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LOWER PERMIAN MICROFLORAS FROM THE CROWN POINT FORMATION, FINKE AREA, NORTHERN TERRITORY

by

P.R. Evans

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SUMMARY

Well preserved Lower Permian microfloras have been extracted from samples of the fluvio-glacial Crown Point Formation from three waterbores, G53/6-113, G53/6-120 (Easter Bore, and G53/6-143 in the Finke area of the Northern Territory. These fossil assemblages are of probable Sakmarian age, and are correlatable with Unit Plb of the subsurface fluvio-glacial sequence in central Queensland, i.e. younger than outcrops of the Joe Joe Formation, but comparable with the Boonderoo Beds near Hughenden. The Crown Point Formation in the Finke area was therefore deposited towards the end of the Australian Upper Palaeozoic glacial phase. The Crown Point Formation contains several pollen species common to the Indian Talchir Stage of the Lower Gondwana System. The main constituents of the Crown Point microflora are briefly described and illustrated and certain taxonomic problems raised by these forms are discussed. The practicability of separating the genus Parasaccites Bharadwaj from Virkkipollenites Lele and Plicatipollenites Lele is questioned.

INTRODUCTION

The Finke 1:250,000 Sheet area lies between latitudes 25°00'S and 26°00'S and longitudes 133°50'E and 135°00'E on the southern border of the Northern Territory, where the westerly margin of the Great Artesian Basin (Eromanga Basin) laps the eastern end of the Palaeozoic Amadeus Basin (text figure 1). The geology of the Finke area and its relationship to the Amadeus Basin were described by Wells et al. (1964), who recognized the following succession below widespread thin veneers of Quaternary and Tertiary deposits.

MESOZOIC	Rumbalara Shale	± 900 feet
	De Souza Sandstone	± 300 feet
	unconformity	
?PERMIAN	Crown Point Formation	150-200 feet
	unconformity	
PALAEOZOIC UNDIFF.	Finke Group	± 2540 feet
	unconformity	
ORDOVICIAN	Larapinta Group	± 1400 feet
	unconformity	
PRECAMBRIAN UNDIFF.		9000+ feet

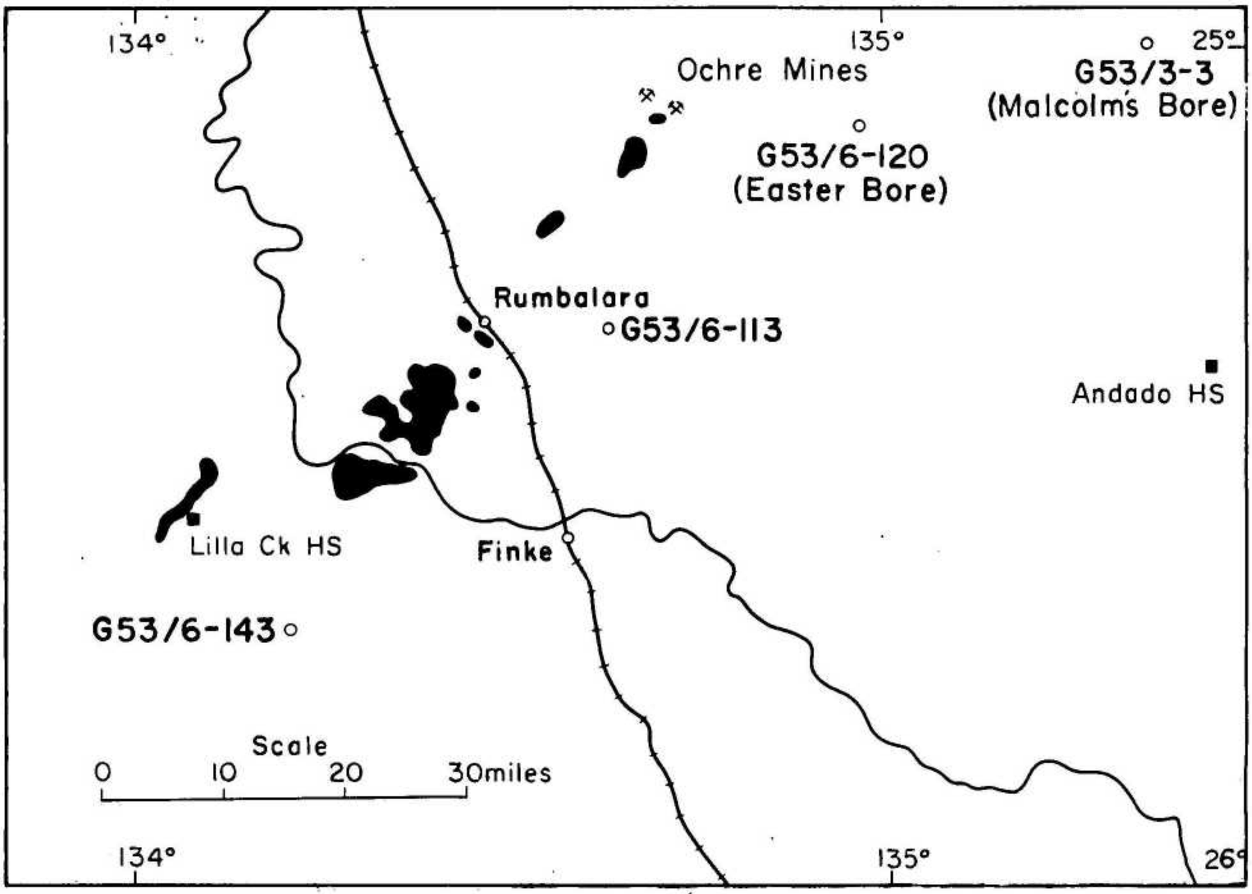

Figure 1— Locations of outcrops of Permian Crown Point Formation (blackened areas) and water bores from which palynomorphs have been obtained in the Finke and Hale River 1:250,000 sheet areas, N.T.

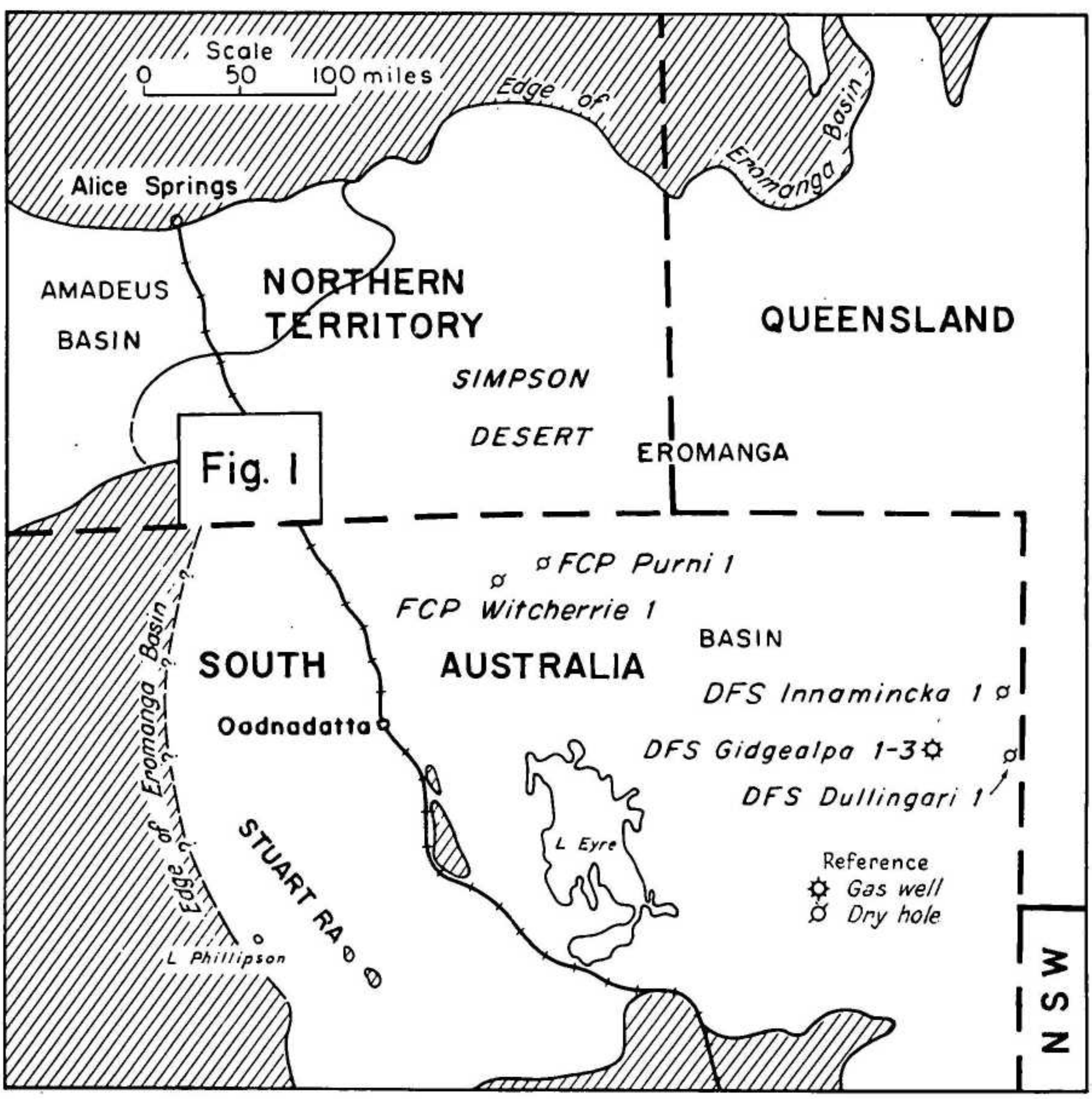

Figure 2 — Locations of Permian deposits below the Western Eromanga Basin.

The Crown Point Formation, outcropping in the central and north-eastern parts of the Sheet area, consists of poorly sorted sandstone, boulder beds, tillite, and interbedded siltstone and claystone, with striated and facetted erratics and large slump structures. Wells et al. provisionally ascribed the formation to the Permian because Balme . . (Appendix A) recorded Artinskian spores from sediments thought to be similar to the Crown Point Formation in Malcolm's Bore on Andado Station, on the Hale River Sheet area, about 40 miles east of the Rumbalara ochre mine.

An opportunity to confirm the age of the Crown Point Formation was provided by the B.M.R. Resident Geologists at Alice Springs who forwarded for palynological study samples of three water bores from the Finke area, G53/6-113, G53/6-120 (Easter Bore), and G53/6-143, which has been drilled through the Mesozoic into the Crown Point Formation to the east of its outcrops. (The G53/6 refers to the index numbers of the 1:250,000 Sheet, and the following number is that given to the water bore by the Resident Geologist.) These samples have been found to contain well preserved Lower Permian spores, pollens and ?algae forming assemblages similar to one associated with glacial deposits in central Queensland (Evans, 1964c). The pollens in particular exhibit close relationships to other "Gondwanaland" microfloras. They provide an opportunity to discuss the morphology and taxonomy of some of these widely distributed types.

OBSERVATIONS

Lithological logs of bores G53/6-113 and G53/6-120, prepared by I.P. Youles, Resident Geologist, Alice Springs, are as follows:-

G53/6-113

Military Grid: 249800E 1846300N

4 - 174'	De Souza Sandstone
14 - 34'	Light brown and white, fine grained, micaceous sandstone. Majority of quartz grains subangular to sub-rounded and clear, a few are ferruginised. Probably the De Souza Sandstone.
34 - 69'	Off white, clayey, micaceous, fine grained sandstone.
69 - 136'	Light brown, fine to coarse grained sandstone. Most of the grains are clear quartz, a few are ferruginised.

136 - 174'	Light brown, slightly clayey, fine to medium grained sandstone.
174 - 295'	<u>Crown Point Formation</u>
174 - 186'	Salmon coloured, clayey, coarse sand and cuttings of fine grained, white sandstone with many minute specks of ?hematite.
186 - 216'	Deep salmon coloured, medium sandy clay - the majority of sand grains are clear.
216 - 243'	Brown yellow, fine clayey sand.
243 - 273'	Salmon coloured. fine sandy clay.
173- 285'	Yellow, brown and mauve clays with a few sandsize quartz grains.
285 - 323'	Mainly dark grey and khaki clay.
323 - 352'	Beige, fine sandy clay.
352 - 358'	Chocolate coloured, silty, coarse sand. Cuttings consist of clear quartz grains in strongly ferruginous matrix.
358 - 365'	Brown, slightly silty sand, with cuttings as per 352' and with some pale brown sandy clay.
365 - 378'	Mottled yellow, dark grey, dark mauve and khaki sandy clay. One cutting of dark green laminated micaceous siltstone.
378 - 395' (TD)	Blue-grey fine sandy clay.

<u>G53/6-120 (Easter Bore)</u>

Military Grid: 279000E 1870000N

0 - 217'	<u>Recent & De Souza Sandstone</u>
Surface	Red-brown fine silty sand.
4 - 25'	Very light brown, calcareous, silty sand with many cuttings of white and pink silicified, fine grained sandstone.
100'	Beige, silty sand with cuttings of medium grained, possibly kaolinitic sandstone and pebbles of quartzite.
216'	Very kaolinitic conglomerate; some of the pebbles appearing to be dreikanters.
217 - 522'	<u>Crown Point Formation</u>
230'	Mainly maroon, a little yellow, brown and grey sandy clay.
320'	Light grey and grey green, sandy micaceous shale.
400'	Dark grey, very sandy, micaceous clay.

430' Light and medium grey, sandy, micaceous shale.

453' Grey, sandy, micaceous shale with many cuttings from boulders.

519 - 522' Grey-green, micaceous, slightly silty, medium sand with cuttings from pebbles and many nodules of quartz grains cemented by pyrite.

G53/6-143

Military Grid: 207100E 1801300N

9 - 562' Crown Point Formation

9 - 26' Pink, medium grained, gritty, silty calcareous sand.

26 - 89' Pink, medium grained, very silty, slightly kaolinitic sand with cuttings of white micaceous siltstone.

89 - 158' White, medium to coarse grained, kaolinitic sandstone with a few pebbles.

158 - 187' Pinkish white, medium to fine grained, kaolinitic sandstone.

187 - 200' Pale yellow-brown, medium to fine grained, very silty, slightly kaolinitic sandstone.

200 - 243' Yellowish brown, medium grained slightly kaolinitic sandy silt.

243 - 284' Very pale brown, medium grained, slightly kaolinitic, very silty sandstone.

Note 9-284' Sand grains range from well rounded to subangular.

284 - 298' Mainly brown, some grey and a little red, pebbly silt.

298 - 312' Light brownish grey and grey pebbly silt. The pebbles are of quartz and metamorphic rocks.

312 - 430' Grey, pebbly siltstone with cuttings of laminated siltstone or claystone.

430 - 470' Greyish yellow, coarse pebbly clay with cuttings of soft sandy claystone.

The interval 470 - 562' is probably similar to 430 - 470'.

562 - 600' Horseshoe Bend Shale (?Devonian, part of Finke Group).

562 - 600' Chocolate brown biotitic siltstone.

Samples of ditch cuttings from the following depths in these bores have been examined:

BORE	DEPTH (feet)	SAMPLE NO. (MFP) (+)
G53/6-113	285-323	3087
	378-395	3088
G53/6-120	320	3240
(Easter Bore)	400	3277
	430	3278
	519-523	3279
G53/6-143	312	3346
	330	3347
	390	3348
	430	3349

They were all fossiliferous, although the abundance of specimens varied, and no distinctions of stratigraphic significance were apparent between them. The forms recognized included:

Spores

Punctatisporites gretensis Balme & Hennelly (sp.5) (*)

Punctatisporites sp. 7

+ MFP: prefix to palynological collection numbers.

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* Form species described or noted in this paper are allocated a number in the B.M.R. palynological type collection, whether or not they have been previously described and named. This avoids possible confusion through the multiple use of particular numbers in differing genera where the formal nomenclature of the types has not yet been cleared.

Retusotriletes diversiformis (B. & H.) (sp.6)
Calamospora sp. 58
cf. Granulatisporites sp. 59
Lophotriletes sp. 183
Apiculatisporis sp. 61
cf. Neoraistrickia sp. 184
Rugulatisporites sp. 22
Cingulati sp. 185

Pollens
Parasaccites sp. 190 (very common)
Parasaccites sp. 191
Potonieisporites neglectus Potonié & Lele
Vestigisporites sp. 193
aff. Protohaploxypinus goraiensis Pot.& Lele (sp. 187)
Protohaploxypinus sp. 198
Striatoabietites sp. 188
Monocolpate sp. 186

?Algae
Leiosphaerids undiff. (fairly common)
Quadrisporites sp.
aff. Botyrococcus.

The most profuse assemblage occurred in MFP3088, which was consequently used for most of the morphographic studies outlined below, although features of specimens in MFP3087 and MFP3277 are also included.

AGE OF THE CROWN POINT FORMATION

The fluvio-glacial character of the Crown Point Formation links this unit with glacigenes ascribed to the Permian, which are scattered widely throughout central Australia (Sprigg, 1963, summarized the relevant literature).

Such deposits in the Lake Phillipson Bore, South Australia, are part of a sequence which Balme (1957) thought ranged from ?Carboniferous to early Artinskian in age. Ludbrook (1961b) logged sections in the Lake Phillipson Bore and in other in the Stuart Range area, separating them into several lithological units; she discovered foraminifera towards the top of the Sakmarian glacigene sequence. Samples from G53/3-3 (Malcolm's Bore), Andado Station, were considered by Balme (Appendix A) to be early Artinskian in age. Rochow (1964) reported that Balme's samples were taken from a sandstone overlying typical Crown Point Formation. The implication that the Crown Point Formation in the Finke area is pre-Artinskian is confirmed by the fact that the Malcolm's Bore section contained, among others, Apiculatisporis cornutus, Verrucosisporites pseudoreticulatus, and Marsupipollenites triradiatus which are not recorded in the Crown Point Formation and which first appear in the central Queensland sequence at a later time than unit Plb with which the Crown Point assemblage is correlated (see below).

Palynological studies have been undertaken at various times on sections below the more central regions of the Eromanga Basin, in FCP(A) Witcherrie No.1 (Magnier, 1964a), FCP(A)-DS Purni No.1 (Magnier, 1964b), DFS Innamincka No.1 (Balme in Ludbrook, 1961a), DS Dullingari No.1 (Evans and Balme in Harrison & Greer, 1963), and DS Orientos No.1 (de Jersey in Harrison et al., 1963). Although probable glacigenes occur in these wells, fossil microfloras were obtained only from the overlying Permian deposits.

The Crown Point Formation assemblage compares closely with ones documented from the glacial series in central Queensland, to the west of the Springsure Shelf, below the north-eastern margin of the Eromanga Basin (Evans, 1964c). The Crown Point Formation assemblage, because of its content of abundant Parasaccites spp. 190 and 191, the presence of cf. Granulatisporites sp. 59, Apiculatisporis sp. 61, Rugulatisporites sp. 22, and a variety of striate disaccate pollens, compares closely with that of Unit Plb of the central Queensland sections. This unit occurs within a fluvio-glacial series of beds in ODNL Maranda No.1 which are younger than outcrops of the Joe Joe Formation, but of roughly comparable age to the Boonderoo Beds near Hughenden (Vine et al., 1964; Evans, 1964a). Although an informal nomenclature is employed to avoid the inevitable but invalid sense of mondial correlation implied by the use of the Russian stage nomenclature, it may be reasoned that Unit Plb is approximately of Sakmarian age.

It therefore appears that the Crown Point Formation was deposited towards the end of Australia's Permo-Carboniferous glacial phase.

From an extra-Australian viewpoint, a remarkable feature of the Crown Point Formation microflora is the close similarity of its pollen component with that of the Indian Talchir Stage of the Lower Gondwana System (Potonié & Lele, 1961; Lele 1964). Disregarding for the moment problems of taxonomy, specifically comparable forms of Parasaccites, Potonieisporites, and Protohaploxypinus occur in these units, emphasizing the singularity of floral province at that time of deposition. Apart from the universally distributed elements

Punctatisporites gretensis Balme & Hennelly and Retusotriletes diversiformis, spores common to both India and Australia in Talchir Stage (=Plb) times are not recognizable. Potonié & Lele (1961) recorded a variety of Apiculatisporis, Lophotriletes, Granulatisporites and Cyclogranisporites from the Talchirs, but none of them appears to be exactly similar to the Australian members of these genera. This contrast in the distribution of pollens and spores between Australia and India seems to persist throughout the Permian (Evans, 1964b).

The significance of the ?algae is obscure. Abundant leiosphaerids are characteristic of Lower Permian assemblages in the Fitzroy-Canning Basin (Grant and Patterson Formations) of Western Australia and in the Murray Basin, New South Wales. Swarms of these organisms were associated with rare hystrichospherid acritarchs and abundant foraminifera at Oaklands (Crespin, 1943; Evans, 1962) and in AOG Jerilderie No.1 (Terpstra, 1963; Evans and Terpstra in Wright & Stuntz, 1963) and might indicate the existence of brackish or marine environments of deposition in that area. On the other hand, swarms so abundant that spores and pollens were extremely rare occurred in AOG Wentworth No.1 in association with varve-like sediments, recalling the seasonal swarms of diatomaceous algae often found in true (freshwater) varves. The problem is complicated further by the complete absence of such leiosphaerids from the Queensland glacigenes, even from varve-like deposits. Perhaps where the leiosphaerids occur in only moderate numbers, such as in the Crown Point Formation, mixed with a larger proportion of pollens and spores, they have been washed in from their locus of growth and cannot be used as an indication of age or environment of deposition.

DISCUSSION OF MICROFLORA

A. Spores

Genus Punctatisporites (Ibr.) Pot. & Kr.

Punctatisporites gretensis Balme & Hennelly 1956 (sp. 5)

Only one specimen which could be referred to P. gretensis was found. It differs from P. gretensis only in its size, 66 µ, which is somewhat smaller than the 70(118)154 u measured by Balme & Hennelly.

Punctatisporites sp. 7.
Plate 1, figure. 1[+]

[+] Registered numbers of the specimens figured in this paper are included in the plate captions. These numbers consist of the sample number; slide number: stage co-ordinates reduced to a reference point marked on the slide in a modified manner to that suggested by Traverse (1958).

Spores with sub-circular outline in polar view, trilete , smooth exine. Diameter of figured specimen 49 µ. All specimens viewed are flattened, but they rarely display body folding indicative of an originally spherical shape. It is therefore presumed that the species is oblate in equatorial view. The Y-mark is usually indistinct, consisting of a simple suture, the rays of which are straight and sometimes almost reach the equatorial margin, although they usually cannot be detected beyond the ½-radius of the grain. No lips or thickenings border the suture. The exine at the equator is about 1-2 µ thick. It is psilate overall, possibly varying slightly and irregularly in thickness as indicated by its typical patchy coloration. In contrast to other members of this assemblage, the species is characteristically not readily stained, and even under low power magnifications, is easily recognized by its brown colour in red-stained preparations.

Genus Retusotriletes Naumova.

Retusotriletes diversiformis (Balme & Hennelly 1956) (sp. 6).

Plate 1, figure 3.

Trilete, psilate spore, outline circular in polar view, Y-mark usually an opened suture with rays extending about half the spore radius. Exine 1-1.5 µ thick, psilate. Curvaturae around the contact areas are apparent. A light-coloured area extending along a 1-2 µ band either side of each suture on closed specimens suggests that the exine thins towards the sutures. Darker inter-radial zones, which frequently take in much more stain than the remainder of the exine, emphasize this characteristic.

These specimens compare closely with Calamospora diversiformis Balme & Hennelly, which Bharadwaj (1962) transferred to Retusotriletes Naumova 1953 because of its curcaturae.

Genus Calamospora Schopf Wilson & Benthall.

Calamospora sp. 58
Plate 1, figure 2

Trilete, psilate, circular spore. Specimens of Calamospora sp. 58 are found in a crumpled state indicative of an original inflated, probably spherical shape, and its relatively thin (1 µ or less) exine. The diameter of the figured specimen is 52 µ. The Y-mark of this species is inconspicuous and its rays cover about ½ - 2/3 radius of the spore. Specimens are not compressed in any preferred direction and so the Y-mark may be found in any position in the field of view. These features indicate the species' affinities with Calamospora Schopf, Wilson & Benthall 1944.

Genus Granulatisporites Pot. & Kr.

cf. Granulatisporites sp. 59

Plate 1, figures 5-7.

Trilete, granulate spore. Outline in polar view triangular with straight inter-radial margins and sharply rounded apices. The diameters of specimens illustrated in Plate 1, figures 5 and 6 are 40 µ and 30 µ respectively. In equatorial view the proximal part of the spore forms a low pyramid, while the distal part is deep and its outline suggestive of an arrow head, thus indicating that the original spore shape was similar to two tetrahedra of unequal heights, but backing onto each other across a common face. The strength of this shape prevents complete flattening of the spores along the polar axis, and specimens are frequently found compressed to display the equatorial view. The Y-mark extends to the apices. The suture is flanked by tenous lips which are of maximum height at the pole and rapidly taper towards the apices. The proximal face is psilate, the distal face granulate. The granules are less than 1 µ high, their bases similar to or less than the height of the granules, closely, but irregularly spaced, and becoming lower near the equator. The development of this ornament is variable, and hardly perceptible on some specimens.

Balme & Hennelly (1956) ascribed both psilate and faintly granulate, trilete, triangular spores to Leiotriletes directus. They placed more strongly granulate types in Granulatisporites micronodosus. The specimens included in cf. Granulatisporites sp. 59 might therefore be separated between L. directus and G. micronodosus. However, the diagnosis of Leiotriletes (Naumova 1937) Potonié Kremp 1954 includes infrapunctate and intrareticulate spores. Bharadwaj (1962) considered the genus to have psilate structureless exine. Although not mentioned in the generic diagnosis of Granulatisporites Pot. & Kr. 1954, its genotype G. granulatus (Ibrahim 1933) Pot. & Kr. 1954 is granulate on the proximal face. The ornament is reduced or absent on the proximal face of G. micronodosus B. & H. so that this species, and sp. 59 is provisionally referred to that genus pending further examination of the problem.

Genus Apiculatisporis Pot. & Kr.

Apiculatisporis sp. 61.
Plate 1, figure 8.

Trilete, acanthins spore, outline rounded in polar view, unobserved in equatorial view. Processes are irregularly space on both the proximal and distal faces, consisting of low rapidly tapering spines, with basal diameters about 2 µ and height 2 - 3 µ. The Y-mark is thin, extending almost to the equator.

Genus Lophotriletes Pot. & Kr.
Lophotriletes sp. 183.

Trilete, apiculate spore, triangular with broadly rounded apices and straight slightly concave inter-radial margins. Y-mark thin, extending almost to apices, with no lips developed. Exine of uniform thickness, about 1 µ, ornamented with widely and irregularly spaced processes of varying shapes: granulate to conical and baculate.

Spores of this type were not recorded by Balme & Hennelly. Bharadwaj recorded similar types (1962, Pl.1,fig. 18) as cf. Lophotriletes sp., pointing out that they differed from the generic diagosis in that the processes on the Indian specimens were baculate, not conical as specified for Lophotriletes. However, species figured and included by Potonié & Kremp (1955) in Lophotriletes, such as the genotype L. gibbesus (Ibr.) Pot. & Kr. and L. pseudaculeatus Pot. & Kr. seem to display equally varied processes as Lophotriletes sp.

Genus Neoraistrickia Pot.
cf. Neoraistrickia sp. 184.
Plate 1, figures 10, 11.

Trilete, acanthine spore. Outline in equatorial view (figure 10) triangular, with fairly sharply rounded apices, inter-radial margins straight or slightly concave. In lateral view the proximal part if pyramidal, about equal in height to the rounded distal part. The Y-mark is straight, extending to the apices. Thin lips, about 3 µ high bound the full length of the sutures (figure 11). The exine is about 2 - 3 µ thick, ornamented with strong, blunted baculae, up to 4 u in height, particularly in the region of the equator. Smaller processes, tending to be large granules are interspersed among the larger baculae and are developed sporadically on the proximal face.

Acanthotriletes ramosus Balme & Hennelly 1956 is the only described Australian Permian form which might resemble sp. 184, but it is more convex and often has bifurcate processes.

A. ramosus was placed in Neoraistrickia Potonié 1956 by Hart (1960) and Horriditriletes by Bharadwaj & Salujha (1964). Sp.184 does not have the isolate well developed baculae of nor the rounded triangular outline like the genotype N. trancatus (Cookson 1953). However, in common with N. truncatus, it posses membranous lips and a reduced ornament on the proximal face (cf. Dettmann, 1963). The circumscription of Horriditriletes could include Neoraistrickia, but none of the figures illustrating Horriditriletes suggest development of lips. Sp. 184 is therefore provisionally referred to Neoraistrickia.

Genus Rugulatisporites Pflug & Thompson

Rugulatisporites sp. 22.
Plate 1, figure 15.

Only one fragmentary spore is shown here. Perfectly preserved specimens of this rare type have not been found. However, as its characteristic ornament is identical to types common in the Joe Joe Formation in Queensland, the fragment is figured here. It appears to be a crushed specimen of a trilete verrucate spore, diameter approximately 65 µ. The equatorial outline was circular, the body shape possibly spherical. The Y-mark is thin and long, the rays become lines of fracture on compression. The exine between verrucae is less than 1 µ thick. The verrucae are irregular and interlocking in plan view, leaving grooves about 1 µ between them Their bases are 2 - 4 µ wide, but they have a relatively uniform height of about 1.5 µ.

Infraturma Cingulati Pot. & Klaus.
Cingulati sp. 185.
Plate 1, figures 13, 14.

Trilete, apiculate spore developing a small equatorial cingulem. Diameters of the figured specimens are 28 u and 30 µ respectively. The outline in polar view is sub-rounded to semi-angular, the shape in equatorial view is unknown. The Y-mark is straight and thin, almost reaching to the equator, with no lips. The exine is thin on both proximal and distal surfaces, but thickens to a narrow cingulum, 2 - 3 u wide, at the equator. Both proximal and distal faces and the cingulum develop irregularly spaced and loosely packed, low cones and verrucae.

No genus which will satisfactorily accommodate this species is known to the author, but it may be allocated to the suprageneric category infraturma Cingulati (Potonié & Klaus 1954) Potonié 1956.

B. Pollens

Genus Parasaccites Bharadwaj

Monosaccate pollens are generally abundant in the samples examined, a feature common to all Gondwanaland Lower Permian deposits. Much has been written in recent years about such forms, particularly those with a circular outline, but the complexities and variations of structure apparent within the group do not yet seem to be fully understood and their taxonomy remains inadequately based. Lele (1964) has usefully started a detailed study of aspects of the problem. However, attempts to follow Lele's approach and to determine the Australian forms in terms of his genera led to the belief that, if the Australian and Indian fossils are as similar as it would first appear, certain structural features of the Australian forms necessitate modification of Lele's generic diagnoses. As this paper is not intended to convey formal generic diagnoses or emendations thereof, the problem is discussed below solely to demenstrate the nomenclature thought to be most fitting for the Australian fossils. The problem cannot be resolved until the Indian material is examined in the light of the following observations.

Illustrated specimens critical to the discussion are described below

Plate 4, figures 34, 36.

Monosaccate pollens with circular outlines and thin walled central bodies, covered by a microrugulate membrane. The body membranes possess "infold systems" such as considered by Lele (1964) to be characteristic of Plicatipollenites. P. indicus Lele 1964 would readily accommodate these specimens.

Plate 5, figures 39, 40, 42, 43.

Large specimens with firmer bodies. The membranes across the central bodies are not so microrugulate, but where folded the membranes crossing the central bodies are visible, particularly under oil immersion (figs. 40, 43).

Plate 6, figures 44, 47.

Bodies completely detached from the sac, but with particles of a thin membrane adhering to it.

Plate 4, figure 38, and text figure 3a.

Body detached from the sac, not folded, with a thin membrane plastered to the central parts of the upper surface. A ragged edge to this membrane is visible where it becomes detached from the psilate body below.

Plate 4, figure 37.

A pollen similar to those illustrated in figures 34 and 36, but which does not contain a folded inner body. Thin membranes completely cross the proximal and distal central areas.

Plate 6, figures 45, 46.

Complete specimens without inner central bodies. The proximal and distal membranes tend to form wrinkles adjacent to the sac. These specimens could be assigned to Virkkipollenites Lele 1964.

Plate 6, figure 48.

A specimen tending to avoid in outline with elongate folds subparallel to the major axis.

Plate 4, figure 35.

A folded specimen showing the outer membrane joining the sac and extending across the body.

Plate 7, figure 49.

Body ovoid, the sac encroaches onto the central membrane.

Plate 7, figure 50.

A complete specimen differing from the preceding forms in that its oval outline is caused by a relatively narrower sac parallel to the short axis. The central area remains circular. The membranes tend to thicken towards the centre.

Plate 7, figure 51.

A very large specimen with no central body. The membranes thicken about the central axis. Concentric folding of the membranes has taken place immediately around the edge of the thickening, rather than at the contact of membrane and sac.

Large monosaccate pollens similar to those described above have been recorded from most "Gondwanaland" Upper Palaeozoic deposits. Potonié & Klaus (1954) tentatively allocated such forms as were described, for example, by Virkki (1939, 1946) and Dulhunty (1945) to their new genus Nuskoisporites, a classification which was accepted with reservations by subsequent authors, e.g. Balme & Hennelly (1956b), until the matter was critically reviewed by Lele (1964). Hart (1963), however, referred Balme & Hennelly's types of Nuskoisporites, N. gondwanensis and N. rotatus to Cordaitina Samoilovich 1953, although he did not go into the matter in detail. Pant & Mehra (1963) did not consider it necessary to distinguish Nuskoisporites from Endosporites Wilson & Coe to which they accordingly assigned N. gondwanensis. Lele compared Indian Talchir Stage types with diplotypes of the German Triassic Nuskoisporites supplied by Hilda Grebe, distinguished the "Gondwanaland" forms from Nuskoisporites because of differing modes of sac attachment, and erected the genera Plicatipollenites and Virkkipollenites to contain them. Bharadwaj & Salujha (1964), in a paper immediately preceding Lele (1964) also diagnosed the genera Parasaccites and Barakarites for closely related forms.

Lele considered the salient features of his genera to be:

Plicatipollenites - "Distal zone of sac attachment associated with a well developed ± regular body infold system; trilete mark ± vestigial".

Virkkipollenites - "Distal zone of sac attachment not associated with body infold system; trilete mark ± vestigial".

Lele did not compare his genera with Parasaccites or Barakarites, although he mentioned the latter briefly on p. 166. The description and figures of Virkkipollenites and Parasaccites indicate that these genera are closely related, the main point of distinction being in the position of the distal sac attachment. However, this seems to be a difficult matter to assess as Lele considered specimens figured by Høeg & Bose (1960, Pl.33, figures 1 & 3) as Nuskoisporites rotatus B.& H. were related to Virkkipollenites obscurus Lele, while Bharadwaj & Salujha allocated the same specimens to Parasaccites korbaensis B. & S. Likewise, specimens figured by Hart (1960, Pl.2, figure 31, Plate 3, figure 32) as Nuskoisporites gondwanensis were placed by Lele into Virkkipollenites mehtae

Lele and _V. obscurus_ Lele respectively, while Bharadwaj & Salujha allocated them to _Parasaccites korbaensis_.

An annular, equatorially sited sac, which does not encroach onto the polar regions of the body, is indicated by Lele and Bharadwaj & Salujha as common to _Parasaccites_, _Plicatipollenites_, and _Virkkipollenites_. Whereas the intrareticulum of the Australian specimens listed above are similarly confined, the presence of a connecting membrane across the proximal and distal surfaces, where a central body is present, a membrane apparently similar in structure to that clearly visible when the central body is absent, warrants reconsideration of the basic structures of the Indian forms. The Finke area specimens are interpreted as composed of two, possibly three layers of exine: an intexine which forms the central body; an ektexine which, across the proximal and distal faces at least, is thin and microreticulate, microrugulate or microgranulate. Where the ektexine is detached from the inner body in an annular equatorial region, the sac is developed. The sac between the detached layers is at least partially filled with the intrareticulum which could be regarded as a mesexinous layer. Such an exine structure is basically similar to that of younger, recognizably gymnospermous saccate pollens. (If this interpretation is correct, it is advisable to reverse the orientation used by Lele and regard the Y-mark, which is developed in both the intexine and ektexine, as being located on the distal face, in the manner of a gymnospermous colpus).

It is demonstrated above that in otherwise similarly constructed specimens considerable variation can take place in the wall thickness of the central body (intexine). Where present, infolding of this body takes place as depicted by Lele for _Plicatipollenites_. When the central body is absent, the outer micro-ornamented membrane remains, as in _Virkkipollenites_. A similar lack of an intexinal body is noted in specimens of aff. _Protohaploxypinus goraiensis_ (sp. 187) and _Protohaploxypinus_ sp. 189 (pp.). When the central body is absent, plications of the thin ektexine may or may not take place on compression. The position of any plications seems to depend greatly on the shape of the more rigid annulus of the surrounding sac or polar zone of thickening. The ektexine commonly buckles in a series of arcuate folds under the inner edge of the sac. Further relief takes place across the centre of the grain: if the outline tends to be ovoid, the folds usually parallel the major elliptical axis.

If the ektexine is observable on the Indian Plicatipollenites, and, if, as it appears from Lele's photographs, the equatorial limit of the 'body' in Virkkipollenites is in fact a compression effect on an outer membrane, the separation of Plicatipollenites from Virkkipollenites does not seem justified.

For similar reasons, it is suspected that the specimens of Parasaccites figured by Bharadwaj & Salujha lack a strong etexinal body. These figures also show that the actual zone of sac attachment is as irregular as in the Finke specimens and in ones illustrated by Lele as Virkkipollenites. It would thus seems that the separation of Parasaccites and Virkkipollenites is not justified.

The relation of Parasaccites etc. to Cordaitina is uncertain. Samoilovich considered that the body of Cordaitina is completely enclosed in the sac. Photographs and drawings support this contention in that an infrareticulum appears to spread right across at least one face of the body. Hart's inculsion (1963a) of Nuskoisporites gondwanensis, a species clearly related to the Indian forms, in Cordaitina is therefore not accepted and the latter genus is separated from Parasaccites, Virkkipollenites and Plicatipollenites.

The inter-relationship of features common to Parasaccites, Virkkipollenites and Plicatipollenites demonstrated by the Finke area material implies that it is inadvisable to maintain these three genera and that they should be combined under the first published name, Parasaccites, the genus to which the forms described above are referred in consequence.

The presence of an ektexinal membrane surrounding an intexinal central body brings Parasaccites close to Nuskoisporites. Lele's comments and interpretation of Nuskoisporites suggest that the outer sac is only in contact with the body on the proximal surface, while figures by Potonié & Klaus, Grebe and Lele show that the intrareticulum extends close to the Y-mark, there being only a small zone of attachment. These characters are accepted here as significant distinctions between Nuskoisporites and Parasaccites.

The preceding discussion necessitates a revision of the diagnosis of Parasaccites, but it should be postponed until Indian specimens have been examined in the light of this thesis.

Parasaccites sp. 190

Plates 4-7, figures 34-51

The specimens noted above are included in one form species, which may be described as follows.

Monosaccate pollen, outline circular, sub-circular, or ovoid in polar view. The central body (intexine) is roughly circular, diameter about 1/2 to 1/3 the overall diameter of the pollen. The thickness of the body wall is variable, often apparently absent. In median view the body was probably originally inflated in a plano-convex shape. Compression has subsequently flattened the convex (proximal) face to produce a series of arcuate annular folds. When the central body is very thin or absent, compression induces annular folds at the roots of the sac. A trilete aperture occurs on the distal face, its rays are from ½ to 1 x the body radius. The sac (ektexine) is concentrically disposed about the median zone of the body. Its proximal and distal roots connect with a thin, microreticulate, microrugulate, or microgranulate membrane (ektexine) which covers the entire proximal and distal faces. The sac infrareticulum tends to be thicker away from the body and to be radially disposed in polar view. Variation in overal outline are due to irregular sac thickness, not to deviation in the central body.

Parasaccites sp. 191

Plate 8, figures 52-59

A monosaccate, circular outlined pollen with a Y-mark. The body diameter to total diameter ratio is about 2:3, lower than that of Parasaccites sp. 190. The outline in polar view is usally crenulate because of strong radial plications in the sac. The central body membrane varies in thickness in a manner similar to sp. 190, but infold systems are rarely developed, perhaps because of the extra rigidity afforded by the annulus of ribbed sac and the relatively smaller body size. The outline also varies from circular to ovoid. MFP3088.2.197.165 (figure 54) is very similar to Virkkipollenites mehtae Lele 1964. Figures 53, 55, 56, and 58 show specimens with denser bodies; figures 56 and 58 show how the sac is attached around annular rings. These specimens could be referred to V. densus Lele 1964. Figure 57 shows a specimen with a body membrane of varying thickness, and figure 59 a specimen without an intexine, and with an oval outline.

Genus Potonieisporites Bhardwaj.

Potonieisporites neglectus Pot. & Lele 1961

Plate 9, figure 61

The figured specimen is ovoid, 163-120 µ, monosaccate, with a roughly circular body, and a monolete mark. The body possesses an infold system similar to that in Parasaccites sp. 190, and the sac encloses the body as far as the fold. The body wall is thin, apparently overlain by a thin membrane in the same manner as in Parasaccites, the infold system consists of two distinct sets of arcuate folds.

The similarity of structure of this specimen with that of Parasaccites sp. 190 is very close; the two forms differ only in the monolete mark, oval outline, and arcuate infolds of the former. The figures specimen agrees closely with Potonieisporites neglectus Pot. & Lele. Potonié & Lele (1961) noted the existence of a transition between Parasaccites (al. Nuskoisporites) types and Potonieisporites. Similar transitions are apparent in the Finke area specimens, and more rigid designations of these taxonomically difficult monosaccate pollen genera are urgently required. Bharadwaj (1964) announced his intention to revise the genus Potonieisporites and so further comment on the matter is not offered at this stage.

Genus Vestigisporites Balme & Hennelly em. Hart.

Vestigisporites sp. 193

Plate 9, figure 61

The figured specimen of a monosaccate, monolete pollen is 158 x 120 µ overall with a body l-a of 64 µ and a t-a of 38 µ. The body membrane (intexine) is 2µ thick at the equator, brown in colour, and covered with an outer thin membrane (ektexine) which becomes the sac when detached from the body. The zone of detachment is marginal on the proximal face, annularly round a zone on the distal face. The sac is distinctly ovoid, reduced in thickness along the body sides where it becomes decidly crimped. The sac is finely intra-reticulate.

This type differs from Parasaccites and Potonieisporites in its diploxylonoid outline, although its mode of sac attachment and exine composition are similar to those of these genera. Vestigisporites Balme & Hennelly em. Hart 1960 will accept sp. 193. Together with Potonieisporites and

Parasaccites, the limits of variation and the constant parameters of this genus need to be further refined. Such action is not possible on present data.

Genus Striatoabietites Sedova em. Hart

Striatoabietites sp. 188

Plate 3, figure 30

Only one specimen of Striatoabietites sp. 188 was found, although it is common in certain Lower Permian horizons in Queensland. The specimen figured has a sub-rectangular body outline in polar view with terminally attached, slightly diploxylonoid sacs which are about the same width as the body, t-a, 50 μ. The sacs leave a wide distal zone. The proximal surface is ornmented with thirteen intrapunctate striae. The overall l-a is 97 μ.

Genus Protohaploxypinus Samoilovich em. Hart

aff. Protohaploxypinus goraiensis (Potonie & Lele 1961 (sp.187)

Plate 2, figures 19-25; Plate 3,, figures 26-29.

A large saccate striate pollen, common to all the samples examined, and particularly abundant in MFP3088. The body outline, as seen in figure 24, is circular in polar view, unknown in lateral view, but possibly trapezoid as evidenced by the position of sac development in figures 21 and 23. The body membrane is possibly not developed in many specimens. Seven or eight ektexinous intramicroreticulate striae occur on the proximal face running parallel to each other and to the long axis of the grain, but they taper terminally and intertongue. The proximal sac roots are arcuate, following the body membrane section. Their positions are usually emphasized by the effects of compression on individual grains. The distal sac roots are slightly convex, straight or slightly concave either side of a relatively narrow distal zone, which may be up to a third of the body diameter in width, but is frequently less. The sacs extend around the lateral margins in the 'monosaccate' condition, although in polar view the species is distinctly haploxylonoid. In lateral view a thin membrane connects the roots of the sacs across the distal zone. The sacs are intrareticulate, the size of lumina within them decreases from the outer extremities towards the roots. Sometimes the thin membrane between the roots is absent, forming a sulcus equal in width to the distal zone. A thin zone, which usually splits to form a sulcus, runs parallel to the grain's longitudinal axis in the middle of the proximal face. The shape of this thin zone depends on the pattern of the striae, occasionally forming an irregular Y-mark (figures 22, 28).

The dimensions of the species averaged from 20 specimens are: l-a 108 (118) 126 μ, t-a 69 (86) 92 μ.

Abnormal growth may have been responsible for the specimens illustrated in figures 27 and 29. The former proximal thin zone, rather like taeniae in Lueckisporites and Taeniaesporites. One cas in figure 29 has grown out along two axes at angles to the average direction of the striae, giving a roughly trisaccate appearance to the grain. Comparable developments in presumed disaccate striate pollens grains were illustrated by Bharadwaj under Striapollenites and Distriatites (1963, Pl. 21, figures 276-278, 283, 284). Both genera were regarded by Hart (1963b) as "monstrosities".

The size, outline, sac to body relationship, and number of striae exhibited by these specimens agree with the characters diagnosed by Potonié & Lele (1961) for Lunatisporites goraiensis, which Hart (1963b) subsequently allocated to the genus, Protohaploxypinus Samoilovich 1953 em. Hart 1963. The Australian specimens differ from P. goraiensis in the occasional discontinuous and intertonguing striae and the general display of a thin zone along the central axis of the proximal face. Neither character is included in the descriptions of P. goraiensis by either Potonié & Lele or Hart. However, both features seem to be possessed by the specimens ascribed to goraiensis by Potonié & Lele (Plate 3, figure 72). Although possession of a proximal thin zone is not mentioned in his emended diagnosis of Protohaploxypinus, Hart incorporates into this genus P. (al. Lunatisporites) globesus (Hart 1960), which prominently exhibits such a feature. Potonié & Lele record that the outline of the body is often not clear in specimens of P. (al. Lunatisporites) goraiensis. A similar apparent lack of a specific intexinal body membrane suggests that this membrane was either not developed in the majority of grains, or that it was destroyed during processing. The complete absence of a body membrane in these specimens seems to preclude the latter possibility. Similar conditions seem to prevail in Parasaccites sp.190 and Parasaccites sp.191 and might be a typical development of these early Permian coniferal pollens. If, as supposed, the body membrane (intexine) is absent, these specimens illustrate the connection between the membrane forming the sacs and the proximal striae (ektexine). The striae may be regarded as an ornamented development of the ektexine, as in present day gymnosperms, with lateral connections to the sacs (where the inflated ektexine is separated from the intexine), rather than as part of the isolate 'proximal cap' depicted in Hart's (1960, 1963b) idealizations of the striate saccate pollen structures.

Protohaploxypinus sp. 189

Plate 3, figures 31-33

Saccate striate pollen. The outline in polar view is haploxylonoid, ovoid or sub-rectangular, occasionally slightly diploxylonoid. The grains are kidney shaped in lateral view, The body outline is sub-circular in polar view, l-a slightly longer than t-a. In transerve view the body is trapezoid (figure 31), but the body membrane (intexine) is generally thin and not always visible, sometimes absent. The proximal ektexinous membrane is ornamented with 6-8 striae, microreticulate thickenings of the membrane which run sub-parallel to the long axis and taper at their extremities. Occasional striae do not cross the body diameter. Narrow thin area separate the striae, forming lines of weakness. It is usual to see two or more ridges running across the body, formed by compression folds along some of the interstriate zones. They are often the first indication that a grain is striate when viewed under low mafnigication. The terminal tapering of the striae introduces a bi-convex effect among the interstriate folds. The sacs are terminally attached on the proxiial face around arcuate zones at the ends of the striae. The distal sac roots are close to a narrow distal zone which varies from a slit to an area about one third the body radius in width. The sacs extend tojust touch in a narrow band around the lateral margins of the body. They contain strong intrareticuli with relatively smaller luminae close to the distal roots. A narrow sulcus is occasionally visible in the distal zone.

Dimensions, measured from 17 specimens:
l-a 54 (63) 77 µ, t-a 36 (45) 58 µ.

Balme & Hennelly (1955) figured Australian striate bisaccate specimens as Lueckisporites limpidus which are similar to Protohaploxypinus sp. 189 in size, body shape, and the arcuate nature of the striae. They record that in some grains the sacs in L. limpidus surround the body equator as occasionally happens in P. sp. 189. However, P. sp. 189 differs from L. limpidus by being generally more haploxylonoid, having a weaker body membrane (intexine) and having a smaller l-a/t-a ratio. No other published species known to the author and referable to Protohaploxypinus resembles P. sp. 189.

Monocolpate sp. 186

Plate 1, figures 15-18

Monocolpate pollens characterized by an intramicroreticulate outer membrane and an inner psilate membrane are relatively common in all the samples examined. They show great varietions in form of outline from obese ovoid (figure 15) with rounded apices to elongate ovoid with pointed apices (figure 18). This parameter seems to depend, however, on the mode of compression suffered by individuals and it cannot be readily employed to distinguish form-species.

Figure 15, a latero-distal view of a specimen flattened in a postero-distal direction. The two exine layers are visible.

Figures 16-18; specimens progressively rotated so that the colpus lies to the right side of each image. On compression, the distal faces of grains lying in such a position seem to be turned inwards, thus accentuating the apical points.

No previously described monocolpate genus which could include sp. 186 is known to the author. Balme & Hennelly (1956a) ascribed certain Australian monocolpate pollens to the genera Marsupipollenites B. & H. and Entylissa (Naumova 1937) Potonié & Kremp 1955. Potonié (1958) considered Entylissa to be homonymous with Ginkgocycadophytus Samoilovich 1953. Bharadwaj (1962) figured some Indian Permian monocolpate forms under Vittatina Luber, and ascribed Marsupipollenites scutatus B. & H. and M. fasciolatus B.&.H. to that genus. Bharadwaj's interpretation of these species is doubted, however, as there appears to be some confusion over the nature of Vittatina; Hart (1963b) regards that genus as one of the Striatiti Pant. Bharadwaj left M. triradiatus B.& H., the genotype, in Marsupipollenites and removed M. sinuosus to the polyplicate Gnetaceaepollenites Thiergart 1938. He thought that the exine of M. sinuosus was smooth, while his figured but unnamed Gnetaceaepollenites is intrapunctate.

Monocolpate sp. 186 does not possess the Y-mark characteristic of Marsupipollenites, and its double layered exine distinguishes it from Ginkgocycadophytus. Although its ektexine intramicroreticulate or intrapunctate, it lacks the fold system of Gnetaceaepollenites. It lacks the striae typical of Vittatina.

C. ?Algae

Quadrisporites sp.

Plate 1, figure 4

Four thin walled grains lying in one plane and compressed together around an axis at right angles to the plane, with a brown, thicker zone of fusion between each grain . and a tendency to leave an aperture in the centre of the tetrad. All the specimens observed are psilate.

Tetrads of fused grains with echinate membranes from the basal Narrabeen Group of the Sydney Basin were described by Hennelly (1958) as Quadrisporites horridus. Potonié & Lele (1961) described similar forms from the Talchir Stage (Upper Carboniferous or Lower Permian) of India. Similar forms with varying amounts of apiculate ornamentation also occur in early Permian beds in central Queensland. Psilate forms have been found in the Lower Permian of the Murray Basin. The specimen illustrated in figure 4 and others in the Finke area samples have similar structures to Q. horridus, but lack apiculate exines. They are therefore referred to as Quadrisporites sp.

Hennelly and Potonié & Lele regarded Quadrisporites as a tetrad of monolete spores. However, it is felt more likely that Quadrisporites is an algal body, possibly somewhat like Protococcus rather than the reproductive agent of a vascular plant.

APPENDIX A

PALYNOLOGICAL REPORT NO. 47

by

B.E. Balme (5.8.59)

Sprigg (1963) referred to a palynological examination by B.E. Balme, University of Western Australia, of a sample from G53/3-3 (Malcolm's Bore) in the Hale River Sheet area, on Andado Station. With Mr. Balme's permission his report is reproduced here as it has not been previously printed in a widely distributed format.

"Sample GDP607 Malcolm's Bore (15 m. N of Andado No.1). Andado Station (via Finke, N.T.) Depth 330-603 ft.

"Lithology - Coal fragments (quartz-garnet, sand pebbles, pyrite, woody lignite).

"This sample yielded a magnificently preserved and diverse assemblage. The following forms occur -

- Leitriletes directus
- Granulatisporites micronodosus
- Granulatisporites sp.
- Acanthotriletes tereteangulatus
- Apiculatisporites cornutus
- Verruscosisporites pseudoreticulatus
- Cirratriradites splendens
- Laevigatosporites vulgaris
- Lueckisporites spp.
- Lunatisporites spp.
- Nuskoisporites gondwanensis
- Vittatina sp.
- Marsupipollenites triradiatus

"This microflora is of Lower Pemian (Artinskian) age. It corresponds closely with assemblages from the lower part of the Nooncanbah Formation in the Fitzroy Basin of Western Australia."

Balme (pers. comm.) has recently commented that, "... it was very like the sort of assemblage one finds in the upper part of the Grant Formation in the Canning Basin, and no doubt it could be as old as late Sakmarian."

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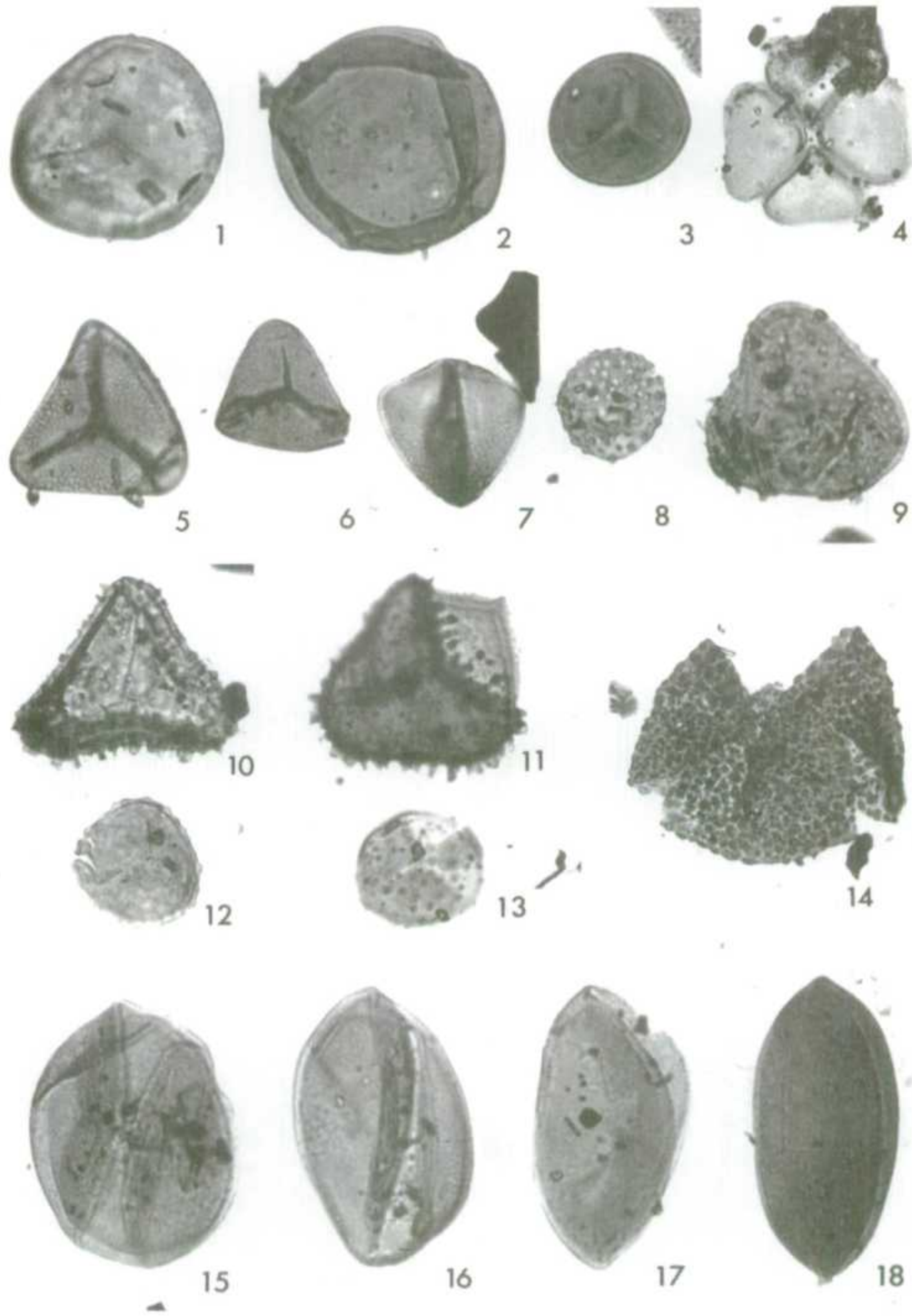
PLATE 1



All magnifications 600x

Punctatisporites sp.7
Fig.1, MFP3087.1.136.143.

Calamospora sp.58
Fig.2, MFP3088.2.236.145.

Retusotriletes diversiformis (B.& H. 1956)(sp.6)
Fig.3, MFP3088.2.108.033.

Quadrisporites sp.
Fig.4, MFP3088.2.194.957.

cf. Granulatisporites sp.59
Fig.5, MFP3088.2.150.085.
Fig.6, MFP3088.2.170.186.
Fig.7, MFP3087.1.083.097.

Apiculatisporis sp.61
Fig.8, MFP3088.2.100.139.

Lophotriletes sp.183
Fig. 9, MFP3088.2.136.082.

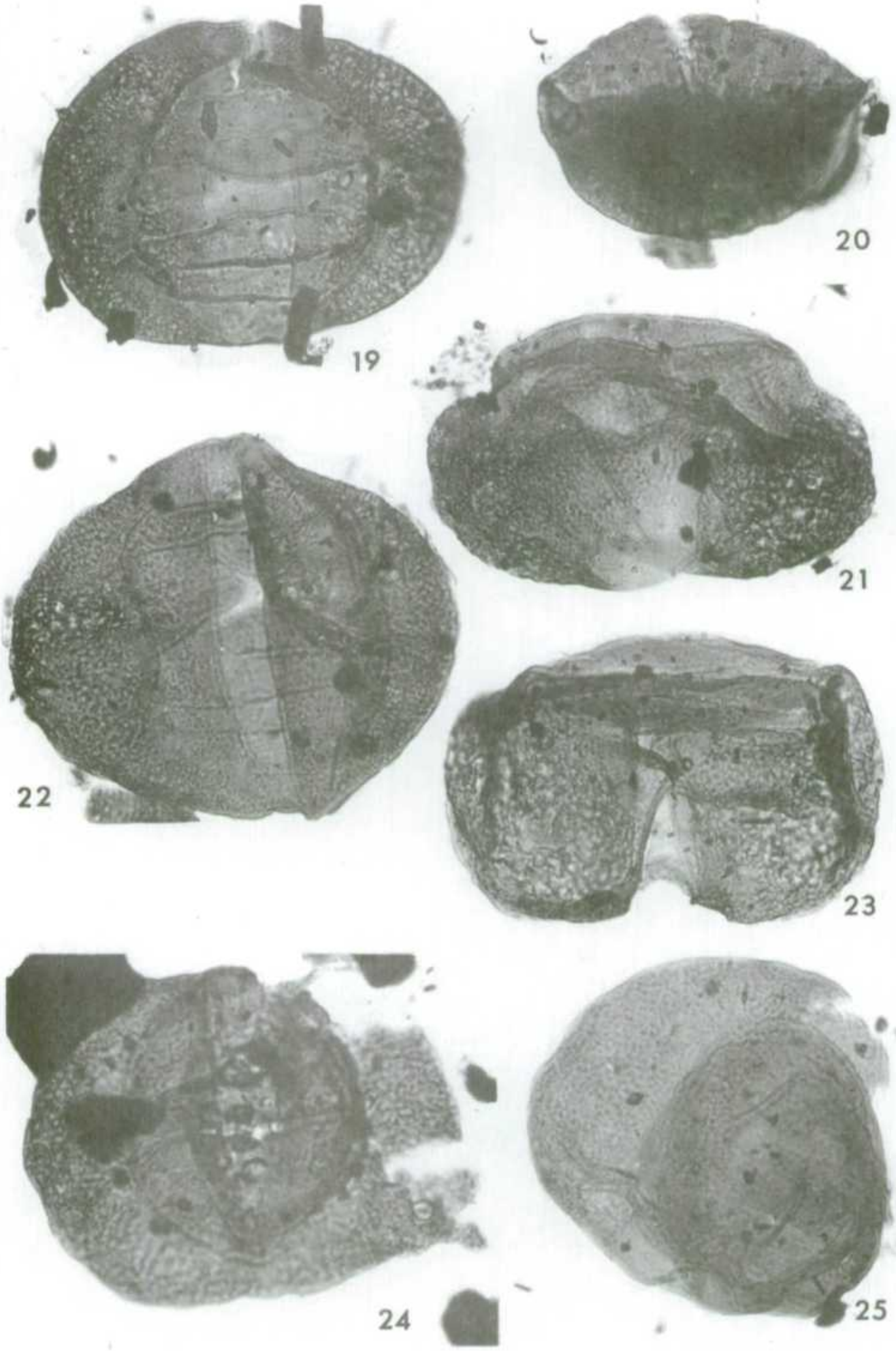
cf. Neoraistrickia sp.184
Fig.10, MFP3088.2.104.111.
Fig.11, MFP3088.2.229.085.

Cingulati sp.185
Fig.12, MFP3087.1.070.120.
Fig.13, MFP3087.1.204.126.

Rugulatisporites sp.22
Fig.14, MFP3277.2.110.137.

Monocolpate sp.186
Fig.15, MFP3088.2.116.110.
Fig.16, MFP3088.2.208.027.
Fig.17, MFP3088.2.058.103.
Fig.18, MFP3088.2.094.982.

PLATE 2

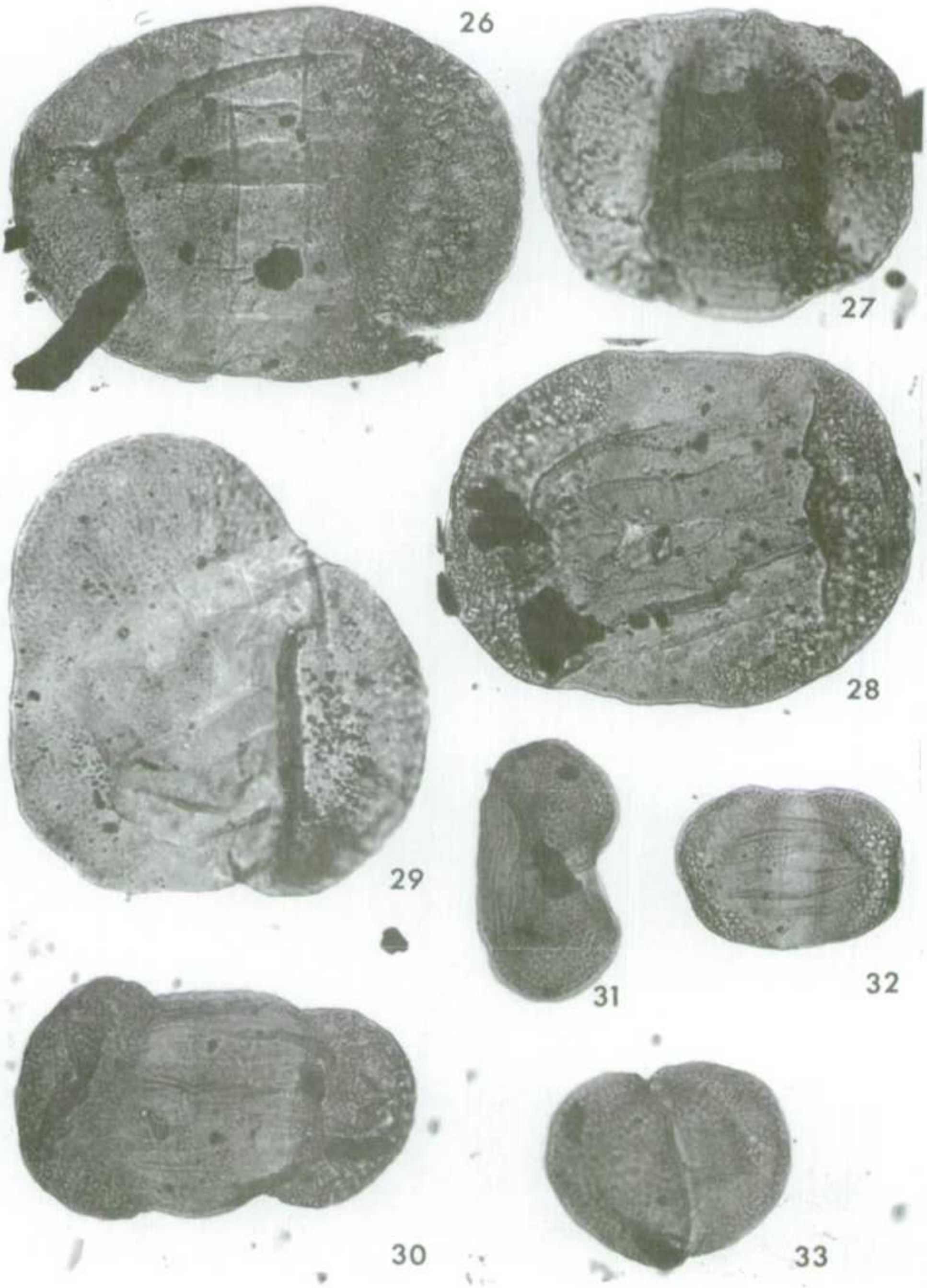


All magnifications 600x

aff. <u>Protohaploxypinus</u> <u>goraiensis</u> (Pot.& Lele 1961)(sp.187)

Fig.19, MFP3088.2.193.165.
Proximal polar view.
Fig.20, MFP3088.2.198.165.
Terminal view.
Fig.21, MFP3088.2.082.094.
Lateral view.
Fig.22, MFP3088.2.073.127.
Distal polar view.
Fig.23, MFP3088.2.122.310.
Lateral view.
Fig.24, MFP3088.2.101.075.
Proximal view, body well developed.
Fig.25, MFP3088.2.164.014.
Fragment, proximal view, intexine (central body) and ektexine (sac and cap) separated.

PLATE 3



All magnifications 600x

aff. Protohaploxypinus goraiensis (Pot.& Lele 1961)(sp.187)

Fig.26, MFP3088.2.131.188.
Fig.27, MFP3088.2.211.100.
Fig.28, MFP3088.2.221.140.
Fig.29, MFP3088.2.130.065.

Striatoabietites sp.188

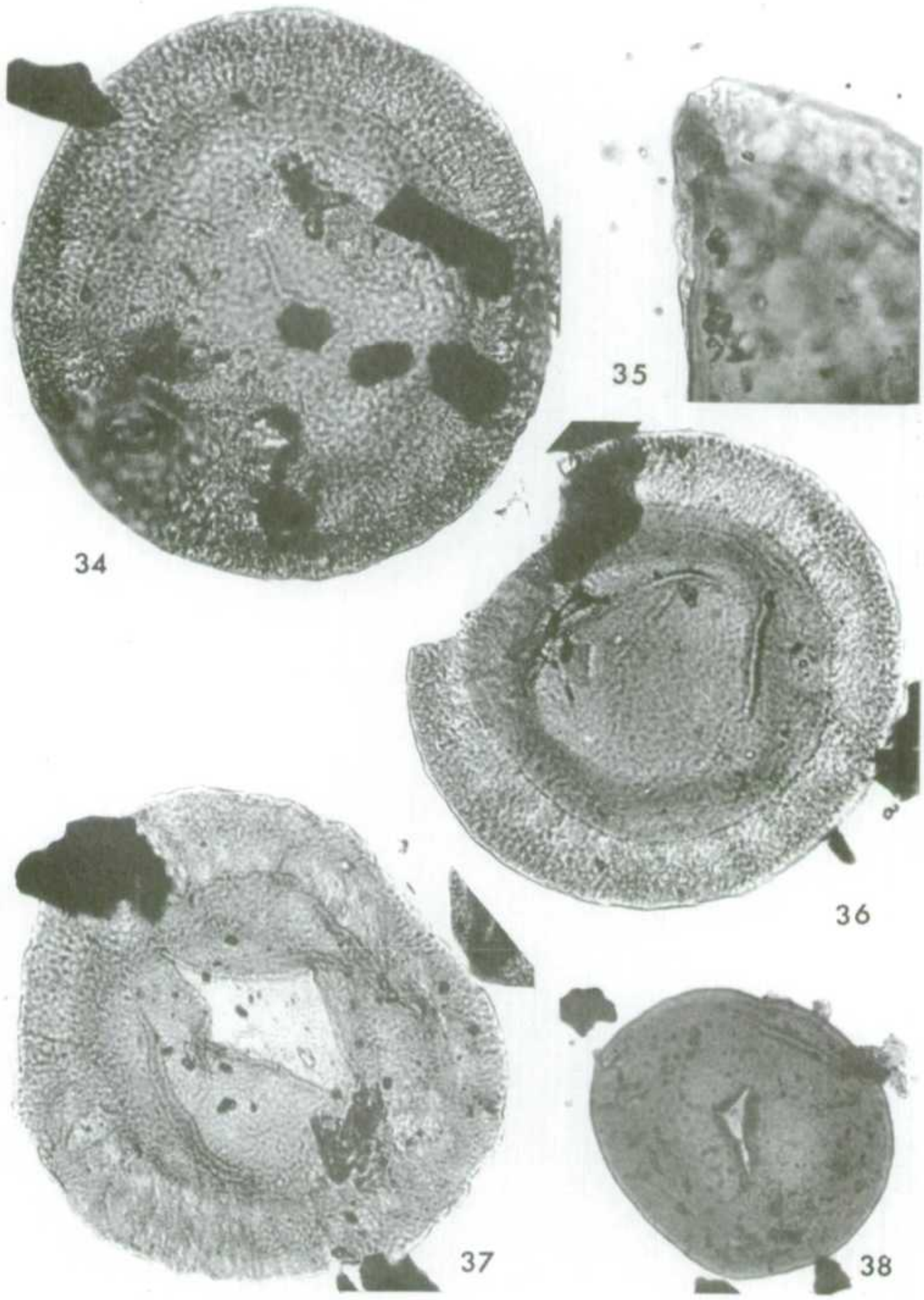
Fig.30, MFP3088.2.086.025.

Protohaploxypinus sp.198.

Fig.31, MFP3088.2.264.187.
Fig.32, MFP3088.2.118.205.
Fig.33, MFP3088.2.222.068.

Figs.34, 36-38, magnification 600x,
Fig.35, magnification 1150x

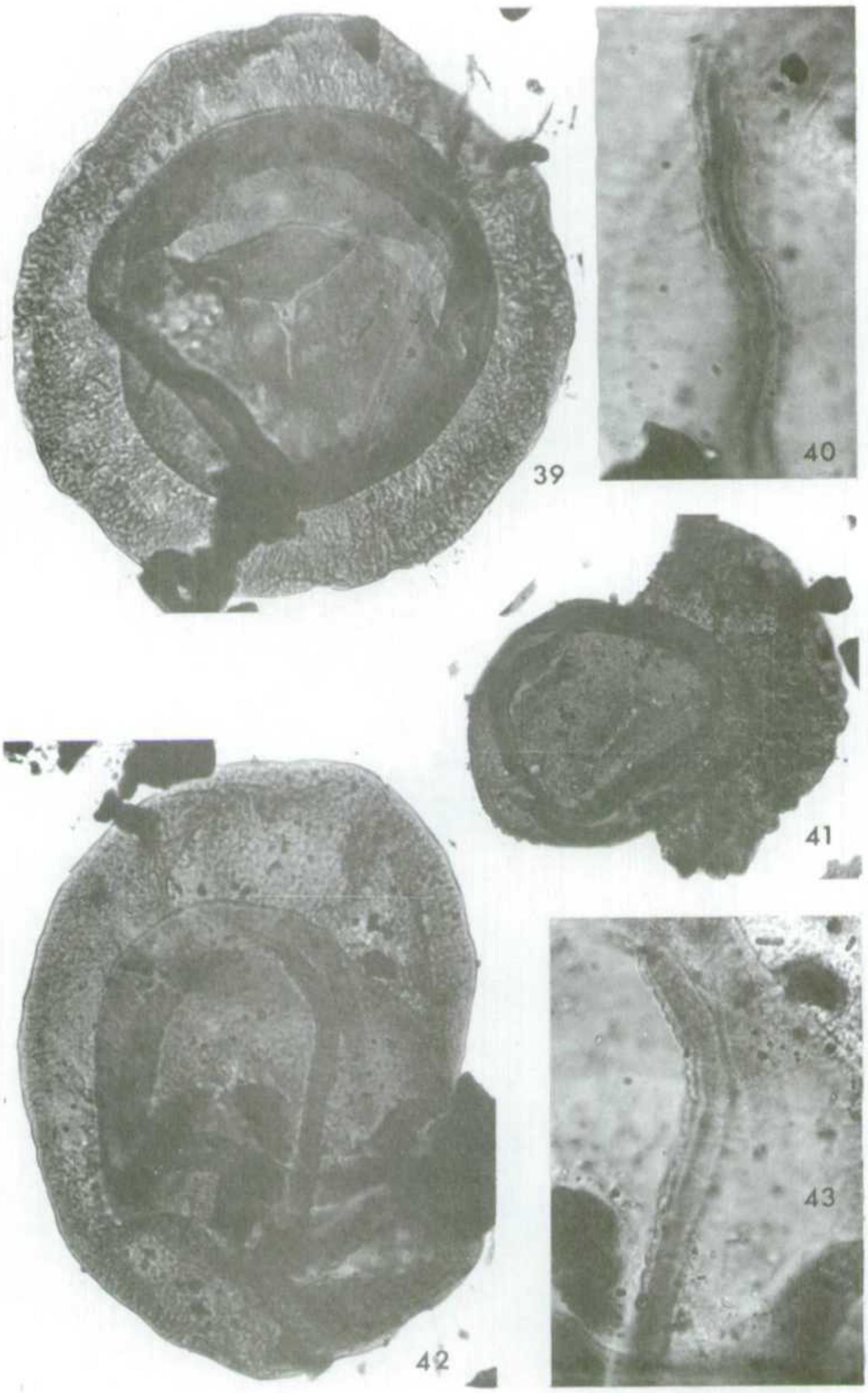
PLATE 4



<u>Parasaccites</u> sp.190

Fig.34, MFP3088.2.120.118.
Fig.35, MFP3277.1.138.112.
Folded specimen showing overlap of sac onto body.
Fig.36, MFP3088.2.108.034.
Fig.37, MFP3088.2.108.145.
Fig.38, MFP3277.2.131.130.
Central body without sac.

PLATE 5



Figs.39,41,42, magnification 600x
Figs.40,43, magnification 1800x

<u>Parasaccites</u> sp.190

Fig.39, MFP3087.1.062.143.
Fig.40, MFP3087.1.062.143,
Detail of fold.
Fig.41, MFP3277.1.106.159.
Body with only part of sac attached.
Fig.42, MFP3277.1.065.134.
Fig.43, MFP3277.1.065.134.
Detail of fold.

PLATE 6

All magnifications 600x

<u>Parasaccites</u> sp.190

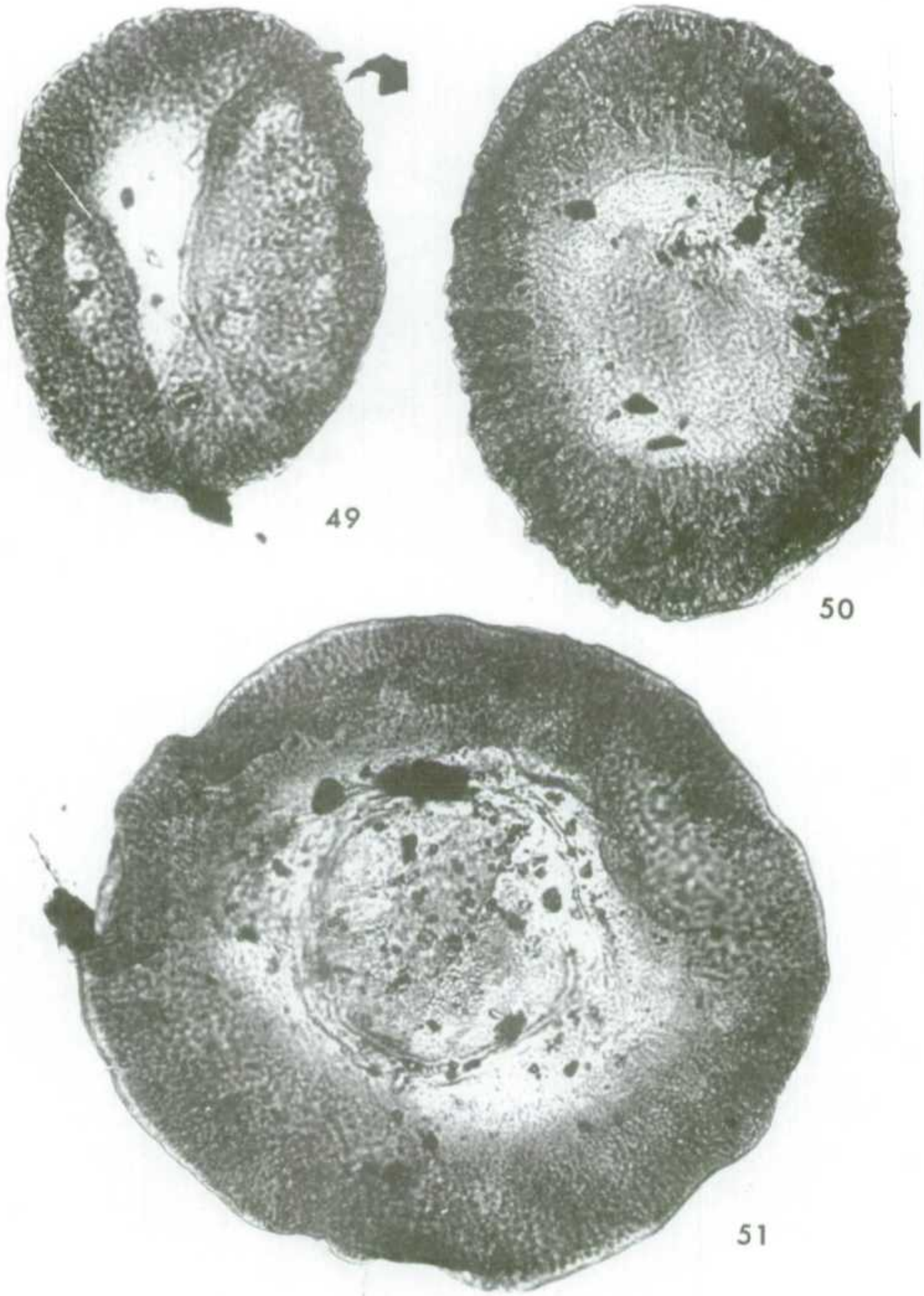
Complete specimens without central bodies.

Fig.45, MFP3088.2.191.174.
Fig.46, MFP3088.2.081.186.
Fig.48, MFP3088.2.058.124.

Central bodies without sacs.

Fig.44, MFP3087.1.161.039.
Fig.47, MFP3087.1.108.113.

PLATE 7

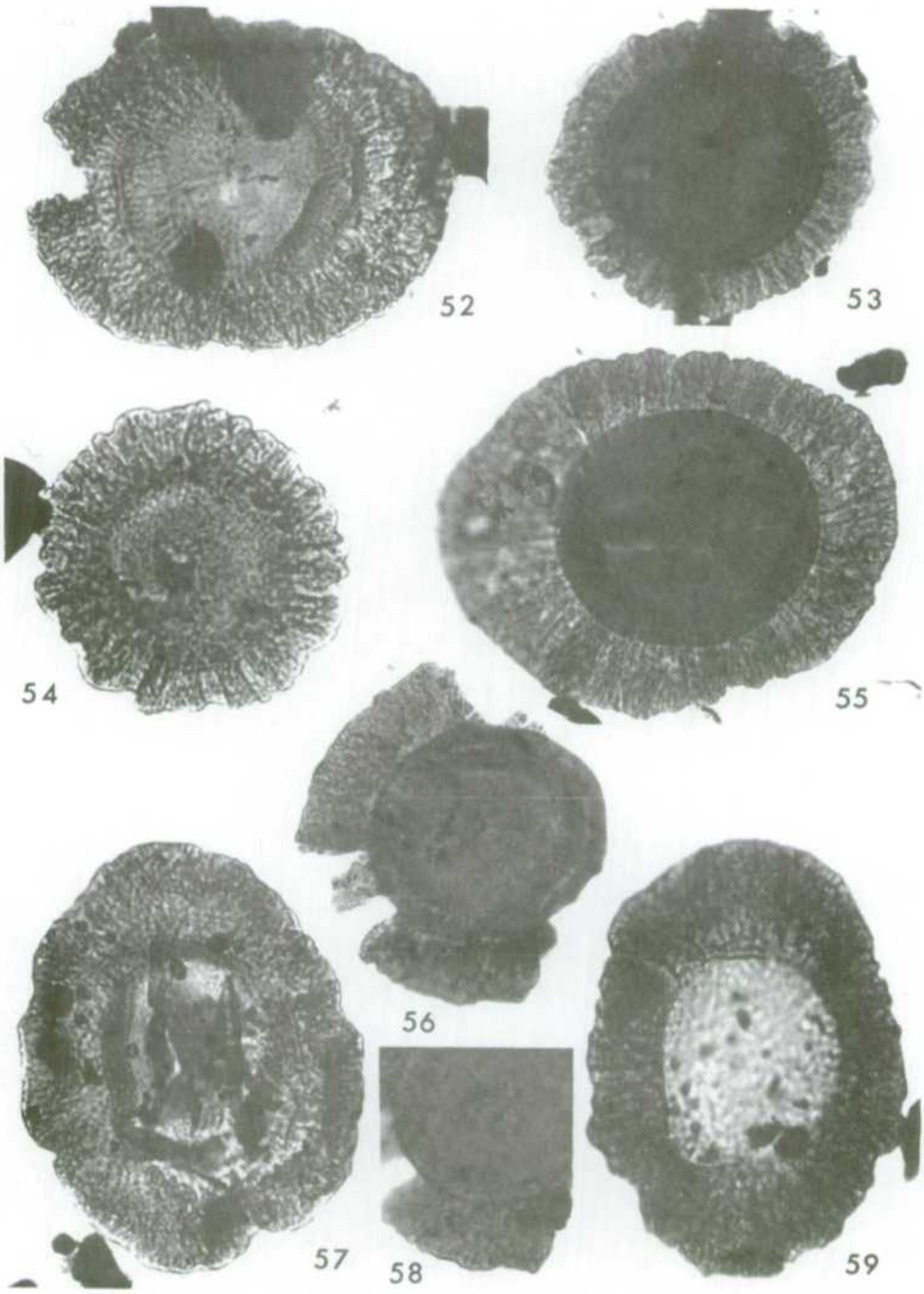


All magnifications 600x

<u>Parasaccites</u> sp.190

Fig.49, MFP3088.2.199.202.
Fig.50, MFP3088.2.148.095.
Fig.51, MFP3088.2.144.175.

PLATE 8

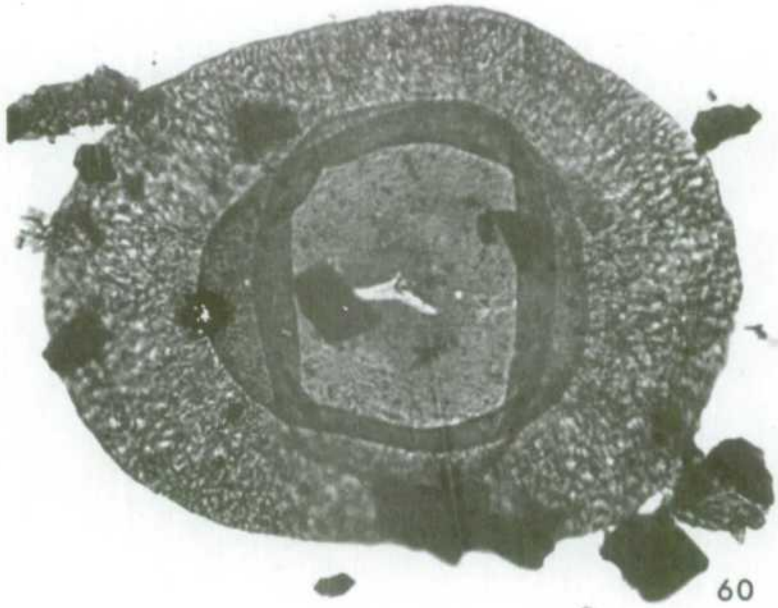


All magnifications 600x

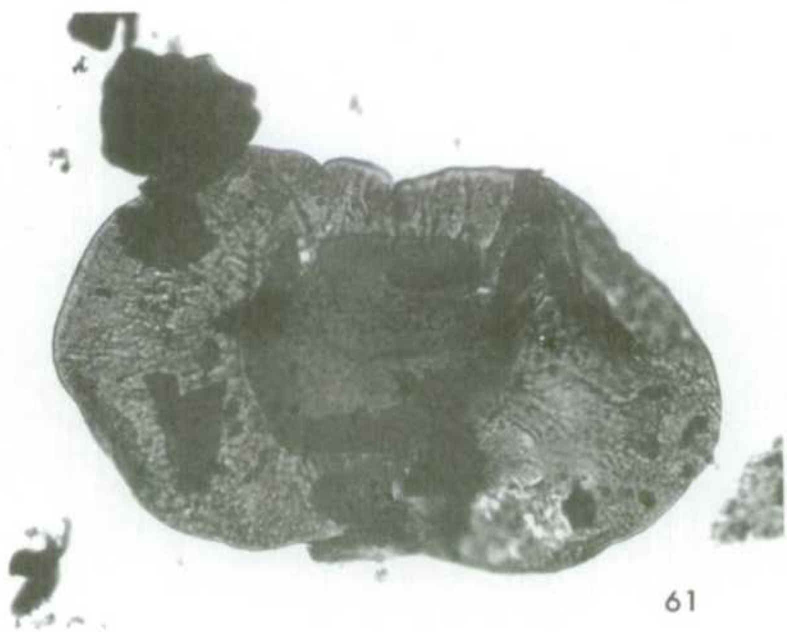
Parasaccites sp.191

Fig.52, MFP3088.2.063.147.
Fig.53, MFP3087.1.180.123.
Fig.54, MFP3088.2.197.165.
Fig.55, MFP3087.1.198.201.
Fig.56,58, MFP3277.1.144.182.
Fig.57, MFP3087.1.104.115.
Fig.59, MFP3088.2.122.164.

PLATE 9



60



61

All magnifications 600x

<u>Potonieisporites</u> <u>neglectus</u> Pot.& Lele 1961 (sp.192)
Fig.60, MFP3277.1.050.036.

<u>Vestigisporites</u> sp.193
Fig.61, MFP3277.2.110.178.