referable to this form genus were previously reported by Balme (in Spry and Banks, 1962, p.185) as '*Radiaspora*' from the Eugenana Beds at Eugenana.

Suggested correlation

The Andersons Creek assemblages have much in common with those which were described from the Golden Valley bore hole, near Poatina, by Helby (1972). These assemblages were not re-examined in the present study, and comparative data are drawn from Helby's report. Broad features held in common between the assemblages from the two localities include the dominance of monosaccate pollens, and the occasional prominence of non-taeniate disaccates of the *Vestigisporites-Jugasporites* alliance. The trilete spore element at Golden Valley includes *Verrucosisporites pseudoreticulatus*, *Lophotriletes scotinus*, *Microbaculispora tentula* and *Granulatisporites micronodosus*. *Granulatisporites trisinus* Balme & Hennelly, 1956 occurs at Golden Valley only in that sample immediately below the Liffey Sandstone.

In Figure 2 a tentative correlation between the Golden Valley and Andersons Creek sections is suggested; the datum line is drawn at the first appearance in each section of *Verrucosisporites pseudoreticulatus*. The suggestion that this point represents a near-synchronous event is reinforced by the abundance of non-taeniate disaccate pollens in samples from that level at both sites.

This correlation suggests that the upper part of the sequence drilled at Andersons Creek correlates with much of the Quamby Mudstone at Golden Valley, and is thus older than the Golden Valley Group. Such a correlation appears to be in accord with faunal data. Clarke and Banks (1975) record their Faunizone 2 from the Billop Sandstone and Glencoe Formation of the Golden Valley Group; i.e. at a younger level than the sequence penetrated

at Andersons Creek. Faunizone 1 is reported from this locality (Clarke, in Gee and Legge, 1974).

Helby (1972) referred the Golden Valley palynological assemblages to Stage 2 of Evans's (1969) zonal scheme. He further suggested their equivalence with upper Stage 2 of that scheme, as this was defined by Norvick (1971) in the Galilee Basin of Queensland. Norvick defined his younger Stage 2 unit by the first appearance of such forms as *Microbaculispora tentula*, *Cycadopites* and *Marsupipollenites*. The Golden Valley sequence, however, also contains *Verrucosisporites pseudoreticulatus*, which Evans (1969), and subsequently Paten (1969) and Price (1976) have used to define the base of Stage 3. Price (1976, and summarised in Kemp et al., 1977) instituted a twofold subdivision of Stage 3; the base of the biostratigraphic unit Substage 3a he defined by the first appearance of *V. pseudoreticulatus*; the base of the younger unit, Substage 3b, he defined by the first appearance of *Granulatisporites trisinus*. Applying Price's scheme to Golden Valley, it is evident that the Quamby Mudstone and Golden Valley Group are referable to Substage 3a; the base of Substage 3b occurs about the level of Sample 1153 (see fig. 2), just below the Liffey Sandstone.

Helby (in Gee and Legge, 1974) referred the sequence in the Andersons Creek bore hole to 'early Stage 2', an assignment which needs revision in the light of current concepts of eastern Australian palynological biostratigraphy. It now seems that the section in Andersons Creek down to and including Sample 6458, should be referred to Substage 3a. Below that, productive samples should be assigned to late Stage 2. Outside Tasmania, the most closely comparable microfloras to those from both Golden Valley and Beaconsfield occur in the Cranky Corner Basin, north of the Sydney Basin (Helby, unpublished). There, in a series of bore holes drilled by the New South Wales Department of Mines, a close correlation between the microfloral stages and the brachiopod zones of Runnegar and McClung (1975) is evident. Stage 2 is coeval with the *Trigonotreta campbelli* Zone; Stage 3a overlaps the top of that zone, and appears to correlate with the *Martiniopsis elongata* and the *M. konincki* Zones.

MERSEY COAL BASIN

SASSAFRAS

Four samples of grey siltstone collected by M.R. Banks from road cuttings on the Bass Highway 5 km east of Sassafras were examined in the course of this study. They were obtained from the Mersey Coal Measures in their type area.

All samples yielded abundant and relatively diverse palynomorphs. Preservation was variable; spores were well-preserved in some cases, but saccate pollens were generally thin and corroded, and hence difficult to identify. The gross composition of three of the recovered assemblages is shown in Figure 3 (10-12); these bar-graphs show that monosaccate pollens are much reduced in relation to the abundance they show in the Beaconsfield and Golden Valley assemblages. Taeniate disaccate pollens, on the other hand, show a marked increase in frequency, reaching proportions in excess of 40%. The group also shows an increase in diversity, and form-species recorded include *Protohaploxylinus goraiensis* (Potonié & Lele) Hart, 1964, *P. limpidus* (Balme & Hennelly) Balme & Playford, 1967, *Striatopodocarpites* spp., and *Striatoabieites* aff. *S. multistriatus* (Balme & Hennelly) Hart, 1964. Non-taeniate saccate pollens remain common, and include some of the forms of *Limitisporites* and *Jugasporites* which were observed in the older

assemblages. Also present are forms referable to *Scheuringipollenites* Tiwari, including *S. ovatus* (Balme & Hennelly) Foster, 1975 and *Sulcatiporites nilssoni* Balme, 1970.

Marsupipollenites triradiatus is a common element, as are the other trilete species, *Verrucosisporites pseudoreticulatus*, *Granulatisporites micronodosus*, *Microbaculispora tentula* and *Granulatisporites trisinus*. A species of *Verrucosisporites* comparable to *V. naumovae* Hart, 1963 was observed rarely. No acritarchs of known marine affinity were seen, but the *incertae sedis* *Maculatasporites minimus* Segroves, 1967, *Quadrisporites horridus* Hennelly, 1958, and *Peltacystia venosa* Balme & Segroves, 1966, are present in low frequencies. The proportions of taeniate, disaccate pollens suggests equivalence to Stage 3 of Evan's sequence; the combined presence of *Verrucosisporites pseudoreticulatus* and *Granulatisporites trisinus* suggests that Substage 3b of Price (1976) is represented.

TARLETON AND ILLAMATHA

As mentioned in the introduction, coal samples from Tarleton and Illamatha in the Mersey Coal Basin and from Latrobe were examined in the early studies of Dulhunty and Dulhunty (1949) and Balme and Hennelly (1955, 1956a, b). In none of these studies were precise localities or stratigraphic details given.

Dulhunty and Dulhunty (1949, table 4, p.135) listed the sporological composition of the Tarleton and Illamatha coals, giving a numerical designation to each spore type. Balme and Hennelly, in the synonymy lists of their taxonomic descriptions, identified the early numbered types with their formally described form-species, so that it is now possible to translate the compositional lists given by Dulhunty and Dulhunty into a more modern taxonomy. From Tarleton, the forms included *Granulatisporites trisinus*, *G. micronodosus*, *Marsupipollenites triradiatus*, *Verrucosisporites pseudoreticulatus* and *V. parmatus* Balme & Hennelly, 1956. Further species described by Balme & Hennelly included *Pakhapites* (al. *Vittatina*) *scutatus* (Balme & Hennelly) Hart, 1965, *Schizosporis scissus* (Balme & Hennelly) Hart, 1965, and *Pityosporites giganteus* Balme & Hennelly, 1956.

Slides or organic residues from the Balme and Hennelly collection were re-examined in the course of this study: labels on these slides read only 'Tarleton' (type slides 16-18, 41-44) and 'Illamatha' (type slide 28). Condition of the slides is poor; some are partly desiccated, and in most the palynomorphs present are thin-walled and pale. In the residues from Tarleton one of the most common forms is *Pakhapites scutatus*; *Verrucosisporites pseudoreticulatus* is common, as are the monosaccate forms *Vestigiosporites rudis* Balme & Hennelly, 1956, and *Parasaccites* spp. Relatively featureless forms, of probable algal origin, such as *Schizosporis* spp., and *Pilasporites calculus* Balme & Hennelly, 1955 occur frequently, and, with *Quadrisporites horridus*, were the only species present in the slide labelled 'Illamatha'. It is unknown whether this lack of diversity reflects poor preservation or a very restricted coal swamp flora. Assessment of these assemblages in terms of biostratigraphic units is difficult, but they are probably as young as Substage 3b.

HELLYER GORGE-WYNYARD AREA

The sequence of the Wynyard Tillite in Hellyer Gorge has been summarised by Gulline (1967), who noted the presence of an interval of varved shales intercalated within massive diamictites at this locality. The sequence is illustrated diagrammatically in Clarke and Banks (1975). The varved

interval has yielded a single complete insect, *Psychroptilus burrettiae* Riek (Riek, 1976), the plants *Botrychiopsis plantiana* (Carruthers) and *Aphlebia* sp. (Gould, 1975), the arthropod trail *Tasmanadia* Chapman, 1929, and, according to Evans (*in* Banks and Clarke, 1973), a microfloral assemblage referable to Stage 1. A Late Carboniferous age was suggested on the basis of the microflora, and this is reinforced by the entomological data - Riek (1976) considered that the extremely primitive nature of *Psychroptilus* might indicate an age as old as early Late Carboniferous.

Older parts of the tillitic sequence are exposed in foreshore sections east of Wynyard (Banks *et al.*, 1955; Banks and Clarke, 1973) where varve-like laminations and disturbed bedding occur. A sample of grey siltstone was collected and macerated by the author in 1973, from the sequence east of Doctors Rocks. This sample (MFP 6129) yielded finely comminuted plant debris and fragmentary spores; fragments of monosaccate pollens were dominant, and both *Parasaccites* spp. and *Potonieisporites* sp. were identified. Rare rugulo-verrucate spores (*Verrucosisporites* sp. 22 of BMR nomenclature; see Evans, 1964) were also present, suggesting broad equivalence with a Stage 1 age. A single specimen of the acritarch *Veryhachium* cf. *valensii* (Valensi) Downie & Sarjeant, 1964, and one of *Michrystridium* Deflandre, suggest that conditions were at least marginally marine during the deposition of these glacial rocks.

Palynological residues from rhythmites in Hellyer Gorge (from the sample previously examined by P.R. Evans) were re-examined in this study (N.S.W. Department of Mines Sample 1780) and the Stage 1 assignment was reinforced. The assemblage is sparse and poorly diversified, although preservation is fair. Monosaccate pollens make up just over half the spectrum; the remainder consists of trilete spores belonging to the genera *Verrucosisporites* (sp. 22 of Evans, 1964), *Retusotriletes* Naumova, and *Punctatisporites* Ibrahim. Assemblages were recovered from the tasmanite oil shale at the base of the Inglis Siltstone (Sample MFP 6115), the formation which overlies the Wynyard Tillite; and from Scolyers Hill (Sample MFP 6131) at a level high in the same formation. The residue recovered from the tasmanite was dominated by *Tasmanites punctatus*, occurring as rare whole specimens and abundant fragments. The rare spores present were corroded and much distorted by pyrite crystal growth, but *Parasaccites* sp., *Limitisporites* sp., *Microbaculispora tentula*, *Horridotriletes* sp. and *Cycadopites* sp. could be identified. Equivalence with Stage 2 of Evans's scheme is tentatively suggested on the basis of limited data.

At Scolyers Hill, the Inglis Siltstone contains a fauna which Clarke (*in* Banks and Clarke, 1973) identifies as his Faunizone 1. A slightly weathered micaceous siltstone with shelly fragments from this locality yielded an assemblage of poorly preserved, fragmented spores, pollen and acritarchs. The spores included *Verrucosisporites pseudoreticulatus*, *Microbaculispora tentula*, *Striatoabieites* sp., and *Cycadopites cymbatus*. These rather sparse data suggest correlation with Substage 3a of Price (1976); correlation with the upper part of the Quamby Mudstone, and the upper part of the drilled sequence at Andersons Creek, Beaconsfield, is suggested. The acritarch component at Scolyers Hill supports such a correlation - the forms referred to *Gorgonisphaeridium* sp. (plate 3, fig. 1-6) and *Cymatio-sphaera* sp. (plate 3, fig. 9-12) occur in both sequences, although their full stratigraphic ranges are currently unknown.

STRAHAN

From basal diamictite and rhythmite sequences near Strahan, seven

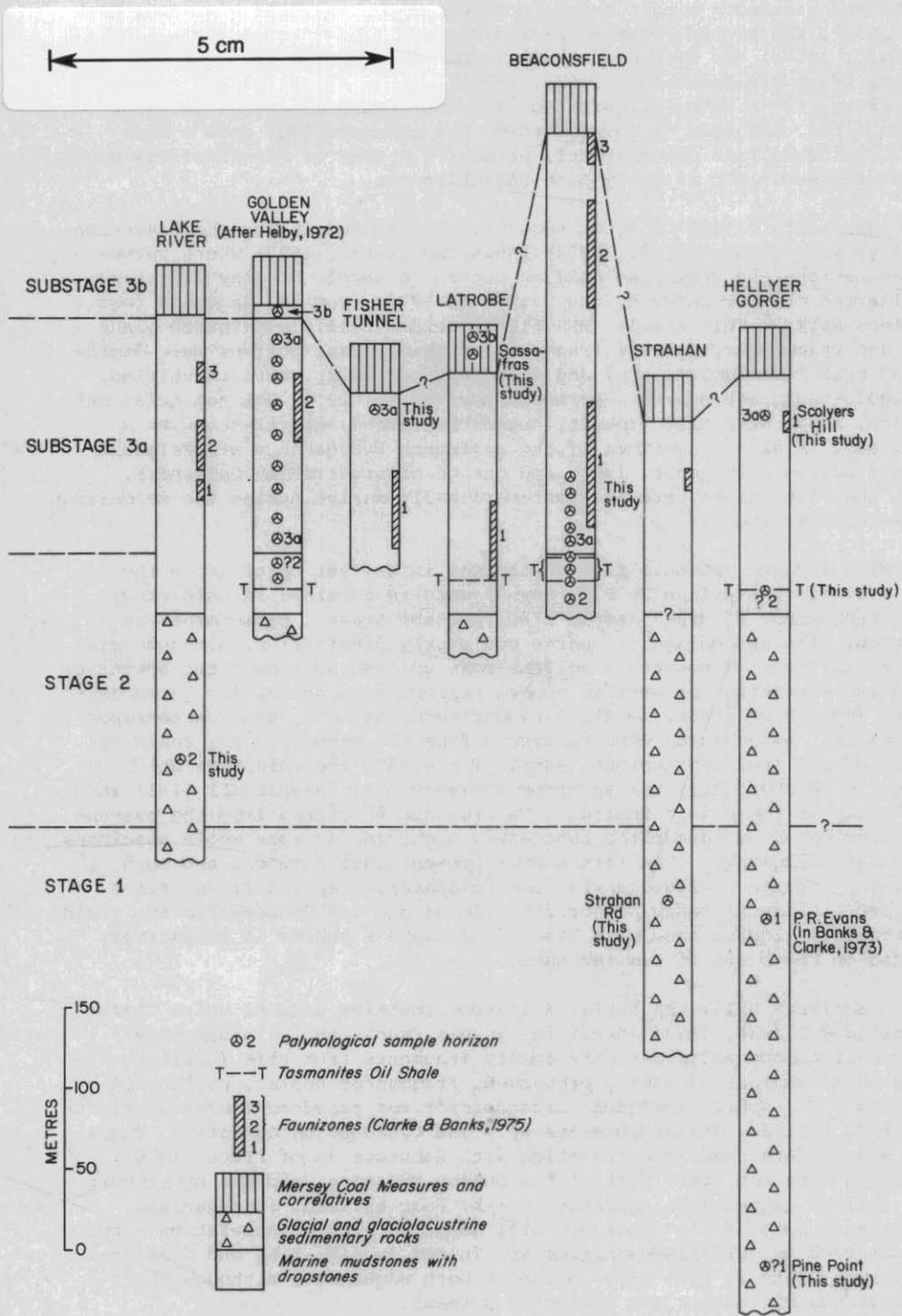


Figure 4. Stratigraphic relation of localities discussed with reference to palynological stages (at left) and to faunizones of Clarke and Banks (1975). Thicknesses and faunal distributions are taken from Figure 3 in Clarke and Farmer (1976).

samples were collected and processed. The two productive samples (MFP 6346 and MFP 6352) were both obtained from massive diamictite, the former from road cuttings 2 km from Strahan on the main Queenstown-Strahan road, and the latter from road cuttings in the Henty Forestry Plantation 6 km north of Strahan. The stratigraphic details are a little uncertain, but both localities are at least 150 m below the top of the basal glacial unit, and at least 220 m below the lowest marine faunas with *Eurydesma*, *Deltopecten* and *Trigonotreta stokesi* Koenig. They yielded sparse but well-preserved spores and pollen. Chief among these were monosaccate pollen, including *Potonieisporites neglectus* Potonié & Lele, 1961, *Plicatipollenites densus* Srivastava, 1970, *Caheniasaccites ovatus* Bose & Kar, 1967. Trilete forms are rare, and only *Leiotriletes* sp., *Apiculatisporis* sp., and *Lophotriletes* cf. *scotinus* were identified. The presence of a single specimen of the spinose acritarch *Michrystidium* in MFP 6346 is noteworthy, again suggesting a marine depositional environment for these glacial rocks. The same sample yielded an abundance of large, thin-walled, crumpled leiospheres, probably of algal origin. The pollen suite, with its dominance of monosaccates, and apparent lack of taeniate disaccate forms, suggests Stage 1, although sparse recovery makes this assignment tentative.

FISHER TUNNEL

The geology of Permian sequences penetrated during tunnelling associated with the Fisher Hydro-Electric Power Scheme was described by Clarke and Farmer (1973). In the course of the present study, palynological examination was carried out on three samples from the tunnel sequence; these came from equivalents of the upper part of the Kansas Creek Beds, from the Liffey Sandstone, and from the overlying Poatina Group (see Clarke and Farmer, 1973, p.49 for sequence). Only one sample, that from the Kansas Creek Beds equivalent (MFP 6343) yielded sufficient palynomorphs for biostratigraphic determination.

Sample MFP 6343, a dark grey indurated siltstone, yielded abundant palynomorphs in a poor state of preservation. The combination of fragmentary taeniate disaccate pollen grains and rare *Verrucosisporites pseudoreticulatus* indicates an age as young as Substage 3a. Swarms of leiospheres and rare acanthomorph acritarchs indicate marine conditions of deposition.

LAKE RIVER

Two samples from diamictites at the base of the Parmeneer Supergroup at Lake River, some 30 km south of Poatina (Sample MFP 6353, 6354) yielded sparse, very poorly preserved pollens. These included tentatively identified taeniate disaccate pollen fragments, suggesting an age no older than Stage 2.

CONCLUSIONS

This preliminary study permits a few generalisations to be made concerning the older part of the Lower Parmeneer Supergroup. Figure 4 summarises the localities discussed here and shows the palynological sampling horizons and their relation to the faunal zones of Clarke and Banks (1975). The emergent generalisations are as follows:

- (1). Glacially derived sediments are associated with both Stage 1 and Stage 2 microfloral assemblages, as is the case in mainland Australia (Kemp, 1975). In the present study, assemblages have been recovered from diamictites and rhythmites at Lake River, Strahan and Hellyer Gorge.

(2). The tasmanite oil shale, sampled at three localities, is associated with Stage 2 assemblages.

(3). The oldest of the faunizones of Clarke and Banks (1975), Faunizone 1, is primarily associated with microfloras referable to Substage 3a. This is evidenced by the co-occurrence of faunas and microfloras at Beaconsfield, and Scolyers Hill, Hellyer Gorge. The oldest parts of Faunizone 1 must, however, overlap with Stage 2, since at Latrobe, Faunizone 1 ranges down to and occurs within the tasmanite oil shale. The persistence of the Substage 3a assemblage into strata with Faunizone 2 faunas is demonstrated in the sequence at Golden Valley.

(4). The Mersey Coal Measures and their correlatives, where sampled, have yielded microfloral assemblages referable to Substage 3b. The sequence in the Golden Valley bore hole suggests that the Substage 3a/3b transition occurs just below the Liffey Sandstone at that locality.

TAXONOMIC NOTES

Trilete spores

?*Rattiganispora* sp.

Plate 1, fig. 1-3

Remarks: This small, distinctive spore is tentatively referred to *Rattiganispora* Playford & Helby 1968, on the basis of the irregular, circum-polar, ring-like murus developed on the distal face. The assignment is made cautiously as the dominant sculpture on the form consists of low verrucae, rather than the spinose or conate sculpture specified in the description of *Rattiganispora*. There is also a suggestion of slight equatorial thickening in some of the grains examined. Proximally, the laesurae extend almost to the grain equator, include low lips, and sometimes terminate in *curvaturae imperfectae*. Verrucae or low conical processes are present in clusters in the interradial areas. Distally, the sculptural elements appear to fuse to form the circum-polar ring.

Dimensions: Equatorial diameter 20-30 μm (10 specimens from Sample MFP 6459 measured). Distal ring 8-10 μm diameter, width of murus 2-3 μm .

Occurrence: In Andersons Creek bore hole, Beaconsfield; all samples down to and including Sample 6459 (fig. 2). Helby (pers. comm., 1976) has identified the form at Cranky Corner in New South Wales; at that locality it is present through the brachiopod zones *Trigonotreta campbelli*, *Martiniopsis elongata* and *M. konincki* (Runnegar and McClung, 1975).

Lophotriletes sp. cf. *scotinus* Segroves, 1970

Plate 1, fig. 4-6

cf. *Lophotriletes scotinus* Segroves 1970, p. 55, plate 4, fig. A-D

Remarks: This form is distinguished by a circular to rounded triangular amb, by laesurae extending almost to the equatorial margin, and by a predominantly distal ornament of spinose processes. The processes are bifurcate, consisting of a bulbous or conical base 2-4 μm diameter, surmounted by a short spine. The sculptural elements are usually absent from a zone 2-3 μm wide about the equator - whether this smooth area is a preservational artifact or not is uncertain; some specimens have a suggestion of differential equatorial thickening. The proximal face is either smooth, or bears a few low bulbous processes.

In *L. scotinus* Segroves, described from the Irwin River Coal Measures of the Perth Basin (Segroves, 1970), the processes are narrower at the base, although their bifurcated shape can be discerned from the published photographs; they are more sparsely distributed than in the Tasmanian form. There is also no suggestion of equatorial thickening. *Apiculatisporis* sp. 385 of Helby (1972) is conspecific with the form described here. Forms referred to *L. scotinus* by Rigby and Hekel (1977) have denser, more robust processes than either the Western Australian or the Tasmanian specimens.

Dimensions: Equatorial diameter 25-34 μm (13 specimens from Sample MFP 6456).

Occurrence: In Andersons Creek bore hole, Beaconsfield. Section above and including Sample 6458. In the Golden Valley bore hole, Helby (1972) recorded the form throughout most of the drilled sequence, down to a level low in the Quamby Mudstone. At Cranky Corner, *L. scotinus* occurs throughout the sequence, down into the Seaham Formation at the base (Helby, unpublished data).

Apiculatisporis cornutus (Balme & Hennelly) Segroves, 1970
Plate 1, fig. 7, 8, 13

1956 *Apiculatisporites cornutus* Balme & Hennelly, 1956, p.247, plate 2, fig. 24-26.

1970 *Apiculatisporis cornutus* (Balme & Hennelly) Segroves, 1970, p.58, plate 4, fig. G-I.

1975 *Apiculatisporis cornutus* (Balme & Hennelly) Hoeg & Bose, 1960, in Foster, p.130, plate 2, fig. 1, 2.

1977 *Apiculatisporis cornutus* (Balme & Hennelly) Segroves, 1970, in Rigby & Hekel, p.8, plate 2, fig. 14.

The nomenclatural history of the genus *Apiculatisporis*, and the implications for the validation of the combination *Apiculatisporis cornutus*, have been discussed by Rigby and Hekel (1977, p.8).

Remarks: The form-species is characterised by an ornament of broad-based processes which taper sharply to slender, pointed extremities. The processes are confined to the distal face and to the near-equatorial parts of the proximal face. The laesurae are slightly sinuous, approximately three-quarters of the spore radius in length, with variable lip development. The processes are somewhat variable, with basal diameters ranging from 1-4 μm , and heights of up to 4 μm . Some forms, such as that illustrated in Plate 1, Figure 13, possess much less robust processes than were originally described for *A. cornutus* (see Balme and Hennelly, 1956b, p.247).

Dimensions: Equatorial diameter 24-30 μm (10 specimens from MFP 6454).

Occurrence: Present throughout the sequence in Andersons Creek, Beaconsfield, down to and including Sample 6465 (see fig. 2). Also common in Sample MFP 6115, a tasmanite shale from Hellyer Gorge.

Diatomozonotriletes townrovii Segroves, 1970
Plate 1, fig. 9, 10

Diatomozonotriletes townrovii Segroves, 1970, p.54, plate 3, fig. E-G.

Remarks: The Tasmanian specimens appear to conform to *D. townrovii*, described originally from the Perth Basin of Western Australia (Segroves, 1970, p.54, plate 3, fig. D-G); similarity to the figured holotype is

particularly close. In his description, Segroves commented that the distal face was only rarely granulate; in all of the observed Tasmanian specimens that face was covered with sparsely scattered grana. In the interradial areas the elongate bacula reach 4 μm in length and are closely spaced to form an incipient corona.

Dimensions: Equatorial diameter 44-47 μm (3 specimens from Sample MFP 6454, Andersons Creek bore hole, Beaconsfield).

Occurrence: *D. townrovi* was observed only in one sample, MFP 6454. In the Perth Basin it is of restricted stratigraphic distribution, occurring in the Holmwood Shale and Fossil Cliff Formation (Segroves, 1970). At Cranky Corner, New South Wales, Helby (unpublished data) has observed *D. townrovi* through an interval corresponding to the top *T. campbelli* to *M. elongata* brachiopod zones.

'*Diatomozonotriletes*' sp.

Plate 1, fig. 23

Remarks: Only two specimens of this type were observed. It is distinguished by a granulate distal face, and by the presence of a few significantly larger grana or verrucae in equatorial interradial regions. The proximal face is smooth, with slightly sinuous laesurae extending to the grain apices. The grana of the distal face are closely spaced, straight-sided in profile. The larger interradial elements are irregular in outline, with maximum diameters of 2-4 μm . The grana at the distal pole also tend to be slightly larger, but not as large as those at the equator.

Attribution to *Diatomozonotriletes* is only provisional, as the interradial elements do not form a corona; P.L. Price (MS) has proposed a new form-genus to accommodate forms with an interradially modified granular ornament. The Tasmanian forms show some resemblance to *Diatomozonotriletes robustus* Foster, described from the Blair Athol Coal Measures (Foster, 1976, p.134, plate 3, fig. 5-7), but the large equatorial grana are more sparse and form a less regular row than they do in the Queensland form.

Dimensions: Equatorial diameter 38, 39 μm .

Occurrence: Sample MFP 6454 only; uppermost sample in Andersons Creek bore hole, Beaconsfield.

Horriditriletes ramosus (Balme & Hennelly) Bharadwaj & Salujha, 1964
Plate 1, fig. 11, 12

1956 *Acanthotriletes ramosus* Balme & Hennelly, p.249, plate 3, fig. 39-41.
1960 *Neoraistrickia ramosus* (Balme & Hennelly) Hart, p.3, plate 3, fig.39.
1964 *Horriditriletes ramosus* (Balme & Hennelly) Bharadwaj & Salujha, p.194, plate 2, fig. 43.
1977 *Raistrickia ramosa* (Balme & Hennelly) Rigby & Hekel, p.14, plate 3, fig. 2, 3, 5, 8, 9.

Remarks: Specimens identified with this form-species exhibit a range of morphological characters between types with few, broad based bacula (plate 1, fig. 12) to forms with more densely spaced, finer processes (plate 1, fig. 11). The more coarsely ornamented forms are closest to specimens originally figured by Balme and Hennelly (1956b, p.249, fig. 39-41). *Neoraistrickia* spp. 506 and 501 of Helby (1972, plate 1, fig. 12, 13) may encompass the same two morphological types. The range of ornament included here may encompass types included by other authors (e.g. Rigby and Hekel, 1977) within *H. curvibaculosus* Bharadwaj & Salujha, 1964.

Occurrence: As a rare form throughout the drilled section at Andersons Creek and at Sassafras and Hellyer Gorge.

Granulatisporites sp. cf. *miconodosus* Balme & Hennelly, 1956
Plate 1, fig. 15, 16

cf. *Granulatisporites miconodosus* Balme & Hennelly, 1956, p.245, plate 1, fig. 9, 10.

Remarks: Specimens included in this comparative category are distinctly rounded triangular, with a granulate distal face, a smooth proximal face and laesurae which incorporate high membranous lips. The distal sculptural elements are 0.8-1.0 μm in height and basal diameter, and are separated by smooth areas of exine 1.5-2.0 μm wide.

Granulatisporites miconodosus differs in that it has a rounded amb and a coarser distal sculpture, with the sculptural elements averaging 2.0 μm in basal diameter (Balme and Hennelly, 1956b, p.245, plate 1, fig. 9, 10). It seems that it may be stratigraphically useful to keep the Tasmanian forms distinct, as the original material from which *G. miconodosus* was described came from the Newcastle Coal Measures and is stratigraphically much younger. *Microbaculispora* sp. 280 of Helby (1972, plate 1, fig. 19, 20) is probably conspecific with the forms figures here, although the distal sculpture is slightly coarser. Forms assigned to *Microbaculispora tentula* have a finer, more densely distributed distal ornament (see plate 1, fig. 14).

Dimensions: Equatorial diameter 38-43 μm (based on 10 specimens from Sample MFP 6456).

Occurrence: Most common in the upper part of the drilled sequence at Andersons Creek and at Sassafras, although always a rare (less than 2%) species.

Verrucosisporites pseudoreticulatus Balme & Hennelly, 1956
Plate 1, fig. 17, 18, 20

Verrucosisporites pseudoreticulatus Balme & Hennelly, 1956, p.250, plate 4, fig. 42-44.

Remarks: This form can be recognised even in fragments by its sculpture of distinctive anastomosing verrucae. There does, however, appear to be considerable variation in morphology, which may have stratigraphic utility. Specimens examined from the cored part of the Masseys Creek Group at Andersons Creek were distinguished by a comprehensive sculpture of linked verrucae in which the elements of the distal face averaged 2.0 μm in diameter. Specimens from the Mersey Coal Measures at Sassafras, however, were characterised by a much coarser sculpture - the average diameter of distal elements in these specimens was close to 4.0 μm . At least some of those specimens showed a restriction of the verrucate sculpture to the distal face (see plate 1, fig. 17, 18). There was also a difference in size and wall thickness: the range of equatorial diameter of 20 specimens from Sample MFP 6456 at Andersons Creek was 46-60 μm (mean 52 μm); at Sassafras, Sample MFP 6340 gave a range of 47-79 μm for 20 specimens, with a mean diameter of 62 μm . In the first sample exine thickness was 2.0 μm on average; at Sassafras it was 3-4 μm . Whether these differences are consistent with age differences is uncertain until further localities have been tested.

Verrucosisporites sp. A

Plate 1, fig. 21, 22

Remarks: This form-species is distinguished by its rounded-triangular amb, by the extension of the laesurae to the spore apices and the enclosure of the commissures in high membranous lips. The sculptural elements are clearly present on both proximal and distal faces and consist predominantly of low domical verrucae 1-3 μm in basal diameter and 1-2 μm high; these show some diversity in shape and size, with the smaller elements having the dimensions of grana. The elements are discrete, separated by areas of smooth exine. There is some reduction in element size towards the laesurae (see plate 1, fig. 22), but the elements clearly persist up to the laesurate margins.

Dimensions: Maximum grain diameter 48-62 μm (6 specimens measured from sample MFP 6464, Andersons Creek bore hole, Beaconsfield).

Occurrence: In the present study the form was recorded only from the Beaconsfield section, as a rare component in Samples MFP 6464 and 6456. Helby (unpublished data) has noted it in the drilled section at Cranky Corner, New South Wales.

Verrucosisporites sp. B

Plate 1, fig. 19

Remarks: This spore is distinguished by its rounded amb and thin, frequently folded exine. The laesurae are rarely discernible, but are simple, straight apertures about three-quarters of the grain radius in length. The surface is comprehensively covered with irregularly shaped verrucae 2-4 μm in maximum diameter, domical in profile and up to 2 μm high. The verrucae are separated by narrow grooves about 1 μm wide; while they are irregularly polygonal in outline, they rarely join, so that the sculptural type is consistently verrucate rather than rugulate. The form shows some similarity to that which has been referred to informally as '*Rugulatisporites* sp. 22' by Evans (1964, plate 1, fig. 14) and as *Rugulatisporites residuus* sp. nov. by Price (MS), except that the laesurae are almost always indistinct in the Tasmanian forms, and the surface sculpture of those specimens could not be described as rugulate.

Verrucosisporites sp. 384 of Helby (1972, plate 1, fig. 25) is similar.

Dimensions: 43-56 μm (6 specimens from sample MFP 6456, Andersons Creek, Beaconsfield).

Occurrence: Observed as a rare form in the upper part of the drilled sequence at Andersons Creek; also in the upper part of the sequence at Golden Valley.

Disaccate pollen

Striatoabieites sp. A

Plate 2, fig. 1

Remarks: Assignment of this form is made with some hesitation as it might equally well be accommodated within *Vittatina* Luber ex Wilson; there is some confusion surrounding the development of sacchi in the type species, *V. subsaccata* Samoilovitch (see discussion in Wilson, 1962). The Tasmanian forms are clearly saccate, with a slight distal pendulance of the sacchi, so they have been assigned to *Striatoabieites* Zoricheva & Sedova ex Sedova.

Species A is haploxyloloid, and is further distinguished by a clear development of a thickened longitudinal costa on the distal face, somewhat in the manner of that in *Vittatina costabilis* Wilson, although that form lacks the small sacci.

Dimensions: Overall breadth 43-51 μm , corpus breadth 38-46 μm , corpus length 34-37 μm , saccus breadth 10-14 μm (4 specimens measured from Sample MFP 6456, Andersons Creek, Beaconsfield).

Occurrence: A rare form present in several samples from the upper part of the sequence at Andersons Creek, Beaconsfield. It also occurs at Scolyers Hill.

Striatoabieites sp. B

Plate 2, fig. 2

Remarks: This form-species differs from *Striatoabieites* sp. A in that it is usually slightly diploxyloloid, and possesses a short, simple monolete scar on the proximal face. The form bears some resemblance to *Vittatina* sp. of Segroves (1969, p.208, plate 12, fig. C-E) but the latter form has a trilete proximal scar.

Dimensions: Overall breadth 48-60 μm , corpus breadth 34-46 μm , corpus length 30-34 μm , saccus length 11-20 μm .

Occurrence: A rare form, with a similar distribution to *Striatoabieites* sp. A.

Illinites purus Leschik, 1956

Plate 2, fig. 3

Illinites purus Leschik, 1956, p.131, plate 21, fig. 6.

Remarks: Only a single specimen of this clearly trilete disaccate form was noted. It bears a distinct remembrance to the form recorded by Leschik (1956, plate 21, fig. 6) from the German Zechstein, in the relative widths of corpus and sacci, the equality of length of the rays of the trilete scar, and the grain size.

Dimensions: Overall breadth 58 μm , corpus breadth 35 μm , corpus length 40 μm , saccus length 15-17 μm .

Occurrence: Sample MFP 6458, Andersons Creek, Beaconsfield.

Vestigisporites sp.

Plate 2, fig. 6, 7

Remarks: Assignment of these forms to the genus *Vestigisporites* (Balme & Hennelly) Hart is not clear-cut, as there is continuous morphological gradation with specimens which could equally well be assigned to *Limitisporites* (Leschik) Potonié. The distinction applied by Hart (1965) is difficult to apply in practice, as the lateral extension of the sacci shows a variable degree of separation from the corpus. In some of the specimens observed in this study the saccus sexine was closely adpressed to the nexine of the corpus, in others the separation formed a lateral saccus extension up to 5 μm wide. All, however, are distinguished by a clearly developed monolete scar on the proximal face.

Dimensions: Overall breadth 50-93 μm , corpus breadth 32-49 μm , corpus length 28-48 μm . (6 specimens from Sample MFP 6464, Andersons Creek, Beaconsfield).

Occurrence: Present as a relatively common (up to 5%) component in all samples examined, except those assigned to Stage 1.

Jugasporites sp.
Plate 2, Fig. 8, 9

Remarks: These somewhat variable saccate forms have been assigned to *Jugasporites* Leschik, on the basis of their distinctly developed dilete proximal scar. The sacchi are relatively large and distally pendant, so that they overlap much of the corpus in compressed specimens; the lateral union of the sacchi is common, but a lateral saccus is not invariably developed. The most distinctive feature of the form is the long dilete scar which is two-thirds to five-sixths of the corpus breadth in length; a third ray, usually very short, is sometimes present. The excessive length of the dilete scar distinguishes the form from previously described species of *Jugasporites*; except for the shorter scar development, some of the specimens figured by Segroves (1969, plate 8) as *Limitisporites moersensis* (Grebe) Klaus are similar. The form figured by Helby (1972, plate 2, fig. 6) as ?*Jugasporites*, from the Golden Valley bore hole, probably falls within the morphological scope of this species.

Dimensions: Overall breadth 48-60 μm , corpus breadth 32-42 μm , corpus length 30-35 μm (6 specimens from Sample MFP 6464, Andersons Creek, Beaconsfield).

Occurrence: Common in most samples from the Andersons Creek bore hole, also in Golden Valley.

Monocolpate pollen

Cycadopites cymbatus (Balme & Hennelly) Hart, 1965
Plate 2, fig. 5

1956 *Entylissa cymbatus* Balme & Hennelly, p.63, plate 3, fig. 53-56.
1965 *Cycadopites cymbatus* (Balme & Hennelly) Hart, p.110.

Remarks: The grains examined were mostly pointed at their extremities, with a sulcus showing a keyhole-shaped expansion at the end. In rare specimens separation of exine layers was discernible, and the infrareticulate nature of the sexine was clearly evident. There may be some overlap of this form with Species 186 of Evans (1964), but the separation of exine layers, which Evans regarded as a diagnostic feature of Species 186, does appear, in the Tasmanian material, to be a feature showing variable development.

Dimensions: Grain length 48-59 μm , which 21-32 μm (10 specimens from Sample MFP 6454, Andersons Creek, Beaconsfield).

Occurrence: Common in the upper part of the sequence at Andersons Creek, i.e. down to and including Sample MFP 6459. Also present at Scolyers Hill and in the Mersey Coal Measure samples. A similar form was described by Helby (1972, plate 2, fig. 11, 12) as *Cycadopites* sp. 379, and was present in the Golden Valley bore hole down to the base of the sampled sequence.

?Pollen *incertae sedis*
Plate 2, fig. 4

Remarks: These indeterminate bodies are oval in outline, usually with one or two major folds in the wall. In optical section at the grain edge the wall structure shows a thick, apparently solid (or punctate?) outer layer, separated from a smooth, dark inner layer by a dense infrareticulum about 3-4 μm thick. The wall structure suggests a pollen grain of some kind, but no aperture could be discerned.

Dimensions: Maximum grain diameter 70-73 μm (3 specimens).

Occurrence: Only 3 specimens were recorded, from Samples MFP 6458 and 6456, Andersons Creek, Beaconsfield.

Acritarchs

Gorgonisphaeridium sp. A
Plate 3, fig. 1-6

Remarks: The vesicle of this form appears to have been spherical before compression, and excystment was by median splitting. The test is ornamented with short (2-4 μm long) processes which have square-profiled, truncate extremities; the extremities expand, or splay out into several short branches. The processes are sparsely scattered, and show alignment into irregular rows, giving a vaguely reticulate surface pattern (see plate 3, fig. 2). They are linked by, and appear to arise from, the junction of low muri. Small grana are scattered on the surface between the processes. The processes appear to be solid, and thus do not communicate with the vesicle interior. The vesicle wall is relatively thick (2-3 μm), hyaline, and shows a faint suggestion of stratification.

Assignment to *Gorgonisphaeridium* is made on the basis of the thick-walled vesicle, the excystment by splitting, and the cover of apparently solid processes. The presence of low muri connecting the processes suggests similarity to *Hapsidopalla* Playford, but the reticulum so formed appears to be imperfect and the processes are solid, so for the present the Tasmanian form is retained in *Gorgonisphaeridium*.

Dimensions: Vesicle diameter 34-40 μm (8 specimens measured from Sample MFP 6131, Scolyers Hill).

Occurrence: Common at Scolyers Hill, occurs more rarely in Samples MFP 6454 and 6464 in the Andersons Creek bore hole, Beaconsfield. Helby (unpublished data) has also noted this form in samples from the upper part of the *Martiniopsis elongata* Zone at Cranky Corner, New South Wales.

Gorgonisphaeridium sp. B
Plate 3, fig. 7, 8

Remarks: This form bears some basic resemblance to *Gorgonisphaeridium* sp. A, but has much smaller processes. The processes are wide-based, solid, dominantly conical, with basal diameters of 2.0 μm , and heights of 1.0-1.5 μm . Their arrangement is distinctly linear. There is no apparent communication between the processes and the vesicle interior. Excystment is by median splitting of the test.

Dimensions: Test diameter 44-48 μm (5 specimens from Sample MFP 6548, Andersons Creek, Beaconsfield).

Occurrence: Rare, observed in only one sample (MFP 6458, Andersons Creek).

Cymatiosphaera sp.
Plate 3, fig. 9-12

Remarks: This form is characterised by an originally spherical vesicle which frequently shows irregular rupturing, due either to compression or to excystment. The vesicle wall is externally divided into some 12-16 fields per hemisphere, separated by smooth, hyaline muri 2-4 μm high. The fields are irregularly polygonal, with maximum diameters ranging from 8-15 μm ; the muri are frequently sinuous. The floor of each field bears a number of minor projections which are clearly visible in scanning electron micrographs (see plate 3, fig. 11) and range in number from 1 to 10 per field; they are usually conical, and less than 1 μm high.

Dimensions: Vesicle diameter 40-52 μm (10 specimens measured from Sample MFP 6464, Andersons Creek bore hole, Beaconsfield).

Occurrence: Abundant in Sample MFP 6464, but present through much of the upper part of the sequence in the Andersons Creek bore hole. Also recorded from Scolyers Hill.

?*Acritarch incertae sedis*
Plate 3, fig. 13-15

Remarks: This form is tentatively classified here with the acritarchs but could equally be an alete type of plant spore. The microfossils appear to have been originally spherical; the outline is circular, with an undulating margin. There is no sign of an aperture. The wall is thick, up to 5 μm where thickness can be determined, and sculptured with a pattern of dense, convoluted, rugulo-verrucate muri. The muri are 2-3 μm wide, strongly arched in profile (see plate 3, fig. 15) and 2-3 μm high.

Dimensions: Overall diameter 70-94 μm (10 specimens measured from Sample MFP 6458, Andersons Creek, Beaconsfield).

Occurrence: Observed in one sample only, where it was common.

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PLATES 1-3

PLATE 1

Magnifications are at X 1000 unless otherwise indicated. Microscope co-ordinates are those of the Leitz Ortholux No. 742105 in the Bureau of Mineral Resources, Canberra.

- Figures 1-3. ?Rattiganispora sp.
1. Proximal aspect, MFP6454/2; 99.0, 46.2.
2. Proximal aspect, MFP6454/2; 105.0, 46.3.
3. Distal aspect, MFP6459/2; 104.5, 47.0.
- Figures 4-6. Lophotriletes sp. cf. scotinus Segroves, 1970.
4. Median focus, MFP6456/2; 98.7, 31.7.
5. Distal aspect, MFP6455/1; 92.8, 38.9.
6. Distal aspect, MFP6457/1; 101.3, 43.3.
- Figures 7, 8, 13. Apiculatisporis cornutus (Balme & Hennelly) Segroves, 1970.
7. Distal focus, MFP6454/2; 108.0, 41.4.
8. Same specimen, proximal focus.
13. Median focus, MFP6454/1; 108.0, 41.8.
- Figures 9-10. Diatomozonotriletes townrovii Segroves, 1970.
9. Distal and equatorial focus, MFP6454/2; 99.0, 34.8.
10. Same specimen, proximal and equatorial focus.
- Figures 11-12. Horriditriletes ramosus (Balme & Hennelly) Bharadwaj & Salujha, 1964.
11. MFP6458/2; 105.4, 29.3.
12. MFP6458/2; 99.5, 37.7.
- Figure 14. Microbaculispora tentula Tiwari, 1965.
Lateral compression MFP6454/2; 105.6, 44.6.
- Figures 15-16. Granulatisporites sp. cf. micronodosus Balme & Hennelly, 1956.
15. Median focus, MFP6456/1; 108.0, 32.5.
16. Same specimen, distal focus.
- Figures 17, 18, 20. Verrucosisporites pseudoreticulatus Balme & Hennelly, 1956.
17-18. Coarsely sculptured form, proximal and distal foci, MFP6340/2; 95.4, 38.5.
20. MFP6340. Proximal focus.
- Figure 19. Verrucosisporites sp. B.
MFP6457/1; 100.8, 35.0.
- Figures 21-22. Verrucosisporites sp. A.
21. MFP6464/1; 91.8, 38.7. X 600.
22. Same specimen, proximal focus, X 1000.
- Figure 23. 'Diatomozonotriletes' sp.
MFP6454/1; 93.8, 45.1.

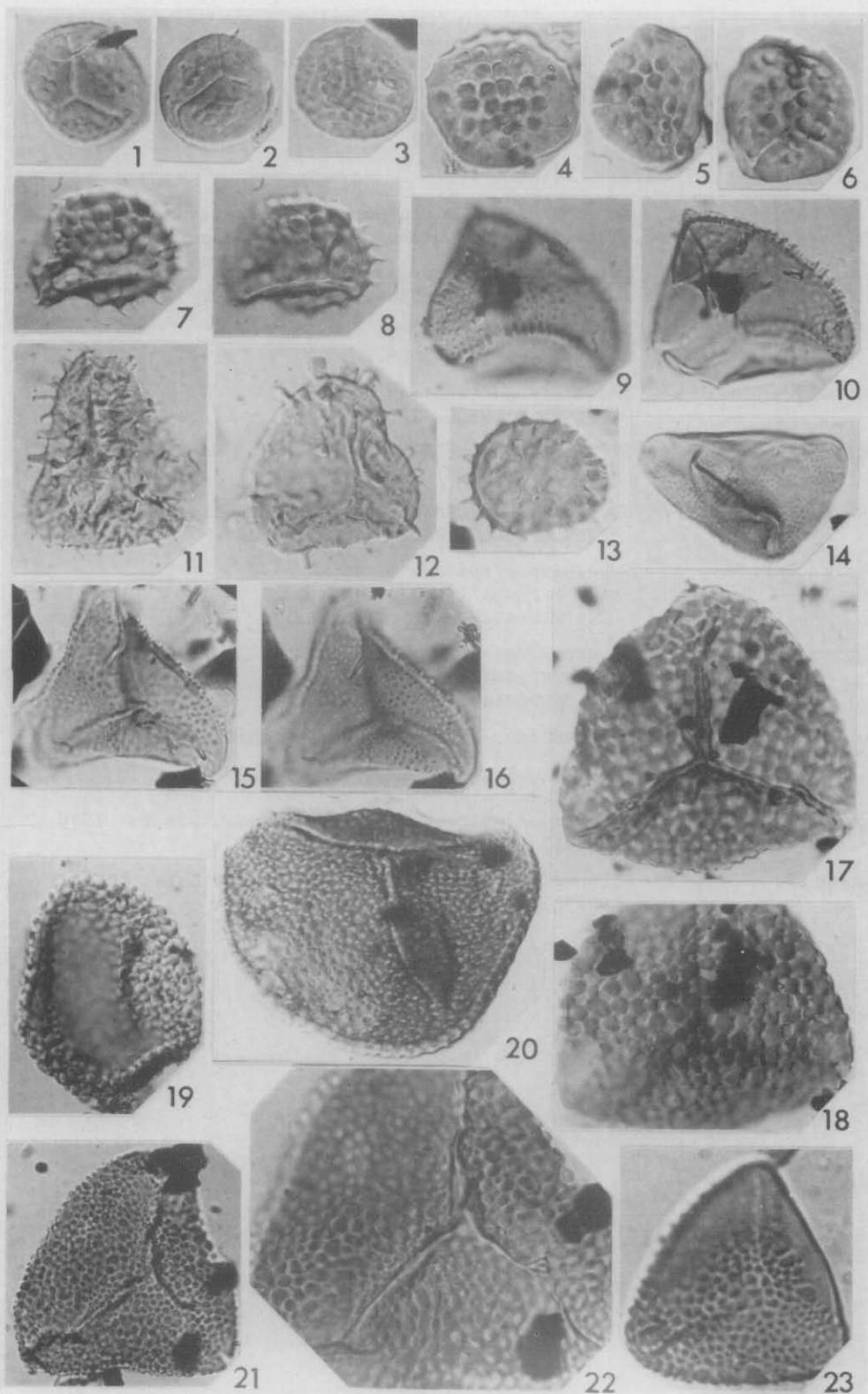


Plate 1. *Photomicrographs of trilete spores.*



PLATE 2

Magnifications are at X 1000. Microscope co-ordinates are those of the Leitz Ortholux No. 742105 in the Bureau of Mineral Resources, Canberra.

- Figure 1. *Striatoabieites* sp. A.
Distal focus. MFP6456/1; 92.0, 29.9.
- Figure 2. *Striatoabieites* sp. B.
MFP6464/1; 106.7, 29.2.
- Figure 3. *Illinites purus* Leschik, 1956.
MFP6458/2; 95.6, 27.2.
- Figure 4. ?*Pollen incertae sedis*.
MFP6458/1; 96.5, 39.3.
- Figure 5. *Cycadopites cymbatus* (Balme & Hennelly) Hart, 1965.
MFP6454/100.0, 36.2.
- Figures 6-7. *Vestigisporites* sp.
6. MFP6455/1; 107.8, 45.0.
7. MFP6464/2; 108.5, 35.5.
- Figures 8-9. *Jugasporites* sp.
8. MFP6464/1; 109.4, 34.5.
9. MFP6464/1; 97.0, 31.4.
- Figure 10. *Parasaccites* sp. cf. *Virkkipollenites mehtae* Lele, 1964.
MFP6457/2; 98.0, 32.8.
- Figure 11. *Plicatipollenites* sp. cf. *densus* Srivastava, 1970.
MFP6457/1; 101.4, 41.2.
- Figure 12. *Potonieisporites neglectus* Potonié & Lele, 1961.
MFP6465/1; 98.8, 44.4.

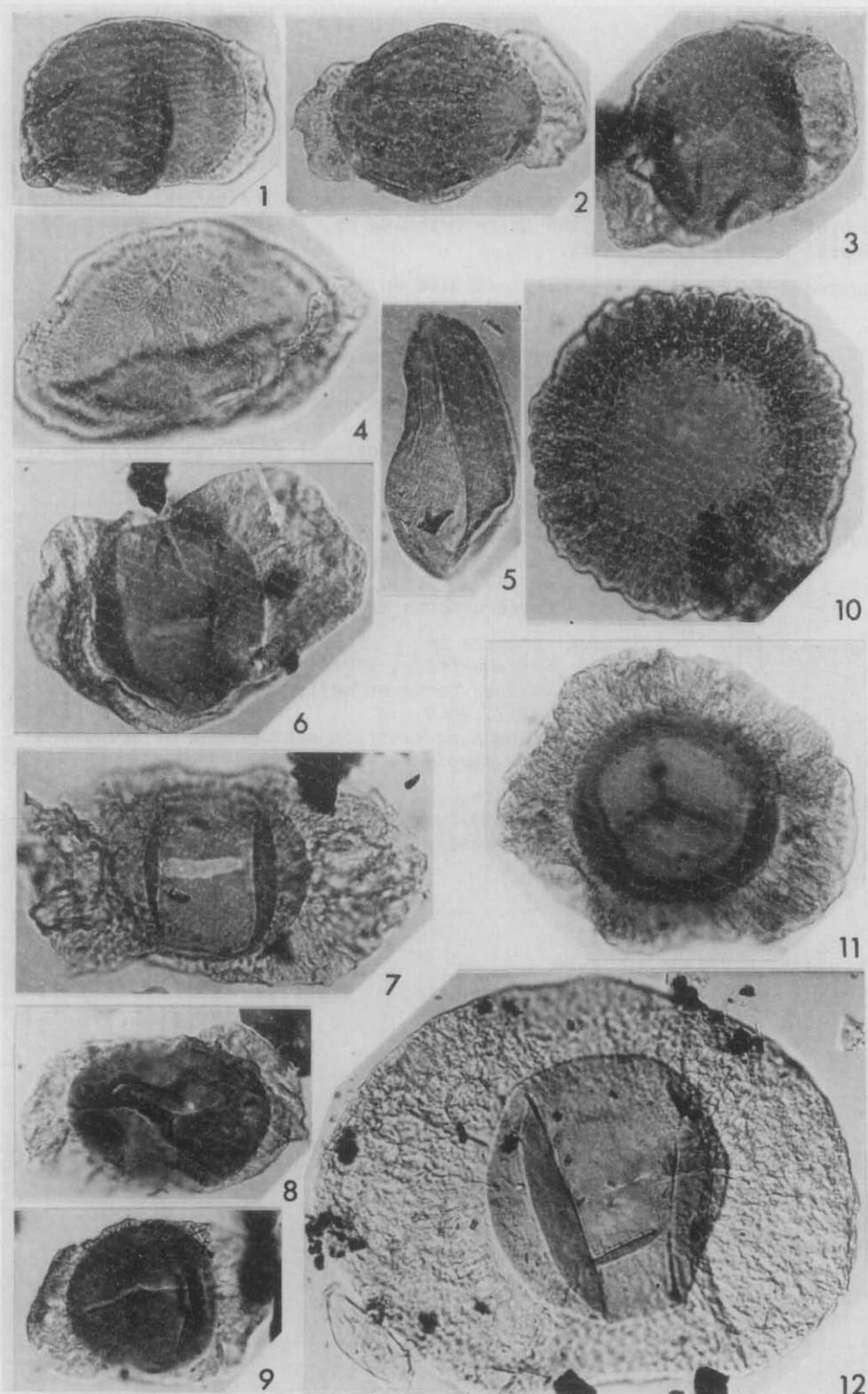


Plate 2. *Photomicrographs of saccate and monocolpate pollen.*

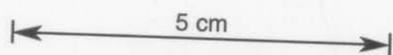


PLATE 3

Magnifications are at X 1000 unless otherwise indicated. Microscope co-ordinates are those of the Leitz Ortholux No. 742105 in the Bureau of Mineral Resources, Canberra.

Figures 1-6.

Gorgonisphaeridium sp. A.

1. Median focus on split specimen. MFP6454/1; 93.5, 32.8.
2. Surface focus on same specimen, showing linear arrangement of processes.
3. Specimen in sectional focus, MFP6131/2; 93.6, 34.7.
- 4-5. Surface and sectional foci, MFP6131/4; 98.4, 30.3.
6. MFP6131/1.

Figures 7-8.

Gorgonisphaeridium sp. B.

7. Surface focus on split specimen. MFP6458/1; 107.5, 38.2.
8. Surface focus MFP6458/1; 98.7, 37.6.

Figures 9-12

Cymatiosphaera sp.

9. Surface focus, MFP6464/1; 102.6, 41.4.
10. Surface focus on split specimen, MFP6464/1; 108.7, 40.9.
- 11-12. Scanning electron micrographs of specimens from sample 6464. X 800.

Figures 13-15

?*Acritarch incertae sedis*.

13. MFP6458/2; 108.0, 39.8. X 600.
- 14-15. MFP6458/2; 92.4, 30.1.

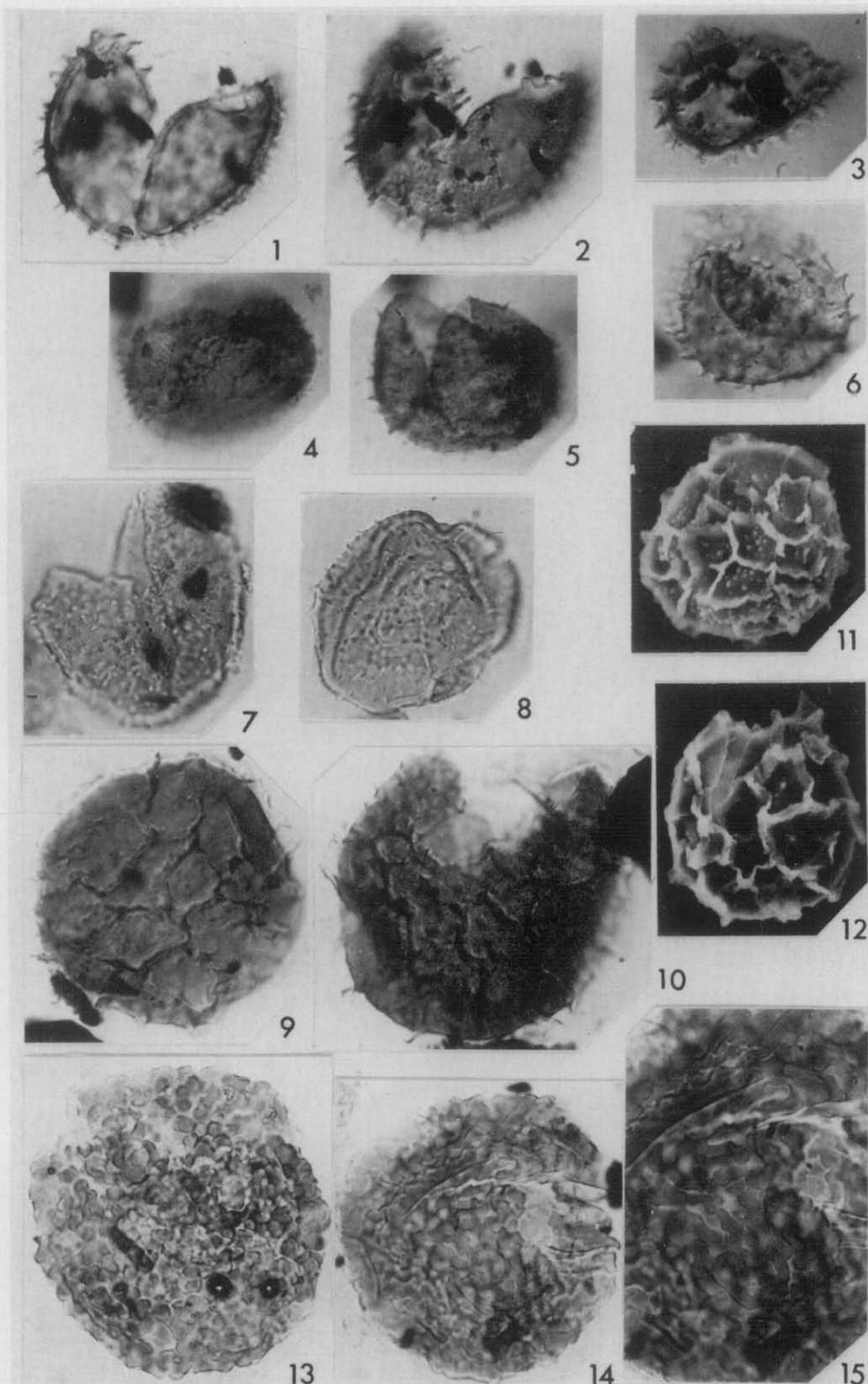


Plate 3. *Photomicrographs of acritarchs.*

