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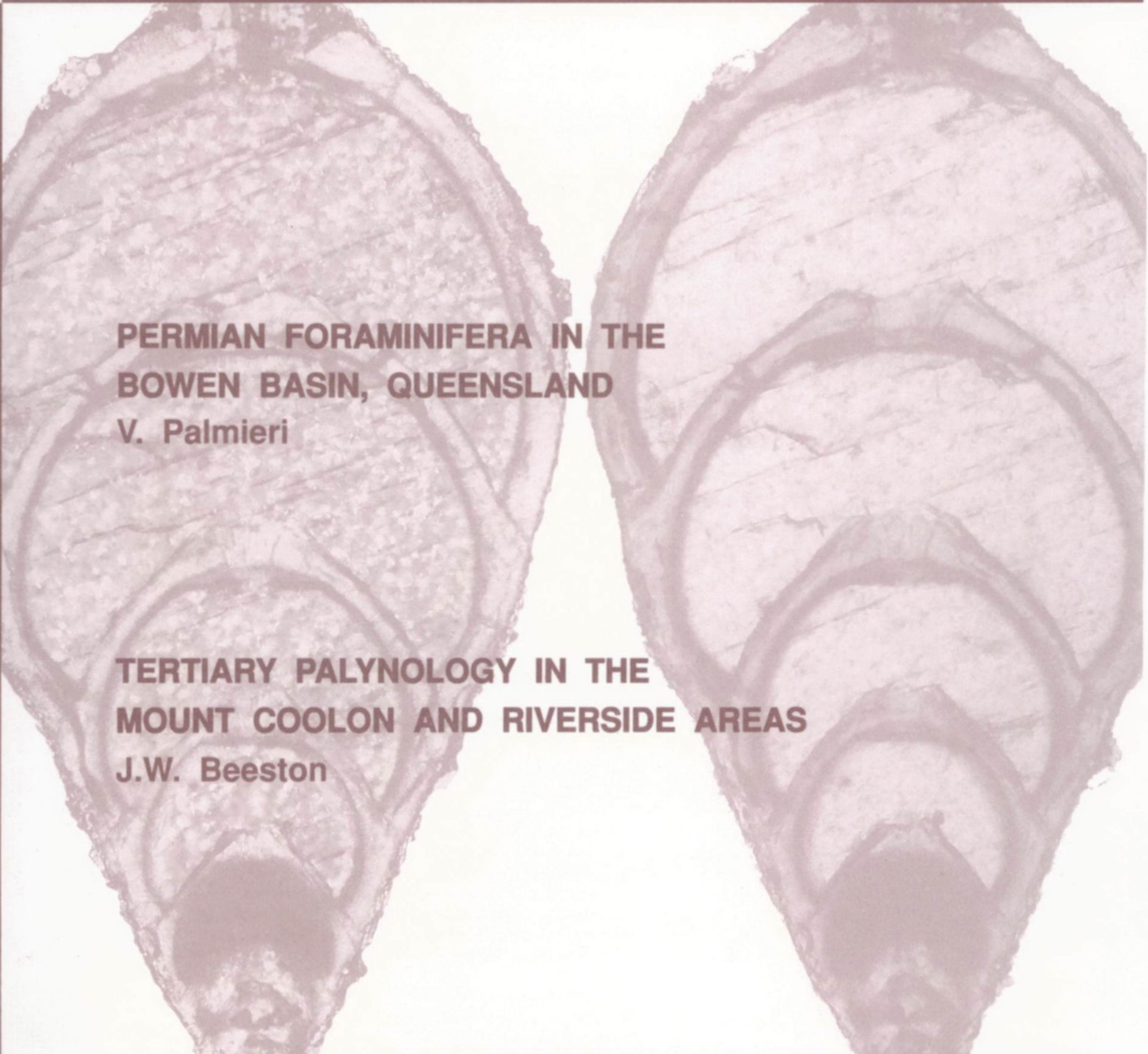

PERMIAN FORAMINIFERA IN THE BOWEN BASIN, QUEENSLAND

V. Palmieri

TERTIARY PALYNOLOGY IN THE MOUNT COOLON AND RIVERSIDE AREAS

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DEPARTMENT OF MINERALS AND ENERGY

6

1994

ISSN 1035 - 4840

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Published by the Department of Minerals and Energy, Queensland

ISSN 1035 - 4840

Production Editor: J.W.Beeston

Cartography: G.O'Shea

Compiled by J.W.Beeston, D.M.Kinman and D.T.Coumarianos on Ventura Publisher Software
Printed by GOPRINT, Vulture Street, Woolloongabba, 4106

Issued July, 1994

REFERENCES:

PALMIERI, V., 1994: Permian Foraminifera in the Bowen Basin, Queensland. *Queensland Geology*, **6**, 1-125.

BEESTON, J.W., 1994: Tertiary palynology in the Mount Coolon and Riverside areas. *Queensland Geology*, **6**, 127-179.

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ABSTRACT

Ninety-one species of foraminifers from the Permian sedimentary rocks of the Bowen Basin (Central Queensland) are briefly described and illustrated. Ten new species, *Ammosdiscus corrugatus*, *Howchinella costata*, *Howchinella incisa*, *Howchinella mantuanensis*, *Howchinella rigida*, *Lunucammina maior*, *Hillella marginodentata*, *Ichthyolaria crassatina*, *Ichthyolaria levicostata* and *Nodosaria draperi*, and two new genera, **Teichertina** and **Hillella**, are proposed. The foraminifera are early Artinskian at the base of the sequence and Kazanian and most probably early Midian at the top of the marine sequence. The late Artinskian, Ufimian and Kazanian faunas are important in a world-wide context: the Artinskian and Ufimian faunas reflect a bipolar distribution with similar faunas in high and relatively high latitudes (Novaya Zemlya, Barents Sea, Central Siberia); the Midian faunas reflect a median latitude distribution, closer to but still colder than a peripheral Tethyan Sea.

Keywords: Micropalaeontology, foraminifera, Bowen Basin, Permian, Queensland.

INTRODUCTION

The listing and description of Permian foraminifers from the Bowen Basin was initiated by the Commonwealth (of Australia) Palaeontologist, Irene Crespin, in 1945 using material collected by Dr K. Washington Gray of Commonwealth Oil Refineries Ltd and by geologists of Oil Search Ltd. The listing of foraminifers discovered in the Permian sediments of Queensland continued for about a decade in unpublished reports on oil exploratory wells until Crespin (1958) published a volume on Permian foraminifers from the whole of Australia. Bowen Basin foraminifers feature in that monograph with 25 species out of the 106 recognised for the Permian of Australia. The author herein recognises 91 species with 10 species and 2 genera proposed as new. Other Permian foraminifera and genera species previously proposed by the author (Palmieri *in* Foster & others, 1985; Palmieri, 1988) are not discussed here.

Foraminiferal biostratigraphy will be the object of a future paper which will discuss and reframe earlier biostratigraphic attempts (Palmieri, 1983, 1988a, 1990).

The foraminiferal faunas here examined come from two separate rock collections: the first from the classic stratigraphic Permian exposures of the Cattle Creek, Tiverton, Freitag, Ingelara, Peawaddy, Blenheim, Buffel, Oxtrack, Barfield, and Flat Top formations, collected by the author during the late 1960s and other geologists of the Geological Survey of Queensland during the 1970s; the second from core material of the stratigraphic boreholes drilled by the Queensland Department of Mines in the 1970s and 1980s.

The recovery of the small Permian foraminifera from usually indurated mudstones has been poor and their extraction painstaking. In this text the connotation of **rare** denotes that less than 10 individuals per sample were recovered; **common** denotes that more than 10 and less than 50 individuals per sample were recovered; and **abundant** denotes that more than 50 individuals per sample were recovered.

The preservation varies from poor to good; silicification, glauconitisation, and pyritisation are common (Palmieri, 1988b).

The nomenclatorial treatment of the species at the generic and suprageneric levels follows Loeblich & Tappan (1987) for the Textulariina and Miliolina, but differs from it in the Lagenina whose diagnosis has been emended to include not only the more primitive calcareous monolamellar foraminifera, but also the 'nodosinellids' whose microgranular test is considered the result of alteration processes of the original radial monolamellar test.

The biostratigraphic validity of the range of certain foraminifera was assessed as independent of the current palaeontologic and palynologic zonations for the Permian strata of the Bowen Basin (Price, 1983; McClung, 1981, 1983, Waterhouse, 1987 a, b) and may assume biochronological significance in an Australian Permian context. The Permian foraminifera of the Bowen Basin are particularly significant in the Artinskian, Ufimian and Kazanian including the early part of the Midian.

The adoption of the Russian Permian stage stratigraphy is also valid in a bipolar panthalassian foraminiferal context (Palmieri, 1983) and here reiterated by the finding of assemblages with Transcaucasian early Midian foraminifera at the top of the Permian marine sections.

Sea level fluctuations have not yet been studied; it is, however, suspected to be a difficult task since the offshore faunas are not showing strong depth variations and the marginal and coastal ones do not show appreciable diversity in depth factor.

Paleoenvironmental aspects list only coastal and offshore variations rather than water depth. It is hoped that this work will provide incentive into fostering further research in the Permian of Australia based on foraminifera. Figured types are stored in the Micropalaeontological Foraminifera collection of the Queensland Geological Survey under GSQMF numbers. Outcrop and core samples are stored in the Exploration Data Centre of the Queensland Geological Survey, under L numbers.

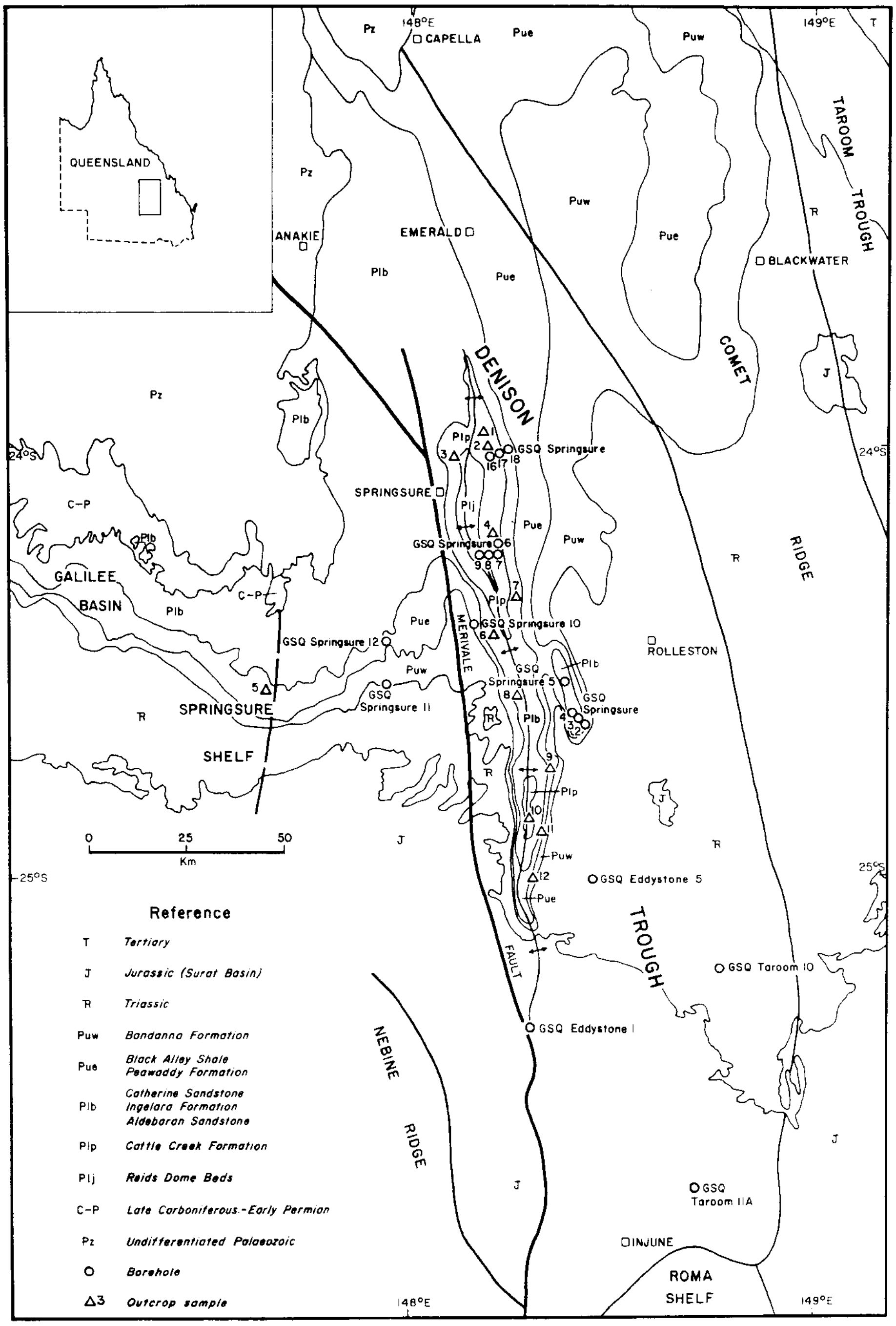

Figure 1. Simplified geological and locality map of the Denison Trough region showing drillholes and samples position (after Palmieri, 1983).

SYSTEMATIC PALAEONTOLOGY

Order FORAMINIFERIDA Eichwald 1830

Suborder TEXTULARIINA Delage & Herouard 1896

Superfamily ASTRORHIZACEA Brady 1881

Family HIPPOCREPINELLIDAE Loeblich & Tappan 1984

Genus **HIPPOCREPINELLA** Heron-Allen & Earland 1932

Type species: *Hippocrepinella hirudinea* Heron-Allen & Earland 1932; SD Cushman 1933.

Hippocrepinella biaperta Crespin 1958 (Pl. 6, figs 6,7)

1958 *Hippocrepinella biaperta* Crespin: p. 37-38, pl. 1, figs 1-8
1967 *Hippocrepinella biaperta* Crespin; Ludbrook: p. 73, pl. 3, fig. 1
1973 *Hippocrepinella biaperta* Crespin; Harris & McGowran: p. 62, pl. 1, figs 3,4
1982 *Hippocrepinella biaperta* Crespin; Scheibnerova: p. 53
1983 *Bathysiphon biapertus* (Crespin); Palmieri: p. 146

Remarks: Fragments of a tubular, medium size agglutinating form are attributed to this species: they show a slight tapering at both ends, openings broadly rounded with thickened apertural lip, irregular growth with collapse or compaction constrictions of test, finely agglutinated siliceous surface and a test wall slightly thicker than that reported for the original types.

Material available: The species is common to rare in the Mostyndale, Moorooloo, and Sirius Mudstone Members to the Cattle Creek Formation (L 3636, 3688, 3721-3723) and rare from one sample of the Blenheim Formation (L 3611).

Figured types: GSQ MF 057/1-2, from sample L 3688.

Distribution: QLD, Bowen Basin: Cattle Creek Formation (Mostyndale, Moorooloo, and Sirius Mudstone Members); Blenheim Formation. NSW, Sydney Basin: Wandravandian Siltstone and Branxton Formation. TAS, Golden Valley Group, Quamby Mudstone. SA, Arkaringa and Trowbridge Basins, Renmark Trough; Stuart Range Formation, Cape Jervis Beds. WA, Perth Basin: Caryngínia Formation; Carnarvon Basin: Callytharra Formation; Canning Basin: Noonkambah Formation.

Age: The species ranges from Artinskian to Ufimian in Queensland; Artinskian in New South Wales; Sakmarian to Artinskian elsewhere in Australia.

Palaeoenvironment: The species is related to periglacial to cold water, shallow marginal seas or embayments where muddy, silty sediments are being deposited.

Family PSAMMOSPHAERIDAE Haeckel 1894

Subfamily PSAMMOSPHAERINAE Haeckel 1894

Genus **PSAMMOSPHAERA** Schultze 1875

Type species: *Psammosphaera fusca* Scultze 1875; OD.

Psammosphaera pusilla Parr 1942 (Pl. 7, fig. 29)

1942 *Psammosphaera pusilla* Parr: p. 106, pl. 1, figs 6,7
1958 *Psammosphaera pusilla* Parr; Crespin: p. 38, 207, pl. 2, figs 4,5
1968 *Psammosphaera pusilla* Parr; Belford: p. 17, pl. 1, figs 2,3
1982 *Psammosphaera pusilla* Parr; Scheibnerova: p. 56, pl. 5, figs 1-3; pl. 6, figs 1,2,4,5; pl. 7, fig. 1

Description: Rounded, but not compressed, to spherical, small size, unilocular test, thick, siliceous, agglutinated wall, smooth surface without distinct openings. Differs from *Thuramminoides* by the smaller size and the thicker, harder test.

Material available: The species is rare in the Sirius Mudstone Member of the Cattle Creek Formation (L 3636, 3639, 3724).

Figured type: GSQ MF 060/1 from the Sirius Mudstone Member of the Cattle Creek Formation (L 3639).

Distribution: QLD, Bowen Basin: Cattle Creek Formation, Sirius Mudstone Member. NSW, Sydney Basin: Wandravandian Siltstone, Branxton Formation. WA, Perth Basin: Holmwood Shale; Carnarvon Basin: Byro Group; Bulgadoo Shale; Canning Basin, Nookambah Formation.

Age: The range of the species is Early Artinskian in Queensland; Artinskian in New South Wales; Sakmarian to Late Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold water, shallow seas in which were deposited muddy, silty sediments.

Genus **THURAMMINOIDES** Plummer 1945

Type species: *Thuramminoides sphaeroidalis* Plummer 1945; OD.

Remarks: The original diagnosis of the genus received amendment (Conkin & Conkin 1961) and revision (Loeblich & Tappan 1987). The latter authors, observing that "more than one species were represented among the type specimens of the type species" restricted their diagnosis to that of the holotype and similar topotypes (Loeblich & Tappan 1988, p. 29), thus leaving coexisting specimens in open nomenclature.

Revised description: "Test free, subglobular to discoidal with broadly rounded periphery; wall agglutinated of fine quartz grains, both inner and outer wall surface smoothly finished; no distinct aperture" (Loeblich & Tappan 1987, p. 29).

Thuramminoides sphaeroidalis Plummer 1945 (Pl. 4, figs 1,2; pl. 7, fig. 21)

1945 *Thuramminoides sphaeroidalis* Plummer: p. 218, pl. 15, figs 4,6,10a-b; *non* figs 5,8 (=?*Thurammina* sp.); *non* figs 7,9 (=?*Teichertina* sp.)
1958 *Thuramminoides sphaeroidalis* Plummer; Crespin: p. 40-41, 206-207, pl. 3, figs 9,11, *non* pl. 3, fig. 10 (=?*Thurammina* sp.); *non* pl. 31, figs 1,2 (=*Teichertina teicherti*)
1965 *Thuramminoides sphaeroidalis* Plummer; Belford: p. 177, pl. 1, fig. 4
1967 *Thuramminoides sphaeroidalis* Plummer; Ludbrook: p. 76-77, pl. 3, figs 15,16

Description: Test spheroidal to discoidal, often centrally depressed, wall agglutinated, siliceous, of fine quartz grains, surface smooth, periphery rounded, no visible openings.

Material available: The species is common in the Cattle Creek and Freitag Formations, and rare in the Ingelara and Peawaddy Formations (L 3708 to 3726).

Figured types: GSQ MF 064/1, 065/1-2, from Cattle Creek Formation: Sirius Mudstone Member, Riverstone Mudstone Member, and Mostyndale Mudstone Member (L 3724, 3722, 3721).

Distribution: QLD, Bowen Basin (Denison Trough): Cattle Creek, Freitag, Ingelara, Peawaddy, Barfield and Flat Top Formations. TAS, Quamby Mudstone. SA, Archaringa Basin, Stuart Range Formation. WA, Perth Basin, Holmwood Shale, High Cliff Sandstone, Caryngynia Formation; Carnarvon Basin: Callytharra Formation, basal Byro Group; Canning Basin: Grant Group, Noonkambah Formation.

Age: The species range is Artinskian to Kazanian in Queensland and New South Wales; Sakmarian in Tasmania; Sakmarian to Artinskian in South Australia and Western Australia.

Palaeoenvironment: This species is related to cold waters and cold temperate of shallow seas depositing sandy, silty, and muddy sediments.

Genus TEICHERTINA gen. nov.

Type species: *Crithionina teicherti* Parr 1942; OD.

Description: Test free, medium to large, sphaerical or flattened, central cavity large, wall agglutinated, of various thickness, internal surface showing numerous moderately sized pits which extend irregularly through the wall and reach the external surface through minute openings.

Remarks: Parr (1942, p. 107) attributed his new species *"teicherti"* to the genus *Crithionina* Goes 1894 and described it as having a "central large cavity connected with the outside by numerous moderately sized pits which extend through the thickness of the shell and reach the external surface through minute openings".

Plummer (1945, p. 218) erected the new genus *Thuramminoides* for her species *T. sphaeroidalis* and Crespin (1958, p. 41-42) included Parr's *C. teicherti* in Plummer's *Thuramminoides*.

Loeblich & Tappan (1961, p. 217-218) proposed their new genus *Oryctoderma* for large free living forms with small central cavity, loosely cemented very thick wall and numerous large circular to polygonal openings on the external surface connected with the internal cavity by ramifying canals. These authors include in *Oryctoderma* not only the extant free living species of *Crithionina*, which they stated was originally based on an attached form (Hoglund 1947, p. 31), but also the Permian *C. teicherti* Parr 1942.

The same authors (Loeblich & Tappan 1964, p. C208, C210) indicated that the original types of *Thuramminoides sphaeroidalis* Plummer included more than one species if not more than one genus; and later (Loeblich & Tappan 1988, p. 29) restricted the definition of *Thuramminoides* to the characters shown by the holotype and some paratypes and topotypes of *T. sphaeroidalis*, leaving in open nomenclature the remaining types figured by Plummer (1945, p. 218, pl. 15, figs 2,3,5,7,8,9) as *T. sphaeroidalis*.

The inclusion of Parr's species *teicherti* in *Oryctoderma* is reasserted and implied by the range given to the genus in the Permian (Artinskian) of Western Australia (Loeblich & Tappan 1964, p. C208; 1988, p. 39-40). However, Parr's species *teicherti*, which by original definition shows large central cavity, variable wall thickness, and minute perforations as external openings is neither a *Thuramminoides* nor a *Oryctoderma* according to the definition of these genera by Loeblich & Tappan, hence the proposal of the new generic name.

Teichertina teicherti (Parr 1942) (Pl. 4, figs 3,4; pl. 7, figs 24-26)

1942 *Crithionina teicherti* Parr: p. 107, pl. 1, figs 9,10
1958 *Thuramminoides sphaeroidalis* Plummer; Crespin: p. 40, pl. 31, figs 1,2
1958 *Thuramminoides teicherti* (Parr); Crespin: p. 41-42, pl. 2, figs 12,13
1961 *Oryctoderma teicherti* (Parr); Loeblich & Tappan: p. 217-218

Remarks: This species is clearly distinguishable from *Thuramminoides sphaeroidalis* by its external surface minute openings, slightly less smooth surface, and slightly bigger size.

Material available: The species is common in the Sirius Mudstone Member of the Cattle Creek Formation and rare in the Moorooloo Mudstone Member of the same formation (L 3723, 3724, 3639).

Figured types: GSQ MF 065/34 from the Moorooloo Mudstone Member of the Cattle Creek Formation (L 3723) and GSQ MF 065/5-7 from the Sirius Mudstone Member of the Cattle Creek Formation (L 3639).

Distribution: QLD, Bowen Basin (Denison Trough): Moorooloo and Sirius Mudstone Members of Cattle Creek Formation. NSW, Sydney Basin: Branxton and Mulbring Formations. WA, Carnarvon Basin: Callytharra Formation, Byro Group; Canning Basin: Grant Group, Noonkambah Formation.

Age: The species range in Queensland is Late Artinskian; in New South Wales Late Artinskian and Ufimian; and in Western Australia Sakmarian and Artinskian.

Palaeoenvironment: The species is related to cold waters of marginal and shallow seas depositing silty, muddy sediments.

Family SACCAMMINIDAE Brady 1884

Subfamily SACCAMMININAE Brady 1884

Genus **SACCAMMINA** Carpenter 1869

Type species: *Saccammina sphaerica* Brady 1871; SD Cushman 1928.

Saccammina ampulla (Crespin 1958) (Pl. 2, figs 5-9; pl. 7, figs 15-19; pl. 8, fig. 28; pl. 30, figs 8,10)

1958 *Pelosina ampulla* Crespin: p. 42-43, 207, pl. 2, figs 1-3
1967 *Lagenammina ampulla* (Crespin); Ludbrook: p. 75, pl. 3, fig. 14
1968 *Pelosina ampulla* Crespin; Belford: p. 4-5, pl. 1, fig. 1
1973 *Pelosina ampulla* Crespin; Harris & McGowran: pl. 1, fig. 22
1982 *Pelosina ampulla* Crespin; Scheibnerova: p. 56-57, pl. 6, fig. 3

Remarks: According to Loeblich & Tappan 1988 the genus *Pelosina* Brady 1879 refers to extant species of elongate fusiform to subcylindrical shape. Forms finely to coarsely agglutinated, siliceous, globular to oblong to flask-like, with short apertural neck, are best placed in *Saccammina*.

Material available: The species is common in strata of the Cattle Creek, Freitag, Ingelara and Barfield Formations; rare in strata of the Peawaddy and Flat Top Formations (L 3592, 3593, 3599, 3632, 3633, 3635, 3636, 3640, 3642, 3708 to 3715, 3719 to 3724).

Figured types: GSQ MF 062/1-5 from L 3722, 3723, Riverstone and Moorooloo Mudstone Members of the Cattle Creek Formation; GSQ MF 062/6-10 from L 3724, Sirius Mudstone Member of the Cattle Creek Formation; GSQ MF 056/1 from L 3720, Ingelara Formation.

Distribution: QLD, Bowen Basin: Cattle Creek, Freitag, Ingelara, Peawaddy, Barfield, Flat Top Formations. NSW, Sydney Basin: Allandale, Rutherford, Farley, Branxton, Mulbring, Snapper Point, Berry, Erinsvale Formations. TAS, Quamby Mudstone. SA, Arckaringa Basin: Stuart Range Formation. WA, Perth Basin: Holmwood Shale, Carnarvon Basin: basal Byro Group; Canning Basin: Noonkambah Formation.

Age: In Queensland, the species range is Artinskian, Ufimian, and Kazanian; in New South Wales, Sakmarian, Artinskian, Kungurian and Ufimian; in Tasmania, Sakmarian; in South Australia, Artinskian; and in Western Australia, Sakmarian and Artinskian.

Palaeoenvironment: The species is related to cold and cold temperate waters of shallow seas depositing silty, muddy sediments.

Saccammina arenosa (Crespin 1958) (Pl. 7, figs 11,12)

1958 *Proteonina arenosa* Crespin 1958: p. 38-39, 206, 207, pl. 2, figs 6,7

Remarks: As the genus *Proteonina* is considered a junior synonym of the multichambered *Reophax*, the globular monochambered, coarsely agglutinated species *arenosa* is best placed in *Saccammina*. The reported Queensland specimens seem to lack the short apertural neck.

Material available: The species is rare in the Mostyndale and Sirius Mudstone Members of the Cattle Creek Formation (L 3639, 3640, 3724).

Figured types: GSQ MF 059/1-2 from L 3724, Sirius Mudstone Member of the Cattle Creek Formation.

Distribution: QLD, Bowen Basin (Denison Trough): Mostyndale and Sirius Mudstone Members of the Cattle Creek Formation. WA, Perth Basin: Fossil Cliff Member of the Holmwood Shale, High Cliff Sandstone, Carynginia Formation; Carnarvon Basin: Byro Group; Canning Basin: Noonkambah Formation.

Age: In Queensland the species ranges from Early to Late Artinskian; in Western Australia from Late Sakmarian to Late Artinskian.

Palaeoenvironment: The species is related to cold waters of shallow, marginal seas depositing sandy, silty sediments.

Saccammina **sp. 1** (Pl. 2, figs 1-4)

Remarks: The species, left in open nomenclature, shows similarity to *S. parvula* Gerke 1960 from the Permian deposits of Central Siberia. It is small, oblong, flattened and thick test with finely agglutinated siliceous internally, rare agglutinating quartz grains externally, and with a simple, non protruding opening.

Material available: The species is rare in the Mostyndale Mudstone Member of the Cattle Creek Formation (L 3721).

Figured types: GSQ MF 061/1-4 from the Mostyndale Mudstone Member of the Cattle Creek Formation (L 3721).

Age: Early Artinskian.

Palaeoenvironment: The species is related to sediments deposited under cold water conditions.

Saccammina spp. (Pl. 7, figs 9,10)

Remarks: The species, left in open nomenclature, groups indeterminable saccamminiform individuals. The figured one shows minute sponge spicules agglutinated in the test. Is small, rounded to oblong, with aperture non discernible.

Material available: The species is very rare in the Staircase Sandstone Member of the Cattle Creek Formation and in the Freitag and Ingelara Formations (L 3626, 3642, 3723).

Age: Artinskian to Ufimian.

Palaeoenvironment: The species is associated with sediments deposited under cold water conditions.

Genus **SACCULINELLA** Crespin 1958

Type species: *Sacculinella australis* Crespin 1958; OD.

Sacculinella australis Crespin 1958 (Pl. 2, figs 10,11)

1958 *Sacculinella australae* Crespin: p. 43-44, pl. 3, figs 4,5

Description: Test siliceous, finely agglutinated, sack-like, with a thickened lip surrounding the large apertural opening (modified after Crespin 1958, p. 43).

Material available: The species is rare throughout the Cattle Creek Formation, it may be more common in the Riverstone Sandstone Member (L 3639, 3640, 3641, 3722, 3723).

Figured types: GSQ MF 063/1-2 from L 3722, 3723, Riverstone Sandstone Member and Moorooloo Mudstone Member of the Cattle Creek Formation.

Distribution: QLD, Bowen Basin (Denison Trough): Cattle Creek Formation. WA, Carnarvon Basin: Byro Group; Canning Basin: Noonkambah Formation.

Age: Artinskian, both in Western Australia and Queensland.

Palaeoenvironment: The species is related to cold water, shallow and marginal seas depositing sandy, silty and muddy sediments.

Subfamily **THURAMMININAE** A.D. Miklukho-Maklay 1963

Genus **THURAMMINA** Brady 1879

Type species: *Thurammina papillata* Brady 1879; SD Cushman 1910.

Thurammina sp. (Pl. 6, figs 8,9)

Remarks: This species, very rare and occurring only in one sample, is left in open nomenclature. It has a rounded, somewhat flattened,

finely agglutinated test with some visible external grains, and with small conical surface openings.

Material available: Very rare in a sample from L 3688, Mostyndale Mudstone Member of the Cattle Creek Formation.

Figured type: GSQ MF 064/2 from L 3688.

Distribution: QLD, Bowen Basin (Denison Trough): Mostyndale Mudstone Member of the Cattle Creek Formation.

Age: Early Artinskian.

Palaeoenvironment: The species is related to cold water, shallow sea depositing silty, muddy sediments.

Superfamily **HIPPOCREPINACEA** Rhumbler 1895

Family **HIPPOCREPINIDAE** Rhumbler 1895

Subfamily **HYPERAMMININAE** Eimer & Fickert 1899

Genus **HYPERAMMINA** Brady 1878

Type species: *Hyperammina elongata* Brady 1878; OD.

Hyperammina fletcheri Crespin 1958 (Pl. 1, figs 2-9; pl. 2, figs 17-22; pl. 7, figs 13,14)

1958 *Hyperammina fletcheri* Crespin: p. 50, pl. 6, figs 1-4

1982 *Hyperammina fletcheri* Crespin; Scheibnerova: p. 55, pl. 1, fig. 1; pl. 2, figs 1,2; pl. 4, fig. 6

Remarks: Nothing can be added to the description offered by Crespin (1958, p. 50) which applies in all aspects to the Bowen Basin specimens.

Material available: The species is common throughout the marine sedimentary formations of the Bowen Basin and particularly in the Cattle Creek Formation (L 3708 to 3727, 3632 to 3640, 3688).

Figured types: GSQ MF 051/3-8; 050/1-6; 050/7-8 from L 3721, 3722; L 3724, 3725, Mostyndale Mudstone, Riverstone Mudstone, and Staircase Sandstone Members of the Cattle Creek Formation.

Distribution: QLD, Bowen Basin: Cattle Creek, Tiverton, Freitag, Ingelara, Peawaddy, Barfield, Flat Top Formations. NSW, Sydney Basin: Dalwood Group, Branxton Formation, Mulbring Siltstone, Wandrawandian Siltstone, Capertee Group.

Age: The species range is Artinskian to Kazanian in Queensland and Sakmarian to Kazanian in New South Wales.

Palaeoenvironment: The species is related to cold and cold temperate waters of marginal seas depositing silty sediments.

Hyperammina fusta Crespin 1958 (Pl. 1, figs 1,1a,17,18)

1958 *Hyperammina fusta* Crespin: p. 51, 206, pl. 4, figs 6-8
1965 *Hyperammina fusta* Crespin; Belford: p. 17, pl. 2, figs 8,9
1982 *Hyperammina fusta* Crespin; Scheibnerova: p. 55, pl. 2, fig. 5; pl. 3, fig. 5; pl. 4, fig. 3

Remarks: Only fragments of relatively small tests were recovered from two boreholes in the Denison Trough: they possess, however, sufficient characters to be attributed to the species: club-like shape of test, constrictions in the tubular chamber, thin, finely arenaceous wall, aperture a round opening at end of tubular chamber.

Material available: The species is rare to common in the Mostyndale and Moorooloo Mudstone Members of the Cattle Creek Formation (L 3721, 3722).

Figured types: GSQ MF 052/1-3 from L 3721.

Distribution: QLD, Bowen Basin (Denison Trough): Mostyndale and Moorooloo Mudstone Members of the Cattle Creek Formation. NSW, Sydney Basin: Branxton Formation, Singleton Supergroup, Snapper Point Formation Wandrawandian Siltstone, Berry Formation. WA, Perth Basin: Carynginia Formation; Carnarvon Basin: ?Callytharra Formation, Byro Group; Canning Basin: Noonkambah Formation, Hardman Formation.

Age: The species range is Early Artinskian in Queensland; Artinskian to Kazanian in New South Wales; ?Sakmarian to Late Kazanian in Western Australia.

Palaeoenvironment: The species is related to cold and cold temperate waters of marginal, shallow seas depositing silty, muddy sediments.

Hyperammina hebdenensis Crespin 1958 (Pl. 2, figs 12-16; pl. 7, fig. 30)

1958 *Hyperammina hebdenensis* Crespin: p. 52-54, pl. 6, figs 8-12
1982 *Hyperammina hebdenensis* Crespin; Scheibnerova: p. 55, pl. 2, figs 3,4; pl. 3, figs 1-4; pl. 4, fig. 5

Remarks: This species has a characteristic large bulbous proloculus and somewhat cylindrical chamber, wall finely agglutinated, compact and translucent in specimens which underwent recrystallisation in burial diagenesis, opaque in others, usually of medium to large size.

Material available: The species is rare to common in the Bowen Basin above the Mostyndale Mudstone Member of the Cattle Creek Formation: it occurs in the Moorooloo and Sirius Mudstone Members of the Cattle Creek Formation, in the Ingelara and Peawaddy Formations; in the upper Tiverton and Blenheim Formations, and in the Barfield and Flat Top Formations (L 3582, 3586, 3593, 3608, 3612, 3636, 3639, 3708, 3709, 3722, 3723).

Figured types: GSQ MF 054/1-5, 054/6 from L 3722, 3723, 3639.

Distribution: QLD, Bowen Basin: Cattle Creek and Tiverton Formations, Ingelara and Blenheim Formations, Barfield, Peawaddy and Flat Top Formations. NSW, Sydney Basin: Dalwood Group, Branxton and Mulbring Formations, Capertee Group.

Age: The species range is Artinskian to Kazanian in Queensland; Sakmarian to Kazanian in New South Wales.

Palaeoenvironment: The species is related to cold and cold temperate waters of shallow marginal seas depositing silty, muddy sediments.

Hyperammina sp. (Pl. 6, figs 4,5)

Remarks: This large species occurs only in fragments of the tubular chamber with a thick agglutinated wall and coarse surface consisting of quartz grains and/or tourmaline crystals.

Material available: The species is common in strata of the Blenheim, Ingelara, and Peawaddy Formations (L 3611 to 3624, 3632, 3642, 3644, 3710 to 3718, 3726, 3727).

Figured types: GSQ MF 058/1-2 from L 3726.

Distribution: The species is distributed in the Bowen Basin in the Ingelara, Catherine, Peawaddy and Blenheim Formations.

Age: The species range is Ufimian to Kazanian.

Palaeoenvironment: The species is related to cold and cold temperate coastal waters of seas depositing sandy, silty sediments.

Family **HYPERAMMINOIDIDAE** Loeblich & Tappan 1984

Genus **KECHENOTISKE** Loeblich & Tappan 1984

Type species: *Hyperamminoides expansus* Plummer 1945; OD.

Kechenotiske hadzeli (Crespin 1958) (Pl. 1, figs 10-12)

1958 *Hyperammina hadzeli* Crespin: p. 51-52, 207, pl. 5, figs 6-10
1968 *Hyperammina hadzeli* Crespin; Belford: p. 5, pl. 1, fig. 24

Description: Test of medium size, finely agglutinated, smooth siliceous surface, proloculus small, expanding chamber towards large apertural opening.

Material available: The species is rare in the Mostyndale Mudstone Member of the Cattle Creek Formation (L 3721).

Figured types: GSQ MF 053/1-3 from L 3721.

Distribution: QLD, Bowen Basin (Denison Trough): Mostyndale Mudstone Member of the Cattle Creek Formation. WA, Perth Basin: Holmwood Shale; Carnarvon Basin: Callytharra Formation, ?Byro Group; Canning Basin: Grant Group.

Age: The species range is Early Artinskian in Queensland; Sakmarian to Artinskian in Western Australia.

Palaeoenvironment: The species is related to periglacial and cold water shallow seas depositing sandy, silty and muddy sediments.

Genus **PSEUDOHYPERAMMINA** Crespin 1958

Type species: *Pseudohyperammina radiostoma* Crespin 1958; OD.

Remarks: In the diagnosis of this monospecific genus given by Loeblich & Tappan (1988, p. 45) the wall is described as thick, whereas Crespin (1958, p. 55) reported it to be thin; the specimens here illustrated show a rather thick test wall.

Pseudohyperammina radiostoma Crespin 1958 (Pl. 5, figs 1-17; pl. 6, figs 1-3; pl. 24, figs 1-4; pl. 30, figs 5-7)

1958 *Pseudohyperammina radiostoma* Crespin: p. 55-56, pl. 8, figs 1-7
1968 *Pseudohyperammina radiostoma* Crespin; Belford: p. 4, pl. 1, fig. 25

Description: Test large, free, elongate to ovate or rapidly expanding, distally and proximally tapering; consisting of an individual chamber showing growth wrinkles or constrictions sometimes strongly accentuated; wall thick, smooth, polished, consisting of a thick internal finely agglutinated part and of a thin external, whitish, finely arenaceous and siliceous layer; aperture terminal, central, rounded, with a slightly thickened lip and usually surrounded by radial grooves (modified after Crespin 1958, p. 55).

Remarks: Individuals of the *P. radiostoma* population from the Denison Trough show a remarkable variability in size, shape, and other more detailed morphological characters: the first obvious distinction is between large elongated and moderately large ovate forms; they may represent, even if no proloculus is present, respectively the microspheric and megalospheric forms.

The ovoid shaped forms are wider than the originals from the Canning Basin (WA) figured by Crespin. The ratio L/W (length versus maximum width) is approximately 2 for the Canning Basin specimens, around 1.5 for the "megalospheric" and 2.5 for the "microspheric" forms of the Denison Trough.

The characteristic apertural, radially arranged grooves do not appear in some specimens of the Denison Trough. Strong "annular" constrictions reflecting growth stages are present and give an "amphora" like shape to some specimens. The test wall consists of a thick internal amorphous agglutinating siliceous mass in which are dispersed granules of both inorganic and organic origin and of a thin, external, whitish, finely arenaceous layer. Collapse features shown in the fossil state are considered as evidence of a somewhat soft or flexible test when living.

Material available: The species is common to abundant at three localities in strata of the Moorooloo and Mostyndale Mudstone Members of the Cattle Creek Formation (L 3688, 3722, 3723).

Figured types: GSQ MF 055/1-24 from L 3688, 3722, 3723.

Distribution: This is the first recorded occurrence of the species in Queensland and eastern Australia. QLD, Bowen Basin (Denison Trough), Mostyndale and Moorooloo Mudstone Members of the Cattle Creek Formation. WA, Perth Basin: the species was found by the writer in strata attributed to the uppermost part of the Holmwood Shale; Carnarvon Basin: Bulgadoo Shale and Wandagee Formation of the Byro Group; Canning Basin: Noonkambah Formation.

Age: The species range is Latest Sakmarian to Late Artinskian in Western Australia; Artinskian in Queensland.

Palaeoenvironment: The species has been so far reported from muddy or shaly sediments of the Early Permian of Western Australia and Queensland, and is considered to represent a facies controlled assemblage zone, related to cold water seas in off shore position, depositing muddy sediments.

Superfamily **AMMODISCACEA** Reuss 1862

Family **AMMODISCIDAE** Reuss 1862

Subfamily **AMMODISCINAE** Reuss 1862

Genus **AMMODISCUS** Reuss 1862

Type species: *Ammodiscus infimus* Bornemann 1874; SD Loeblich & Tappan, 1952.

Ammodiscus corrugatus sp. nov. (Pl. 8, figs 18-23)

Description: Test free, medium to large in size, round, deflated, consisting of a small proloculus followed by an undivided tubular second chamber, planispirally enrolled, increasing considerably in size in the last two or three whorls, and consequently giving the test an accentuated biconcavity. Distinct corrugations appear in these last whorls. The test wall is siliceous, fine to medium agglutinated and including quartz grains or siliceous sponge spicules. Dimensions: diameter 0.65mm, max. height of tubular chamber 0.12mm. Diameter of paratypes varying between 1.5 and 0.5mm.

Remarks: This species differs from *A. oonahensis* Crespin by its more roughened surface, more rounded periphery and by the slightly tapering of the tubular chamber before the apertural opening. Crespin (1958, p. 69) reported *A. oonahensis* from the "Aldebaran Creek Group" near Springsure, Queensland, however these should be considered as *A. corrugatus*.

Material available: The species is common to abundant in strata of the Freitag, Ingelara, Catherine, Peawaddy, Barfield, Flat Top, Maria and Blenheim Formations (L 3592, 3596, 3599, 3611, 3614, 3619, 3620, 3623, 3626, 3632, 3633, 3637, 3642, 3644, 3708 to 3720, 3726, 3727).

Figured types: GSQ MF 066/9-11 from L 3632; GSQ MF 066/12-15 from L 3720 both in Ingelara Formation.

Distribution: The species is uniquely present in the Bowen Basin in sediments equivalent to and above the upper part of the Aldebaran Sandstone and including the Freitag, Ingelara, Catherine, Peawaddy, Barfield, Flat Top, Maria and Blenheim Formations.

Age: The species range is Ufimian to Kazanian.

Palaeoenvironment: The species is ubiquitous in cold to cold temperate waters of shallow, marginal seas depositing muddy, silty sediments and is taken to represent a facies controlled assemblage zone.

Ammodiscus multicinctus Crespin & Parr 1941 (Pl. 4, figs 5,7; pl. 7, figs 22,23; pl. 8, figs 15,17)

1941 *Ammodiscus multicinctus* Crespin & Parr: p. 303-304, pl. 12, fig. 1a,b
1958 *Ammodiscus multicinctus* Crespin & Parr; Crespin: p. 67-68, pl. 12, figs 4-6
1982 *Ammodiscus multicinctus* Crespin & Parr; Scheibnerova: p. 58, pl. 14, fig. 4; pl. 15, figs 1-3
1985 *Ammodiscus multicinctus* Crespin & Parr; Palmieri *in* Foster & others: p. 79, pl. 4, figs 2,3

Description: Test arenaceous, tubular chamber planispirally enrolled in about six whorls, slightly increasing in diameter in last whorl and constricted at fairly regular intervals, giving a lobulate periphery; surface roughened, aperture generally circular (abridged from Crespin & Parr, 1941, p. 303).

Material available: The species is fairly common in the Early Permian formations of the Bowen Basin (Cattle Creek and Tiverton Formations), less common in the Late Permian (Freitag, Ingelara, Peawaddy, Barfield, Flat Top, Maria, Blenheim Formations) (L 3607, 3613, 3614, 3636, 3642, 3644, 3688, 3708 to 3727.

Figured types: GSQ MF 066/1, 066/5-8, 066/13 from L 3688, 3724, 3636, 3642, 3722.

Distribution: QLD, Bowen Basin: Cattle Creek, Tiverton, Freitag, Ingelara, Peawaddy, Barfield, Flat Top, Maria, Blenheim Formations. NSW, Sydney Basin: Dalwood, Maitland, Singleton, Conjola Groups, Berry Formation. TAS, Quamby Mudstone. WA, Perth Basin: Fossil Cliff Member of the Holmwood Shale; Carnarvon Basin: Callytharra Formation, Byro Group.

Age: The species range is Artinskian to Kazanian in Queensland; Sakmarian to Ufimian (?Kazanian) in New South Wales; Sakmarian in Tasmania; Sakmarian to Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold temperate waters of shallow, marginal seas depositing muddy, silty sediments.

Ammodiscus nitidus Parr 1942 (Pl. 4, fig. 6, 8-13; pl. 30, fig. 9)

1942 *Ammodiscus nitidus* Parr: p. 103, pl. 1, fig. 1a,b

1958 *Ammodiscus nitidus* Parr; Crespin: p. 68-69, 206-207, pl. 12, figs 7-9

1968 *Ammodiscus nitidus* Parr; Belford: pl. 1, figs 5-7

1982 *Ammodiscus nitidus* Parr; Scheibnerova: p. 58, pl. 11, fig. 2; pl. 13, figs 2,4; pl. 14, figs 1,3a,b,5

1985 *Ammodiscus nitidus* Parr; Palmieri *in* Foster & others: p. 79. pl. 4, figs 4,5

Remarks: All the specimens recovered from the Bowen Basin clearly follow the original description in Parr (1942, p. 103).

Material available: The species is common in the Cattle Creek and Tiverton Formations of the Bowen Basin (L 3607, 3636, 3688, 3708, 3709, 3718 to 3724).

Figured types: GSQ MF 066/1-3, 067/4-8, from L 3688, 3723, 3724.

Distribution: QLD, Bowen Basin: Cattle Creek and Tiverton Formations. NSW, Sydney Basin: Dalwood, Maitland, Singleton Groups, Berry Formation. WA, Perth Basin: Holmwood Shale, High Cliff Sandstone, Carynginia Formation; Carnarvon Basin: Callytharra Formation, Byro Group, Canning Basin: Nura Nura Member of Poole Sandstone, Noonkambah Formation.

Age: The species range is Artinskian in Queensland; Sakmarian to Artinskian in Western Australia; Sakmarian to Ufimian in New South Wales.

Palaeoenvironment: The species is related to cold and cold temperate waters of shallow seas depositing sandy, silty and muddy sediments.

Ammodiscus sp. cf. ***A. oonahensis*** Crespin 1958 (Pl. 4, figs 14-16)

Remarks: Common to rare, small *Ammodiscus* usually oblong or oval in their planispiral shape, with arenaceous agglutinated wall and with higher, compressed, and slightly constricted last whorl which make more deeply depressed the final part of the spiral suture, are here compared to *A. oonahensis* Crespin from which, however differ in their size, planispiral arrangement, and more coarsely arenaceous surface.

Material available: The species is common to rare in the Mostyndale Mudstone and Riverstone Sandstone Members of the Cattle Creek Formation (L 3721, 3722).

Figured types: GSQ MF 066/2-4 from L 3722, 3721.

Distribution: Bowen Basin (Denison Trough): Mostyndale Mudstone and Riverstone Sandstone Members of the Cattle Creek Formation.

Age: The species range is Early Artinskian.

Palaeoenvironment: The species is related to cold waters of shallow seas depositing sandy, muddy sediments.

Subfamily **TOLYPAMMININAE** Cushman 1928

Genus **TOLYPAMMINA** Rhumbler 1895

Type species: *Hyperammina vagans* Brady 1879; OD(M).

Tolypammina undulata Parr 1942 (Pl. 7, fig. 20; pl. 13, fig. 5)

1942 *Tolypammina undulata* Parr: p. 104, pl. 2, fig. 2
1958 *Tolypammina undulata* Parr; Crespin: p. 72, pl. 19, figs 7,8
1967 *Tolypammina undulata* Parr; Ludbrook: p. 79-80, pl. 4, figs 5,9
1968 *Ammovertella undulata* (Parr); Belford: p. 6, pl. 2, fig. 12
1973 *Tolypammina undulata* Parr; Harris & Mcgowran: p. 62, pl. 1, figs 5,6
1982 *Hyperammina vagans* Scheibnerova (*non* Brady): p. 55-56, pl. 4, fig. 4

Remarks: The small specimens of this encrusting, tubular, arenaceous foraminifer recovered from various formations of the Bowen Basin do comply in nearly all aspects with the description in Parr (1942, p. 104); the exception being in the less expanded tubular chamber.

Material available: The species is rare to common in the Bowen Basin; rare in the Cattle Creek Formation and more common in the Freitag, Ingelara, Catherine, Peawaddy and Blenheim Formations (L 3708 to 3727, 3611, 3613, 3623, 3633, 3640, 3642).

Figured types: GSQ MF 070/1-2 from L 3724, 3726.

Distribution: QLD, Bowen Basin: Cattle Creek Formation and Freitag, Ingelara, Catherine, Peawaddy Formations. NSW, Sydney Basin: Maitland Group. SA, Archaringa Basin: Stuart Range Formation. WA, Carnarvon Basin: Byro Group; Canning Basin: Noonkambah Formation.

Age: The species range is Artinskian to Ufimian-Kazanian in Queensland; Artinskian in New South Whales, South Australia and Western Australia.

Palaeoenvironment: The species is related to cold and cold temperate waters of marginal, shallow seas depositing sandy, muddy sediments.

Subfamily **AMMOVERTELLININAE** Saidova 1981

Genus **GLOMOSPIRELLA** Plummer 1945

Type species: *Glomospira umbilicata* Cushman & Waters 1927; OD.

Glomospirella nyei Crespin 1958 (Pl. 8, figs 24-27)

1958 *Glomospirella nyei* Crespin: p. 70-71, 207, pl. 13, figs 1-5
1968 *Glomospirella nyei* Crespin: pl. 2, fig. 2
1982 *Glomospirella nyei* Crespin; Scheibnerova: p. 59
1985 *Glomospirella nyei* Crespin; Palmieri *in* Foster & others: p. 79, pl. 4, figs 6,7

Remarks: The *G. nyei* here considered conform in all aspects to the paratype material from the Blenheim Formation (L 3619) described by Crespin (1958, p. 71), rather than to the holotype which comes from the Early Permian Callytharra Formation.

Material available: The species is common to abundant in the Freitag, Ingelara, Catherine, Peawaddy, Barfield, Flat Top, and Blenheim Formations of the Bowen Basin (L 3708 to 3720, 3611 to 3623, 3633, 3642, 3582, 3586, 3593, 3608).

Figured types: GSQ MF 068/1-4 from L 3726.

Distribution: QLD, Bowen Basin: Freitag, Ingelara, Catherine, Peawaddy, Barfield, Flat Top, Blenheim Formations. NSW, Sydney Basin: Branxton Formation. WA, Perth Basin: Holmwood Shale; Carnarvon Basin: Callytharra Formation, Byro Group; Canning Basin: Grant Group, Nura Nura Member of the Poole Sandstone, Noonkambah Formation.

Age: The species range is Ufimian to Kazanian in Queensland; Artinskian in New South Wales; Sakmarian to Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold temperate waters of shallow seas depositing muddy, silty sediments.

Glomospirella sp. cf. ***G. nyei*** Crespin (Pl. 12, figs 8-13)

Remarks: Small *Glomospirella*, which can only be compared with *G. nyei*, have been separated from the main group; they show a smoother wall surface and a smaller test.

Material available: The species is rare in the Cattle Creek Formation.

Figured types: GSQ MF 202/1-4 from L 3718.

Distribution: QLD, Bowen Basin: Cattle Creek Formation.

Age: The species range is Artinskian.

Palaeoenvironment: The species is related to cold waters of shallow seas depositing silty, muddy sediments.

Glomospirella sp. cf. ***G. umbilicata*** Cushman & Waters (Pl. 4, figs 17,18)

Remarks: The species shows a somewhat twisted tubular chamber with abrupt change of direction, which gives a polygonal rather than a circular appearance; the peripheral part is flattened giving the appearance of a keel and the surface is translucent: these characters justify the comparison with the classic Pennsylvanian species.

Material available: The species is rare in the Cattle Creek, Ingelara, Barfield, Flat Top, and Blenheim Formations of the Bowen Basin (L 3592, 3593, 3599, 3699, 3713, 3720, 3722, 3723, 3724).

Figured types: GSQ MF 069/1-2 from L 3724.

Distribution: Bowen Basin: Cattle Creek, Ingelara, Barfield, Flat Top, Blenheim Formations.

Age: The species range is Artinskian to Kazanian in Queensland.

Palaeoenvironment: The species is related to cold and cold temperate waters of shallow seas depositing sandy to muddy sediments.

Superfamily **HORMOSINACEA** Haeckel 1894

Family **HORMOSINIDAE** Haeckel 1894

Subfamily **REOPHACINAE** Cushman 1910

Genus **REOPHAX** de Monfort 1808

Type species: *Reophax scorpiurus* de Monfort 1808; OD.

Reophax asper Cushman & Waters 1928 (Pl. 3, figs 12-14; pl. 7, figs 4-8)

1928 *Reophax asperus* Cushman & Waters: p. 37, pl. 4, fig. 7
1930 *Reophax asper* Cushman & Waters: p. 37, pl. 2, fig. 10
1958 *Reophax asper* Cushman & Waters; Crespin: p. 59-60, pl. 10, figs 1-4

Remarks: *R. asper* includes here medium to large size (0.75 to 1.5mm in length) specimens with coarsely arenaceous surface and nearly indistinct chambers or segments.

Material available: The species is rare to common in the Staircase Sandstone and Sirius Mudstone Members of the Cattle Creek Formation (L 3636, 3639, 3724).

Figured types: GSQ MF 071/1-8 from L 3724, 3639.

Distribution: QLD, Bowen Basin: Staircase Sandstone and Sirius Mudstone Members of the Cattle Creek Formation; Ingelara Formation, Catherine Sandstone. NSW, Sydney Basin: Dalwood Group, Maitland Group, Shoalhaven Group. WA, Canning Basin: Grant Group.

Age: The species range is Artinskian to Ufimian in Queensland; Sakmarian to Ufimian in New South Wales; Sakmarian in Western Australia.

Palaeoenvironment: The species is related to cold water, shallow seas depositing sandy and muddy sediments.

Reophax belfordi Crespin 1958 (Pl. 8, figs 6-8)

1958 *Reophax belfordi* Crespin: p. 60-61, pl. 10, figs 8-11
1982 *Reophax belfordi* Crespin; Scheibnerova: p. 60, pl. 9, figs 1,4; pl. 10, fig. 2

Description: Test small, slender, tapering, irregularly elongated, and composed of small angular quartz grains (Crespin 1958, p. 60).

Remarks: This species may belong to the genus *Scherochorella* (Loeblich & Tappan 1984), however, insufficient regularity is seen in the test of our specimens.

Material available: The species is rare to common in the Cattle Creek, Freitag, and Ingelara Formations (L 3632, 3636, 3639, 3642, 3722, 3723).

Figured types: GSQ MF 077/6-8 from L 3642.

Distribution: QLD, Bowen Basin: Cattle Creek, Freitag, and Ingelara Formations. NSW, Sydney Basin: ?Singleton Group. WA, Carnarvon Basin: Byro Group.

Age: The species range is Artinskian to Ufimian in Queensland; ?Ufimian in New South Wales; Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold waters of shallow, marginal seas depositing sandy, muddy sediments.

Reophax fittsi (Warthin 1930) (Pl. 3, fig. 7)

1930 *Nodosinella? fittsi* Warthin: p. 27, pl. 2, fig. 7
1945 *Reophax fittsi* (Warthin); Plummer: p. 228, pl. 17, figs 10-17
1958 *Reophax fittsi* (Warthin); Crespin: p. 228, pl. 11, figs 7-9

Remarks: The figured specimen illustrate the main characters of the species, namely, the moderately coarsely arenaceous surface, the tapering chambers, the slightly depressed sutures, and the aperture with a faintly produced neck.

Material available: The species is rare in the Mostyndale Mudstone Member of the Cattle Creek Formation.

Figured types: GSQ MF 072/1 from L 3688.

Distribution: QLD, Bowen Basin: Cattle Creek Formation. WA, Carnarvon Basin: basal Byro Group; Canning Basin: Grant Group.

Age: The species range is Artinskian in Queensland; Sakmarian to Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold waters of shallow seas depositing silty, muddy sediments.

Reophax minutissimus Plummer 1945 (Pl. 3, figs 8,9; pl. 7, figs 1-3)

1945 *Reophax minutissimus* Plummer: p. 230, pl. 17, figs 25-30
1958 *Reophax minutissimus* Plummer; Crespin: p. 63-64, pl. 10, figs 5-7
1982 *Reophax minutissimus* Plummer; Scheibnerova: p. 60-61, pl. 10, figs 2,3

Remarks: This small species was identified by Crespin from samples collected in the Ingelara or Catherine Sandstone Formation of the Bowen Basin; the specimens here figured extend the range of the species down to the Cattle Creek Formation. As for *R. belfordi*, this species may belong to the genus *Scherochorella* (Loeblich & Tappan 1984).

Material available: The species is rare in the Mostyndale and Sirius Mudstone Members of the Cattle Creek Formation (L 3636, 3688, 3709, 3724).

Figured types: GSQ MF 072/2-3; 072/6-8 from L 3688, 3724.

Distribution: QLD, Bowen Basin: Cattle Creek, Ingelara and Catherine Formations. NSW, Sydney Basin: Mulbring Siltstone, Berry Formation, Singleton Group. WA, Carnarvon Basin: basal Byro Group.

Age: The species range is Artinskian to Ufimian in Queensland; Ufimian in New South Wales; Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold waters of shallow, marginal seas depositing sandy, muddy sediments.

Reophax subasper Parr 1942 (Pl. 3, figs 10,11)

1942 *Reophax subasper* Parr: p. 108-109, pl. 1, fig. 12
1958 *Reophax subasper* Parr; Crespin: p. 64, pl. 11, figs 10,11
1982 *Reophax subasper* Parr; Scheibnerova: p. 61, pl. 9, fig. 2a,b

Remarks: The specimens here illustrated conform in all aspects except in their smaller size the original description by Parr.

Material available: The species is rare in the Cattle Creek Formation (L 3636, 3639, 3723, 3724).

Figured types: GSQ MF 072/4-5 from L 3724.

Distribution: QLD, Bowen Basin: Cattle Creek Formation. NSW, Sydney Basin: Conjola Group, Maitland Group. WA, Carnarvon Basin: Byro Group; Canning Basin: Noonkambah Formation, Liveringa Group Lightjack Member.

Age: The species range is Artinskian in Queensland; Artinskian and Ufimian in New South Wales and Western Australia.

Palaeoenvironment: The species is related to cold waters of shallow, marginal seas depositing sandy to muddy sediments.

Superfamily **LITUOLACEA** de Blainville 1827

Family **HAPLOPHRAGMOIDIDAE** Maync 1952

Genus **HAPLOPHRAGMOIDES** Cushman 1910

Type Species: *Nonionina canariensis* d'Orbigny 1839; OD.

***Haplophragmoides*?** sp. (Pl. 8, fig. 14; pl. 11, figs 6-10; pl. 23, figs 12,13)

Remarks: Three slightly different agglutinating tests are here doubtfully attributed to species of the genus *Haplophragmoides*: the first, figured on pl. 8, fig. 14, has a coarsely agglutinated wall and a relatively smooth surface, is planispirally enrolled and biumbilicate, and has an apertural slit at the base of the last chamber; the second, figured on pl. 11, figs 6-10, is a more flattened, planispirally enrolled agglutinating form with a very smooth surface, and the apertural slit in equatorial position at the base of the last chamber; the third, figured on pl. 23, figs 12,13, has a finely arenaceous agglutinated wall, smooth surface, and planispiral enrolment. They have been left in open nomenclature because they are very rare in their sample of origin.

Distribution: The specimens come, in order of illustration, from the Ingelara Formation (L 3642), the Cattle Creek Formation (L 3709), and the Mantuan Productus bed (L 3727).

Figured types: GSQ MF 074/1, 252/2, 075/1 from L 3642, 3709, 3727 respectively.

Age: The three specimens come from samples of Ufimian, Artinskian, and Kazanian age, respectively.

Palaeoenvironment: The specimens are related to cold and cold temperate waters of shallow, marginal seas depositing sandy to muddy sediments.

Family LITUOLIDAE de Blainville 1827

Subfamily AMMOMARGINULININAE Podobina 1878

Genus AMMOBACULITES Cushman 1910

Type species: *Spirolina agglutinans* d'Orbigny 1846; OD

Ammobaculites woolnoughi Crespin & Parr 1941 (Pl. 3, figs 1-6; pl. 6, fig. 10; pl. 7, figs 27,28)

1941 *Ammobaculites woolnoughi* Crespin & Parr: p. 304-305, pl. 12, figs 2a,b,3a,b
1942 *Ammobaculites woolnoughi* Crespin & Parr; Parr: p. 108, pl. 1, fig. 11
1945 *Ammobaculites woolnoughi* Crespin & Parr; Crespin: p. 25, pl. 3, fig. 11
1947 *Ammobaculites woolnoughi* Crespin & Parr; Crespin: p. 19, 22, pl. 1, fig. 4; pl. 2, figs 16,17
1958 *Ammobaculites woolnoughi* Crespin & Parr; Crespin: p. 75-76, 206, pl. 14, figs 10,11
1968 *Ammobaculites woolnoughi* Crespin & Parr; Belford: p. 4, pl. 1, fig. 10
1982 *Ammobaculites woolnoughi* Crespin & Parr; Scheibnerova: p. 63, pl. 18, figs 2,5; pl. 21, figs 1,6; pl. 22, fig. 2
1982 *Ammobaculites crescendo* Scheibnerova: p. 62, pl. 18, fig. 6; pl. 21, fig. 5
1985 *Ammobaculites woolnoughi* Crespin & Parr: Palmieri *in* Foster & others: p. 79-80, pl. 4, fig. 1

Description: Test medium to moderately large in size, crozier-shaped, early portion closely coiled, followed by four to six chambers in rectilinear series, gradually increasing in size; sutures depressed; wall coarsely arenaceous with rough surface; aperture terminal, nearly circular (from Crespin and Parr, 1941, p. 304, abridged).

Remarks: The species *A. crescendo* Scheibnerova 1982 is considered to fall within the range of variability shown by *A. woolnoughi* Crespin & Parr 1941. Crespin reports the occurrence of this species in the Ingelara Formation and Catherine Sandstone; the present author could not confirm this occurrence in the samples investigated.

Material available: The species is rare to common in the Cattle Creek and in the Tiverton Formations (L 3607, 3636, 3720, 3721, 3722).

Figured types: GSQ MF 078/1-9 from the Riverstone Sandstone, Mostyndale Mudstone, Moorooloo Mudstone, and Sirius Mudstone Members of the Cattle Creek Formation (L 3636, 3720 to 3722).

Distribution: QLD, Bowen Basin: Cattle Creek, Tiverton, ?Ingelara Formations. NSW, Sydney Basin: Dalwood Group, Maitland Group, Capertee Group, Wandarawandian Siltstone. TAS, Quamby Mudstone. WA, Perth Basin: Fossil Cliff Member of the Holmwood Shale; Carnarvon Basin: Byro Group; Canning Basin: Noonkambah Formation.

Age: The species range is Artinskian to ?Ufimian in Queensland; Sakmarian to Kazanian in New South Wales; Sakmarian in Tasmania; Sakmarian to Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold waters of marginal seas depositing sandy to muddy sediments.

Ammobaculites sp. cf. **A. eccentricus** Crespin 1958 (Pl. 8, figs 9-13,16)

cf. 1958 *Ammobaculites eccentrica* Crespin: p. 73-74, pl. 14, figs 4-9
non 1968 *Ammobaculites* sp. cf. *A. eccentrica* Crespin; Belford: p. 5, pl. 1, fig. 9

Description: A small, agglutinating arenaceous test, with initial chambers planispirally coiled then uniserially arranged with base in eccentrical position;

test wall finely arenaceous in planispiral portion, slightly coarser with small quartz grains in uniserial portion; sutures indistinct in early part, distinct and depressed in later; dimension of microsphaeric test: length 0.5mm; diameter of planispiral portion: 0.2mm; of megalosphaeric test: length 0.4mm; diameter of planispiral portion: 0.3mm.

Remarks: This species has a slightly bigger size than *A. eccentricus*, smoother surface, somewhat flattened or lenticular planispiral portion and much longer uniserial stage.

Material available: The species is common in outcrop samples from L 3642, Ingelara Formation.

Figured types: GSQ MF 076/1-5, 084/1 from L 3642, Ingelara Formation.

Distribution: QLD, Bowen Basin (Denison Trough), Ingelara Formation.

Age: The species known range in Queensland is Ufimian.

Palaeoenvironment: The species is related to cold waters of marginal seas depositing sandy to muddy sediments.

Ammobaculites sp. cf. ***A. wandageensis*** Crespin 1958 (Pl. 8, figs 1-5)

cf. 1958 *Ammobaculites wandageensis* Crespin: p. 74-75, pl. 14, figs 1-3

Description: A medium size arenaceous test with small coiled section consisting of 4-5 chambers and a uniserial portion of 6-8 chambers; test wall and surface medium to coarsely arenaceous, sutures depressed and distinct; average length of figured specimens 1.25mm; average diameter of coiled section 0.15mm (microsphaeric forms only).

Remarks: Similarity features to *A. wandageensis* are the nearly cylindrical shape of the chambers in uniserial portion and the small size of the coiled portion; dissimilarity by the bigger size of the uniserial portion.

Material available: The species is rare to common in the latest part of the Sirius Mudstone Member of the Cattle Creek Formation and in the Ingelara and Freitag Formations (L 3632, 3636, 3642).

Figured types: GSQ MF 077/1-5 from L 3632, Ingelara Formation.

Distribution: QLD, Bowen Basin (Denison Trough): Sirius Mudstone Member of the Cattle Creek Formation, Freitag and Ingelara Formations.

Age: The species known range is latest Artinskian to Ufimian.

Palaeoenvironment: The species is related to cold waters of marginal seas depositing sandy to muddy sediments.

Superfamily **TROCHAMMINACEA** Schwager 1877

Family **TROCHAMMINIDAE** Schwager 1877

Subfamily **TROCHAMMININAE** Schwager 1877

Genus **PATELLOVALVULINA** Neagu 1975

Type species: *Patellovalvulina patruliusi* Neagu 1975; OD.

***Patellovalvulina*?** sp. (Pl. 11, figs 1-5)

Description: A free, relatively small, agglutinating, finely arenaceous test, slightly convexo-concave; overlapping chambers visible on dorsal side, indistinct on umbilical side; broadly keeled periphery; intermarginal aperture, a small slit covered by an apparently lobate flap.

Remarks: The species is only dubiously referred to *Patellovalvulina*, which has only been reported from the Early Cretaceous.

Material available: The species is rare in one locality of the Cattle Creek Formation (L 3709).

Figured type: GSQ MF 252/1 from L 3709.

Distribution: The species is only known from one locality of the Cattle Creek Formation (L 3709), Bowen Basin (Denison Trough), Queensland.

Age: The species is known so far only from the late Artinskian.

Palaeoenvironment: The species is related to cold water sea depositing muddy sediments.

Genus TROCHAMMINA Parker and Jones 1859

Type species: *Nautilus inflatus* Montagu 1808; OD.

Trochammina laevis Crespin 1958 (Pl. 13, figs 1-4)

1958 *Trochammina laevis* Crespin: p. 90, pl. 21, figs 1-4

1982 *Trochammina laevis* Crespin; Scheibnerova: p. 65, pl. 26, figs 2-5; pl. 27, figs 2,3; pl. 28, figs 1-4

Description: Test of medium size, rounded or oblong, usually compressed; chambers trochospirally arranged, 6-8 in last whorl; sutures distinct, straight; test-wall finely agglutinated; average diameter of figured specimens: 0.7mm.

Remarks: The species was originally found only from a section through Mt Hope, 24 miles southeast of Springsure (Bowen Basin), which include lithotypes belonging to the Ingelara Formation, Catherine Sandstone, and Peawaddy Formation (Crespin 1958). Reports of the species from Early Permian outcrops of the Sydney Basin (Scheibnerova 1983) are considered doubtful.

Material available: The species is rare to common in the Ingelara, Peawaddy and Blenheim Formations; common to abundant in the Catherine Sandstone (L 3611, 3633, 3637, 3643, 3709, 3710, 3712, 3714, 3715, 3726).

Figured types: GSQ MF 084/2-4 from L 3726, Catherine Sandstone.

Distribution: QLD, Bowen Basin: Ingelara Formation, Catherine Sandstone, Peawaddy Formation; Blenheim Formation. NSW, Sydney Basin: Mulbring Siltstone, Berry Siltstone.

Age: The species range is Ufimian to Kazanian in the Bowen Basin and possibly in the Sydney Basin.

Palaeoenvironment: The species is related to cold and cold temperate waters of shallow, very marginal shelf sea depositing sandy, silty sediments.

Trochammina pulvilla Crespin & Parr 1941 (Pl. 10, figs 1-16)

1941 *Trochammina pulvillus* Crespin & Parr: p. 308-309, pl. 12, fig. 6a-c

1947 *Trochammina pulvillus* Crespin & Parr; Crespin: pl. 2, figs 21,22

1958 *Trochammina pulvilla* Crespin & Parr; Crespin: p. 91-92, pl. 22, figs 1-4

1982 *Trochammina pulvilla* Crespin & Parr; Scheibnerova: p. 65, pl. 29, fig. 1

Remarks: Under *T. pulvilla* are here included specimens with their last whorl consisting of six to four chambers, and the remaining specific characters unchanged: test small, trochoid, almost circular, consisting of three whorls, sutures slightly curved, ventral side umbilicate and slightly concave, dorsal side convex, aperture at base of last chamber, in umbilical position.

Material available: The species is common to rare in outcrop samples of the Sirius Mudstone Member of the Cattle Creek Formation; of the Buffel and Oxtrack Formations and of the undifferentiated Cattle Creek Formation in GSQ Eddystone 4 (L 3588, 3589, 3601, 3636, 3709).

Figured types: GSQ MF 251/1-5, from L 3709, undifferentiated Cattle Creek Formation.

Distribution: QLD, Bowen Basin: Sirius Mudstone Member of the Cattle Creek Formation, undifferentiated Cattle Creek Formation, Buffel Formation, Oxtrack

Formation. NSW, Sydney Basin: Branxton Formation, Mulbring Formation, Capertee Group, Berry Formation. WA, Carnarvon Basin: Wandagee Formation.

Age: The species range is Late Artinskian and Ufimian in Queensland and New South Wales; Late Artinskiam in Western Australia.

Palaeoenvironment: The species is related to cold temperate waters of shallow, marginal seas depositing muddy silty sediments.

Trochammina subobtusa Parr 1942 (Pl. 12, figs 14-23)

1942 *Trochammina subobtusa* Parr: p. 109, pl. 1, fig. 14a-c
1958 *Trochammina subobtusa* Parr; Crespin: p. 92, 207, pl. 21, figs 5,6
1965 *Trochammina subobtusa* Parr; Belford: p. 17, pl. 2, figs 1,2
1982 *Trochammina subobtusa* Parr; Scheibnerova: p. 65-66, pl. 25, figs 7; pl. 29, figs 2-4

Description: Test small to medium size, globose, chambers inflated, trochospirally arranged in three whorls, sutures distinct and depressed, wall finely arenaceous, surface smooth, aperture at base of last chamber in umbilical position (abridged from Parr 1942, p. 109).

Material available: The species is rare to common in the Sirius Mudstone Member of the Cattle Creek Formation, in the Buffel Formation, and in the undifferentiated Cattle Creek Formation of GSQ Eddystone 4 (L 3588, 3636, 3709).

Figured types: GSQ MF 202/4-7 from L 3709, undifferentiated Cattle Creek Formation.

Distribution: QLD, Bowen Basin: Sirius Mudstone Member, Cattle Creek Formation, Buffel Formation, undifferentiated Cattle Creek Formation. NSW, Sydney Basin: Dalwood Group, Singleton Supergroup, Wandrawandian Siltstone. WA, Perth Basin: Holmwood Shale and Fossil Cliff Member; Carnarvon Basin: Calytharra Formation and Byro Group; Canning Basin: Noonkambah Formation.

Age: The species range is Late Artinskian in Queensland; Late Sakmarian to ?Kazanian in New South Wales; Late Sakmarian to Late Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold waters of shallow seas depositing muddy to sandy sediments.

Trochammina sp. (Pl. 9, figs 1-9)

Remarks: A few specimens of *Trochammina* are left in open nomenclature: the figured ones occur in the undifferentiated Cattle Creek Formation of GSQ Eddystone 4; the species may be compared with *T. pulvilla* from which, however, can be distinguished by its flatter shape, its recurved sutures and deep umbilical depression.

Material available: The figured species is rare in the Cattle Creek Formation of GSQ Eddystone 4 (L 3709); other rare indeterminated *Trochammina* occur in L 3721-3723, 3707, 3688, and 3610.

Figured types: GSQ MF 250/1-2 from L 3709.

Distribution: QLD, Bowen Basin, Cattle Creek Formation.

Age: The species range is confined to the Artinskian.

Palaeoenvironment: The species is related to cold waters of shallow, marginal seas depositing muddy, silty sediments.

Superfamily **VERNEULINACEA** Cushman 1911

Family **VERNEULINIDAE** Cushman 1911

Subfamily **VERNEULINOIDINAE** Suleymanov 1973

Genus **MOOREINELLA** Cushman & Waters 1928

Type species: *Mooreinella biserialis* Cushman & Waters 1928; OD.

Remarks: Under *Mooreinella* are here included the Permian species previously referred to the genera *Digitina* Crespin & Parr 1941, *Textularia* Defrance 1824 by Crespin 1958 (synonymy), and *Bigenerina* d'Orbigny 1826 by Cushman & Waters 1930. This is in agreement with the reinterpretation and reclassification of *Mooreinella* Cushman and Waters 1928 by Loeblich & Tappan 1987: *Mooreinella* is, in fact, considered the only available genus for agglutinating, non canaliculate test species with primitive trocho-trispiral or irregularly triserial early stage, a biserial and monoserial later stage and an interiomarginal arched aperture at base of last chamber.

Mooreinella bookeri (Crespin 1958) (Pl. 1, figs 15,16; pl. 3, figs 20-28; pl. 24, fig. 8)

1941 *Textularia eximia* Crespin & Parr (*non* Eichwald 1860): p. 305-306, pl. 13, figs 7a-c,8a-c

1958 *Textularia bookeri* Crespin: p. 77-78, pl. 15, figs 1-7

1967 *Textularia bookeri* Crespin; Ludbrook: p. 82, pl. 4, fig. 18

1982 *Textularia bookeri* Crespin; Scheibnerova: p. 64, pl. 22, figs 5,6; pl. 23, figs 1-4,6; pl. 24, figs 2-6; pl. 25, figs 4,6

Description: Test small, elongate, straight or slightly curved; chambers round to subquadrate, slowly expanding, irregularly triserially arranged in early stage, then biserially and may become uniserially in later stage of autogeny. Test wall siliceous, hyaline from finely to medium coarsely agglutinated, sutures horizontal to slightly inclined, depressed. Average height of figured specimens: 0.57mm; average width: 0.15.

Material available: The species is rare in the Mostyndale Mudstone Member, and common in the Moorooloo and Sirius Mudstone Members of the Cattle Creek Formation; it is also rare in the Tiverton Formation (L 3610, 3636, 3639, 3709, 3721 to 3724).

Figured types: GSQ MF 081/1, GSQ MF 079/1-10, from L 3721, 3722.

Distribution: QLD, Bowen Basin: Mudstone Members of the Cattle Creek Formation, Tiverton Formation. NSW, Sydney Basin: Dalwood group, Branxton and Mulbring Formations, Singleton and Capertee Group, Wandravandian Siltstone and Berry Formation. SA, Arckaringa and Trowbridge Basins: Stuart Range Formation, Cape Jervis Beds. WA, Carnarvon Basin: Byro Group.

Age: The species range is Artinskian in Queensland; Sakmarian to Kazanian in New South Wales; Artinskian in South Australia and Western Australia.

Palaeoenvironment: The species is related to cold waters of shallow seas depositing muddy, silty sediments.

Mooreinella improcera (Crespin 1958) (Pl. 15, figs 22-24; pl. 24, fig. 9)

1958 *Textularia improcera* Crespin: p. 78-79, pl. 15, figs 8,9

1982 *Textularia improcera* Crespin; Scheibnerova: p. 64, pl. 23, fig. 5

Remarks: A small, stout, finely agglutinating test, consisting of an irregularly arranged and partly broken early stage followed by a biserially arranged stage in which the chambers are greatly expanding is attributed to the species *improcera*; its dimensions are: height: 0.6mm; width: 0.2mm.

Material available: One specimen from outcrop sample in L 3639.

Distribution: QLD, Bowen Basin, Denison Trough: upper part of Sirius Mudstone Member of the Cattle Creek Formation. NSW, Sydney Basin: Mulbring

Siltstone, Singleton Supergroup. WA, Carnarvon Basin Coyrie and Baker Formations, Byro Group.

Age: The species range is Late Artinskian in Queensland and Western Australia; Ufimian-Kazanian in New South Wales.

Palaeoenvironment: The species is related to cold waters of shallow seas depositing muddy, silty sediments.

Mooreinella recurvata (Crespin & Parr 1941) (Pl. 1, figs 13,14; pl. 3, figs 15-19; pl. 24, figs 6,7)

1941 *Digitina recurvata* Crespin & Parr: p. 306, pl. 13, figs 9a-b,10a-b

1958 *Digitina recurvata* Crespin & Parr; Crespin: p. 79, pl. 15, figs 10,11

1967 *Digitina recurvata* Crespin & Parr; Ludbrook: p. 83, pl. 4, figs 10-12

1973 *Digitina recurvata* Crespin & Parr; Harris & McGowan: p. 62-63, pl. 1, figs 15-20

1982 *Digitina recurvata* Crespin & Parr; Scheibnerova: p. 66, pl. 22, fig. 8a-b; pl. 24, fig. 1

Description: Test small to medium size, elongate, curved, early chambers small, arranged irregularly, triserially, later chambers expanding, rounded, biserially arranged; wall agglutinating coarsely arenaceous, single layered; chambers internally undivided, aperture arched, interiomarginal, at base of last chamber (modified after Crespin & Parr 1941, p. 306).

Material available: The species is rare to common in the Bowen Basin (Denison Trough), Cattle Creek Formation (L 3639, 3707, 3721 to 3725).

Figured types: GSQ MF 081/2-6; 085/2-3 from L 3721, 3722.

Distribution: QLD, Bowen Basin: Cattle Creek Formation. NSW, Sydney Basin: Dalwood Group, Maitland Group, Capertee Group, Singleton Group. TAS, Quamby Mudstone. SA, Arckaringa Basin: Stuart Range Beds, Mt Tondina Beds. WA, Carnarvon Basin: Byro Group; Canning Basin: Noonkambah Formation.

Age: The species range is Artinskian in Queensland, Sakmarian to Kazanian in New South Wales; Sakmarian in Tasmania; Sakmarian to Artinskian in South Australia, Artinskian in Western Australia.

Palaeoenvironment: The species is related to periglacial and cold waters of shallow seas depositing muddy sediments.

?Mooreinella* sp. cf. *M. improcera (Crespin 1958) (Pl. 23, fig. 11)

Remarks: A small textularia-like individual which can only be doubtfully compared with *M. improcera* was found in the Mantuan *Productus* bed of L 3727. It consists of an incomplete megalosphaeric proloculus followed by eight biserially arranged, subrectangularly shaped chambers with sutures depressed and inclined with respect to a median frontal depression; the periphery is slightly lobate, the aperture is arched, at base of last chamber; the test wall is coarsely arenaceous. The dimensions are: height 0.95mm, width 0.47mm.

Material available: One specimen from Peawaddy Formation (Mantuan *Productus* bed) of L 3727.

Figured type: GSQ MF 082/1 from L 3727.

Age: Kazanian.

Palaeoenvironment: Cold temperate waters of shallow, marginal seas depositing sandy, coquinitic, glauconitic sediments.

***?Mooreinella* sp.** (Pl. 18, figs 16,17; pl. 24, fig. 5)

Remarks: A few bigenerina-like specimens retrieved from one sample, are left in open nomenclature and doubtfully included in *Mooreinella*. Their test is elongated, with an early stage of growth consisting of four to six pairs of subrectangular to subrounded chambers biserially arranged, followed by a later stage of four to six subcylindrical chambers uniserially arranged, and with sutures slightly depressed. The test wall is agglutinating arenaceous and the surface is smooth to rough with coarse inclusions; the aperture is central at top of last chamber. Dimensions: height 0.85mm; 1.28mm; width 0.33mm; 0.28mm; test wall thickness 0.02mm.

Material: The species is rare in the Catherine Sandstone of L 3726.

Figured types: GSQ MF 083/1-3 from L 3726.

Distribution: QLD, Bowen Basin (Denison Trough): Catherine Sandstone.

Age: Ufimian.

Palaeoenvironment: The species is related to cold temperate waters of shallow, marginal seas depositing sandy sediments.

Suborder **FUSULININA** Wedekind 1937

Superfamily **EARLANDIACEA** Cummings 1955

Family **EARLANDINIDAE** Cummings 1955

Genus **EARLANDIA** Plummer 1930

Type species: *Earlandia perparva* Plummer 1930; OD.

Earlandia condoni Crespin 1958 (Pl. 14, fig. 13)

1958 *Earlandia condoni* Crespin: p. 58-59, pl. 23, figs 6-8

Description: Test small to medium size, elongate, proloculus globular, second chamber tubular, with faint constrictions, but non septate; test wall calcareous microgranular on thin dark organic lining, surface smooth, at times translucent.

Material available: The species is rare in the lower part of the Cattle Creek Formation, Bowen Basin (L 3709, 3720, 3721, 3723.

Figured type: GSQ MF 087/1 from L 3721.

Distribution: QLD, Bowen Basin: Mostyndale Mudstone Member, Riverstone Sandstone Member, and lower part of Moorooloo Mudstone Member of the Cattle Creek Formation. NSW, Sydney Basin: Dalwood Group, Rutherford Formation. TAS, Gray Limestone. WA, Carnarvon Basin: Callytharra Formation.

Age: The species range is Early Artinskian in Queensland and Tasmania; Late Sakmarian in New South Wales and Western Australia.

Palaeoenvironment: The species is related to cold and cold temperate waters of shallow, marginal sea.

Suborder **MILIOLINA** Delage & Herouard 1896

Superfamily **CORNUSPIRACEA** Schultze 1854

Family **CORNUSPIRIDAE** Schultze 1854

Subfamily **CORNUSPIRINAE** Schultze 1854

Genus **RECTOCORNUSPIRA** Warthin 1930

Type species: *Rectocornuspira lituiformis* Warthin 1930, OD.

Rectocornuspira sp. (Pl. 12, fig. 5)

Remarks: Very rare specimens doubtfully referrable to *Rectocornuspira* were found at L 3720 and are left in open nomenclature: the figured specimen was picked from an acid treated residue and is considered silicified; a mica flake covers its planispiral stage; its maximum diameter measures 0.35mm.

Material available: The species is very rare in the Riverstone Sandstone Member of the Cattle Creek Formation at L 3720.

Figured type: GSQ MF 097/1 from L 3720.

Distribution: QLD, Bowen Basin (Denison Trough): Riverstone Sandstone Member of the Cattle Creek Formation.

Age: The species range so far ascertained is Early Artinskian.

Palaeoenvironment: The species is related to cold waters of shallow, coastal sea depositing sandy, muddy sediments.

Subfamily **MEANDROSPIRINAE** Saidova 1981

Genus **MEANDROSPIRA** Loeblich & Tappan 1946

Type species: *Meandrospira washitensis* Loeblich & Tappan 1946.

Meandrospira **sp. 1**

Remarks: One small specimen attributed to *Meandrospira* was retrieved from L 3720 in the upper part of the Cattle Creek Formation. During observation it fractured and fragmented. Its occurrence is here reported as it is the first of this genus in the Permian (Artinskian) of Queensland. *Meandrospira australae* Crespin & Belford, a possibly related species was reported to occur in the northern Sydney Basin in the Early Permian Dalwood Group (Scheibnerova 1960).

Meandrospira **sp. 2**

Remarks: One medium size specimen attributable to **Meandrospira** was retrieved from a sample of the Ingelara Formation from L 3633. It is left in open nomenclature as not enough material is at hand. Its main significance is in the range of the genus in the Ufimian of the Bowen Basin.

Subfamily **CALCIVERTELLINAE** Loeblich & Tappan 1964

Genus **CALCITORNELLA** Cushman & Waters 1928

Type species: *Calcitornella elongata* Cushman & Waters 1928, OD.

Calcitornella elongata Cushman & Waters 1928 (Pl. 13, figs 6-8, 13)

1928 *Calcitornella elongata* Cushman & Waters: p. 47, pl. 6, fig. 5
1958 *Calcitornella elongata* Cushman & Waters; Crespin: p. 82-83, pl. 17, figs 1-3
1982 *Calcitornella elongata* Cushman & Waters; Scheibnerova: p. 68, pl. 34, fig.2a-b
1985 *Calcitornella elongata* Cushman & Waters; Palmieri *in* Foster & others: p. 80, pl. 5, figs 11-13

Remarks: As reported in Palmieri (1985, p. 80) this genotypic species was originally described for encrusting individuals which show an undivided second chamber forming an irregular coil or zig-zag, covered by an imperforated calcareous layer with a heavily pitted external surface. Loeblich & Tappan (1988, p. 312) described its surface as rough. The specimens here illustrated encrust productid spines, are irregularly coiled, and show a roughly pitted surface.

Material available: The species is rare to common in the Riverstone Sandstone Member of the Cattle Creek Formation and common to frequent in the Oxtrack Formation and in the Ingelara to Peawaddy Formations of the Bowen Basin (L 3591, 3708 to 3710, 3719, 3720, 3726, 3727).

Figured types: GSQ MF 094/1-3 from L 3726.

Distribution: QLD, Bowen Basin: Cattle Creek Formation (mainly in the marine Riverstone Sandstone Member), Oxtrack Formation, Ingelara Formation, Catherine Sandstone, Peawaddy Formation (mainly in the Mantuan *Productus* bed). NSW, Sydney Basin: Rutherford Formation (Pokolbin Limestone), Singleton Supergroup. WA, Perth Basin: Fossil Cliff Member of the Holmwood Shale; Carnarvon Basin: Callytharra Formation.

Age: The species range is Early Artinskian and Ufimian to Kazanian in Queensland; Late Sakmarian and Kazanian in New South Whales; Late Sakmarian in Western Australia.

Palaeoenvironment: The species is related to cold to cold temperate waters of shallow coastal marine environment depositing sandy, biodetrital sediments.

Calcitornella heathi Cushman & Waters 1928 (Pl. 13, fig. 12)

1928 *Calcitornella heathi* Cushman & Waters: p. 48, pl. 6, fig. 8a-b

1958 *Calcitornella heathi* Cushman & Waters; Crespin: p. 83, pl. 13, figs 8-11; pl. 19, fig. 11

1968 *Calcitornella heathi* Cushman & Waters; Belford: p. 4, pl. 2, figs 17,18

1982 *Calcitornella heathi* Cushman & Waters; Scheibnerova: p. 68, pl. 34, figs 3,4

1985 *Calcitornella heathi* Cushman & Waters; Palmieri *in* Foster & others: p. 80-81, pl. 5, fig. 14; pl. 6, figs 15,16

Description: A small to medium size scalelike encrusting foraminifer with internal side conforming to surface to which is attached and external side irregular with earlier coils obscured; a proloculum is followed by an elongate tubular second chamber,with early portion definitely spiral and later ones bending back and forward about the periphery of the earlier ones, often partially involute; sutures distinct on internal side; wall calcareous, imperforate; external surface roughened; aperture formed by open end of tubular chamber (Modified from Cushman & Waters, 1928, p. 48).

Material available: The species is common in Early and Late Permian samples throughout the Bowen Basin (L 3591, 3594, 3609, 3610, 3626, 3634, 3636, 3641, 3707 to 3709, 3712, 3713, 3718 to 3720, 3726, 3727).

Figured type: GSQ MF 095/1 from L 3726, Catherine Sandstone.

Distribution: QLD, Bowen Basin: Cattle Creek (Riverstone and Sirius Members), Tiverton, and Buffel Formations; Ingelara Formation, Catherine Sandstone, and Peawaddy Formation; Oxtrack Formation. NSW, Sydney Basin: Rutherford Formation. WA, Perth Basin: Fossil Cliff Member of the Holmwood Shale; Carnarvon Basin: Callytharra Formation; Canning Basin: Noonkambah Formation.

Age: The species range is Artinskian, Ufimian and Kazanian in Queensland; Late Sakmarian in New South Wales; Late Sakmarian and Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold temperate waters of shallow, coastal seas depositing biodetrital and sandy sediments.

Calcitornella stephensi (Howchin 1894)

1882 *Cornuspira* sp. Jones: p. 6

1894 *Nubecularia lucifuga* Defrance var. *stephensi* Howchin: p. 345, pl. 1, figs 10a-11a

1905 *Nubecularia stephensi* Howchin; Chapman & Howchin: p. 5, pl. 1, figs 1,2; pl. 3, figs 3,4; pl. 5, figs 1-4

1934 *Calcitornella stephensi* (Howchin); Chapman & others: p. 187

1945 *Calcitornella stephensi* (Howchin); Crespin: p. 25, pl. 3, fig. 3

1958 *Calcitornella stephensi* (Howchin); Crespin: p. 84-85, pl. 17, figs 4-8; pl. 32, figs 1, 2, 4, 9

1968 *Calcitornella stephensi* (Howchin); Belford: p. 4, 5, pl. 2, figs 19,20

1982 *Nubecularia stephensi* Howchin; Scheibnerova: p. 68-69, pl. 32, figs 1-4; pl. 33, figs 1-3; pl. 34, fig. 1

1982 *Calcitornella stephensi* (Howchin); Palmieri *in* Foster & others: p. 81, pl. 5, figs 1-4

Remarks: This species was the first Permian foraminifer to be observed in the Permian sediments of Australia. Originally described as a bottom surface encrusting foraminifer (Jones, 1882; Howchin, 1894), it was later found to be commonly encrusted around productid spines (Chapman & Howchin, 1905). It is here considered one of the better distributed foraminifer in the Permian sediments of Australia, particularly in near shore to mid shelf waters: it has been found in Tasmania, New South Wales, Queensland, Northern Territory, and Western Australia. In Queensland this species is common in the Camboon Volcanics, Tiverton, Cattle Creek, Buffel and Oxtrack Formations, totally ranging in age from Late Sakmarian to Ufimian.

Genus **CALCIVERTELLA** Cushman and Waters 1928

Type species: *Calcivertella adherens* Cushman and Waters 1928.

Calcivertella sp. cf. ***C. adherens*** Cushman & Waters 1928 (Pl. 13, figs 9, 16)

cf. 1928 *Calcivertella adherens* Cushman & Waters: p. 48-49, pl. 6, fig. 7

Remarks: The figured specimens, although incomplete, show the characteristic irregular initial coiling followed by the definite zig-zag second stage with the side of the tests nearly parallel; they lack, however, the last portion which tends to become straight in *C. adherens*.

Material available: The species is rare to common in Late Permian formations of the Bowen Basin (L 3595, 3598, 3603, 3726, 3727.

Figured types: GSQ MF 093/1-2 from L 3726, 3727.

Distribution: QLD, Bowen Basin: Oxtrack, Barfield and Flat Top Formations, Catherine Sandstone, and Peawaddy Formation.

Age: The species range in Queensland is Ufimian to Kazanian.

Palaeoenvironment: The species is related to cold, temperate waters of shallow seas depositing biodetritic and sandy sediments.

Genus **PLUMMERINELLA** Cushman & Waters 1928

Type species: *Plummerinella complexa* Cushman & Waters 1928 OD.

Plummerinella sp. (Pl. 13, figs 17,18)

Remarks: A single, small, encrusting test showing in its internal side a distinct coiling in zig-zag fashion is here figured and left in open nomenclature; a ?pilamminid individual has enveloped the periphery and the external side.

Material available: A rare species from L 3727, Mantuan *Productus* bed.

Figured type: GSQ MF 092/1 from L 3727.

Distribution: A single specimen was found in the Mantuan *Productus* bed of the Peawaddy Formation from L 3727.

Age: Late Permian, Kazanian.

Palaeoenvironment: The species is related to cold, temperate waters of shallow, coastal sea depositing sandy, biodetritic sediments.

Genus **TREPEILOPSIS** Cushman & Waters 1928

Type species: *Turritellella grandis* Cushman & Waters 1928 OD.

Trepeilopsis australiensis Crespin 1958 (Pl. 13, figs 10,11)

1958 *Trepeilopsis australiensis* Crespin: p. 86-88, pl. 18, figs 1-4; pl. 22, figs 3,5-8
1968 *Trepeilopsis australiensis* Crespin; Belford: p. 4-5, pl. 3, figs 1-3
1982 *Trepeilopsis australiensis* Crespin; Scheibnerova: p. 59, pl. 34, fig. 5

1985 *Trepeilopsis australiensis* Crespin; Palmieri *in* Foster & others: p. 81, pl. 5, figs 8-10

Remarks: This encrusting species develops its tubular chamber in a characteristic helical spiral around productid spines, with coils that may or may not be at right angle to the spine; the figured specimen has its calcareous imperforate test wall in part worn out.

Material available: The species is common in the Early and Late Permian of the Bowen Basin (L 3591, 3595, 3596, 3600, 3601, 3603, 3709, 3720, 3726, 3727).

Figured type: GSQ MF 096/1 from L 3726.

Distribution: QLD, Bowen Basin: Cattle Creek (Riverstone Sandstone and Sirius Mudstone Members), Tiverton, Buffel Formations, and Camboon Volcanics; Oxtrack, Barfield, Flat Top, Catherine Sandstone, and Peawaddy Formations. NSW, Sydney Basin: Dalwood Group, Mulbring Siltstone. TAS, Gray Limestone. WA, Perth Basin: Fossil Cliff Member of the Holmwood Shale; Carnarvon Basin: Callytharra Formation; Canning Basin: Nura Nura Member of the Poole Sandstone.

Age: The species range is Late Sakmarian, Artinskian, Ufimian, Kazanian in Queensland; Late Sakmarian, Ufimian, Kazanian in New South Wales; Late Sakmarian in Tasmania and Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow, coastal seas depositing sandy and biodetritic sediments.

Family **HEMIGORDIOPSIDAE** A. Nikitina 1969

Subfamily **HEMIGORDIOPSINAE** A. Nikitina 1969

Genus **AGATHAMMINA** Neumayr 1887

Type species: *Serpula pusilla* Geinitz 1848 SD Cushman 1927.

Agathammina pusilla (Geinitz) (Pl. 13, figs 19-22; pl. 29, figs 12,13)

1848 *Serpula pusilla* Geinitz *in* Geinitz & Guthier: p. 6, fig. 1
1869 *Trochammina pusilla* (Geinitz); Jones & others: p. 390, pl. 13, figs 4-6, 15
1876 *Trochammina pusilla* (Geinitz); Brady: p. 79, pl. 3, fig. 4
1914 *Glomospira pusilla* (Geinitz); Cherdyntzev, p. 74, pl. 3, figs 15,16
non 1927 *Glomospira pusilla* (Geinitz); Cushman & Waters: p. 108, pl. 22, fig. 1a-b
1935 *Glomospira pusilla* (Geinitz); Paalzoow, p. 31, pl. 3, figs 8, 10,11; pl. 5, fig. 10
1950 *Agathammina pusilla* (Geinitz); Douglas: p. 42, pl. 4, fig. 10a-b
non 1956 *Agathammina pusilla* (Geinitz); Ireland: p. 848, pl. 4, figs 15-17
1962 *Agathammina pusilla* (Geinitz); Scherp: p. 304, pl. 5, figs 1-10
1988a *Agathammina pusilla* (Geinitz); Pronina: p. 59, pl. 3, figs 5,6
1988b *Agathammina pusilla* (Geinitz); Pronina: p. 90-92, pl. 1, figs 25,26

Description: test oblong consisting of a globular proloculus and of an undivided, nonseptate, "quinqueloculine-like" coiled, tubular chamber. The coiling is performed along coaxial longitudinal planes, each 60 to 70 degrees apart in regularly grown individuals. Irregular coiling outside the "quinqueloculine" arrangement is also common. The test wall consists of a calcareous imperforate layer on dark organic lining. Aperture terminal, simple, at end of tubular chamber. Average dimension of figured specimens (all from L 3727): Height: 0.8mm; width: 0.5mm; Thickness: 0.25mm; Test-wall thickness 0.010-0.012mm. Average dimension of a group of 10 specimens from outcrop locality L 3632: Height: 0.35mm; Width: 0.5mm; Thickness: 0.15mm.

Remarks: This is the first record of the genus and species in Australia. Its occurrence is restricted to the uppermost part of the marine section of the Permian in the Bowen Basin.

Material available: The species is relatively common in Late Permian samples (L 3596, 3632, 3634, 3727).

Figured types: GSQ MF 088/1-6 from L 3727.

Distribution: Outside Australia the species has a world wide distribution, particularly in the Late Permian. Pronina (1988b, p. 91) considers the predominance of miliolids (including *A. pusilla*) as characteristic of the Transcaucasian Khachik horizon which she equates with the Midian stage and correlates with deposits straddling the top of the Murgabian and the bottom of the Djulfian Stages. In Queensland the species is reported so far from the upper part of the Mantuan *Productus* bed and from the upper part of the Flat Top Formation; outside the Bowen Basin the species has been recorded from a sample of the Gigoomgan Limestone in the Gympie Basin.

Age: The species range is here considered exclusively Late Permian: the reports of *Agathammina pusilla* from the Pennsylvanian of the USA or from the European Jurassic represent misidentifications. In Queensland this species ranges at the top of the Australian equivalent of the Kazanian Stage which may possibly include an horizon (?Mantuan *Productus* bed) coeval to Early Midian deposits.

Palaeoenvironment: The species is related to cold, temperate waters of a shallow, marginal sea or gulf depositing sandy or biodetritic sediments.

Genus **HEMIGORDIUS** Schubert 1908

Type species: *Cornuspira schlumbergeri* Howchin 1895 SD Schubert 1908.

Hemigordius harltoni Cushman & Waters 1928 (Pl. 12, figs 6,7; pl. 13, figs 23-25)

1928 *Hemigordius harltoni* Cushman & Waters: p. 43, pl. 5, figs 8,9
1958 *Hemigordius harltoni* Cushman & Waters; Crespin: p. 79-91, pl. 16, figs 1-6; pl. 31, fig. 6
1968 *Hemigordius harltoni* Cushman & Waters; Belford: p. 3, pl. 2, figs 14-16
1982 *Hemigordius harltoni* Cushman & Waters; Scheibnerova: p. 67, pl. 12, fig. 3

Remarks: Test small to medium in size, compressed, circular in outline, early stage coiled in varying planes, later planispiral, consisting of a proloculum and a tubular, undivided second chamber; test wall calcareous imperforate, thin, on dark organic lining; figured megalosphaeric specimens (pl.12, figs 6,7) have the middle portion of the test covered by a secondary growth; figured microsphaeric specimens (pl.13, figs 23-25) display full coiling; aperture is the round opening end of the tubular chamber.

Material available: The species is rare in the Early Permian L 3720, and more common in the Late Permian L 3727 and 3596.

Figured types: GSQ MF 090/1-2 from L 3720; GSQ MF 089/1-3 from L 3727.

Distribution: QLD, Bowen Basin: Riverstone Sandstone Member of the Cattle Creek Formation; Peawaddy and Flat Top Formations. NSW, Sydney Basin: Branxton Formation and Mulbring Siltstone. WA, Carnarvon Basin: Callytharra Formation and Byro Group; Canning Basin: Noonkambah Formation.

Age: The species range is Early Artinskian and Late Kazanian in Queensland and New South Wales; Late Sakmarian and Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow, marginal sea depositing sandy and biodetritic sediments.

Genus **ORTHOVERTELLA** Cushman & Waters 1928

Type species: *Orthovertella protea* Cushman & Waters 1928 OD.

Orthovertella protea Cushman & Waters 1928 (Pl. 13, figs 14,15)

1928 *Orthovertella protea* Cushman & Waters: p. 45, pl. 6, figs 3,4
1958 *Orthovertella protea* Cushman & Waters; Crespin: p. 82, pl. 18, figs 7-9
1985 *Orthovertella protea* Cushman & Waters; Palmieri *in* Foster & others: p. 81, pl. 5, figs 5-7

Remarks: This apparently free test is relatively small, and consists of a proloculus followed by a streptospirally coiled tubular second chamber later becoming rectilinear.

Material available: The species is rare in Early Permian samples from L 3720 and common in Late Permian samples from L 3726 and 3727.

Figured types: GSQ MF 091/1 from L 3727.

Distribution: QLD, Bowen Basin: Cattle Creek Formation (Riverstone Sandstone Member), Catherine Sandstone, and Peawaddy Formation (Mantuan *Productus* bed). NSW, Sydney Basin: Dalwood Group. TAS, Gray Limestone. WA, Perth Basin: Fossil Cliff Member of the Holmwood Shale; Carnarvon Basin: Callytharra Formation; Canning Basin: Noonkambah Formation.

Age: The species range is Artinskian and Ufimian-Kazanian in Queensland; Late Sakmarian to Artinskian in New South Wales; Artinskian in Tasmania; Late Sakmarian and Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold temperate waters of shallow, marginal sea depositing sandy and biodetritic sediments.

Suborder **LAGENINA** Delage & Herouard 1896

Diagnosis: Wall of monolamellar, hyaline, fibrous, radiate or radial calcite on a thin, dark, organic layer or lining or membrane; primitive taxa may be without secondary lamination, more advanced forms become secondarily lamellar or multilamellar due to continued growth. Late Silurian to Holocene. (Emended from Loeblich & Tappan 1987, p. 386.)

Remarks: Primitive, Palaeozoic forms may have undergone processes of alteration which have rendered micro or macrogranular their original hyaline, fibrous, or radiate calcitic layer.

With this emendation the superfamily Geinitzinacea is removed from the Fusulinina and included in the Lagenina. The fundamental reason for removing the Geinitzinacea from the Fusulinina stays in the recognition that the inner, dark, thin organic layer of the geinitzinid wall is very similar, if not identical, to the one found in foraminiferal wall of the other Lagenina families: it is thin, is not microgranular, is organic and is definitely different from the inner, thick layer of dark microgranular calcite of the Fusulinina. However, the clear, outer, calcitic layer is normally monolamellar to plurimonolamellar and some evidence of granularity may be explained by process of alteration to which the more primitive forms may have undergone. Hansen (1979) gave a clear example of it in its analysis of the structure of the wall in topotypes of *Nodosinella*.

Superfamily **GEINITZINACEA** Bozorgnia 1973

Family **GEINITZINIDAE** Bozorgnia 1973

Genus **HOWCHINELLA** Palmieri 1985

Type species: *Frondicularia woodwardi* Howchin 1895, OD.

Howchinella aulax (Crespin 1945) (Pl. 17, figs 1-8; pl. 18, fig. 6; pl. 19, fig. 2; pl. 20, figs 13-17; pl. 27, figs 3-5b; pl. 30, figs 13,15; pl. 31, figs 3-7; pl. 32, fig. 25)

1945 *Frondicularia woodwardi* Crespin (*non* Howchin): pl. 3, fig. 13
1947 *Frondicularia woodwardi* Crespin (*non* Howchin): pl. 1, fig. 13
1958 *Frondicularia aulax* Crespin: p. 109-110, pl. 28, figs 1-4
1968 *Frondicularia aulax* Crespin; Belford: p. 5, pl. 3, figs 12,13

Remarks: The writer has availed himself of topotypic material and has viewed the holotype of the species: the median furrow described in Crespin (1958, p. 109) is not as deep as portraited and therefore its distinction from the holotype (Howchin 1895) and topotypic material (Palmieri, *in* Foster & others 1985) of *H. woodwardi* is not solely dependent on it but rather on the straight, elongate, gently tapering form of the test, on the radiate, protruding aperture, and on the thicker calcitic test wall. There is considerable variation within *H. aulax* as there is in all other *H. woodwardi* derived species. Moreover interspecific varieties may be present. Decorticated specimens, which are deprived of the aperture, may be very similar to '*Spandelina excavata*' (Cushman & Waters 1928, p. 363-364, pl. 48, figs 3a-4b).

Material available: The species is common in the late Early Permian and Late Permian of the Bowen Basin and particularly in the Denison Trough (L 3587 to 3591, 3599 to 3603, 3617, 3624, 3626, 3633 to 3636, 3639, 3643, 3705, 3707, 3718 to 3720, 3724, 3726, 3727).

Figured types: GSQ MF 098/9-14, 20-21, 25-28, 31-33 from L 3639 (near topotypic material); GSQ MF 099/8-9, 19 from L 3727; GSQ MF 099/12-13 from L 3724; GSQ MF 108/1, and 114/1 from L 3726; GSQ MF 109/3 from L 3727.

Distribution: QLD, Bowen Basin: Sirius Mudstone Member of the Cattle Creek Formation; Ingelara and Peawaddy Formations; Blenheim Formation, Oxtrack, Barfield, and Flat Top Formations. NSW, Sydney Basin: Maitland Group. TAS, Golden Valley Group. WA, Carnarvon Basin: Callytharra Formation; Canning Basin: Nura Nura Member of the Poole Sandstone; Noonkambah Formation.

Age: The species range is Artinskian (Late Artinskian) to Kazanian in Queensland and New South Wales; Sakmarian in Tasmania; Late Sakmarian and Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of relatively shallow seas depositing sandy, muddy biodetritic sediments.

Howchinella costata sp. nov. (Pl. 17, fig. 10; pl. 18, figs 19,20; pl. 20, figs 9,10; pl. 31, figs 1,2; pl. 32, figs 4,5)

Description of holotype: A small to medium size, moderately elongate, compressed test, formed by a proloculus and six to seven chevron shaped, increasing in size chambers, sutures flashed, surface smooth, ornate on frontal and retral sides by four to six longitudinal costae, reaching the protruding, neck-like, apertural, radiate opening. The medial, longitudinal depression is present between the two central costae. Test wall consists of a hyaline radial calcitic layer on a thin, dark organic lining; costae consist of hyaline calcite. Dimensions: height, 0.60mm; max. width, 0.29mm; max. thickness, 0.11mm.

Remarks: Within *H. costata* are included individuals which display not only the major, characteristic costae but also minor striation covering the surface; these may be considered as ecophenotypic variations.

Material available: The species is common to rare in the late Early Permian and in the Late Permian of the Bowen Basin (Denison Trough) where it was found in the following localities (L 3626, 3635, 3636, 3705, 3709, 3713, 3718, 3720, 3726, 3727).

Figured types: Holotype, GSQ MF 104/1 from L 3636; Hypotypes, GSQ MF 104/2-3 from L 3726; GSQ MF 117/5,6 from L 3727; GSQ MF 104/4 from L 3726.

Distribution: QLD, Bowen Basin: Sirius Mudstone Member of the Cattle Creek Formation; Ingelara, Catherine Sandstone, and Peawaddy Formations.

Age: The species range is Late Artinskian to Kazanian.

Palaeoenvironment: The species is related to cold and cold temperate waters of shallow seas depositing muddy, sandy and biodetritic sediments.

Howchinella hillae (Crespin 1958) (Pl. 18, figs 23,24; pl. 31, fig. 19)

1958 *Frondicularia hillae* Crespin: p. 111-112, pl. 28, figs 5-8

Remarks: This is a peculiarly ornate howchinellid species with a certain amount of variation not well portraited in Crespin's drawings; for instance the holotype has a more regular striation pattern than the paratypes, and the median, frontal depression is present. The specimens here figured show strong irregular striations interrupted at chamber sutural position.

Material available: The species is rare in the Early Permian and more common in the Late Permian of the Bowen Basin (Denison Trough), where it was found in the following localities (L 3713, 3720, 3724, 3726).

Figured types: GSQ MF 113/1-3 from L 3726.

Distribution: QLD, Riverstone Sandstone Member and Sirius Mudstone Member of the Cattle Creek Formation; Ingelara, Catherine Sandstone, and Peawaddy Formations. NSW, Sydney Basin: Maitland Group. TAS, Golden Valley Group. WA, Carnarvon Basin: Callytharra Formation.

Age: The species range is Artinskian, Ufimian and Kazanian in Queensland; Artinskian in New South Wales; Sakmarian in Tasmania; Late Sakmarian in Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing sandy, muddy and biodetritic sediments.

Howchinella incisa sp. nov. (Pl. 20, figs 6-8; pl. 22, fig. 4; pl. 23, figs 1,2; pl. 32, figs 20-22; pl. 33, figs 14-17)

Description of holotype: Test medium in size, tapering, compressed; proloculus followed by six or seven chevron shaped chambers in megalospheric form, and by ten to twelve chambers in microspheric form. A strong frontal median longitudinal depression or furrow or incision is characteristically present; the apertural opening is radiate, on a slightly protruding neck; the surface is smooth to translucent, and may be ornate by costae or by striations on the sides of the median furrow. The test wall consists of a hyaline, radial calcitic layer on a thin dark, organic layer or lining. Dimensions: height, 0.69mm; max. width, 0.2mm; thickness, 0.08mm.

Remarks: *H. incisa* with its strong and deep median furrow and ornamentation is quite distinguishable among the Late Permian howchinellids of the Bowen Basin, where it is distributed in Late Permian sediments.

Material available: The species is rare to common in samples of Late Permian age from the following localities (L 3626, 3634, 3635, 3643, 3713, 3719, 3720, 3726, 3727).

Figured types: Holotype, GSQ MF 117/3; Hypotypes, GSQ MF 117/2,4,7-9 from L 3727; GSQ MF 117/10 from L 3726; all from Peawaddy Formation.

Distribution: The species is distributed in the Ingelara and Peawaddy Formations only.

Age: The species range so far ascertained is Ufimian-Kazanian.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy, biodetritic sediments.

Howchinella mantuanensis sp. nov. (Pl. 21, figs 3-6; pl. 22, figs 1-3,6-10; pl. 23, figs 6,7; pl. 28, figs 4a-5b; pl. 33, figs 18-23)

Description of holotype: Test medium to large in size, elongate, compressed, tapering to lanceolate, consisting of ten to eighteen chevron shape to arcuate chambers; sutures flush, surface smooth to polished, frontal median longitudinal depression present, but not deep; aperture central, radiate or dentate, may be slightly protruding; test wall thick, consisting of lamellar to multilamellar radial calcite on thin, dark organic linings. Dimensions: height, 1.31mm; max. width, 0.67mm; thickness, 0.19mm.

Material available: The species is common in the Peawaddy Formation (Mantuan *Productus* bed) from the following localities (L 3632, 3635, 3720, 3727).

Figured types: Holotype, GSQ MF 120/1; Hypotypes, GSQ MF 098/23, 099/10-11, 120/2-4, 120/6-11, 123/1; all from L 3727 Mantuan *Productus* Bed.

Distribution: The species is uniquely distributed in the upper Peawaddy Formation (Mantuan *Productus* bed and coeval sediments), where it is used as local zonal index.

Age: The species range so far ascertained is Kazanian (Late Kazanian).

Palaeoenvironment: The species is related to cold, temperate waters of shallow seas depositing sandy, biodetritic sediments.

Howchinella parri (Crespin 1945) (Pl. 18, figs 14,15,21; pl. 23, figs 9,10)

1945 *Frondicularia parri* Crespin: p. 27, pl. 3, figs 9-11
1958 *Frondicularia parri* Crespin; Crespin: p. 113, pl. 29, figs 3-7
1958 *Frondicularia semicostula* Crespin: p. 113-114, pl. 29, figs 8,9

Remarks: Under *H. parri* are here included all those small, slender or slightly stout howchinellid tests which show the median depression and frontal surface covered with small costae or striae, sometimes not clearly visible or worn out in last two chambers. '*Spandelina fissicostata*' Cushman & Waters (1928: p. 366, pl. 48, figs 7a,8) from the Permian of Texas, may be a close species.

Material available: The species is rather rare in the Bowen Basin Late Permian sediments; it was found in the following localities (L 3634, 3713, 3719, 3726, 3727).

Figured types: GSQ MF 110/1-2, 117/1 from L 3726; GSQ MF 122/5 from L 3727.

Distribution: QLD, Bowen Basin: Ingelara, Catherine Sandstone, and Peawaddy Formations. NSW, Sydney Basin: Maitland Group and Branxton Formation. TAS, Gray Limestone. WA, Carnarvon Basin: Byro Group; Canning Basin: Noonkambah Formation.

Age: The species range is Ufimian to Kazanian in Queensland; Artinskian in New South Wales and Tasmania; Late Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy, biodetritic sediments.

Howchinella rigida sp. nov. (Pl. 14, figs 3,4,6-9; pl. 15, figs 25-27; pl. 27, fig. 9a,b)

Description of holotype: A stout to elongate, medium size test very gently tapering, compressed but not flattened, with rounded periphery and median frontal depression, and consisting of a relatively inflated, sphaerical proloculus followed by six to ten quite inflated, chevron shaped chambers; surface lobulate when specimens are decorticated, and flash, polished, when preserved; aperture central, radiate, may be slightly protruded; test wall consists of a calcitic hyaline, radial layer on thin dark, organic layer or lining. Dimensions: height, 0.88mm; max. width, 0.25mm; thickness, 0.09mm.

Material available: The species is rare to common in samples of Early Permian age from the following localities (L 3688, 3589, 3608, 3639, 3707, 3709, 3713, 3721, 3722).

Figured types: Holotypes, GSQ MF 099/4; Hypotypes, GSQ MF 098/2, 099/2-3, 098/3, 099/5-7, 098/37 from L 3721, 3721, 3722, 3639, 3639.

Distribution: The species was found in the Cattle Creek, Buffel, and Tiverton Formations of the Bowen Basin, where it is used as a local zonal index.

Age: The species range so far established is Artinskian.

Palaeoenvironment: The species is related to cold waters of shallow seas depositing sandy, muddy sediments.

Howchinella woodwardi (Howchin 1895) (Pl. 14, figs 1,2,5,17-19; pl. 15, figs 5-9; pl. 17, fig. 9; pl. 19, figs 4-6; pl. 21, figs 7,8; pl. 27, figs 1,2,8)

1895 *Frondicularia woodwardi* Howchin: p. 197-98, pl. 10, figs 4-6
1905 *Frondicularia woodwardi* Howchin; Chapman & Howchin, p. 16, pl. 3, fig. 2
1958 *Frondicularia woodwardi* Howchin; Crespin, p. 115, pl. 29, figs 10-12
1982 *Frondicularia woodwardi* Howchin; Scheibnerova: p. 71, pl. 35, figs 1,2; pl. 37, fig. 1-5; pl. 38, figs 5,8; pl. 39, figs 2,3
1985 *Howchinella woodwardi* (Howchin); Palmieri *in* Foster & others: p. 84, pl. 9, figs 5-20

Remarks: The species in its original definition was considered to possess test "subject to considerable variation in external form"; this has probably led to a too broad concept of the species morphology; a return to the original morphology of the holotype is sought; in the writer's opinion the howchinellid foraminifera of the Bowen Basin Permian all stem up from *H. woodwardi*, with the main stream leading through *H. rigida*, *H. aulax*, to *H. mantuanensis*.

Being the first recognized in the Early Permian of the Bowen Basin, *H. woodwardi* is considered a local zonal index.

Material available: The species is common in the Permian of the Bowen Basin where it was found in samples from the following localities (L 3582-3583, 3587-3589, 3592, 3595-3596, 3598-3604, 3606-3610, 3624, 3626, 3635-3636, 3639, 3707-3713, 3718-3727.

Figured types: GSQ MF 098/1, 099/1, 100/1, 102/1 from L 3721; GSQ MF 098/4 from L 3724; GSQ MF 098/5-8, 099/5-7 from L 3639; GSQ MF 103/1 from L 3636; GSQ MF 098/16-18 from L 3726; GSQ MF 099/8,9,19; 098/22-23, from L 3727, GSQ MF 098/29-30 from L 3721; GSQ MF 098/25-26,35 from L 3639.

Distribution: QLD, Bowen Basin: Cattle Creek, Ingelara, Catherine Sandstone, Peawaddy, Blenheim, Tiverton, Buffel, Oxtrack, Barfield, and Flat Top Formations. NSW, Northern Sydney Basin: Dalwood Group, Branxton Formation, Maitland Group. TAS, Golden Valley Group, Gray Limestone. WA, Perth Basin: Fossil Cliff Member of the Holmwood Shale; Carnarvon Basin: Callytharra Formation, Byro Group; Canning Basin: Noonkambah Formation, Liveringa Group.

Age: The species range is Late Sakmarian to Kazanian in Queensland, New South Wales, and Western Australia; Late Sakmarian to Artinskian in Tasmania.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing sandy, muddy and biodetritic sediments.

Howchinella striatosulcata (Crespin 1958) (Pl. 21, fig. 9; pl. 22, fig. 5; pl. 23, figs 3-5; pl. 31, figs 8-11; pl. 33, figs 10-13)

1958 *Geinitzina striatosulcata* Crespin: p. 116-118, pl. 30, figs 4-7

Remarks: The species *striatosulcata* is transferred here under the genus *Howchinella* because of the protruded aperture (even if it is not shown in the drawing of the holotype, it is present) the size, and the proportion of its sides. *Howchinella striatosulcata* has a stout, elongate, medium to large test with frontal median depression and fine striations covering the whole surface.

Material available: The species is rare in the Early Permian and common in the Late Permian of the Bowen Basin, in samples from the following localities: L 3635, 3704, 3707, 3709, 3713, 3720, 3726, 3727.

Figured types: GSQ MF 122/1-3, 112/3-4 from L 3727; GSQ MF 122/6-7 from L 3726.

Distribution: QLD, Bowen Basin: Cattle Creek Formation, Buffel Formation, Ingelara Formation, Catherine Sandstone, and Peawaddy Formation. WA, Canning Basin: Noonkambah Formation.

Age: The species range is Artinskian, Ufimian, Kazanian in Queensland; Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy and biodetritic sediments.

Genus **LUNUCAMMINA** Spandel 1898

Type species: *Geinitzella (Lunucammina) permiana* Spandel 1898; SD Cushman 1928.

Lunucammina maior sp. nov. (Pl. 12, figs 2-4; pl. 18, figs 7,8; pl. 20, figs 11,12; pl. 28, fig. 6; pl. 32, figs 23,24,26,27)

Description of holotype: Test of medium size, stout, elongate, subtriangular, compressed but thicker than normally for species of the genus; chambers 6 to 8, nearly rectilinear, reniform, increasing in size, with median frontal depression; sutures slightly depressed; aperture terminal, ovate, with radial grooves; test wall calcareous with an inner, dark, organic layer and an outer radially fibrous layer. Dimensions: height, 0.65mm; max. width, 0.35mm; thickness, 0.22mm.

Material available: The species is rare in the Late Permian of the Bowen Basin, in samples from the following localities: L 3591, 3635, 3708, 3709, 3726, 3727.

Figured types: Holotypes, GSQ MF 109/5 from L 3727, GSQ MF 140/1 from L 3591; GSQ MF 109/1-2 from L 3726; GSQ MF 118/1 from L 3635; GSQ MF 118/2 from L 3726.

Distribution: The species was found to be distributed in the Late Permian formations of the Bowen Basin: Oxtrack Formation; Catherine Sandstone, and Peawaddy Formation.

Age: The species range is Ufimian-Kazanian.

Palaeoenvironment: The species is relate to cold and cold, temperate waters of shallow seas depositing silty, sandy and biodetritic sediments.

Lunucammina triangularis (Chapman & Howchin 1905) (Pl. 12, fig. 1; pl. 16, figs 1-21)

1905 *Geinitzina triangularis* Chapman & Howchin: p. 16, pl. 2, figs 9a,b,10

1905 *Geinitzina postcarbonica* Chapman & Howchin (*non* Spandel): p. 17, pl. 4, fig. 5

1915 *Geinitzina chapmani* Schubert: p. 58, pl. 39 (1), fig. 4

1934 *Geinitzina triangularis* Chapman & Howchin; Chapman & others: p. 180, text figs 1-5

1945 *Geinitzina triangularis* Chapman & Howchin; Crespin: p. 29, pl. 3, figs 14,15

1958 *Geinitzina triangularis* Chapman & Howchin; Crespin: p. 118-119, pl. 30, figs 8-11; pl. 31, fig. 8

1968 *Geinitzina triangularis* Chapman & Howchin; Belford: p. 3, 5, pl. 3, figs 17,18

1982 *Geinitzina triangularis* Chapman & Howchin; Scheibnerova: p. 72, pl. 38, fig. 7

1985 *Lunucammina triangularis* (Chapman & Howchin); Palmieri *in* Foster & others: p. 83, pl. 8, figs 1-17

Remarks: This species is here illustrated in a variety of forms, including those with a definite planispiral initial stage.

Material available: This species is rare to common in the Permian of the Bowen Basin, where it has been found in the following localities: L 3587-88, 3591, 3595-99, 3601, 3610, 3707, 3709, 3719-20, 3726.

Figured specimens: GSQ MF 253 from L 3587; GSQ MF 2545/1-17 from L 3709.

Distribution: QLD, Bowen Basin: Camboon Volcanics, Buffel, Oxtrack, Barfield, Flat Top Formations; Tiverton Formation, Cattle Creek, Ingelara, and Peawaddy Formations. NSW, Sydney Basin: Dalwood Group, Branxton Formation, Mulbring Siltstone. TAS, Darlington Limestone. WA, Perth Basin: Fossil Cliff Member of the Holmwood Shale; Carnarvon Basin: Callytharra Formation; Canning Basin: Noonkambah Formation.

Age: The species range is Late Sakmarian-Kazanian in Queensland; Late Sakmarian-Artinskian-Ufimian in New South Wales; Late Sakmarian in Tasmania; Late Sakmarian-Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy, and biodetritic sediments.

Genus **PSEUDOTRISTIX** K.V. Miklukho-Maklay 1960

Type species: *Tristix (Pseudotristix) tcherdynzevi* K.V. Miklukho-Maklay 1960, OD.

Remarks: This genus is considered polyphyletic: the four species left here in open nomenclature, all seem to be associated with different species of *howchinellid*.

Pseudotristix **sp. 1** (Pl. 14, figs 11,12; pl. 30, fig. 14)

Remarks: Two megalospheric, (one juvenile) specimens showing the inflated proloculus followed by chambers which are the trilateral expression of the bilateral chambers of *Howchinella rigida* from the same assemblage, are here attributed to the genus *Pseudotristix* and left in open nomenclature.

Available material: Two specimens.

Figured type: GSQ MF 101/1 from L 3721; GSQ MF 101/2 from L 3724.

Distribution: Bowen Basin (Denison Trough), Cattle Creek Formation, Mostyndale Mudstone Member and Sirius Mudstone Member.

Age: Early Artinskian and Late Artinskian.

Palaeoenvironment: Shallow, marine, cold water.

Pseudotristix **sp. 2** (Pl. 18, fig. 22)

Remarks: A single specimen probably representing the trilateral form of *Howchinella incisa* from the same assemblage is left here in open nomenclature.

Figured type: GSQ MF112/1 from L 3726, Catherine Sandstone.

Age: Ufimian-Kazanian

Pseudotristix **sp. 3** (Pl. 19, fig. 20)

Remarks: A single specimen, probably the trilateral expression of an as yet unidentified howchinellid form, is left here in open nomenclature.

Figured type: GSQ MF 116/1 from L 3726, Catherine Sandstone.

Age: Ufimian-Kazanian.

Pseudotristix **sp. 4** (Pl. 20, figs 18,19; pl. 33, figs 4,5)

Remarks: Two specimens, probably the trilateral expression of *Howchinella aulax* retrieved from the same assemblage, are left here in open nomenclature.

Figured types: GSQ MF 119/1-2 from L 3727, Peawaddy Formation (Mantuan *Productus* bed).

Age: Kazanian.

Genus **SPANDELINOIDES** Cushman & Waters 1928

Type species: *Spandelina (Spandelinoides) nodosariformis* Cushman & Waters 1928, OD.

?***Spandelinoides*** sp. (Pl. 22, fig.12)

Remarks: A few tests of elongate, nearly cylindrical shape showing an early stage with chevron shaped chambers and a later stage with rounded, nodosariform chambers, were retrieved from the Late Permian of the Bowen Basin. Not enough material is available to understand whether these tests are mere howchinellid forms tending to become nodosariid; for this reason they are left in open nomenclature.

Material available: The species is very rare in the Late Permian of the Bowen Basin, where it was found in the following localities: L 3624, 3632, 3635, 3720, 3726, 3727.

Figured type: GSQ MF123/1 from L 3727.

Distribution: QLD, Bowen Basin: Blenheim Formation, Ingelara and Peawaddy Formations.

Age: The species range Ufimian-Kazanian.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy, and biodetritic sediments.

Superfamily **ROBULOIDACEA** Reiss 1960

Family **ICHTHYOLARIIDAE** Loeblich & Tappan 1986

Genus **CRYPTOSEPTIDA** Sellier de Civrieux & Dessauvagie 1965

Type species: *Cryptoseptida anatoliensis* Selliers de Civrieux & Dessauvagie 1965, OD.

Cryptoseptida caseyi (Crespin 1958) (Pl. 21, figs 10-20; pl. 23, fig. 8; pl. 29, figs 7-11; pl. 33, figs 6-9)

1958 *Geinitzina caseyi* Crespin: p. 116, pl. 30, figs 1-3
1982 *Geinitzina caseyi* Crespin; Scheibnerova: p. 71-72, pl. 36, figs 1,2
1983 *Pachyphloia caseyi* (Crespin); Palmieri, p. 141, 146

Remarks: The characters of the species, as described in Crespin 1958, p. 116, fall well within those of the genus *Pachyphloides* which is synonymised with *Cryptoseptida* in Loeblich & Tappan (1987, p. 388). It is possible that a future restudy of the well preserved Australian species *caseyi* may solve this nomenclatorial problem.

Material available: The species is common to abundant in the Late Permian of the Bowen Basin where it was found from the following localities: L 3632, 3634, 3635 and 3727.

Figured types: GSQ MF 121/1-16, from L 3727 (Mantuan *Productus* bed).

Distribution: QLD, Bowen Basin: Peawaddy Formation (Mantuan *Productus* bed). NSW, Sydney Basin: Mulbring Siltstone. WA, Canning Basin: Noonkambah Formation.

Age: The species range is Kazanian (Late Kazanian) in Queensland; Kazanian in New South Wales; ?Late Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold, temperate waters of shallow seas depositing sandy, biodetritic sediments.

Genus **HILLELLA** gen. nov.

Type species: *Hillella marginodentata* sp. nov.

Name: The genus is named in honour of Emeritus Professor Dorothy Hill, who gave faith, scientific incentive, and honour to palaeontology in Australia and the world.

Diagnosis: Test free, small to medium in size, elongate, flattened to ovate in section, tapering at first, then with near parallel sides, chambers numerous, uniserially arranged, distinct, from strongly arcuate to less arcuate, overlapping, sutures depressed; lateral margins cerivate or dentate; aperture small, terminal, radiate, slightly protruding, wall calcareous fibrous or radial, on thin, dark, organic layer.

Range and distribution: Late Permian (Ufimian) of Queensland; Late Permian of Germany; Permian of Texas (USA).

Taxa provisionally included are: *Spandelina texana* Cushman & Waters 1928, and *Frondicularia draco* Paalzow 1935.

Hillella marginodentata sp. nov. (Pl. 18, figs 1-5; pl. 28, fig. 3a,b; pl. 31, figs 14-18)

Description of holotype: Test medium in size, elongate, flattened to slightly biconvex, gently tapering at initial stage, then with nearly parallel sides; chambers 10 to 14, arcuate, overlapping, increasing in size, the last one twice or three times as big as the second last, extending to the lateral, carinate sides and forming spinose or dentate lateral flanges; sutures distinct, depressed, and slanting towards the periphery; surface smooth, translucent; test wall calcareous consisting of a calcitic fibrous or radial layer on a thin, dark, organic layer or lining; aperture small, radiate, terminal, slightly protruding. Dimensions: height, 0.80mm; max. width, 0.32mm; max. thickness, 0.15mm.

Remarks: Rare specimens with trilateral or quadrilaterial final chambers are found in some assemblages of *Hillella*.

Material available: The species is rare to common in areas of the Bowen Basin, in Late Permian (Ufimian-Kazanian) sediments from the following localities: L 3598, 3709, 3712, 3713, 3718 to 3720, 3726.

Figured types: Holotype, GSQ MF 107/1; hypotypes, GSQ MF 107/2-5, 11 from L 3720; GSQ MF 107/10 from L 3726.

Distribution: QLD, Bowen Basin, Ingelara Formation and Catherine Sandstone, Barfield Formation; the species is considered the index taxon of a biostratigraphic zone.

Age: The species range is Ufimian-Kazanian.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy sediments.

Genus **ICHTHYOLARIA** Wedekind 1937

Type species: *Frondicularia bicostata* d'Orbigny 1850, OD.

Ichthyolaria crassatina sp. nov. (Pl. 17, figs 14,15; pl. 19, figs 18,19)

Description of holotype: Test small, stout, elongate, tapering, flattened; chambers 6-7, strongly arched, increasing in size, chevron shaped, overlapping, peripherally rounded; sutures broadly depressed; surface smooth to slightly rough; test wall calcareous: a radial calcite layer on a thin dark organic lining; aperture terminal, central, rounded, radiate. Dimensions: height, 0.64mm; max. width, 0.37; max thickness, 0.12mm.

Remarks: The small size, the rounded periphery, and the depressed sutures distinguish this species from any other previously described.

Material available: The species is rare in the late Early and in the Late Permian of the Bowen Basin, where it was found from the following localities: L 3636, 3713, 3720, 3726.

Figured types: GSQ MF 105/1-2 from L 3636; GSQ MF 105/3-4 from L 3726.

Distribution: QLD, Bowen Basin: Sirius Mudstone Member of the Cattle Creek Formation; Ingelara Formation and Catherine Sandstone.

Age: The species range is Late Artinskian and Ufimian-Kazanian.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy sediments.

Ichthyolaria impolita (Crespin 1958) (Pl. 19, figs 3,7; pl. 32, figs 9,10)

1958 *Frondicularia impolita* Crespin: p. 111, pl. 28, figs 9-12

non 1968 *Frondicularia impolita* Crespin; Belford: p. 5, pl. 3, fig. 14, =?*Lunucammina triangularis* (Chapman & Howchin 1905)

Description: Test small to medium, elongate angled to arcuate initial and last stages, chambers 7-8, chevron shaped, sutures distinct, slightly depressed, strongly arched, wall calcareous, surface slightly rough.

Material available: The species is rare to common in the Early and Late Permian of the Bowen Basin where it was found from the following localities: L 3707, 3709, 3712, 3713, 3720, 3726.

Figured types: GSQ MF 098/15, 111/3, from L 3726.

Distribution: QLD, Bowen Basin: Buffel Formation, Cattle Creek Formation, Ingelara Formation and Catherine Sandstone. WA, Canning Basin: Noonkambah Formation.

Age: The species range is Artinskian and Ufimian-Kazanian in Queensland, and Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy sediments.

Ichthyolaria levicostata sp. nov. (Pl. 19, figs 9-17; pl. 29, figs 1-6; pl. 32, figs 6-8)

Description of holotype: Test small, flattened, relatively thin, elongate, tapering, with a weak, frontal, central, longitudinal costa; other costae diverging from it, may be present; chambers 8-10, chevron shaped, overlapping; sutures arcuate, slightly depressed; surface smooth, translucent; test wall calcareous: a fibrous, radial, calcitic layer on a thin, dark, organic layer, aperture central, terminal, rounded, protruding, radiate. Dimensions: height, 0.64mm; max. width, 0.24mm; max. thickness, 0.08mm.

Remarks: This small sized, flattened, sharply marginal species is unlike any other previously observed.

Material available: The species is common in samples from one locality of Late Permian.

Figured types: GSQ MF 115/1-7, 115/9-16 from L 3726.

Distribution: QLD, Bowen Basin: Catherine Sandstone.

Age: The species range is Ufimian-Kazanian.

Palaeoenvironment: The species is related to cold, temperate waters of shallow seas depositing muddy, sandy sediments.

Ichthyolaria limpida (Crespin 1958) (Pl. 18, fig. 18; pl. 19, fig. 1; pl. 22, figs 13,14; pl. 27, fig. 6; pl. 30, figs 16-18; pl. 31, figs 20,21; pl. 33, figs 26,27)

1958 *Frondicularia limpida* Crespin: p. 112-113, pl. 29, figs 1,2

Remarks: This species is distinct because of its elongate, lanceolate shape flaring from a sharp base to a parallel-sided middle stage with the outline of the final chamber sharply tapering toward the aperture, and a smooth, translucent test with transparent chamber sutures.

Material available: The species is rather common in the late Early Permian and the Late Permian of the Bowen Basin where it was found from the following localities: L 3624, 3632, 3635, 3636, 3705, 3707, 3709, 3713, 3719, 3720, 3724, 3726, 3727.

Figured types: GSQ MF 098/35; GSQ MF 111/1, 2; GSQ MF 106/3-4, 7; GSQ MF 125/1 from L 3636, 3724, 3726-3727.

Distribution: QLD, Bowen Basin: Buffel Formation, Sirius Mudstone Member of the Cattle Creek Formation, Blenheim Formation; Ingelara Formation, Catherine Sandstone, and Peawaddy Formation. WA, Carnarvon Basin: Callytharra Formation.

Age: The species range is Late Artinskian, Ufimian and Kazanian in Queensland; Late Sakmarian in Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy, and biodetritic sediments.

Ichthyolaria sutilis (Crespin 1958) (Pl. 15, fig. 10; pl. 17, fig. 18; pl. 19, fig. 8; pl. 30, figs 11,12; pl. 32, figs 2,3)

1958 *Frondicularia sutilis* Crespin: p. 114, pl. 27, figs 11,12

Remarks: Crespin's diagnosis "test elongate, tapering, sutures limbere and flush, very oblique" distinguishes the flattened, relatively thin tests here illustrated, which are characteristically showing 10-11 angulated chambers with their translucent sutures.

Material available: The species is relatively common in the late Early Permian and the Late Permian of the Bowen Basin, where it was found from the following localities: L 3587, 3595, 3596, 3598, 3610, 3624, 3632, 3635, 3636, 3639, 3643, 3699, 3707, 3709, 3713, 3718-3720, 3724, 3726, 3727.

Figured types: GSQ MF 106/1, 106/5, from L 3724; GSQ MF 106/2 from L 3636; GSQ MF 106/3 from L 3726.

Distribution: QLD, Bowen Basin: Buffel Formation, Tiverton Formation, Cattle Creek Formation (Sirius Mudstone Member), Blenheim Formation, Barfield Formation, Flat Top Formation, Ingelara Formation, Catherine Sandstone, Peawaddy Formation (Mantuan *Productus* bed).

Age: The species range is Artinskian, Ufimian, Kazanian.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy and biodetritic sediments.

Family **ROBULOIDIDAE** Reiss 1963

Genus **CALVEZINA** Sellier de Civrieux & Dessauvagie 1965

Type species: *Calvezina ottomana* Sellier de Civrieux & Dessauvagie 1965 OD.

Calvezina sp. (Pl. 19, figs 25,26)

Remarks: One only specimen of this Tethyan Late Permian

genus has been left in open nomenclature. The test is somewhat decorticated and pyrite infilled.

Material available: One single specimen from L 3726.

Figured type: GSQ MF 137/1 from L 3726.

Distribution: QLD, Bowen Basin: Catherine Sandstone.

Age: Ufimian-Kazanian.

Palaeoenvironment: The species is relate to cold, temperate waters of a shallow sea depositing muddy, sandy sediments.

Genus **EOCRISTELLARIA** K.V. Miklukho-Maklay 1954

Type species: *Eocristellaria permica* K.V. Miklukho-Maklay 1954, OD.

Eocristellaria initialis (Crespin 1958) (Pl. 19, figs 21-23; pl. 21, figs 1,2; pl. 29, figs 14,15; pl. 32, fig. 1; pl. 33, figs 1-3)

1958 *Lenticulina (Astacolus) initialis* Crespin: p. 96, pl. 24, figs 1-3

Remarks: Crespin's diagnosis: "Small, compressed test, with initial portion involute, adult chamber becoming evolute, periphery rounded and wall smooth and polished" fits well most of the specimens here illustrated. This species is not, however, confined to the Mantuan *Productus* bed; it was found also in the Ingelara Formation and Catherine Sandstone.

Material available: The species is rare to common in the Late Permian of the Bowen Basin, where it was found from the following localities: L 3595 to 3598, 3600, 3603, 3624, 3626, 3632, 3635, 3710, L.3719-3720, 3726-3727.

Figured types: GSQ MF 135/1-3,5, from L 3726; GSQ MF 135/4 from L 3727; GSQ MF 136/2 from L 3635.

Distribution: QLD, Bowen Basin: Blenheim Formation, Ingelara Formation, Catherine Sandstone, and Peawaddy Formation.

Age: The species range is Ufimian-Kazanian.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy, and biodetritic sediments.

Superfamily **NODOSARIACEA** Ehrenberg 1838

Diagnosis: Older taxa with monolamellar or multilamellar test wall as a result of partial secondary growth, becoming secondary laminated as a result of continued growth in younger taxa. (Emended from Loeblich and Tappan 1988, p. 394.)

Family **NODOSARIIDAE** Ehrenberg 1838

Genus **LINGULONODOSARIA** A. Silvestri 1903

Type species: *Lingulina nodosaria* Reuss 1863, SD Galloway 1933.

Lingulonodosaria sp. (Pl. 22, fig. 11)

1960 *Lingulinella?* sp. Gerke: p. 31, pl. 45, fig. 7a,b

Remarks: A rare specimen from the Late Permian Peawaddy Formation (Mantuan *Productus* bed) is possibly close to the Siberian species of Gerke.

Material available: The species is rare in the Bowen Basin, from L 3727.

Figured type: GSQ MF 138/1 from L 3727.

Distribution: The species is rare in the Mantuan *Productus* bed of the Peawaddy Formation.

Age: The species range is Kazanian.

Palaeoenvironment: The species is related to cold, temperate waters of a shallow sea depositing muddy, biodetritic sediments.

Lingulonodosaria sp. cf. ***L. arctica*** (Gerke 1952) (Pl. 20, figs 20-22)

cf. 1960 *Lingulinella arctica* Gerke: p. 29, pl. 45, figs 1-4b

Remarks: *Lingulonodosaria* as well as other lagenid genera such as *Protonodosaria* and *Pseudonodosaria* found in the Bowen Basin are closely comparable with Siberian and Novaya Zemlya Permian genera (Palmieri 1983).

Material available: The species is rare to common in the Late Permian of the Bowen Basin where it was found in the following localities: L 3598, 3600, 3632, 3698, 3703, 3712-3713, 3720, 3726-3727.

Figured types: GSQ MF 127/4-5 from L 3727.

Distribution: QLD, Bowen Basin: Barfield Formation, Ingelara Formation, Peawaddy Formation.

Age: The species range is Ufimian-Kazanian.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy, and biodetritic sediments.

Genus **MAICHELINA** Sosnina 1977

Type species: *Maichelina consueta* Sosnina 1977, OD.

Remarks: The genus is placed in the *Nodosaridae* because of cylindrical, uniserial, rectilinear chambers and polymonolamellar wall, granular if altered.

Maichelina sp. (Pl. 33, figs 24,25)

Remarks: A rare, thick walled nodosariid is here attributed to *Maichelina* from the Late Permian of Russia.

Material available: The species is quite rare in the Late Permian of the Bowen Basin: it was found in the following localities: L 3617, 3626, 3632, 3634-3635, 3726-3727.

Figured type: GSQ MF 139/1 from L 3727.

Distribution: QLD, Bowen Basin: Blenheim Formation, Catherine Sandstone Formation, Peawaddy Formation (Mantuan *Productus* bed).

Age: The species range is Ufimian-Kazanian.

Palaeoenvironment: The species is related to cold temperate, waters of shallow seas depositing muddy, sandy, and biodetritic sediments.

Genus **NODOSARIA** Lamarck 1812

Type species: *Nautilus radicula* Linne' 1758; SD Lamarck 1816.

Nodosaria draperi sp. nov. (Pl. 18, figs 9,10; pl. 20, fig. 5; pl. 32, figs 16-18)

Origin of name: From Mr J.Draper, Geological Survey of Queensland.

Description of holotype: Test small, multilocular, uniserial, very gently tapering, chambers five, sutures flush, surface with seven strong, equidistant, longitudinal costae, test wall calcareous hyaline, radial, aperture terminal, central, protruding, radiate. Dimensions: height, 0.89mm; max. width, 0.30mm.

Remarks: In the opinion of the writer costate forms are common and variable within the genus *Nodosaria* in the Permian of Australia (see also Crespin 1958): this is in disagreement with Loeblich & Tappan (1987, p.397).

Material available: The species is common in the Late Permian of the Bowen Basin: it was found in the following localities: L 3626, 3633-3634, 3637, 3643, 3697, 3709, 3712-37134, 3719-3720, 3726-3727.

Figured types: Holotype, GSQ MF 132/4 from L 3726; GSQ MF 132/1-2 from L 3720; GSQ MF 132/3 from L 3727; GSQ MF 132/5 from L 3726.

Distribution: QLD, Bowen Basin: Ingelara Formation, Catherine Sandstone, and Peawaddy Formation.

Age: The species range is Ufimian-Kazanian.

Palaeoenvironment: The species is related to cold and cold temperate waters of shallow seas depositing muddy, sandy, biodetritic sediments.

Nodosaria raggatti Crespin 1958 (Pl. 15, figs 14,16,17; pl. 17, fig. 16; pl. 26, figs 3,4,6,8; pl. 27, fig. 10; pl. 32, figs 12,13)

1958 *Nodosaria raggatti* Crespin: p. 104, pl. 27, figs 1-5

1968 *Nodosaria raggatti* Crespin; Belford: p. 4-5, pl. 3, fig. 5, *non* figs 6,7 = *Protonodosaria tereta* (Crespin 1958)

1982 *Nodosaria raggatti* Crespin; Scheibnerova: p. 69, l.38, figs 1-3

Description: Test short, stout, tapering, consisting of globular proloculus, followed by four to six slightly inflated chambers, which gradually increase in width and height, the last-formed chambers being distinctly lobate. Sutures distinct, straight, depressed. Wall calcareous, perforate; surface smooth. Aperture terminal, radiate (modified from Crespin 1958, p. 104).

Material available: The species is quite common in the Early and Late Permian of the Bowen Basin, from the following localities: L 3587-3591, 3595-3598, 3600, 3603-3604, 3609-3610, 3617, 3624, 3626, 3632, 3635-3636, 3639, 3703, 3707-3713, 3720, 3726-3727.

Figured types: GSQ MF 125/5-7 from L3639; GSQ MF 131/1, 131/3, 131/6 from L 3636; GSQ MF 131/4-5, 131/7 from L 3726.

Distribution: QLD, Bowen Basin: Buffel, Tiverton, and Cattle Creek Formations; Oxtrack, Barfield and Flat Top Formations; Blenheim Formation; Ingelara Formation, Catherine Sandstone, and Peawaddy Formation. NSW, Sydney Basin: Branxton Formation and Maitland Group. WA, Carnarvon Basin: Byro Group; Canning Basin: Noonkambah Formation.

Age: The species range is Artinskian to Kazanian in Queensland and New South Wales; Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas, depositing muddy, sandy and biodetritic sediments.

Nodosaria springsurensis Crespin 1945 (Pl. 17, figs 11,12; pl. 18, fig. 11; pl. 26, figs 1,2; pl. 32, fig. 19)

1945 *Nodosaria springsurensis* Crespin: p. 26, pl. 2, fig. 5
1958 *Nodosaria springsurensis* Crespin: p. 106, pl. 26, figs 11,12

Diagnosis: "Test elongate, gently tapering, greatest width near apertural end, circular in transverse section. Chambers six, sutures distinct, depressed. Test covered with about 16 raised, longitudinal costae, which extend over the length of the shell. Aperture central, terminal radiate" (Crespin, 1945, p. 26).

Remarks: In the opinion of the writer costate forms are common and variable within the genus *Nodosaria* in the Permian of Australia (see also Crespin 1958).

Material available: The species is rare to common in the late Early Permian an the Late Permian of the Bowen Basin from the following localities: L 3636, 3707, 3709, 3720, 3726-3727.

Figured types: GSQ MF 129/1-4 from L 3636; GSQ MF 133/1 from L 3720; GSQ MF 132/5 from L 3727.

Distribution: QLD, Bowen Basin: Buffel Formation, Sirius Mudstone Member of the Cattle Creek Formation, Ingelara Formation, Catherine Sandstone, and Peawaddy Formation. WA, Carnarvon Basin: Byro Group.

Age: The species range is Late Artinskian-Kazanian in Queensland; Late Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy, and biodetritic sediments.

Nodosaria sp. cf. ***N. raggatti*** Crespin 1958 (Pl. 14, figs 23-25; pl. 25, fig. 8)

Remarks: Medium size tests with inflated chambers, slightly depressed sutures, lobate periphery, and rougher surface are here compared with *N. raggatti*.

Material available: The species is rare to common in the Early Permian, and rare in the Late Permian of the Bowen Basin; it was retrieved from: L 3610, 3636, 3707, 3707, 3720-3724.

Figured types:GSQ MF 125/1, 3, 4, 8, from L 3721.

Distribution: QLD, Bowen Basin: Cattle Creek Formation, Tiverton Formation, Barfield Formation, Ingelara Formation, Blenheim Formation, Peawaddy Formation.

Age: The species range is Artinskian to Kazanian.

Palaeoenvironment: The species is associated with cold and cold, temperate waters of shallow seas depositing muddy, sandy sediments.

Nodosaria? sp. (Pl. 17, figs 13,17; pl. 20, figs 3,4; pl. 27, fig. 7; pl. 32, figs 11,14,15)

Remarks: Small, conical, incomplete tests of nodosariid, with smooth surface and fibrous, radial calcitic test wall on dark, organic layer, are left in open nomenclature.

Material available: The species is rare in the late Early Permian and Late Permian of the Bowen Basin, where it was found from: L 3636, 3726-27.

Figured types: GSQ MF 130/1-2, 098/34, from L 3636; GSQ MF 130/3-4 from L 3727; GSQ MF/5-6, from L 3726.

Distribution: QLD, Bowen Basin: Sirius Mudstone Member of the Cattle Creek Formation, Catherine Sandstone, and Peawaddy Formation.

Age: The species range is Late Artinskian and Ufimian-Kazanian.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy, and biodetritic sediments.

Genus PROTONODOSARIA Gerke 1959

Type species: *Nodosaria proceraformis* Gerke 1952, OD.

Protonodosaria tereta (Crespin 1958) (Pl. 14, figs 10,22,26; pl. 15, fig. 15; pl. 26, fig. 7a,b; pl. 30, fig. 4)

1958 *Nodosaria tereta* Crespin: p. 99-100, pl. 26, figs 1-4; pl. 31, figs 9,10,12

1982 *Nodosaria tereta* Crespin; Scheibnerova: p. 69, pl. 33, fig. 4

1985 *Protonosaria tereta* (Crespin); Palmieri *in* Foster & others: p. 82-83, pl. 7, figs 1-10

Remarks: *Protonodosaria tereta* is a rare but characteristic species in the Early Permian of the Bowen Basin as it is in the Early Permian of Australia. The test may have a rounded aperture with faint, fine, radiated depressions over the apertural rim and the test wall consists of a fibrous or microgranular when altered, calcitic layer on a thin, dark, organic lining. The test surface is usually smooth, sometimes translucent; the periphery may be flush or slightly lobate. Morphological variation of test and chambers may be present.

Material available: The species is rather rare in the Early Permian of the Bowen Basin from the following localities: L 3587-3589, 3604, 3608, 3639, 3641, 3720-3722.

Figured types: GSQ MF 124/1-3 from L 3721-3722; GSQ MF 128/1, 124/4 from L 3639 and 3636.

Distribution: QLD, Bowen Basin: Buffel Formation, Tiverton Formation, Cattle Creek Formation (Mostyndale Mudstone Member). NSW, Sydney Basin: Dalwood Group, Maitland Group. TAS, Gray Limestone. WA, Perth Basin: Fossil Cliff member of the Holmwood Shale; Carnarvon Basin: Callytharra Formation; Canning Basin: Grant Group, Nura Member of the Poole Sandstone, Noonkambah Formation.

Age: The species range is ?Late Sakmarian-Artinskian in Queensland; Late Sakmarian-?Kazanian in New South Wales; Late Sakmarian-Artinskian in Tasmania; Late Sakmarian-Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold waters of shallow seas depositing muddy, sandy and calcareous sediments.

Genus **PSEUDONODOSARIA** Boomgaart 1949

Type species: *Glandulina discreta* Reuss 1850, OD.

Pseudonodosaria antiqua (Chapman & Howchin 1905) (Pl. 14, figs 14-16,20,21; pl. 15, figs 18-21; pl. 25, figs 1-6; pl. 26, fig. 5; pl. 30, figs 1-3)

1905 *?Pleurostomella antiqua* Chapman & Howchin: p. 14, pl. 2, fig. 5
1934 *Nodosaria? antiqua* (Chapman & Howchin); Chapman, Howchin & Parr, p. 185
1958 *Lingulina antiqua* (Chapman & Howchin); Crespin: p. 108, pl. 24, fig. 8

Remarks: The apertural slit for the figured test of this species reported in Crespin (1958, p. 108) is here considered as due to compression of the test. All the specimens here illustrated show a small rounded and radiate or radial aperture; individual with various morphological differences in the overlapping mode of the chambers, but possessing a definitely more inflated last chamber are included in *Pseudonodosaria antiqua*; a primitive entosolenian tube is visible in one specimen only (Pl. 26, fig. 5), possibly conducive to a link between pseudonodosariid and glandulinid foraminifera.

Material available: The species is rare in the Early and Late Permian of the Bowen Basin from the following localities: L 3636, 3639, 3709, 3712, 3720-3721, 3727.

Figured types: GSQ MF 126/1-5, 126/10-12, 126/14-19, from L 3721; GSQ MF 126/6-9 from L 3639; GSQ MF 126/20 from L 3636.

Distribution: QLD, Bowen Basin: Cattle Creek Formation (Mostyndale Mudstone Member, Sirius Mudstone Member), Ingelara Formation, Catherine Sandstone, Peawaddy Formation. NSW, Sydney Basin: Branxton Formation, Maitland Group.

Age: The species range is Artinskian to Kazanian in Queensland and in New South Wales.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy sediments.

Pseudonodosaria serocoldensis (Crespin 1945) (Pl. 15, figs 1-4; pl. 18, figs 12,13; pl. 20, figs 1,2; pl. 28, figs 1,2; pl. 31, figs 12,13)

1945 *Nodosaria serocoldensis* Crespin: p. 26, pl. 3, figs 6,7
1958 *Rectoglandulina serocoldensis* (Crespin); Crespin: p. 107, pl. 27, figs 6-8, 10; non fig.9 = P. borealis (Gerke, 1952)
1968 *Rectoglandulina serocoldensis* (Crespin); Belford: p. 17, pl. 3, fig. 11

Remarks: The species, which already underwent a few nomenclatorial changes, would be even at present without proper generic placement like many other nodosariid foraminifera if the Loeblich & Tappan (1987) classification were to be accepted in toto. Loeblich and Tappan seem, in fact, to have disregarded the permian nodosariid from Australia (Crespin 1958) or from Russia (Gerke 1952, 1960). For example, *Pseudonodosaria* ranges, according to Loeblich & Tappan (1987) from the Mesozoic.

The hypotype figured in Crespin, 1958, pp. 27, fig.9, as well as the specimen here figured in pl. 31. figs 12-13, may belong to P. borealis (gerke, 1954).

Similar forms were separated by the author as P. Minuta (Palmien, in Draper, et al, 1991, p. 31, fig. 4).

Material available: The species is rare in the late Early Permian and common in the Late Permian of the Bowen Basin; it was found in following localities: L 3582-3583, 3590, 3595, 3597-3598, 3601, 3603, 3626, 3633-3634, 3636, 3651, 3698, 3703, 3709-3710, 3712-3713, 3715, 3718-3720, 3724, 3726-3727.

Figured types: GSQ MF 134/1-4 from L 3724; GSQ MF 134/5-6, 134/9, 134/11-12, from L 3726; GSQ MF 134/7-8, from L 3727.

Distribution: QLD, Bowen Basin: Sirius Mudstone Member of the Cattle Creek Formation, Ingelara Formation, Catherine Sandstone, and Peawaddy Formation, Oxtrack, Barfield, and Flat Top Formations. NSW, Sydney Basin: Mulbring

Siltstone, Maitland Group. WA, Carnarvon Basin: Byro Group; Canning Basin: Noonkambah Formation, Liveringa Formation. The species is considered as index taxon of a biostratigraphic zone.

Age: The species range is latest Artinskian-Kazanian in Queensland; Ufimian-Kazanian in New South Wales; Late Artinskian to Kazanian in Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy sediments.

Genus **DENTALINA** Risso 1826

Type species: *Nodosaria (Dentalina) cuvieri* d'Orbigny 1926, OD.

Dentalina grayi Crespin 1945 (Pl. 15, figs 11-13; pl. 20, fig. 23; pl. 25, figs 7a,b,9a,b)

1945 *Dentalina grayi* Crespin: p. 27, pl. 3, fig. 8

1958 *Dentalina grayi* Crespin; Crespin: p. 97, pl. 24, figs 4,5

Diagnosis: "Test small, elongate, slender, gently curved and tapering, with greatest width in apertural chamber. Chambers seven, slightly inflated, and gradually increasing in size towards apertural chamber. Sutures distinct, straight, depressed. Aperture terminal, radiate" (Crespin 1945, p. 97).

Remarks: The species may be referred to the genus *Laevidentalina* because it lacks surface ornamentation. However, according to Loeblich & Tappan (1987), *Laevidentalina* ranges from the Mesozoic.

Material available: The species is rare in the late Early Permian and Late Permian of the Bowen Basin, where it was found from the following localities: L 3610, 3632, 3636, 3639, 3703, 3709, 3720, 3724, 3726-3727.

Figured types:GSQ MF 127/1-3, 127/8-9 from L 3639; GSQ MF 127/7 from L 3727.

Distribution: QLD, Bowen Basin: Sirius Mudstone Member of the Cattle Creek Formation, Ingelara Formation, Catherine Sandstone, Peawaddy Formation. NSW, Sydney Basin: Maitland Group. WA, Carnarvon Basin: Byro Group; Canning Basin: Noonkambah Formation.

Age: The species range is Late Artinskian and Ufimian-Kazanian in Queensland; Ufimian-Kazanian in New South Wales; Late Artinskian in Western Australia.

Palaeoenvironment: The species is related to cold and cold, temperate waters of shallow seas depositing muddy, sandy, and biodetritic sediments.

Family **POLYMORPHINIDAE** d'Orbigny 1839

Subfamily **POLYMORPHININAE** d'Orbigny 1839

Genus **EOGUTTULINA** Cushman & Ozawa 1930

Type species: *Eoguttulina anglica* Cushman & Ozawa 1930, OD.

Eoguttulina sp. (Pl. 19, fig. 24)

Remarks: A single specimen, found in the Ingelara Formation from localities L 3720, is attributed to *Eoguttulina* and left in open nomenclature. A close species, reported in Gerke & others (1960; pl. 99, figs 1a-2b), is *Eoguttulina permica* Voronov, from the Late Permian of Siberia.

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APPENDIX 1

FOSSIL LOCALITY DESCRIPTIONS

L3582
Monto 1:250 000 Sheet area
Bowen Basin - western flank of Ferguson Syncline
Barfield Formation
Station Mudstone Member
dark grey, silty mudstone
outcrop, BARF 1

L3583
Monto 1:250 000 Sheet area
Bowen Basin - western flank of Ferguson Syncline
Flat Top Formation (lower most beds)
grey, brownish, silty to sandy mudstone
outcrop, FLTOP 2

L3586
Monto 1:250 000 Sheet area
Bowen Basin
Barfield Formation
Four Mile Mudstone Member
outcrop, BARF 5

L3587
Monto 1:250 000 Sheet area
Bowen Basin
Camboon Volcanics (uppermost beds)
limestone lenses in tuff beds
outcrop, CAM VOL 8

L3588
Monto 1:250 000 Sheet area
Bowen Basin
Buffel Formation (lowermost beds)
limestones, fossiliferous
outcrop, BUFFEL 9

L3589
Monto 1:250 000 Sheet area
Bowen Basin
Buffel Formation (uppermost beds)
limestones, fossiliferous
outcrop, BUFFEL 10

L3590
Monto 1:250 000 Sheet area
Bowen Basin
Oxtrack Formation (lowermost beds)
muddy, silty limestones
outcrop, MT OX 11

L3591
Monto 1:250 000 Sheet area
Bowen Basin
Oxtrack Formation (uppermost beds)
limestones impure, finely bedded and biodetrital
outcrop, MT OX 12

L3592
Monto 1:250 000 Sheet area
Bowen Basin
Barfield Formation (uppermost beds)
mudstone, claystone, fossiliferous, biodetrital
outcrop, BARF 13

L3593
Monto 1:250 000 Sheet area
Bowen Basin
Flat Top Formation (lower most beds)
sandy mudstones and sandstones
outcrop, FL TOP 14

L3594
Monto 1:250 000 Sheet area
Bowen Basin
Flat Top Formation
olive green, calcareous, sandstones, fossiliferous
outcrop, FL TOP 15

L3595
Monto 1:250 000 Sheet area
Bowen Basin
Flat Top Formation
fossiliferous limestone
outcrop, FL TOP 16

L3596
Monto 1:250 000 Sheet area
Bowen Basin
Upper Flat Top Formation (uppermost beds)
calcareous, fossiliferous sandstones or calcarenites
outcrop, FL TOP 18

L3597
Mundubbera 1:250 000 Sheet area
Bowen Basin
Flat Top Formation (basal beds)
fossiliferous, limey and sandy mudstone
outcrop, FL TOP 19

L3598
Mundubbera 1:250 000 Sheet area
Bowen Basin
Barfield Formation (upper part)
crinoidal mudstone
outcrop, BARF 20

L3599
Mundubbera 1:250 000 Sheet area Bowen Basin
Barfield Formation
fossiliferous, limey mudstone
outcrop, BARF 21

L3600
Mundubbera 1:250 000 Sheet area
Bowen Basin

Barfield Formation
muddy limestone, very fossiliferous, crinoids, corals
outcrop, BARF 22

L3601
Mundubbera 1:250 000 Sheet area
Bowen Basin
Oxtrack Formation
muddy, silty, biodetrital limestones
outcrop, MT OX 23

L3603
Mundubbera 1:250 000 Sheet area
Bowen Basin
Oxtrack Formation
silty limestones, fossiliferous
outcrop, MT OX 25

L3604
Monto 1:250 000 Sheet area
Bowen Basin
Camboon Volcanics
tuffaceous limestones, fossiliferous
outcrop, CAM VOL 26

L3606
St Lawrence 1:250 000 Sheet area
Bowen Basin
Lizzie Creek Volcanics
tuffaceous, recrystallised, fossiliferous limestone
outcrop, CAM VOL 40

L3607
Mackay 1:250 000 Sheet area
Bowen Basin
Tiverton Formation
muddy, sandy siltstone
outcrop, TIV 41

L3608
Mackay 1:250 000 Sheet area
Bowen Basin
Tiverton Formation
silty mudstones
outcrop, TIV 43

L3609
Mackay 1:250 000 Sheet area
Bowen Basin
Tiverton Formation
sandy, coquinitic mudstone
outcrop, TIV 44

L3610
Mackay 1:250 000 Sheet area
Bowen Basin
Tiverton Formation
silty mudstone, very fossiliferous
outcrop, TIV 45

L3611
Mackay 1:250 000 Sheet area
Bowen Basin
Blenheim Formation
sandstones, silty mudstones, siltstones
outcrops, BLEN 46-51

L3612
Mackay 1:250 000 Sheet area
Bowen Basin
Blenheim Formation
silty mudstone
outcrops, BLEN 52-53

L3613
Mt Coolon 1:250 000 Sheet area
Bowen Basin
Blenheim Formation
sandstone, siltstone
outcrops, BLEN 54-57

L3614
Mackay 1:250 000 Sheet area
Bowen Basin
Blenheim Formation
clayey siltstones
outcrop, BLEN 61-63

L3615
Mt Coolon 1:250 000 Sheet area
Bowen Basin
Blenheim Formation (basal part)
sandy siltstone
outcrop, BLEN 66

L3616
Bowen 1:250 000 Sheet area
Bowen Basin
Blenheim Formation (lowermost part)
sandstone, siltstone, fossiliferous sandstone
outcrop, BLEN 67

L3617
Bowen 1:250 000 Sheet area
Bowen Basin
Blenheim Formation (upper part)
sandstones, siltstones, fossiliferous
outcrop, BLEN 71-74

L3618
Bowen 1:250 000 Sheet area
Bowen Basin
Blenheim Formation (lower part)
fossiliferous sandstones
outcrops, BLEN 75-77

L3619
Bowen 1:250 000 Sheet area
Bowen Basin
Blenheim Formation (middle part)
silty mudstones
outcrops, BLEN 78,79

L3620
Bowen 1:250 000 Sheet area
Bowen Basin
Blenheim Formation (middle to upper part)
sandstone, siltstone, fossiliferous
outcrops, BLEN 80,81

L3621
Bowen 1:250 000 Sheet area
Bowen Basin
Blenheim Formation
sandstone, siltstone, fossiliferous
outcrop, BLEN 82

L3622
Bowen 1:250 000 Sheet area
Bowen Basin
Blenheim Formation (upper most beds)
sandstones, siltstones
outcrops, BLEN 83, 84

L3623
Clermont 1:250 000 Sheet area
Bowen Basin
Blenheim Formation (lower middle part)
sandstones, siltstones, fossiliferous
outcrops, BLEN 85,87

L3624
Clermont 1:250 000 Sheet area
Bowen Basin
Blenheim Formation
sandstones, siltstones, fossiliferous
outcrop, BLEN 87-89

L3625
Clermont 1:250 000 Sheet area
Bowen Basin
Blenheim Formation (middle upper part)
sandstones, siltstones, fossiliferous
outcrop, BLEN 90

L3626
Duaringa 1:250 000 Sheet area
Bowen Basin
Ingelara Formation
dark grey shales with solitary corals and silicified wood
outcrop, INGE 98

L3627
Duaringa 1:250 000 Sheet area
Bowen Basin
Freitag Formation
siltstones and sandstones
outcrops, INGE 99-101

L3632
Eddystone 1:250 000 Sheet area
Ingelara and Peawaddy Formations
mudstones, shales, clays, siltstones, sandstones, fossiliferous
outcrops, INGE 156-159; PWD 172, 173 MPB

L3633
Eddystone 1:250 000 Sheet area
Ingelara and Peawaddy Formations
mudstones, siltstones, sandstones, fossiliferous
outcrops, INGE 155, 159; PWD 176-184

L3634
Springsure 1:250 000 Sheet area
Bowen Basin
Peawaddy Formation
sandstones, siltstones, fossiliferous
outcrop, PWD 189-192 MPD

L3635
Springsure 1:250 000 Sheet area
Bowen Basin
Peawaddy Formation
shales, silty mudstones, sandstones, fossiliferous
outcrops, PWD 189-192 MPB

L3636
Springsure 1:250 000 Sheet area
Bowen Basin
Cattle Creek Formation
conglomeratic silty mudstones, siltstones, coquinites
outcrops, CCF 193-198

L3637
Springsure 1:250 000 Sheet area
Bowen Basin
Ingelara Formation, Catherine Sandstone
sandstones, siltstones, mudstones, fossiliferous
outcrops, INGE 199-204

L3638
Springsure 1:250 000 Sheet area
Bowen Basin
Ingelara Formation, Catherine Sandstone
sandstone, siltstone, mudstone
outcrops, INGE 205-209

L3639
Springsure 1:250 000 Sheet area
Bowen Basin
Cattle Creek Formation, Sirius Mudstone Member
shales, mudstone
outcrop CCF 216

L3640
Emerald 1:250 000 Sheet area
Cattle Creek Formation
Mostyndale Mudstone Member
shales, silty mudstones
outcrop CCF 216

L3641
Springsure 1:250 000 Sheet area
"Dilly Beds" = Cattle Creek Formation, Riverstone Member
sandy calcarenites, coquinites in lenses
outcrops CCF 221, 222

L3642
Springsure 1:250 000 Sheet area
Freitag and Ingelara Formations
claystones, mudstones, shales
outcrops, FREIT 223, 224; INGE 225-239

L3643
Springsure 1:250 000 Sheet area
Peawaddy Formation, Mantuan Productus bed
siltstone and limey coquinites
outcrop, PWD 240-247

L3644
Springsure 1:250 000 Sheet area
Peawaddy Formation
siltstones, sandstones, fossiliferous
outcrops, PWD 243-247

L3651
Emerald 1:250 000 Sheet area
BHP Capella DH2
German Creek Formation
siltstones
core Samples

L3688
Springsure 1:250 000 Sheet area
Springsure Creek Section
Cattle Creek Formation
mudstone, fossiliferous
outcrop 556 (J. DRAPER)

L3697
Bowen 1:250 000 Sheet area
Bowen NS 599
Blenheim Formation
mudstones, siltstones, sandstones
core samples

L3698
Emerald 1:250 000 Sheet area
Emerald NS 3
Ingelera Formation
silty mudstone
core samples

L3699
Emerald 1:250 000 Sheet area
Emerald NS 7
Maria Formation & German Creek Formation
sandstones, siltstones and mudstones
core samples

L3702
Clermont 1:250 000 Sheet area
Cairns Country NS 3
Maria Formation, German Creek Formation
sandstones, siltstones, mudstones
core samples

L3703
Clermont 1:250 000 Sheet area
Dickson NS 4
Maria Formation, German Creek Formation
sandstones, siltstones, mudstones
core samples

L3704
Clermont 1:250 000 Sheet area
Cairns County NS 4
Maria Formation, German Creek Formation
sandstones, siltstones, mudstones
core samples

L3705
Clermont 1:250 000 Sheet area
Plantagenet NS 6
Maria Formation, German Creek Formation
sandstones, siltstones, mudstones
core samples

L3707
Mundubbera 1:250 000 Sheet area
GSQ Mundubbera 11
Back Creek Group, Camboon Volcanics
sandstones, siltstones, limestones, fossiliferous
core samples

L3708
Eddystone 1:250 000 Sheet area
GSQ Eddystone 5
Cattle Creek Formation Peawaddy Formation
sandstones, siltstones, mudstones
core samples

L3709
Eddystone 1:250 000 Sheet area
GSQ Eddystone 4
Cattle Creek Formation, Peawaddy Formation
core samples

L3710
Springsure 1:250 000 Sheet area
GSQ Springsure 19
Cattle Creek to Peawaddy Formations
core samples

L3711
Springsure 1:250 000 Sheet area
GSQ Springsure 12
Ingelara Formation, Catherine Sandstone
core samples

L3712
Springsure 1:250 000 Sheet area
GSQ Springsure 17
Ingelara Formation
core samples

L3713
Springsure 1:250 000 Sheet area
GSQ Springsure 18
Ingelara Formation
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L3714
Springsure 1:250 000 Sheet area
GSQ Springsure 11
Ingelara Formation, Peawaddy Formation
core samples

L3715
Springsure 1:250 000 Sheet area
GSQ Springsure 10
Catherine Sandstone
core samples

L3717
Springsure 1:250 000 Sheet area
GSQ Springsure 16
Cattle Creek Formation
core samples

L3718
Eddystone 1:250 000 Sheet area
GSQ Eddystone 1
Cattle Creek Formation, Ingelara Formation, Peawaddy formation
core samples

L3719
Taroom 1:250 000 Sheet area
GSQ Taroom 11-11A
Ingelara Formation
core samples

L3720
Taroom 1:250 000 Sheet area
GSQ Taroon 10
Cattle Creek Formation, Ingelara Formation, Peawaddy Formation
core samples

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Springsure 1:250 000 Sheet area
GSQ Springsure 9
Cattle Creek Formation
core samples

L3722
Springsure 1:250 000 Sheet area
GSQ Springsure 8
Cattle creek formation
core samples

L3723
Springsure 1:250 000 Sheet area
GSQ Springsure 7
Cattle Creek Formation
core samples

L3724
Springsure 1:250 000 Sheet area
GSQ Springsure 6
Cattle Creek Formation
core samples

L3725
Springsure 1:250 000 Sheet area
GSQ Springsure 5
Cattle Creek Formation
core samples

L3726
Springsure 1:250 000 Sheet area
GSQ Springsure 3
Freitag Formation, Ingelara Formation
Catherine Sandstone, Peawaddy Formation
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L3727
Springsure 1:250 000 Sheet area
GSQ Springsure 2
Catherine Sandstone, Peawaddy Formation
core samples

APPENDIX 2

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PLATE EXPLANATIONS

Plate 1

Figures 1-1a, 17, 18 ***Hyperammina fusta*** Crespin 1958. Frontal view of proximal part fragments. x32, GSQ Springsure 9, 178.5m, Cattle Creek Formation, Mostyndale Mudstone Member, GSQ MF 052/1-3.

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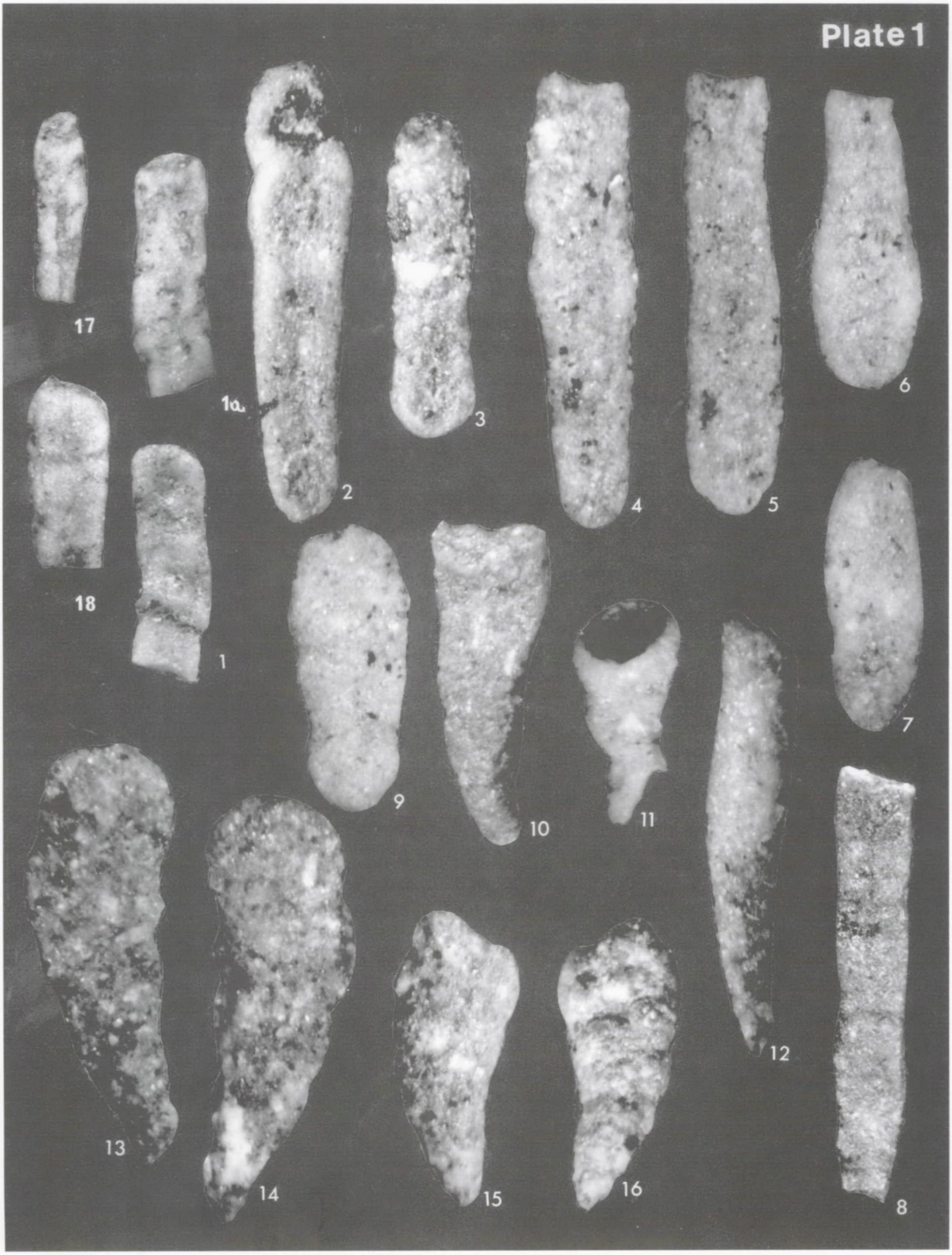
Plate 1
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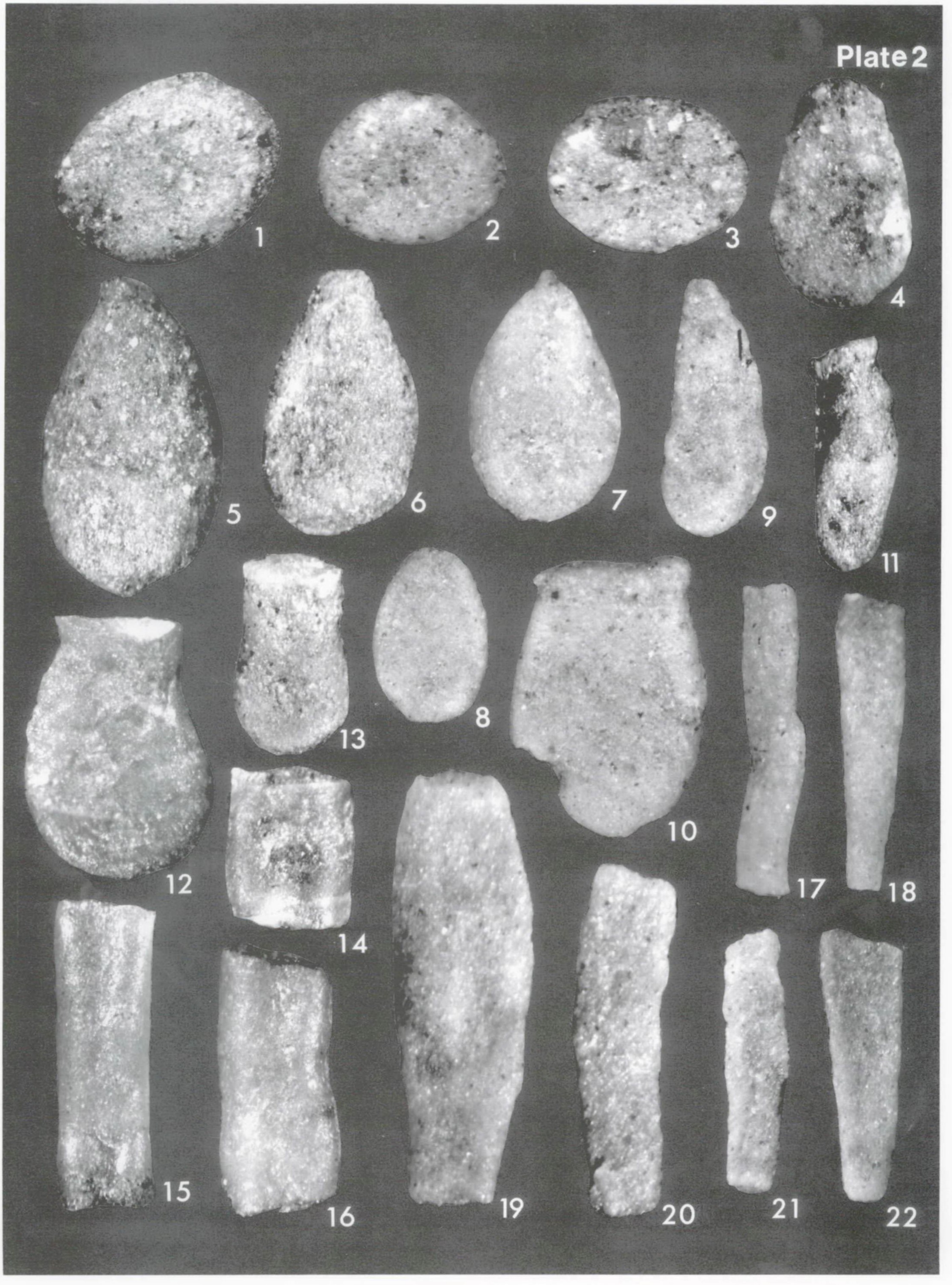
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Figures 1-6 ***Ammobaculites woolnoughi*** Crespin & Parr 1941. Lateral views. 1-5, x32, GSQ Taroom 10, 1080.9m, GSQ MF 078/1-5, Cattle Creek Formation; 6, x31, GSQ Springsure 9, 178.7m, GSQ MF 078/6, Cattle Creek Formation, Mostyndale Mudstone Member. See also pl. 6, fig. 10; pl. 7, figs 27, 28.

Figure 7 ***Reophax fittsi*** (Warthin 1930), lateral view. x31, GSQ MF 072/1, outcrop sample S56, Cattle Creek Formation, Mostyndale Mudstone Member.

Figures 8-9 ***Reophax minutissimus*** Plummer 1945, lateral views. x31, GSQ MF 072/2-3, locality and lithostratigraphy as in fig. 7. See also pl. 7, figs 1-3.

Figures 10-11 ***Reophax subasper*** Parr 1942, lateral views. x62, GSQ Springsure 6, 278.2m, GSQ MF 072/4-5; Cattle Creek Formation, Staircase Sandstone Member.

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Figures 15-19 ***Mooreinella recurvata*** (Crespin & Parr 1941). Lateral views. x62, GSQ Springsure 8, 103.7m, GSQ MF 081/2-5, 085/2; Cattle Creek Formation, Moorooloo Mudstone Member. See also pl. 1, figs 13, 14; pl. 24, figs 6, 7.

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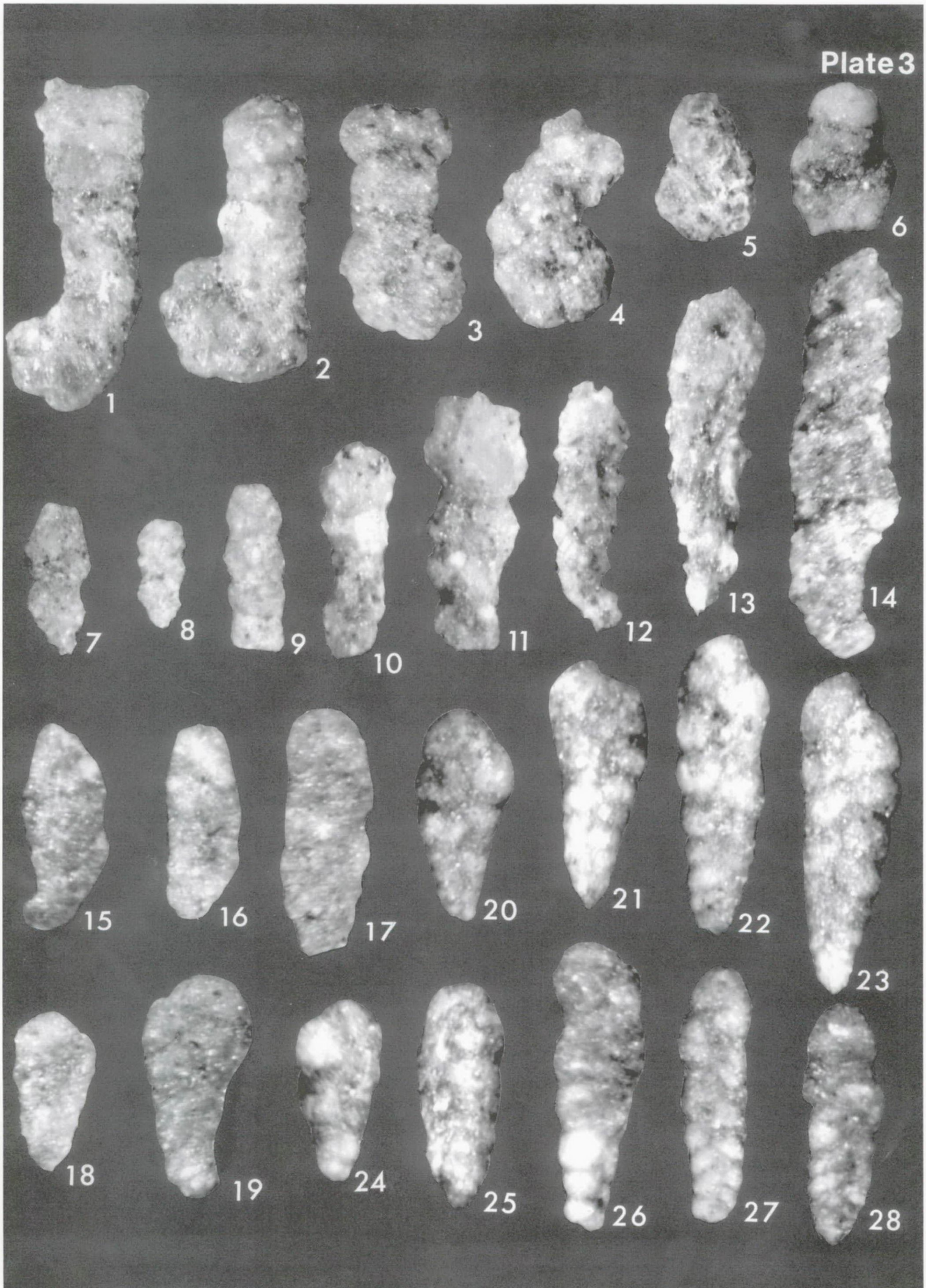
Plate 3
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Figures 5, 7 ***Ammodiscus multicinctus*** Crespin & Parr 1941. Frontal views. 5, x124, GSQ MF 066/1, outcrop sample S56, Cattle Creek Formation, Mostyndale Mudstone Member; 7, x124, GSQ Springsure 8, 161.9m, GSQ MF 066/13, Cattle Creek Formation, Riverstone Sandstone Member. See also pl. 7, figs 22, 23; pl. 8, figs 15, 17.

Figures 6, 8-13 ***Ammodiscus nitidus*** Parr 1942. Frontal views. 6, 8-9, x124, outcrop sample S56, GSQ MF 067/1-3, Cattle Creek Formation, Mostyndale Mudstone Member; 10-13, x124, GSQ Springsure 7, 336.7m, GSQ MF 067/4-7, Cattle Creek Formation, Moorooloo Mudstone Member. See also pl. 30, fig. 9.

Figures 14-16 ***Ammodiscus*** sp. cf. ***A. oonahensis*** Crespin 1958. Frontal, lateral views. 14, x124, GSQ Springsure 8, 161.9m, GSQ MF 066/2, Cattle Creek Formation, Riverstone Sandstone Member; 15-16, x124, GSQ Springsure 9, 65.6m, GSQ MF 066/3-4, Cattle Creek Formation, Mostyndale Mudstone Member.

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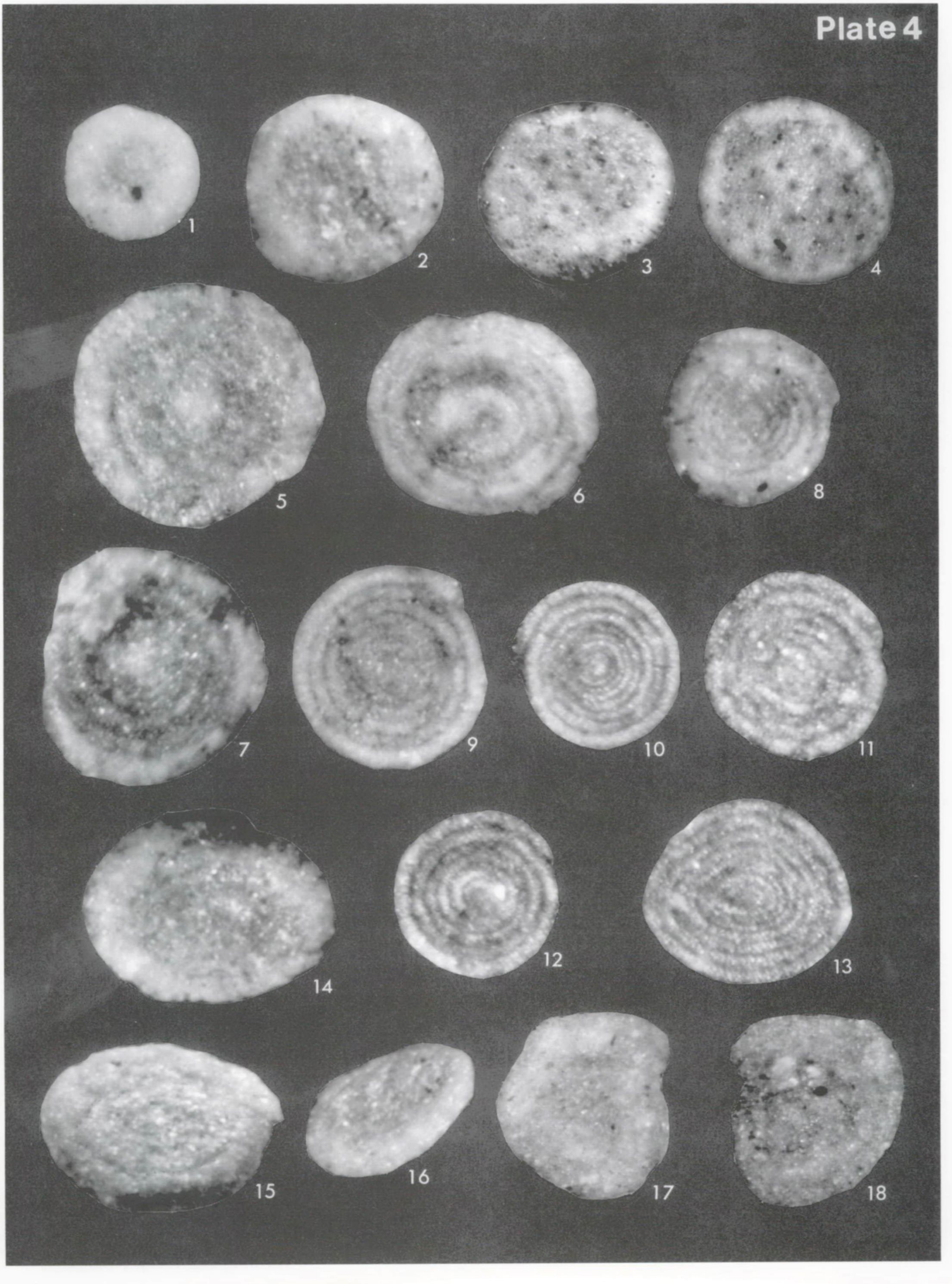
Plate 4
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Plate 5

Figures 1-17 ***Pseudohyperammina radiostoma*** Crespin 1958. Lateral, proximal and apertural views of 16 specimens showing apertural radial grooves, thickened apertural lips and growth rings with example of growth of a second chamber. 1, x9, 17, x11, GSQ Springsure 7, 356.5m, GSQ MF 055/1, 16. 2-3, x8, GSQ Springsure 7, 350.5m, GSQ MF 055/2, 4. 4, x8, GSQ Springsure 16, 738.4m, GSQ MF 055/3. 8-14, x16, outcrop sample S56, GSQ MF 055/7-13, Cattle Creek Formation, Mostyndale Mudstone Member. 5-7, x16, 15, x8, GSQ Springsure 7, 336.7m, GSQ MF 055/4-6, 14. 16, x11, GSQ Springsure 8, 44.5m, GSQ MF 055/15; all from Cattle Creek Formation, Moorooloo Mudstone Member. See also pl. 6. figs 1-3; pl. 24, figs 1-4; pl. 30, figs 5-7.

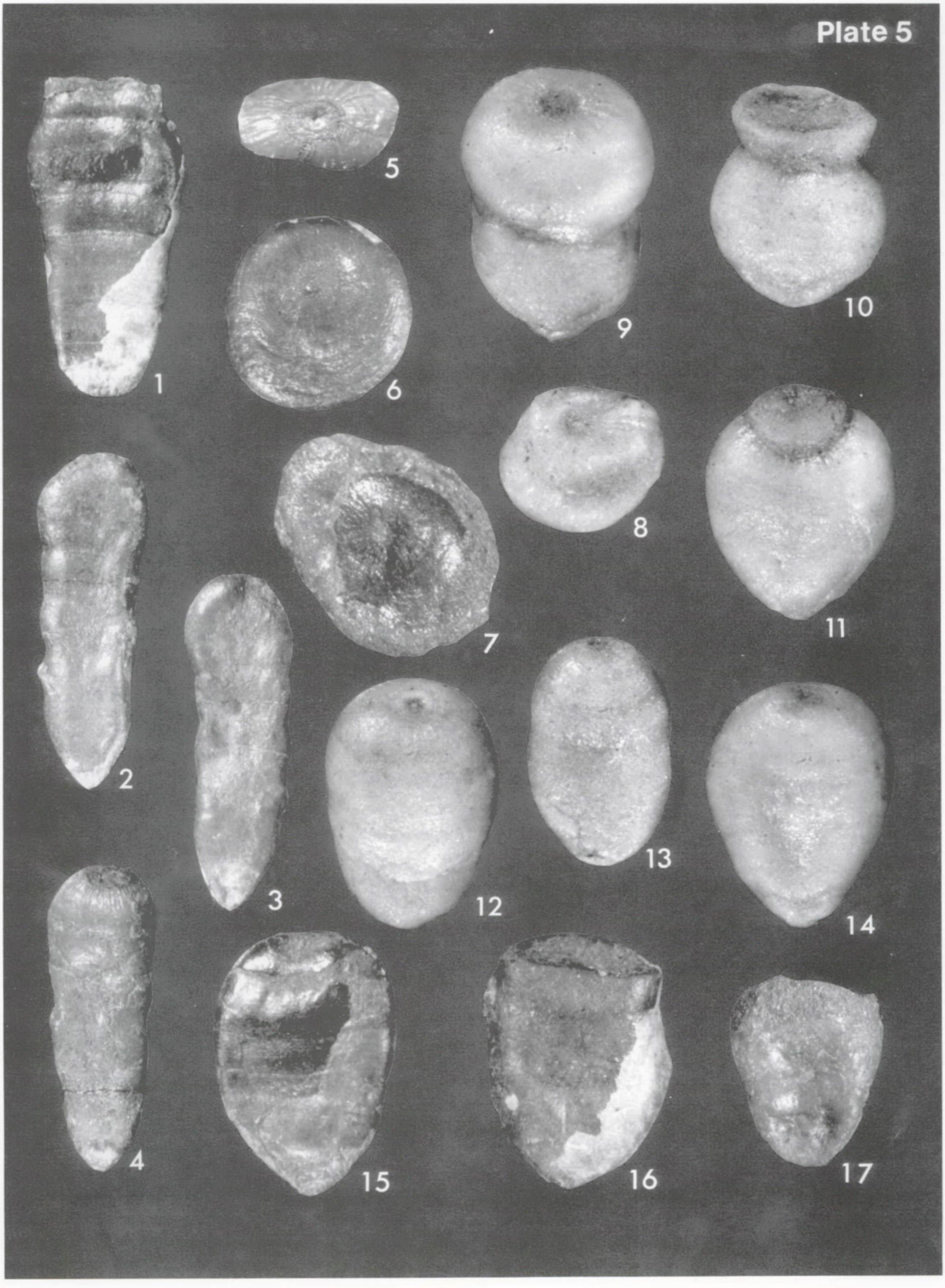
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Plate 6

Figures 1-3 ***Pseudohyperammina radiostoma*** Crespin 1958, showing latero-apertural view of a laterally compressed specimen and distal and proximal views of a longitudinally compressed specimen, with no radial apertural grooves to be seen. 1, x14, 2, 3, x26, outcrop sample S56, GSQ MF 055/22-24, Cattle Creek Formation, Mostyndale Mudstone Member. See also pl. 5, figs 1-17; pl. 24, figs 1-4; pl. 30, figs 5-7.

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Figures 6-7 ***Hippocrepinella biaperta*** Crespin 1958. Lateral views of 2 fragments. x18, outcrop sample S56, GSQ MF 057/1-2, Cattle Creek Formation, Mostyndale Mudstone Member.

Figures 8-9 ***Thurammina*** sp. Distal and proximal views. x18, outcrop sample S56, GSQ MF 064/2, Cattle Creek Formation, Mostyndale Mudstone Member.

Figure 10 ***Ammobaculites woolnoughi*** Crespin and Parr 1941, lateral view. x50, GSQ Springsure 8, 103.7m, GSQ MF 078/7, Cattle Creek Formation, Moorooloo Mudstone Member. See also pl. 3, figs 1-6; pl. 7, figs 27, 28.

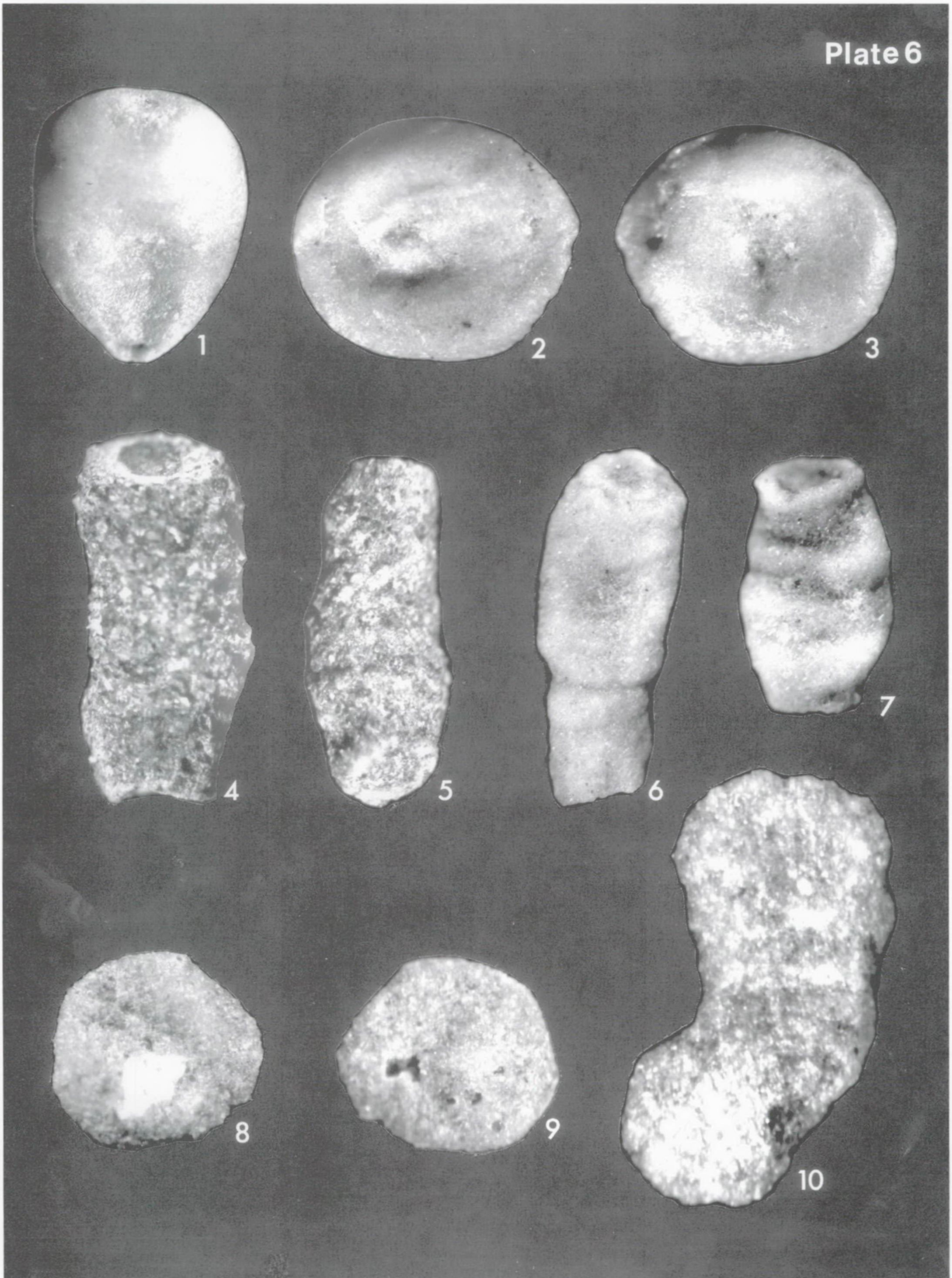
Plate 6
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Plate 7

Figures 1-3 ***Reophax minutissimus*** Plummer 1945. Lateral views. x31, GSQ Springsure 6, 278.2m, GSQ MF 072/6-8, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 3, figs 8, 9.

Figures 4-8 ***Reophax asper*** Cushman & Waters 1928. Lateral views. 4-5, x31, GSQ Springsure 6, 205.7m, GSQ MF 071/6-7; 6-7, x31, GSQ Springsure 6, 278.2m, GSQ MF 071/4-5; 8, x31, outcrop sample 210, GSQ MF 071/8; all from Cattle Creek Formation, Sirius Mudstone Member. See also pl. 3, figs 12-14.

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Figures 13-14 ***Hyperammina fletcheri*** Crespin 1958. Lateral views of megalospheric and microspheric specimens. x25, GSQ Springsure 5, 771.9m, GSQ MF 050/7-8, Cattle Creek Formation, Staircase Sandstone Member. See also pl. 1, figs 2-9; pl. 2, figs 17-22.

Figures 15-19 ***Saccammina ampulla*** Crespin 1958. Lateral views. x31, GSQ Springsure 6, 278.2m, GSQ MF 062/6-10, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 2, figs 5-9; pl. 8, fig. 28; pl. 30, figs 8-10.

Figure 20 ***Tolypammina undulata*** Parr 1942. Frontal view. x31, GSQ Springsure 6, 278.2m, GSQ MF 070/1, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 13, fig. 5.

Figure 21 ***Thuramminoides sphaeroidalis*** Plummer 1945. Frontal view. x62, GSQ Springsure 6, 278.2m, GSQ MF 064/1, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 4, figs 1, 2.

Figures 22-23 ***Ammodiscus multicinctus*** Crespin & Parr 1942. Frontal views. 22, x31, GSQ Springsure 6, 278.2m, GSQ MF 066/5; 23, x50, outcrop sample 193, GSQ MF 066/6; Cattle Creek Formation, Sirius Mudstone Member. See also pl. 4, figs 5, 7; pl. 8, figs 15, 17.

Figures 24-26 ***Teichertina teicherti*** (Parr 1942). Frontal views, one (fig. 24) showing internal surface with opening pits. x16, outcrop sample 212, GSQ MF 065/5-7, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 4, figs 3, 4.

Figures 27-28 ***Ammobaculites woolnoughi*** Crespin & Parr 1941. Lateral views. x25, outcrop sample 193, GSQ MF 078/8-9, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 3, figs 1-6; pl. 6, fig. 10.

Figure 29 ***Psammosphaera pusilla*** Parr 1942. Frontal view. x62, outcrop sample 210, GSQ MF 060/1, Cattle Creek Formation, Sirius Mudstone Member.

Figure 30 ***Hyperammina hebdenensis*** Crespin. Lateral view. x25, outcrop sample 210, GSQ MF 054/6, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 2, figs 12-16.


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Plate 8

Figures 1-5 ***Ammobaculites*** sp. cf. ***A. wandageensis*** Crespin 1958. Lateral views. x31, outcrop sample 159, GSQ MF 077/1-5, Ingelara Formation.

Figures 6-8 ***Reophax belfordi*** Crespin 1958. Lateral views. 6, x31, 7-8, x62, outcrop sample 224, GSQ MF 077/6-8, Freitag Formation.

Figures 9-13, 16 ***Ammobaculites*** sp. cf. ***A. eccentricus*** Crespin 1958. Lateral views. 9-11, 13, x62, outcrop sample 236, GSQ MF 076/1-4; 12, 16, x62, outcrop sample 235, GSQ MF 076/5, 084/1. Ingelara Formation.

Figure 14 ?***Haplophragmoides*** sp., latero-apertural view. x31, outcrop sample 235, GSQ MF 074/1, Ingelara Formation. See also pl. 11, figs 6-10; pl. 23, figs 12, 13.

Figures 15, 17 ***Ammodiscus multicinctus*** Crespin & Parr 1941. Frontal views. x61, outcrop sample 235, GSQ MF 066/7-8, Ingelara Formation. See also pl. 4, figs 5, 7; pl. 7, figs 22, 23.

Figures 18-23 ***Ammodiscus corrugatus*** n. sp., frontal views, 18, holotype, 19-23, paratypes; 18, 20. x62, 19, x31, outcrop sample 158, GSQ MF 066/9-11; 21, x31, 22-23, x62, GSQ Taroom 10, 757.6m, GSQ MF 066/12-15; all from Ingelara Formation.

Figures 24-27 ***Glomospirella nyei*** Crespin 1958. Frontal views. x50, GSQ Springsure 3, 157.1m, GSQ MF 068/1-4, Catherine Sandstone.

Figure 28 ***Saccammina ampulla*** Crespin 1958. x62, GSQ Taroom 10, 757.1m, GSQ MF 056/1, Ingelara Formation. See also pl. 2, figs 5-9; pl. 7, figs 15-19; pl. 30, figs 8-10.

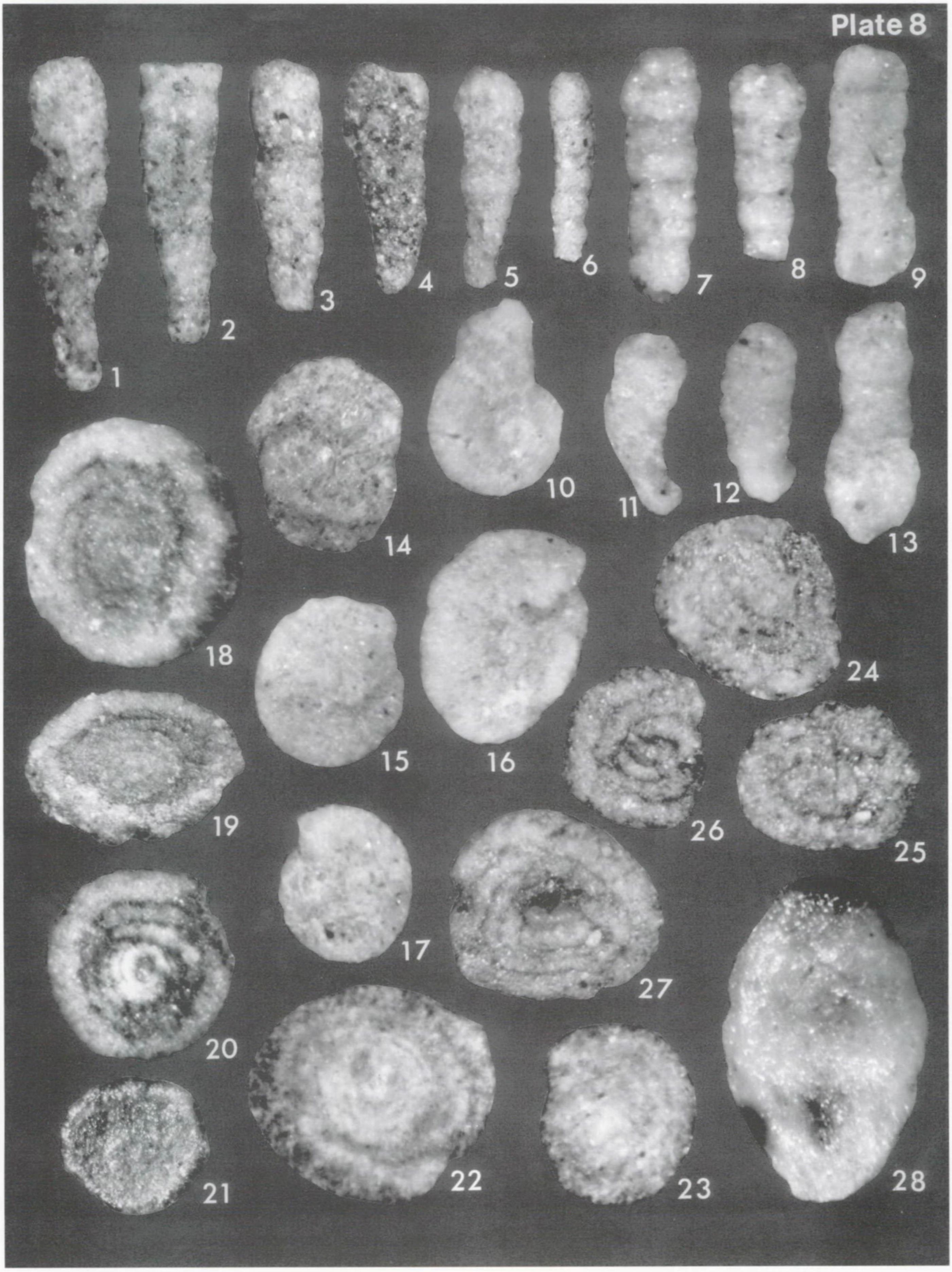
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Plate 9

Figure 1-9 ***Trochammina*** sp. 1-2, dorsal and umbilical view, x120; 3, latero dorsal view, x125; 4, particular of dorsal view, showing internal honeycomb structure, x500; 5, transversal section showing pyritic infilling, x125; 6-7, umbilical and lateral view, x130; 8-9, particulars of umbilical side showing apertural area and surface pits produced by tiobacteria, x500; GSQ MF 250/1-2, GSQ Eddystone 4, 720.3m, Cattle Creek Formation.

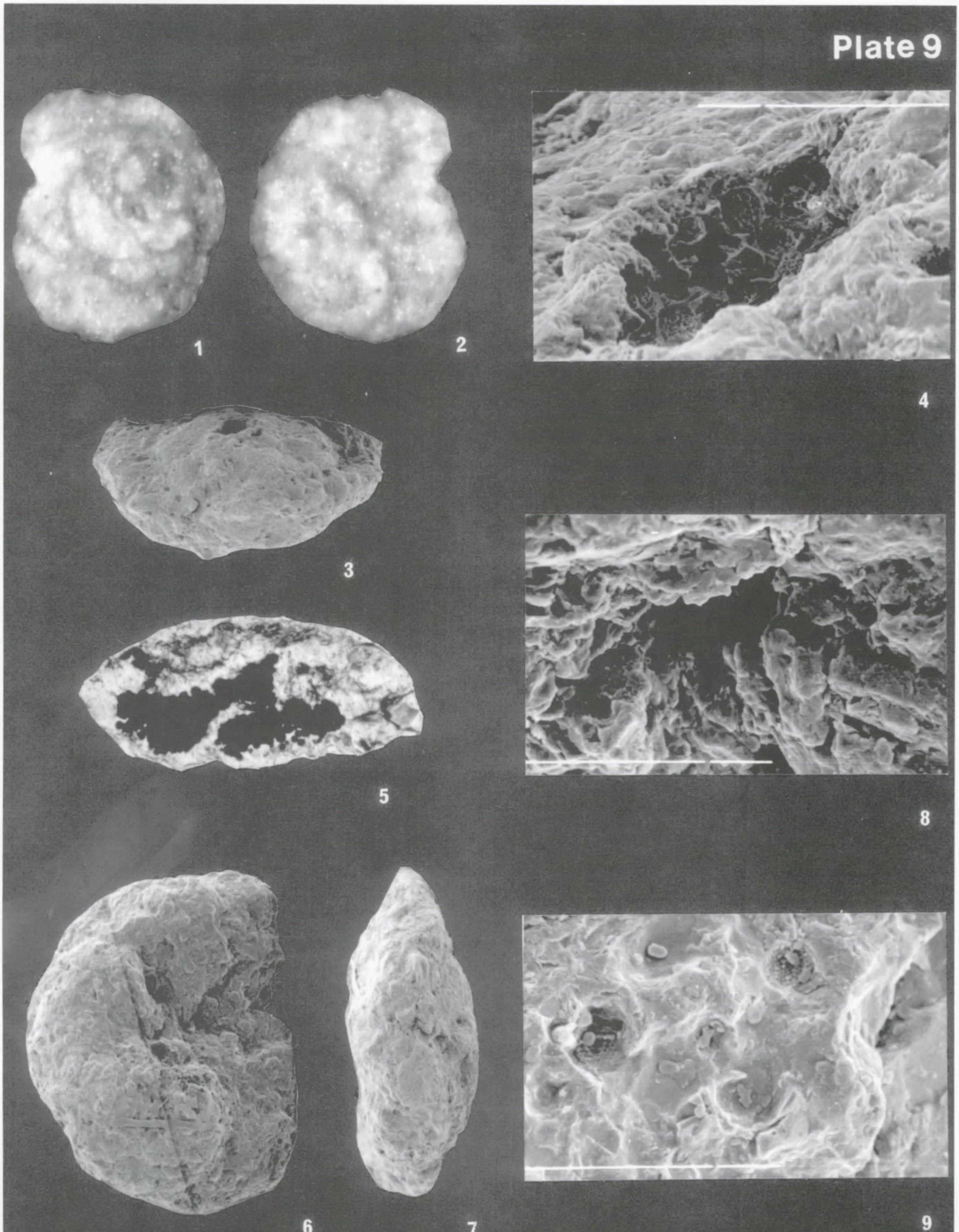
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Plate 10

Figures 1-16 ***Trochammina pulvilla*** Crespin & Parr 1941. Umbilical and spiral views, lateral view and transversal section. 1-2, 4, 6-10, 15-16, x120; 3, x200, 5, x130, 11-12, x125, 13-14, x140, GSQ MF 251/1-5, GSQ Eddystone 4, 720.3m, 709.7m, Cattle Creek Formation.

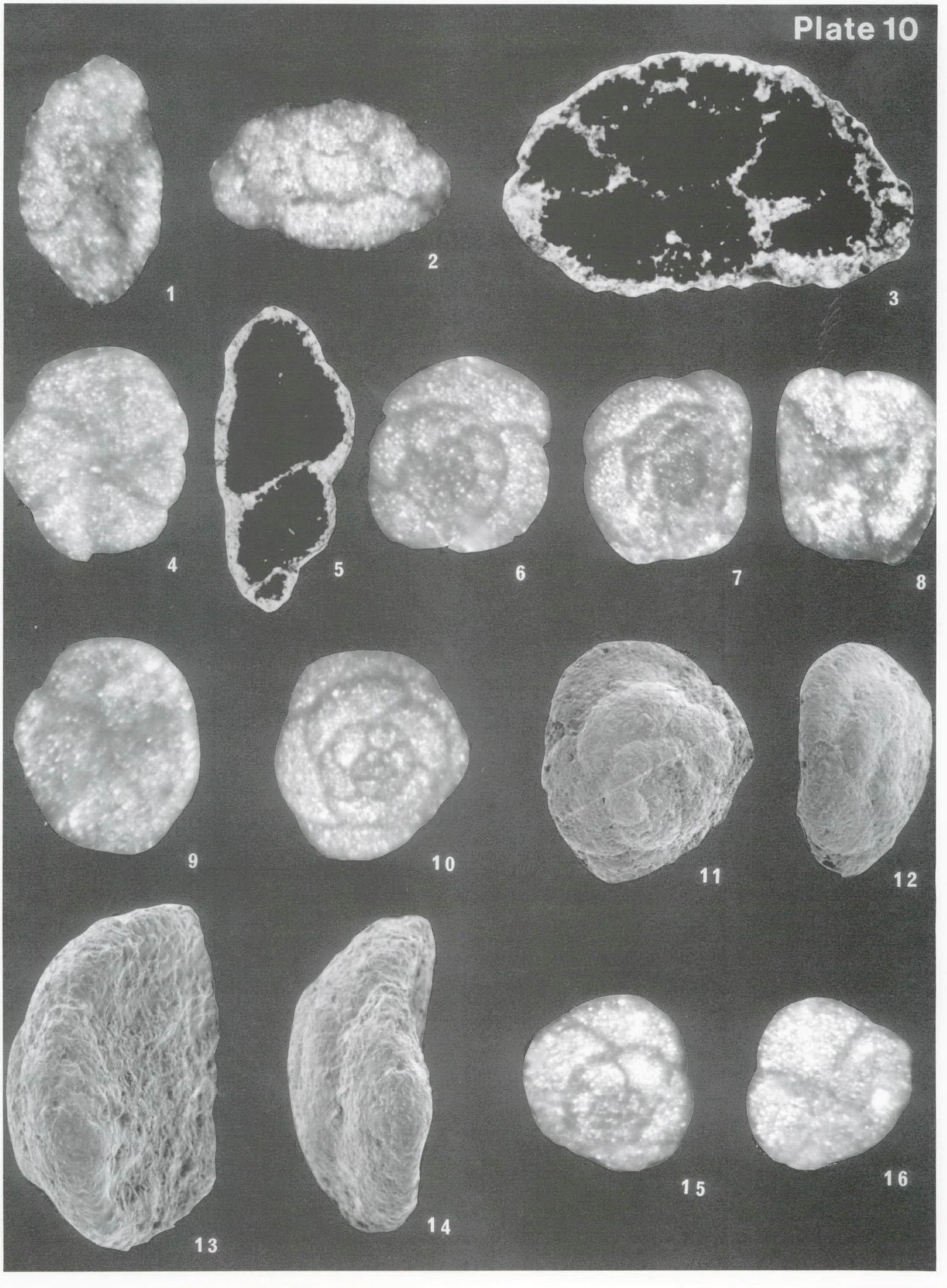
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Plate 11

Figures 1-5 ***Patellovalvulina***? sp. Spiral and umbilical views and particulars of spiral and peripheral side. 1, 2, x120, 3, x200, 4-5, x500, GSQ MF 252/1, GSQ Eddystone 4, 709.7m, Cattle Creek Formation.

Figures 6-10 ***Haplophragmoides***? sp., lateral and apertural views, 6-7, x120, 8-10, x200, GSQ MF 252/2, GSQ Eddystone 4, 709.7m, Cattle Creek Formation.

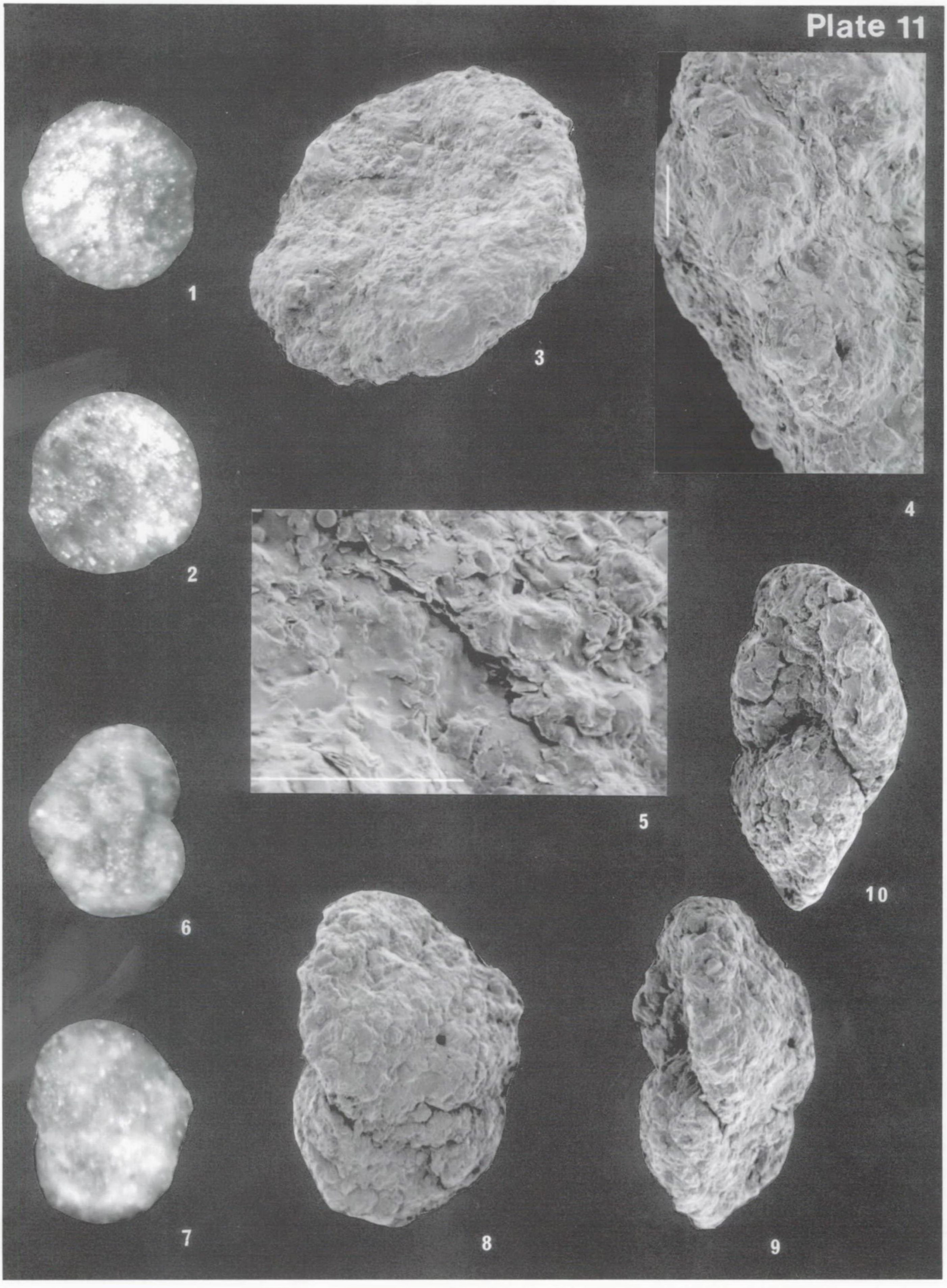
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Plate 12

Figure 1 ***Lunucammina triangularis*** (Chapman & Howchin 1905). Lateral view. x60, GSQ Taroom 10, 1080.9m, Cattle Creek Formation, specimen lost. See also pl. 16, figs 1-21.

Figures 2-4 ***Lunucammina maior*** sp. nov., aperture and foramina views of silicified, decorticated fragments, x60, GSQ MF 140/1, outcrop sample from Oxtrack Creek, Mt. Ox Group. See also pl. 18, figs 7, 8; pl. 20, figs 11, 12; pl. 28, fig. 6; pl. 32, figs 23, 24, 26, 27.

Figure 5 ***Rectocornuspira*** sp., frontal view, x60, GSQ MF 097/1, GSQ Taroom 10, 1035.7m, Cattle Creek Formation.

Figures 6-7 ***Hemigordius harltoni*** Cushman & Waters 1928. Frontal views, x60, GSQ MF 090/1-2, GSQ Taroom 10, 1035.7m, Cattle Creek Formation. See also pl. 13, figs 23-25.

Figures 8-13 ***Glomospirella*** sp. cf. ***G. nyei*** Crespin 1958. Frontal views, 8-11, x70, 12-13, x100, GSQ MF 202/1-4, GSQ Eddystone 4, 709.7m, Cattle Creek Formation.

Figures 14-23 ***Trochammina subobtusa*** Parr 1942. Spiral, lateral, umbilical views, and equatorial and sagittal sections. 14, 16, 17, 19, 20, x60; 15, x300, 18, x120; 21, 22, x150; 23, x100; GSQ MF 202/5-7, GSQ Eddystone 4, 720.3m, Cattle Creek Formation.

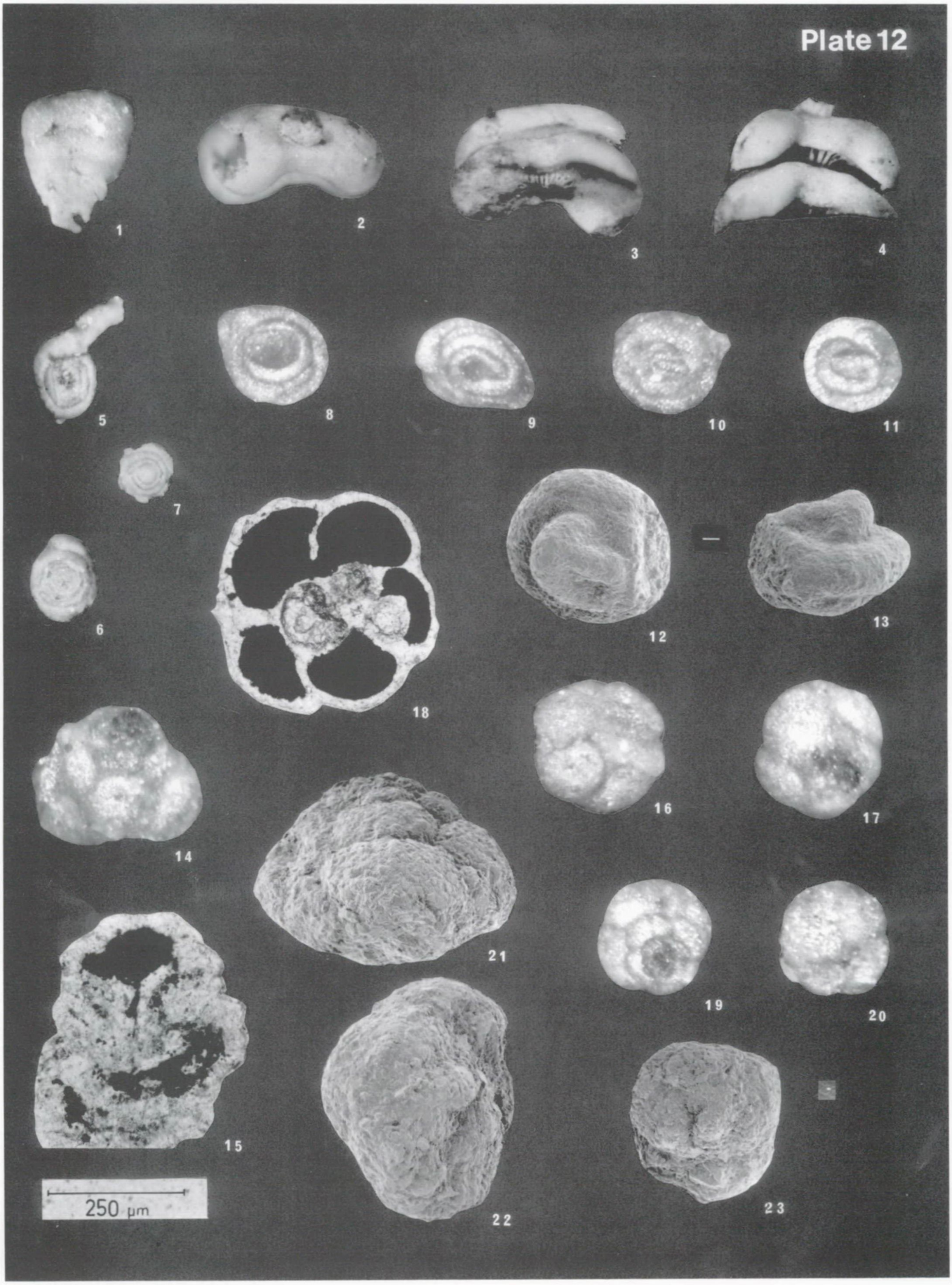
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Plate 13

Figures 1-4 ***Trochammina laevis*** Crespin 1958, spiral and umbilical views. 1, x50, GSQ Springsure 3, 150.8m, GSQ MF 084/2; 2, x50, 3, x25, 4, x62, GSQ Springsure 3, 120.0m, GSQ MF 084/3-4, Catherine Sandstone.

Figure 5 ***Tolypammina undulata*** Parr 1942, frontal view. x25, GSQ Springsure 3, 157.1, GSQ MF 070/2, Catherine Sandstone. See also pl. 7, fig. 20.

Figures 6-8, 13 ***Calcitornella elongata*** Cushman & Waters 1928, lateral views. 6-8, x15, GSQ Springsure 3, 138.3m, GSQ MF 094/2-3, Catherine Sandstone; 13, x50, GSQ Springsure 3, 59.0m, GSQ MF 094/1, Peawaddy Formation.

Figures 9, 16 ***Calcivertella*** sp.cf. ***C. adhaerens*** Cushman & Waters 1928, dorsal and attached side views. 9, x50, GSQ Springsure 3, 59.0m, GSQ MF 093/1; 16, x19, GSQ Springsure 2, 243.0m, GSQ MF 093/2, Peawaddy Formation.

Figures 10-11 ***Trepeilopsis australiensis*** Crespin 1958, lateral views. x25, GSQ Springsure 3, 138.3m, GSQ MF 096/1, Catherine Sandstone.

Figure 12 ***Calcitornella heathi*** Cushman & Waters 1928, attached side view. x62, GSQ Springsure 3, 138.3m, GSQ MF 095/1, Catherine Sandstone.

Figures 14-15 ***Orthovertella protea*** Cushman & Waters 1928, lateral views. x37, GSQ Springsure 2, 243.0m, GSQ MF 091/1, Peawaddy Formation.

Figures 17-18 ***Plummerinella*** sp., attached side and external side views, showing encrusting pilamminid foraminifer. x25, GSQ Springsure 2, 114.7m, GSQ MF 092/1, Peawaddy Formation, Mantuan ***Productus*** Bed.

Figures 19-22 ***Agathammina pusilla*** (Geinitz 1848), frontal views. x50, GSQ Springsure 2, 114.7m, GSQ MF 088/1-4, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 29, figs 12, 13.

Figures 23-25 ***Hemigordius harltoni*** Cushman & Waters 1928, frontal views. x50, GSQ Springsure 2, 114.7m, GSQ MF 089/1-3, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 12, figs 6, 7.

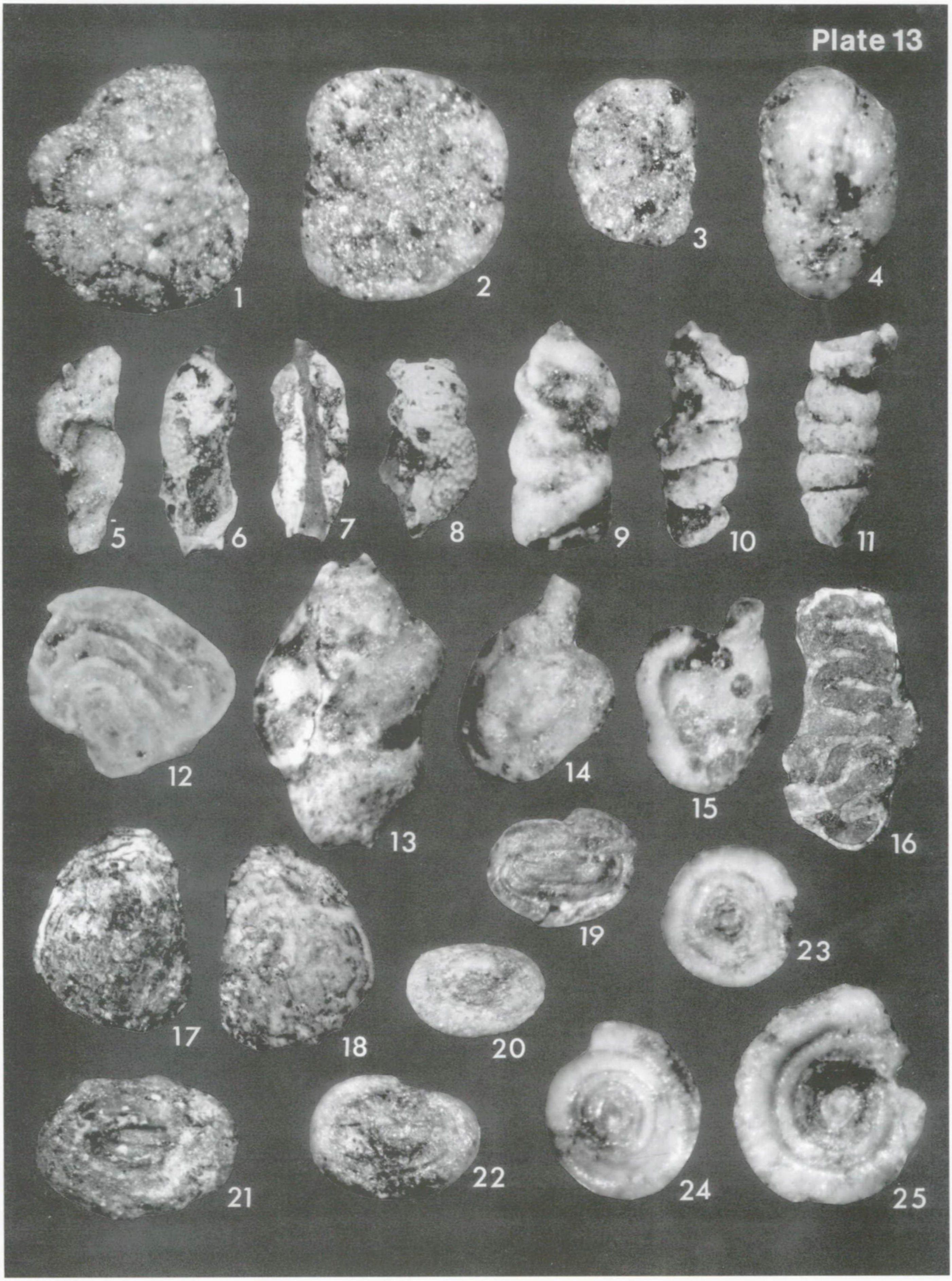
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Plate 14

Figures 1, 2, 5, 17-19 ***Howchinella woodwardi*** (Howchin 1895), frontal views and apertural view. 1, x62, GSQ Springsure 9, 171.6m, GSQ MF 098/1; 2, x62, GSQ Springsure 9, 83.8m, GSQ MF 099/1; 5, x31, GSQ Springsure 9, 138.9m, GSQ MF 100/1; 17-19, x31, GSQ Springsure 9, 153.4m, GSQ MF 102/1; Cattle Creek Formation, Mostyndale Mudstone Member. See also pl. 15, figs 5-9; pl. 17, fig. 9; pl. 19, figs 4-6; pl. 21, figs 7, 8; pl. 27, figs 1, 2, 8.

Figures 3, 4, 6-9 ***Howchinella rigida*** sp.nov., frontal views and apertural view. 3, x62, GSQ Springsure 9, 83.8m, GSQ MF 098/2, paratype A; 4, x31, GSQ Springsure 9, 77.4m, GSQ MF 098/3, paratype B; 6-7, x31, GSQ Springsure 8, 411.4m, GSQ MF 099/2, paratype C; 8, x31, GSQ Springsure 9, 91.4m, GSQ MF 099/4, holotype; 9, x62, GSQ Springsure 8, 411.4m, GSQ MF 099/3, paratype D; Cattle Creek Formation, Mostyndale Mudstone Member. See also pl. 15, figs 25-27; pl. 27, fig. 9a, b.

Figures 10, 22, 26 ***Protonodosaria tereta*** (Crespin 1958), lateral view of a complete (22) and two decorticated specimens showing pore-like openings in sutural positions; 10, juvenile form, x62, GSQ Springsure 9, 153.5m, GSQ MF 124/1; 22, x62, GSQ Springsure 9, 121.9m, GSQ MF 124/2; 26, x62, GSQ Springsure 8, 411.4m, GSQ MF 124/3; Cattle Creek Formation, Mostyndale Mudstone Member. See also pl. 15, fig. 15; pl. 26, fig. 7a, b; pl. 30, fig. 4.

Figures 11-12 ***Pseudotristix*** sp. 1, apertural and lateral views of possibly polyphiletic howchinellid. x62, GSQ Springsure 9, 91.4m, GSQ MF 101/1, Cattle Creek Formation. Mostyndale Mudstone Member. See also pl. 30, fig. 14.

Figure 13 ***Earlandia condoni*** Crespin 1958, lateral view. x62, GSQ Springsure 9, 153.5m, GSQ MF 087/1, Cattle Creek Formation, Mostyndale Mudstone Member.

Figures 14-16, 20-21 ***Pseudonodosaria antiqua*** (Chapman and Howchin 1905), lateral views. 14, 20, x62, GSQ Springsure 9, 121.9m, GSQ MF 126/3-4; 15, 16, x62 GSQ Springsure 9, 126.3m, GSQ MF 126/1-2; 21, x31, GSQ Springsure 9, 91.4m, GSQ MF 126/5, Cattle Creek Formation, Mostyndale Mudstone Member. See also pl. 15, figs 18-21; pl. 25, figs 1-6; pl. 26, fig. 5; pl. 30, figs 1-3.Plate 14 cont.

Figures 23-25 ***Nodosaria*** sp. cf. ***N. raggatti*** Crespin 1958, lateral views. 23, x62, GSQ Springsure 9, 121.9m, GSQ MF 125/1; 24, x31, GSQ Springsure 9, 77.4m, GSQ MF 125/3; 25, x62, GSQ Springsure 9, 153.4m, GSQ MF 125/4, Cattle Creek Formation, Mostyndale Mudstone Member. See also pl. 25, fig. 8.


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Plate 15

Figures 1-4 ***Pseudonodosaria serocoldensis*** (Crespin 1945), lateral views of a semidecorticated and three complete specimens. 1, 2, x62, 3, 4, x31, GSQ Springsure 6, 206.4m, 222.6m, 194.2m, 201.1m, GSQ MF 134/1-4, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 18, figs 12, 13; pl. 20, figs 1, 2; pl. 28, figs 1, 2; pl. 31, figs 12, 13.

Figures 5-9 ***Howchinella woodwardi*** (Howchin 1895). 5, x62, GSQ Springsure 6, 205.7m, GSDQ MF 098/4; 6-9, x62, outcrop sample 213, GSQ MF 098/5-8, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 14, figs 1, 2, 5, 17-19; pl. 17, fig. 9; pl. 19, figs 4-6; pl. 27, figs 1, 2, 8.

Figure 10 ***Ichthyolaria sutilis*** (Crespin 1958), frontal view of fragment. x62, GSQ Springsure 6, 194.2m, GSQ MF 106/1, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 17, fig. 18; pl. 19, fig. 8; pl. 30, figs 11, 12; pl. 32, figs 2, 3.

Figures 11-13 ***Dentalina grayi*** Crespin 1958, lateral view of semidecorticated or fragmented specimens. x62, outcrop sample 213, GSQ MF 127/1-3, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 20, fig. 23; pl. 25, figs 7a-9b.

Figures 14, 16-17 ***Nodosaria raggatti*** Crespin 1958, lateral views. 14, 16, x62, 17, x31, outcrop sample 213, GSQ MF 125/5-7, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 17, fig. 16; pl. 26, figs 3, 4, 6, 8; pl. 27, fig. 10; pl. 32, figs 12, 13.

Figure 15 ***Protonodosaria tereta*** (Crespin 1958), lateral view. x62, outcrop sample 213, GSQ MF 128/1, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 14, figs 10, 22, 26; pl. 26, fig. 7; pl. 30, fig. 4.

Figures 18-21 ***Pseudonodosaria antiqua*** (Chapman and Howchin 1905), lateral views. x62, outcrop sample 213, GSQ MF 126/6-9, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 14, figs 14-16, 20, 21; pl. 25, figs 1-6; pl. 26, fig. 5; pl. 30, figs 1-3.

Figures 22-24 ***Mooreinella improcera*** (Crespin 1958), frontal and lateral views. x62, outcrop sample 211, GSQ MF 080/1, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 24, fig. 9.

Figure 25-27 ***Howchinella rigida*** sp. nov., frontal view of fragmented, silicified, and decorticated specimens. x62, outcrop sample 213, GSQ MF 099/5-7, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 14, figs 3, 4, 6-9; pl. 27, fig. 9a, b.


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Plate 16

Figures 1-20 ***Lunucammina triangularis*** (Chapman & Howchin 1905). 5, from outcrop sample 8, Mt Breast, Buffel Formation; all other specimens from GSQ Eddystone 4, 654.7m, Cattle Creek Formation. 1-5, frontal views showing planispiral beginning. 1-4, x50, GSQ MF 254/1-2; 5, x30, GSQ MF 253/0; 8-9, showing strongly arched sutures of last few chambers; 5, 10 showing large final chamber; 11, 13-18, showing parallel, weakly curved chamber sutures; 1-4, 6, 7, 12, 19, 20 showing accentuated frontal median depression, 6-20, GSQ MF 254/3-17, Cattle Creek Formation, upper part. See also pl. 12, fig. 1.

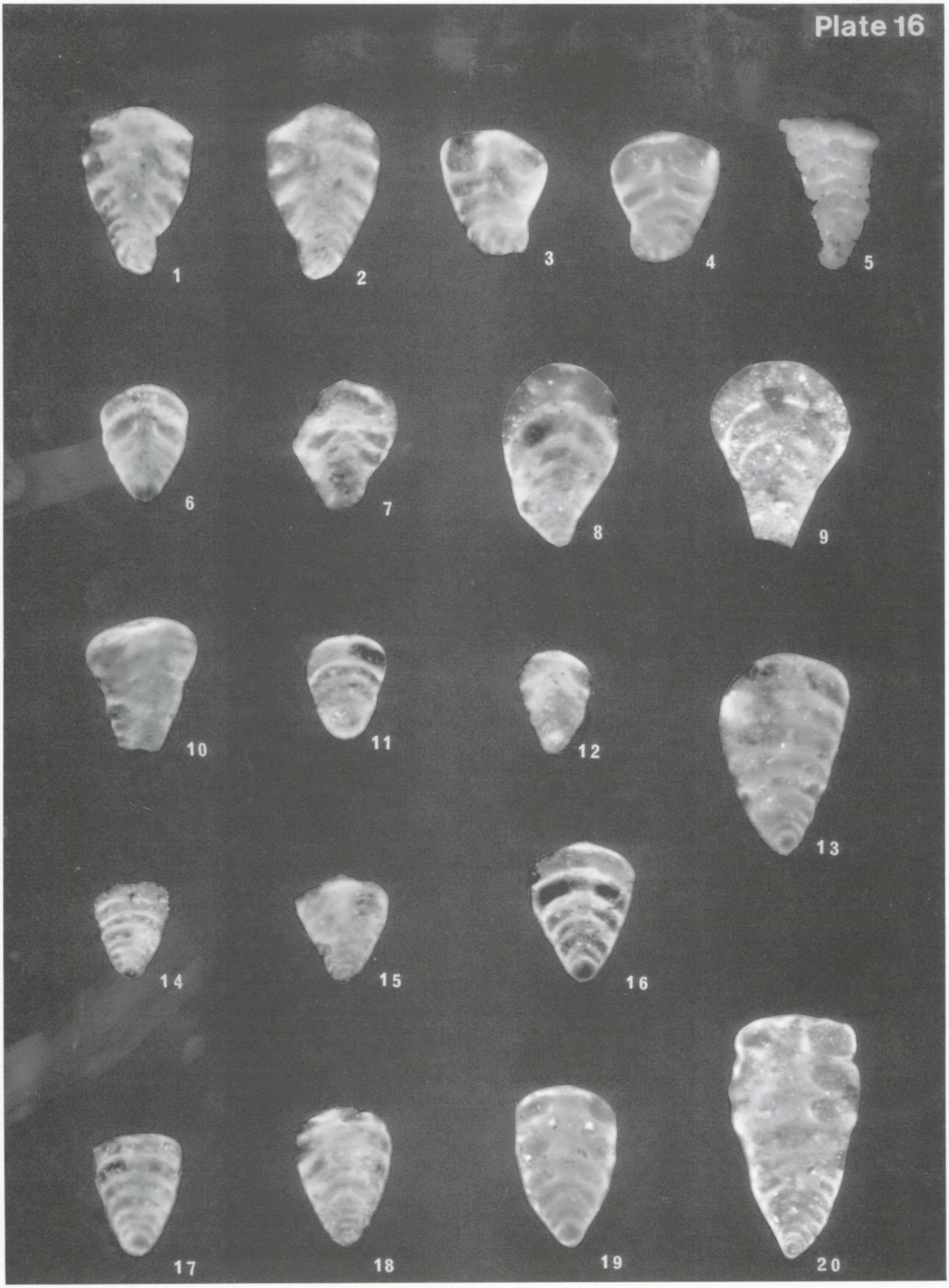
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Plate 17

Figures 1-8 ***Howchinella aulax*** (Crespin 1958), frontal views and longitudinal sections. 1-2, x50, outcrop sample 194, GSQ MF 098/9-10; 3-4, 7-8, x62, 5-6, x124, GSQ MF 098/11-14, outcrop sample 194, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 18, fig. 6; pl. 19, fig. 2; pl. 20, figs 13-17; pl. 27, figs 3-5b; pl. 30, figs 13, 15; pl. 31, figs 3-7; pl. 32, fig. 25.

Figure 9 ***Howchinella woodwardi*** (Howchin 1905), frontal view of a microspheric form fragment, x124, outcrop sample 195, GSQ MF 103/1, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 14, figs 1, 2, 5, 17-19; pl. 15, figs 5-9; pl. 19, figs 4-6; pl. 21, figs 7, 8; pl. 27, figs 1, 2, 8.

Figure 10 ***Howchinella costata*** sp. nov., frontal view of holotype, x124, outcrop sample 193, GSQ MF 104/1, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 18, figs 19, 20; pl. 20, figs 9, 10; pl. 31, figs 1, 2; pl. 32, figs 4, 5.

Figures 11, 12 ***Nodosaria springsurensis*** Crespin 1958, lateral views of fragments, x62, outcrop sample 193, GSQ MF 129/1-2, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 18, fig. 11; pl. 26, figs 1, 2; pl. 32, fig. 19.

Figures 13, 17 ***Nodosaria****?* sp., lateral views of conical nodosariids, x125, outcrop sample 193, GSQ MF 130/1-2, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 20, figs 3, 4; pl. 27, fig. 7; pl. 32, figs 11, 14, 15.

Figures 14-15 ***Ichthyolaria crassatina*** n. sp., frontal views of paratype and holotype, x62, outcrop sample 195, GSQ MF 105/1-2, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 19, figs 18, 19.

Figure 16 ***Nodosaria raggatti*** Crespin 1958, lateral view, x62, outcrop sample 195, GSQ MF 131/1, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 15, figs 14, 16, 17; pl. 26, figs 3, 4, 6, 8; pl. 27, fig. 10; pl. 32, figs 12, 13.

Figure 18 ***Ichthyolaria sutilis*** (Crespin 1958), frontal view, x62, outcrop sample 193, GSQ MF 106/2, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 15, fig. 10; pl. 19, fig. 8; pl. 30, figs 11, 12; pl. 32, figs 2, 3.


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Plate 18

Figures 1-5 ***Hillella marginodentata*** gen. nov., sp. nov., frontal view of holotype, hypotype, and of 3 polyphiletic types. 1, x62, 2-4, x31, GSQ Taroom 10, 750.9m; 5, x31, GSQ Taroom 10, 775.8m, GSQ MF 107/1-5, Ingelara Formation. See also pl. 28, fig. 3a, b; pl. 31, figs 14-18.

Figure 6 ***Howchinella aulax*** (Crespin 1958), frontal views. 6, x25, GSQ Springsure 3, 59.0m, GSQ MF 108/1, Peawaddy Formation. See also pl. 17, figs 1-8; pl. 19, fig. 2; pl. 20, figs 13-17; pl. 37, figs 3-5b; pl. 30, figs 13, 15; pl. 31, figs 3-7; pl. 32, fig. 25.

Figure 7-8 ***Lunucammina maior*** n. sp. 8, hypotype, x37, 7, fragmented and distorted specimen, x48, GSQ Springsure 3, 59.0m, GSQ MF 109/2, Peawaddy Formation. See also pl. 12, figs 2-4; pl. 20, figs 11, 12; pl. 28, fig. 6; pl. 32, figs 23, 24, 26, 27.

Figures 9, 10 ***Nodosaria draperi*** sp. nov., lateral views of paratypes, x48, GSQ Taroom 10, 750.9m, GSQ MF 132/1-2, Ingelara Formation. See also pl. 20, fig. 5; pl. 32, figs 16-18.

Figure 11 ***Nodosaria springsurensis*** Crespin 1958, lateral view of fragment, x24, GSQ Taroom 10, 750.9m, GSQ MF 133/1, Ingelara Formation. See also pl. 17, figs 11, 12; pl. 26, figs 1, 2; pl. 32, fig. 19.

Figures 12, 13 ***Pseudonodosaria serocoldensis*** (Crespin 1945), lateral views. 12, x48, 13, x62, GSQ Springsure 3, 133.9m, GSQ MF 134/5-6, Catherine Sandstone. See also pl. 15, figs 1-4; pl. 20, figs 1, 2; pl. 28, figs 1, 2; pl. 31, figs 12, 13.

Figures 14-15 ***Howchinella parri*** (Crespin 1945), lateral views of megalospheric forms, x48, GSQ Springsure 3, 133.9m, GSQ MF 110/1-2, Catherine Sandstone. See also fig. 21; pl. 23, figs 9, 10.

Figures 16, 17 ?***Mooreinella*** sp., latero-frontal views of megalospheric and microspheric forms. 16, x48, 17, x24, GSQ Springsure 3, 120.9m, GSQ MF 083/1-2, Catherine Sandstone. See also pl. 24, fig. 5.

Figure 18 ***Ichthyolaria limpida*** (Crespin 1958), frontal view, x48, GSQ Springsure 3, 157.1m, GSQ MF 111/1, Catherine Sandstone. See also pl. 19, fig. 1; pl. 22, figs 13, 14; pl. 27, fig. 6; pl. 30, figs 16-18; pl. 31, figs 20, 21; pl. 33, figs 27-27?????

Figures 19, 20 ***Howchinella costata*** n. sp., frontal view of paratypes, x62, GSQ Springsure 3, 157.1m, GSQ MF 104/2-3, Catherine Sandstone. See also pl. 17, fig. 10; pl. 20, figs 9, 10; pl. 31, figs 1, 2; pl. 32, figs 4, 5.

Figure 21 ***Howchinella parri*** (Crespin 1945), frontal view of microspheric form, x62, GSQ Springsure 3, 138.3m, GSQ MF 117/1, Catherine Sandstone. See also above, figs 14, 15.

Figure 22 ***Pseudotristix*** sp. 2, lateral view of polyphiletic howchinellid, x62, GSQ Springsure 3, 133.9m, GSQ MF 112/1, Catherine Sandstone.

Figures 23, 24 ***Howchinella hillae*** (Crespin 1958), frontal views, x62, GSQ Springsure 3, 157.1m, GSQ MF 113/1-2, Catherine Sandstone. See also pl. 31, fig. 19.


Plate18
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Plate 19

Figure 1 ***Ichthyolaria limpida*** (Crespin 1958), frontal view, x50, GSQ Springsure 3, 59.0m, GSQ MF 111/2, Peawaddy Formation. See also pl. 18, fig. 18; pl. 22, figs 13, 14; pl. 27, fig. 6; pl. 30, figs 16-18; pl. 31, figs 20, 21; pl. 33, figs 26, 27.

Figure 2 ***Howchinella aulax*** (Crespin 1958), frontal view showing last three chambers tendency to "***Pseudotristix***" form, x25, GSQ Springsure 3, 59.0m, GSQ MF 114/1, Peawaddy Formation. See also pl. 17. figs 1-8; pl. 18, fig. 6; pl. 20, figs 13-17; pl. 27, figs 3-5b; pl. 30, figs 13, 15; pl. 31, figs 3-7; pl. 32, fig. 25.

Figures 3, 7 ***Ichthyolaria impolita*** (Crespin 1958), frontal views of microsphaeric, distally curved form, and megalosphaeric, fragmented form. 3, x36, GSQ Springsure 3, 133.9m, GSQ MF 098/15; 7, x50, GSQ Springsure 3, 133.9m, GSQ MF 111/3; Catherine Sandstone. See also pl. 32, figs 9, 10.

Figures 4-6 ***Howchinella woodwardi*** (Howchin 1985), frontal views. 6, possibly transitional to ***Spandelinoides***, x62, GSQ Springsure 3, 138.3m, GSQ MF 098/16-18, Catherine Sandstone. See also pl. 14, figs 1, 2, 5, 17-19; pl. 15, figs 5-9; pl. 17, fig. 9; pl. 21, figs 7, 8; pl. 27, figs 1, 2, 8.

Figure 8 ***Ichthyolaria sutilis*** (Crespin 1958), frontal view, x62, GSQ Springsure 3, 133.9m, GSQ MF 106/3, Catherine Sandstone. See also pl. 15, fig. 10; pl. 17, fig. 18; pl. 30, figs 11, 12; pl. 32, figs 2, 3.

Figures 9-17 ***Ichthyolaria levicostata*** n. sp., frontal views; 10, holotype, 11-17, paratypes. 10, 13, x62, GSQ Springure 3, 133.9m, GSQ MF 115/8-9; 9, 11-2, 14-17, x62, GSQ Springsure 3, 138.3m, GSQ MF 115/1-6; Catherine Sandstone. See also pl. 29, figs 1-6; pl. 32, figs. 6-8.

Figures 18-19 ***Ichthyolaria crassatina*** n. sp., frontal views, x62, GSQ Springsure 3, 138.3m, GSQ MF 105/3-4, Catherine Sandstone. See also pl. 17, figs 14, 15.

Figure 20 ***Pseudotristix*** sp. 3, lateral view of a slightly decorticated specimen, possibly a polyphyletic expression of an ichthyolariid form, x50, GSQ Springsure 3, 138.3m, GSQ MF 116/1, Catherine Sandstone.

Figures 21-23 ***Eocristellaria initialis*** (Crespin 1958), lateral views. 21-23, x62, GSQ Springsure 3, 138.3m, 133.9m, GSQ MF 135/1-3, Catherine Sandstone. See also pl. 21, figs 1, 2; pl. 29, figs 14, 15; pl. 32, fig. 1; pl. 33, figs 1-3.

Figure 24 ***Eoguttulina*** sp., lateral view, x62, GSQ Taroom 10, 775.8m, GSQ MF 136/1, Ingelara Formation.

Figures 25-26 ***Calvezina*** sp., lateral views, x62, GSQ Springsure 3, 133.9m, GSQ MF 137/1. Catherine Sandstone.

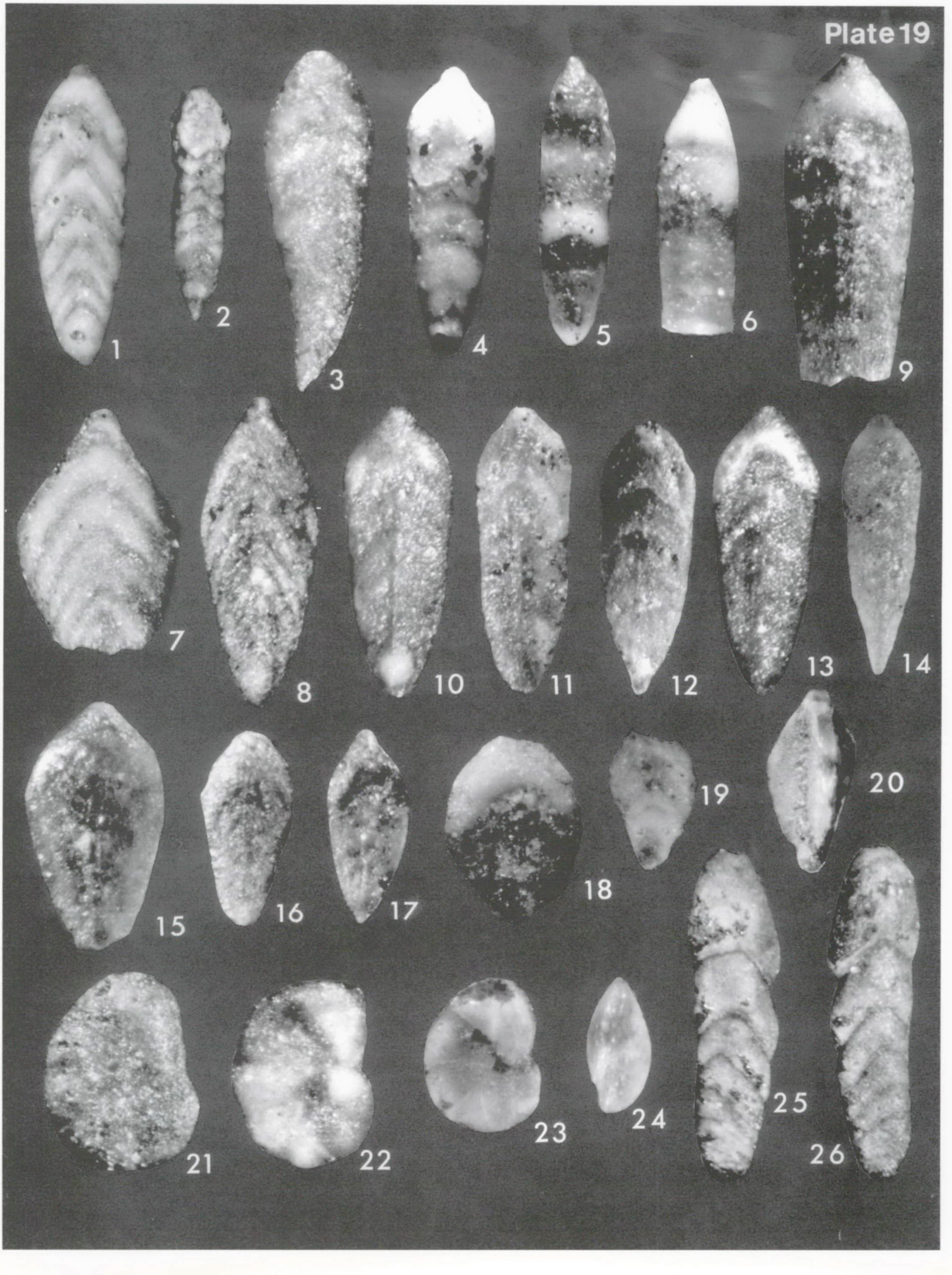
Plate 19
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Plate 20

Figures 1-2 ***Pseudonodosaria serocoldensis*** (Crespin 1945), lateral views, x50, GSQ Springsure 2, 243.0m, GSQ MF 134/6-7, Peawaddy Formation. See also pl. 15, figs 1-4; pl. 18, figs 12, 13; pl. 28, figs 1, 2; pl. 31, figs 12, 13.

Figures 3-4 ***Nodosaria*?** sp., lateral views of possibly transitional forms between ***Nodosaria*** and ***Pseudonodosaria***; 3, x62, 4, x50, specimen lost, GSQ Springsure 2, 114.5m, GSQ MF 130/3-4, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 17, figs 13, 17; pl. 32, figs 11, 14, 15.

Figure 5 ***Nodosaria draperi*** sp. nov., lateral view of a proximal part, x50, GSQ Springsure 2, 243.0m, GSQ MF 132/3, Peawaddy Formation. See also pl. 18, figs 9, 10; pl. 32, figs 16-18.

Figures 6-8 ***Howchinella incisa*** sp. nov., 7, frontal view of holotype, 6, 8, hypotypes; 6, 7, x50, GSQ Springsure 2, 243.0m, GSQ MF 117/2-3; 8, x50, GSQ Springsure 2, 114.7m, GSQ MF 117/4; Peawaddy Formation and Mantuan ***Productus*** Bed. See also pl. 22, fig. 4; pl. 23, figs 1, 2; pl. 32, figs 20-22; pl. 33, figs 14-17.

Figures 9-10 ***Howchinella costata*** sp. nov., frontal view of hypotypes, 9, x40, 10, x50, GSQ Springsure 2, 114.7m, GSQ MF 117/5-6, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 17, fig. 10; pl. 18, figs 19, 20; pl. 31, figs 1, 2; pl. 32, figs 4, 5.

Figures 11-12 ***Lunucammina maior*** sp. nov., frontal view and section of a proximally fragmented specimen, 11, x50, 12, x31, outcrop sample 189a, GSQ MF 118/1, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 12, figs 2-4; pl. 18, fig. 8; pl. 20, figs 11, 12; pl. 28, fig. 6; pl. 32, figs 23, 24, 26, 27.

Figures 13-17 ***Howchinella aulax*** (Crespin 1958), frontal views. 13, x50, 14, x62, 15, x37, 16-17, x62, GSQ Springsure 2, 114.5m, 114.7m, GSQ MF 099/8-9, 19; 098/20-21 Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 17, figs 1-8; pl. 18, fig. 6; pl. 27, figs 3-5b; pl. 30, figs 13, 15; pl. 31, figs 3-7; pl. 32, fig. 25.

Figures 18-19 ***Pseudotristix*** sp. 4, lateral views of possibly polyphyletic forms of howchinellids, 18, x31, GSQ Springsure 2, 114.7m, 19, x50, outcrop sample 189a, GSQ MF 119/1-2, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 33, figs 4, 5.

Figures 20-22 ***Lingulonodosaria*** sp. cf. ***L. arctica*** (Gerke 1952), lateral views. 20-21, x62, 22, x40, GSQ Springsure 2, 114.7m, GSQ MF 127/4-5 (22, specimen lost), Peawaddy Formation, Mantuan ***Productus*** Bed.

Figure 23 ***Dentalina grayi*** Crespin 1945, lateral view, x40, GSQ Springsure 2, 114.7m, GSQ MF 127/7, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 15, figs 11-13; pl. 25, figs 7-9.

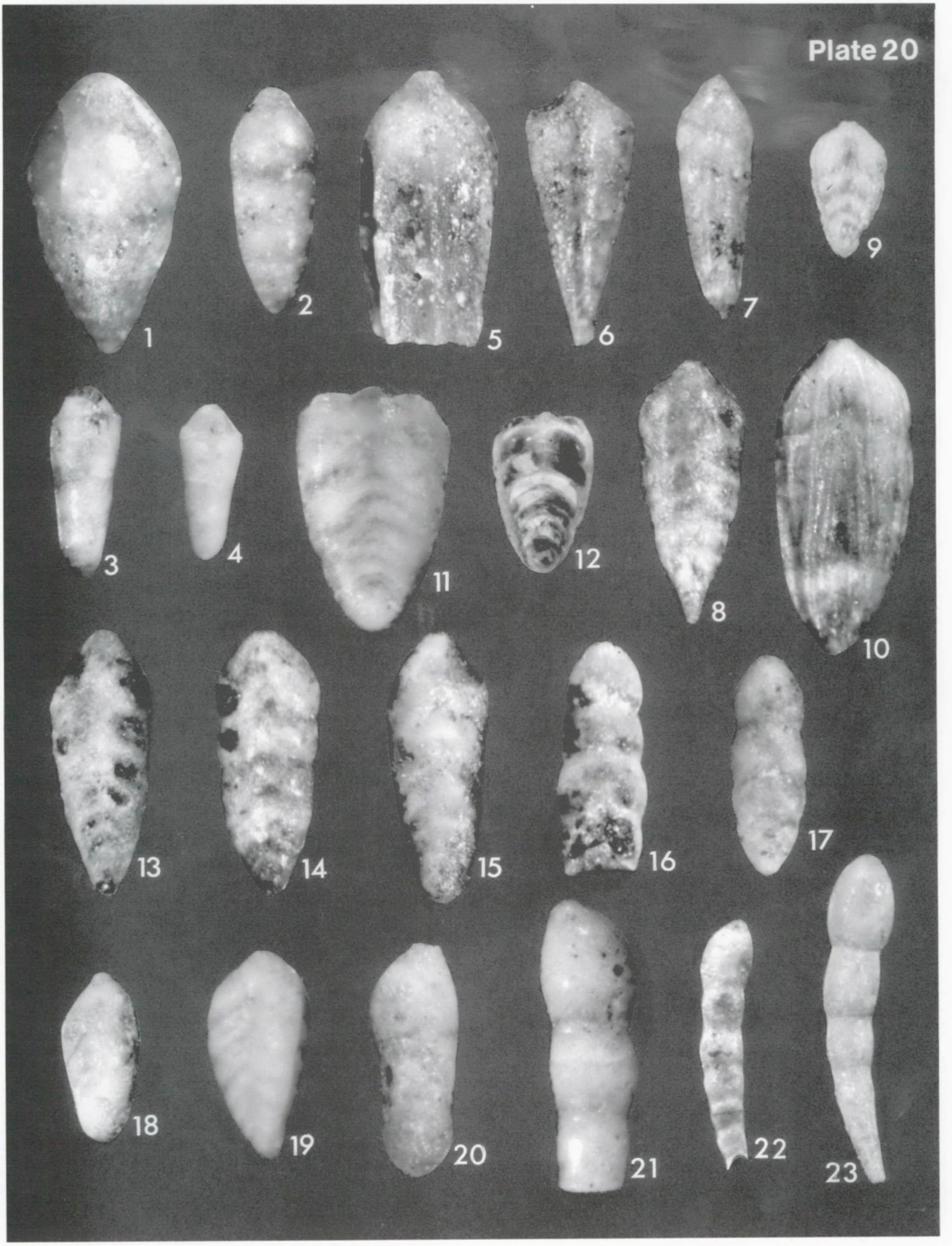
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Plate 21

Figures 1-2 ***Eocristellaria initialis*** (Crespin 1958), lateral and frontal views. 1, x50, 2, x30, GSQ Springsure 2, 114.7m, GSQ MF 135/4, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 19, figs 21-23; pl. 29, figs 14, 15; pl. 32, fig. 1; pl. 33, figs 1-3.

Figures 3-6 ***Howchinella mantuanensis*** sp. nov., frontal views of holotype (3), and hypotypes (4-6); 3-4, x37, 5-6, x50, GSQ Springsure 2, 114.7m, GSQ MF 120/1-4, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 22, figs 1-3, 6-10; pl. 23, figs 6, 7; pl. 28, figs 4a-5b; pl. 33, figs 18-23.

Figures 7-8 ***Howchinella woodwardi*** (Howchin 1895), frontal views. 7, X50, 8, x37, GSQ Springsure 2, 114.7m, GSQ MF 098/22-23, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 14, figs 1, 2, 5, 17-19; pl. 15, figs 5-9; pl. 17, fig. 9; pl. 19, figs 4-6; pl. 27, figs 1, 2, 8.

Figure 9 ***Howchinella striatosulcata*** (Crespin 1958), frontal view, x50, GSQ Springsure 2, 114.7m, GSQ MF 122/1, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 22, fig. 5; pl. 23, figs 3-5; pl. 31, figs 8-11; pl. 33, figs 10-13.

Figures 10-20 ***Cryptoseptida caseyi*** (Crespin 1958), frontal views, GSQ Springsure 2, 114.7m, GSQ MF 121/1-11, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 23, fig. 8; pl. 29, figs 7-11; pl. 33, figs 6-9.

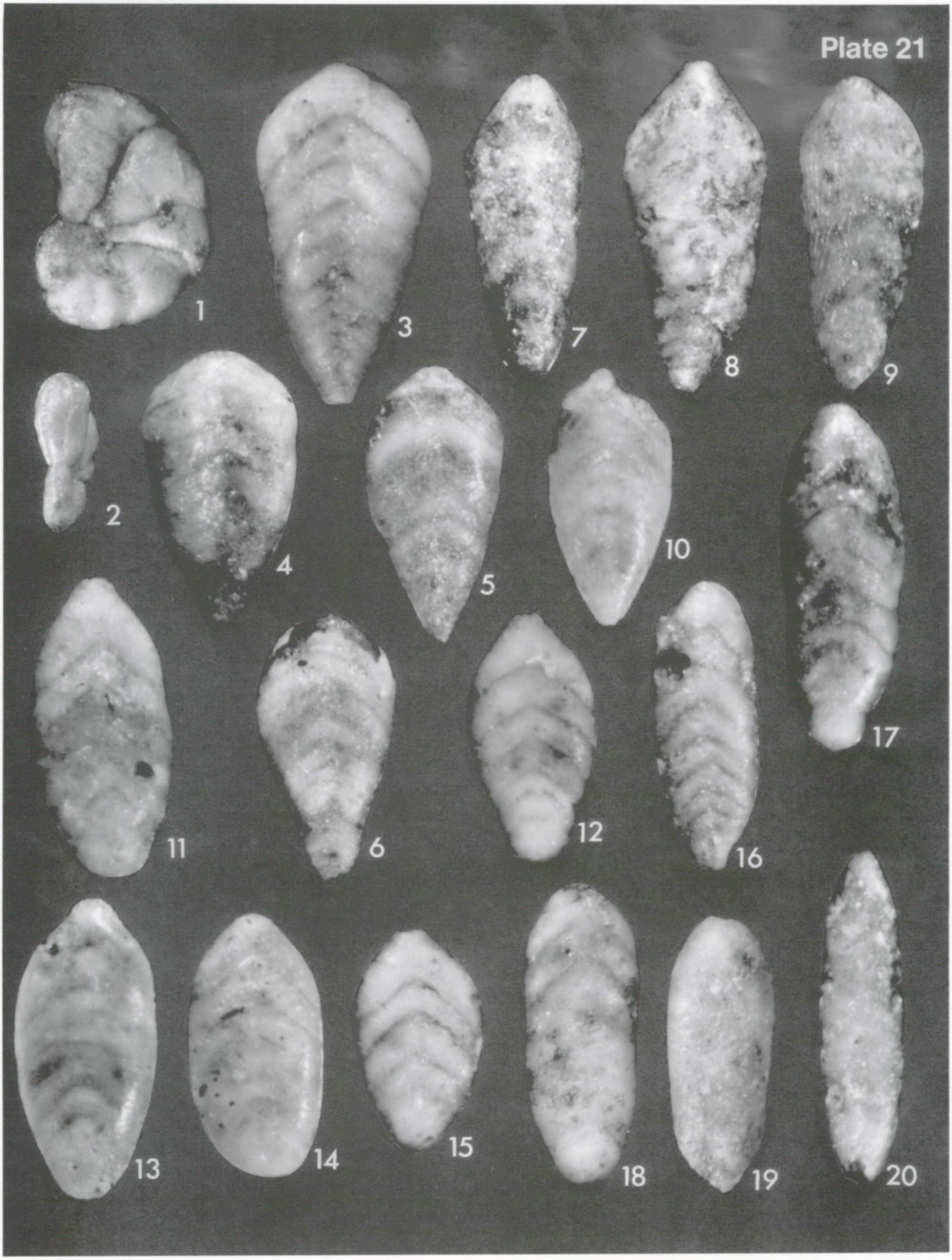
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Plate 22

Figures 1-3, 6-10 ***Howchinella mantuanensis*** sp. nov., frontal views of holotype (7), paratypes (6, 8, 9), idiotypes (1-3), and a sinuate (stressed) specimen (10), all x50, GSQ Springsure 2, 114.7m, GSQ MF099/10-11, 120/1, 6-9, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 21, figs 3-6; pl. 23, figs 6, 7; pl. 28. figs 4a-5b; pl. 33, figs 18-23.

Figure 4 ***Howchinella incisa*** n. sp., frontal view, showing bacterial perforations, x50, GSQ Springsure 2, 114.5m, GSQ MF 117/7, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 20, figs 6-8; pl. 23, figs 1, 2; pl. 32, figs 20-22; pl. 33, figs 14-17.

Figure 5 ***Howchinella striatosulcata*** (Crespin 1958), frontal view, x50, GSQ Springsure 2, 114.7m, GSQ MF 122/2, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 21, fig. 9; pl. 23, figs 3-5; pl. 31, figs 8-11; pl. 33, figs 10-13.

Figure 11 ***Lingulonodosaria*** sp., lateral view of semidecorticated specimen, x62, GSQ Springsure 2, 114.7m, GSQ MF 138/1, Peawaddy Formation, Mantuan ***Productus*** Bed.

Figure 12 ?***Spandelinoides*** sp., frontal view of fragment, x50, GSQ Springsure 2, 114.7m, GSQ MF 123/1, Peawaddy Formation, Mantuan ***Productus*** Bed.

Figures 13-14 ***Ichthyolaria limpida*** (Crespin 1958), x50, GSQ Springsure 2, 114.7m, GSQ MF 106/3-4, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 18, fig. 18; pl. 19, fig. 1; pl. 27, fig. 6; pl. 30, figs 16-18; pl. 31, figs 20, 21; pl. 33, figs 26, 27.


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Plate 23

Figures 1-2 ***Howchinella incisa*** n. sp., frontal views. 1, x50, GSQ Springsure 2, 243.0m, GSQ MF 117/8, Peawaddy Formation; 2, x62, GSQ Springsure 2, 114.5m, GSQ MF 117/9, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 20, figs 6-8; pl. 22, fig. 4; pl. 32, figs 20-22; pl. 33, figs 14-17.

Figures 3-5 ***Howchinella striatosulcata*** (Crespin 1958), frontal views, x50, GSQ Springsure 2, 114.7m, 114.5m, GSQ MF 112/3-4, Peawaddy Formation, Mantuan ***Productus*** Bed, 4-5 are two frontal views of the same specimen. See also pl. 21, fig. 9; pl. 22, fig. 5; pl. 31, figs 8-11; pl. 33, figs 10-13.

Figures 6-7 ***Howchinella mantuanensis*** n. sp., frontal views of paratype, x50, GSQ Springsure 2, 114.5m, GSQ MF 123/1, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 21, figs 3-6; pl. 22, figs 1-3, 6-10; pl. 28, figs 4a-5b; pl. 33, figs 18-23.

Figure 8 ***Cryptoseptida caseyi*** (Crespin 1958), frontal view, x50, GSQ Springsure 2, 114.5m, GSQ MF 123/2, Peawaddy Formation (Mantuan ***Productus*** Bed). See also pl. 21, figs 10-20; pl. 29, figs 7-11; pl. 33, figs 6-9.

Figures 9-10 ***Howchinella parri*** (Crespin 1958), frontal view, x62, GSQ Springsure 2, 114.5m, GSQ MF 122/5, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 18, figs 14, 15, 21.

Figure 11 ?***Mooreinella*** sp. cf. ***M. improcera*** (Crespin 1958), frontal view, x50, GSQ Springsure 2, 114.5m, GSQ MF 082/1, Peawaddy Formation, Mantuan ***Productus*** Bed.

Figures 12-13 ?***Haplophragmoides*** sp., lateral views of compressed and distorted specimen, x50, GSQ Springsure 2, 115.5m, GSQ MF 075/1, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 8, fig. 14; pl. 11, figs 6-10.

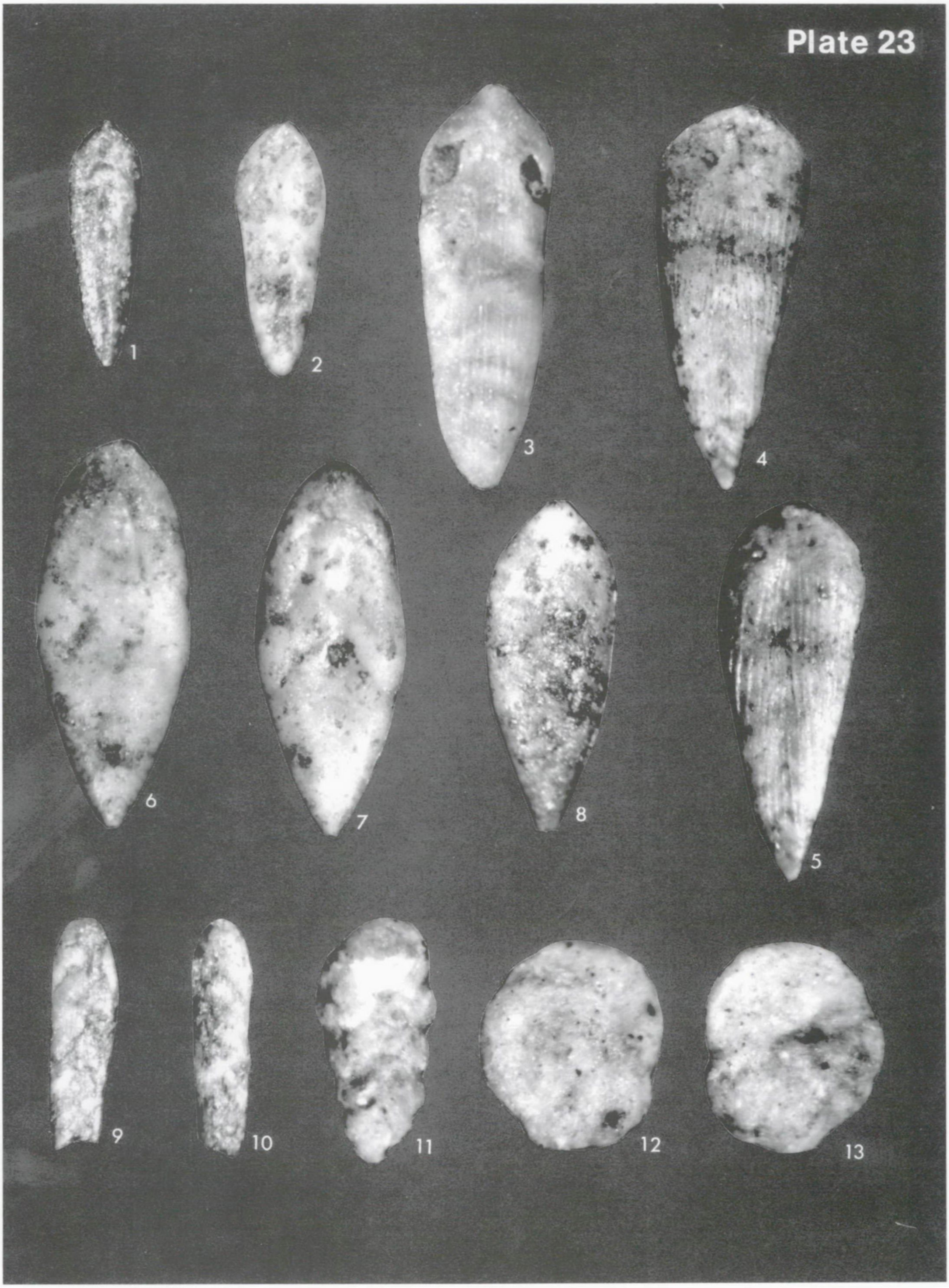
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Plate 24

Figures 1-4 ***Pseudohyperammina radiostoma*** Crespin 1958, 1, 3, near longitudinal sections, x21; 2, 4, particulars, showing opening canal and test wall structure, x56; 1, 2, outcrop sample S56, GSQ MF 055/21; 3, 4, GSQ Springsure 7, 336.7m, GSQ MF 055/20. Cattle Creek Formation, Moorooloo Mudstone Member. See also pl. 5, figs 1-17; pl. 6, figs 1-3; pl. 30, figs 5-7.

Figure 5 ?***Mooreinella*** sp. longitudinal section of proximal part of a fragmented specimen, x55, GSQ Springsure 3, 120.4m, GSQ MF 083/3, Catherine Sandstone. See also pl. 18, figs 16, 17.

Figures 6-7 ***Mooreinella recurvata*** (Crespin & Parr 1941), longitudinal sections, x87, GSQ Springsure 8, 103.7m, GSQ MF 085/3, 081/6, Cattle Creek Formation, Moorooloo Mudstone Member. See also pl. 1, figs 13, 14; pl. 2, figs 15-19.

Figure 8 ***Mooreinella bookeri*** (Crespin 1958), longitudinal section, x87, GSQ Springsure 8, 103.7m, GSQ MF 079/10, Cattle Creek Formation, Moorooloo Mudstone Member. See also pl. 1, figs 15, 16; pl. 3, figs 20-28.

Figure 9 ***Mooreinella improcera*** (Crespin 1958), longitudinal section, x87, outcrop sample 211, GSQ MF 080/1, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 15, figs 22-24.

Plate 24

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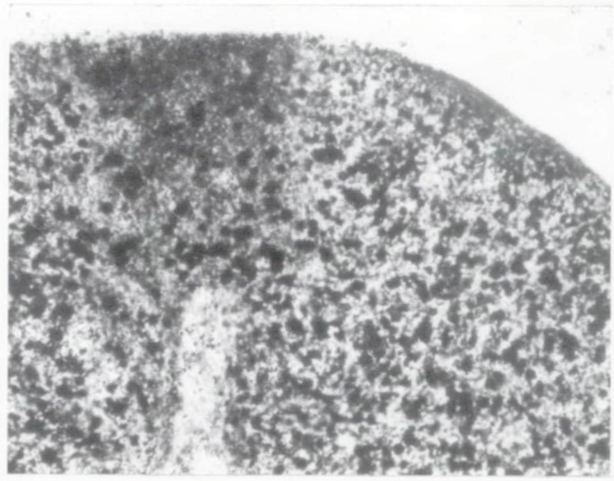

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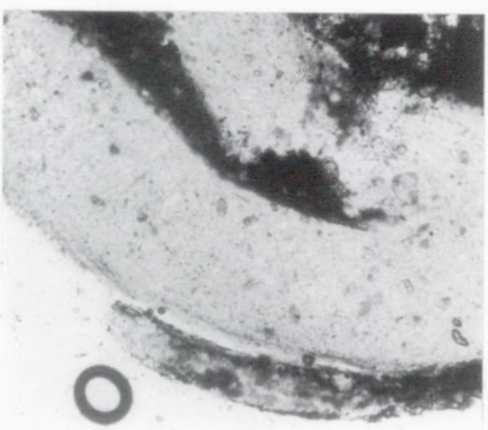

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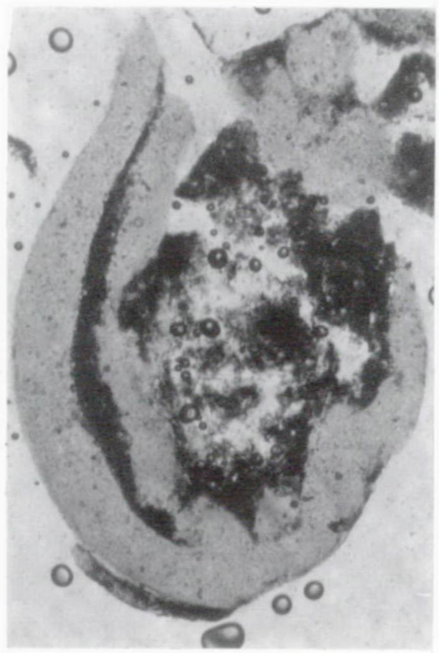

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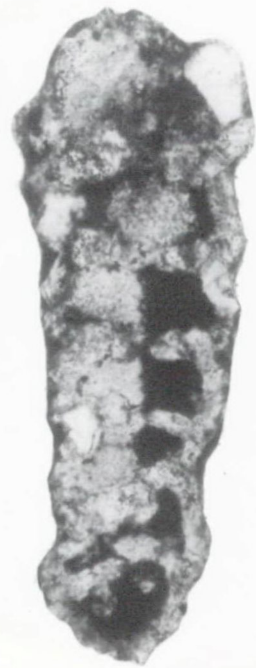

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Plate 25

Figures 1a-6 ***Pseudonodosaria antiqua*** (Chapman & Howchin 1905), longitudinal sections. 1a, 2b, 3, 4a, 5a, under xnicols illumination; 1, 2, 3, 5, x90; 4, x56; 6, x184; GSQ Springsure 9, 121.9m, GSQ MF 126/14-19, Cattle Creek Formation, Mostyndale Mudstone Member. See also pl. 14, figs 14-16, 20-21; pl. 15, figs 18-21; pl. 26, fig. 5; pl. 30, figs 1-3.

Figures 7ab, 9ab ***Dentalina grayi*** Crespin 1958, longitudinal sections of megalosphaeric and microsphaeric forms. 7a, 9a, under crossed nicols illumination, x90, outcrop sample 213, GSQ MF 127/8-9, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 15, figs 11-13; pl. 20, fig. 23.

Figure 8 ***Nodosaria*** sp. cf. ***N. raggatti*** Crespin 1958, longitudinal section of fragment, x72, GSQ Springsure 9, 138.9m, GSQ MF 125/8, Cattle Creek Formation, Mostyndale Mudstone Member. See also pl. 14, figs 23-25; pl. 27, fig. 7.

Plate 25

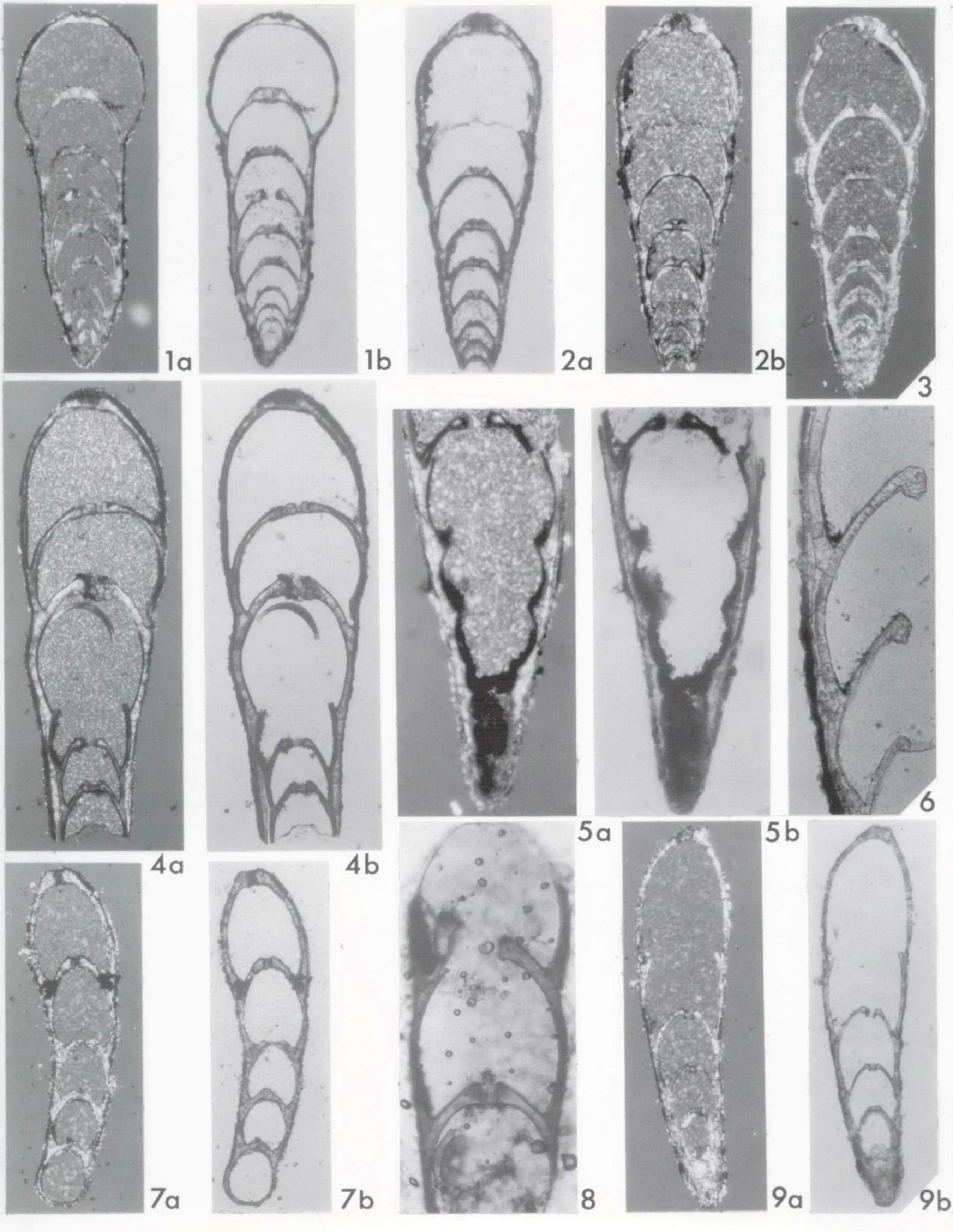

Plate 26

Figures 1ab-2ab ***Nodosaria springsurensis*** Crespin 1945, longitudinal section. 1a, 2a, under crossed nicol illumination; 1ab, x90, 2ab, x56, outcrop sample 193, GSQ MF 129/3-4, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 17, figs 11, 12; pl. 18, fig. 11; pl. 32, fig. 19.

Figures 3, 4, 6, 8 ***Nodosaria raggatti*** Crespin 1958, longitudinal sections. 3b, 4a, 8a, under crossed nicols illumination; 3, 4, x72, outcrop sample 194, GSQ MF 131/3, 6, Cattle Creek Formation, Sirius Mudstone Member; 6, 8, x90, GSQ Springsure 3, 138.3m, 133.9m, GSQ MF 131/4, 5, Catherine Sandstone. See also pl. 15, figs 14, 16, 17; pl. 17, fig. 16; pl. 27, fig. 10; pl. 32, figs 12, 13.

Figure 5 ***Pseudonodosaria antiqua*** (Chapman & Howchin 1905), longitudinal section, note ?entosolenian tube, X 56, outcrop sample 195a, GSQ MF 126/20, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 14, figs 14-16, 20, 21; pl. 15, figs 18-21; pl. 25, figs 1-6; pl. 30, figs 1-3.

Figures 7ab ***Protonodosaria tereta*** (Crespin 1958), longitudinal section, 7a under crossed nicols illumination, x90, outcrop sample 195a, GSQ MF 124/4, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 14, figs 10, 22, 26; pl. 15, fig. 15; pl. 30, fig. 4.

Plate 26

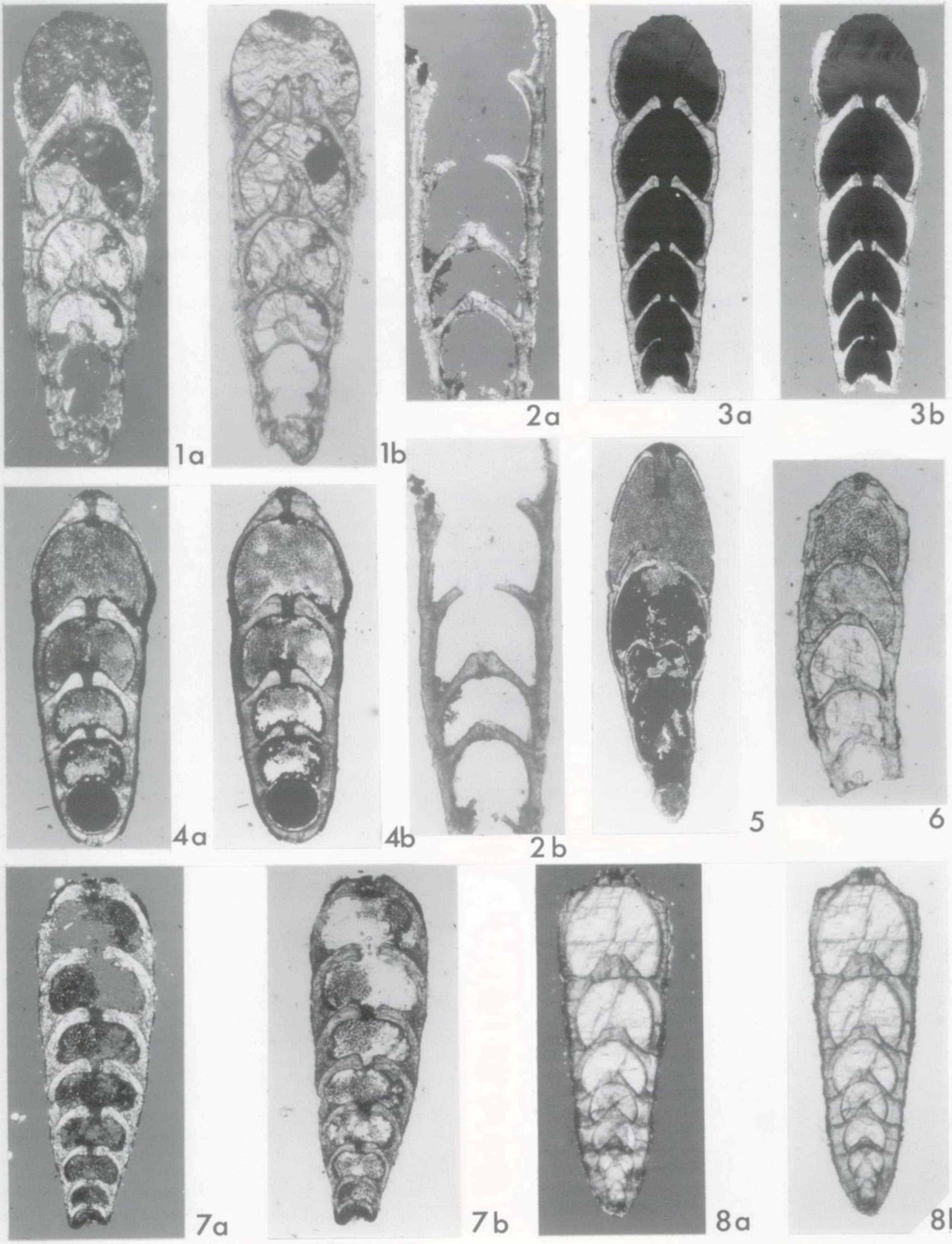

Plate 27

Figure 1a-2b, 8 ***Howchinella woodwardi*** (Howchin 1895), longitudinal frontal section. 1a, under crossed nicols illumination; 1a, b, x72, topotype, outcrop sample WA 17, Holmwood Shale, Fossil Cliff Member, GSQ MF 098/29; 2a, b. x72, GSQ Springsure 9, 171.6m, GSQ MF 098/30, Cattle Creek Formation, Mostyndale Mudstone Member; 8, x72, outcrop sample 194, GSQ MF 098/35, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 14, figs 1, 2, 5, 17-19; pl. 15, figs 5-9; pl. 17, fig. 9; pl. 19, figs 4-6; pl. 21, figs 7, 8.

Figure 3-5b ***Howchinella aulax*** (Crespin 1958, longitudinal, frontal section. 2a, 5a, under crossed nicols illumination; 3-5b, outcrop sample 193, GSQ MF 098/31-33, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 17, figs 1-8; pl. 18, fig. 6; pl. 19, fig. 2; pl. 20, figs 13-17; pl. 30, figs 13, 15; pl. 31, figs 3-7; pl. 32, fig. 25.

Figure 6 ***Ichthyolaria limpida*** (Crespin 1958), longitudinal, frontal section, x56, outcrop sample 193, GSQ MF 098/35, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 18, fig. 18; pl. 19, fig. 1; pl. 22, figs 13, 14; pl. 30, figs 16, 18; pl. 31, figs 20, 21; pl. 33, figs 26, 27.

Figures 7 ***Nodosaria***? sp., longitudinal section of a conical form, x72, outcrop sample 194, GSQ MF 098/34, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 17, figs 13, 17; pl. 20, figs 3, 4; pl. 32, figs 11, 14, 15.

Figure 9a-b ***Howchinella rigida*** sp. nov., longitudinal, frontal section. 9a, under crossed nicols illumination, x72, outcrop sample 213, GSQ MF 099/7, Cattle Creek Formation, Sirius Mudstone Member. See also pl. 14, figs 3, 4, 6-9; pl. 15, figs 25-27.

Figure 10 ***Nodosaria raggatti*** Crespin 1958, longitudinal section, x72, GSQ Springsure 3, 133.3m, GSQ MF 131/7, Catherine Sandstone. See also pl. 15, figs 14, 16, 17; pl. 17, fig. 16; pl. 26, figs 3, 4, 6, 8; pl. 32, figs 12, 13.

Plate 27

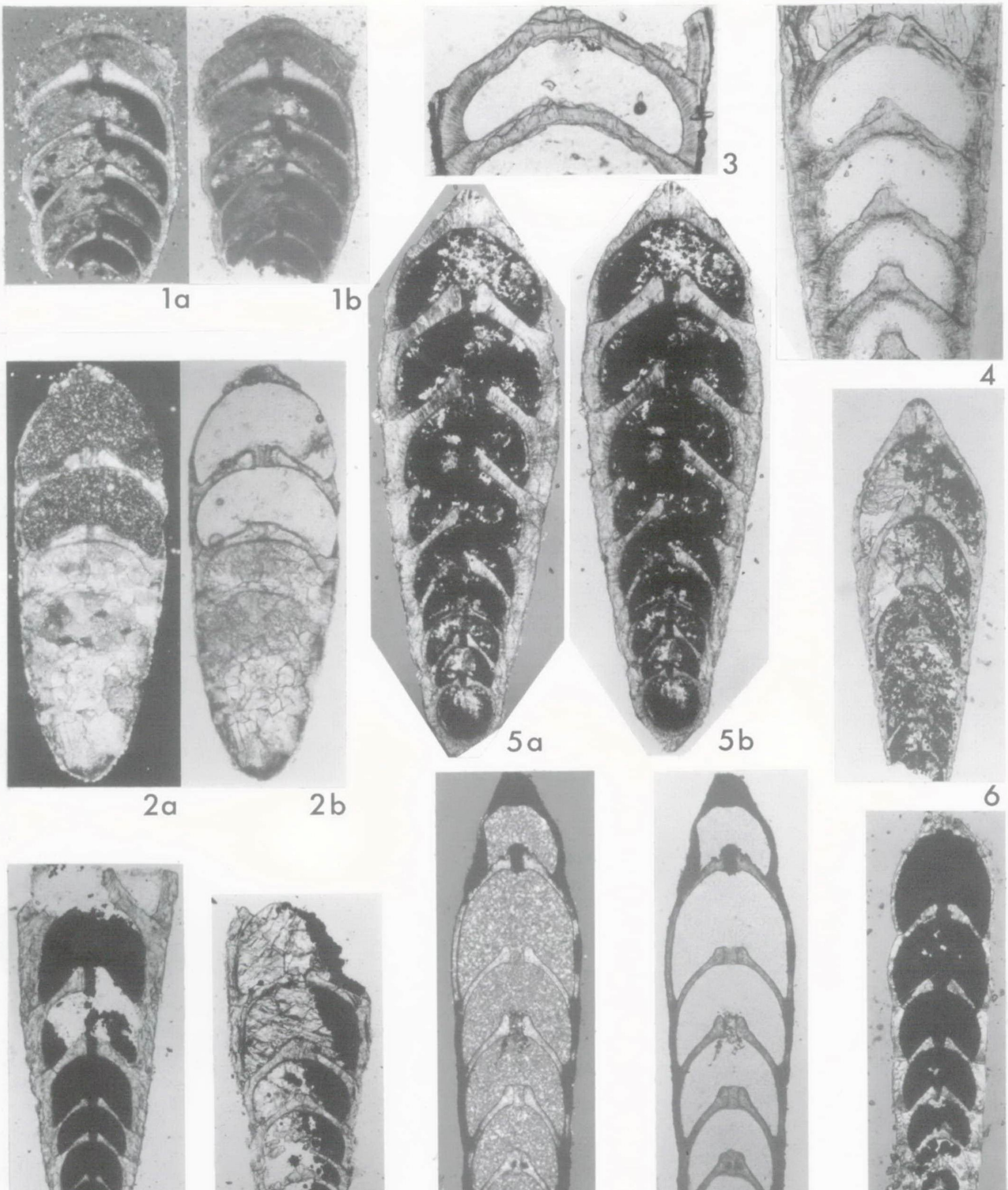

Plate 28

Figures 1ab, 2ab ***Pseudonodosaria serocoldensis*** (Crespin 1945), longitudinal sections. 1a, 2a under crossed nicol illumination, x56, GSQ Springsure 3, 133.9m, GSQ MF 134/11-12, Catherine Sandstone. See also pl. 15, figs 1-4; pl. 18, figs 12, 13; pl. 20, figs 1, 2; pl. 31, figs 12, 13.

Figures 3a, b ***Hillella marginodentata*** gen. nov. sp. nov., longitudinal frontal section of paratype. 3a, under crossed nicols illumination, x56, GSQ Taroom 10, 750.92m, GSQ MF 107/11, Ingelara Formation. See also pl. 18, figs 1-5; pl. 31, figs 14-18.

Figures 4a-5b ***Howchinella mantuanensis*** sp nov., longitudinal frontal sections of paratypes. 4a, 5a, under crossed nicols illumination, x56, GSQ Springsure 2, 114.5m, GSQ MF 120/10-11, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 21, figs 3-6; pl. 22, figs 1-3, 6-10; pl. 23, figs 6, 7; pl. 33, figs 18-23.

Figure 6 ***Lunucammina maior*** n. sp., longitudinal frontal section of hypotype, x90, GSQ Springsure 3, 133.9m, GSQ MF 118/2, Catherine Sandstone. See also pl. 12, figs 2-4; pl. 18, figs 7, 8; pl. 20, figs 11, 12; pl. 32, figs 23, 24, 26, 27.

Plate 28

Plate 29

Figures 1-6 ***Ichthyolaria laevicostata*** n. sp., 1-2, 4-6 longitudinal frontal section, x90; 3, longitudinal transversal section, x72; GSQ Springsure 3, 138.9m, GSQ MF 115/11-16. Catherine Sandstone. See also pl. 19, figs 1-6; pl. 32, figs 6-8.

Figures 7-11 ***Cryptoseptida caseyi*** (Crespin 1958). 7, 10, 11, longitudinal frontal sections, 8, 9, longitudinal transversal sections. 7, x72; 8-11, x90, GSQ Springsure 2, 114.5m, GSQ MF 121/12-16, Peawaddy Formation, Mantuan ***Productus*** Bed. See also pl. 21, figs 10-20; pl. 23, fig. 8; pl. 33, figs 6-9.

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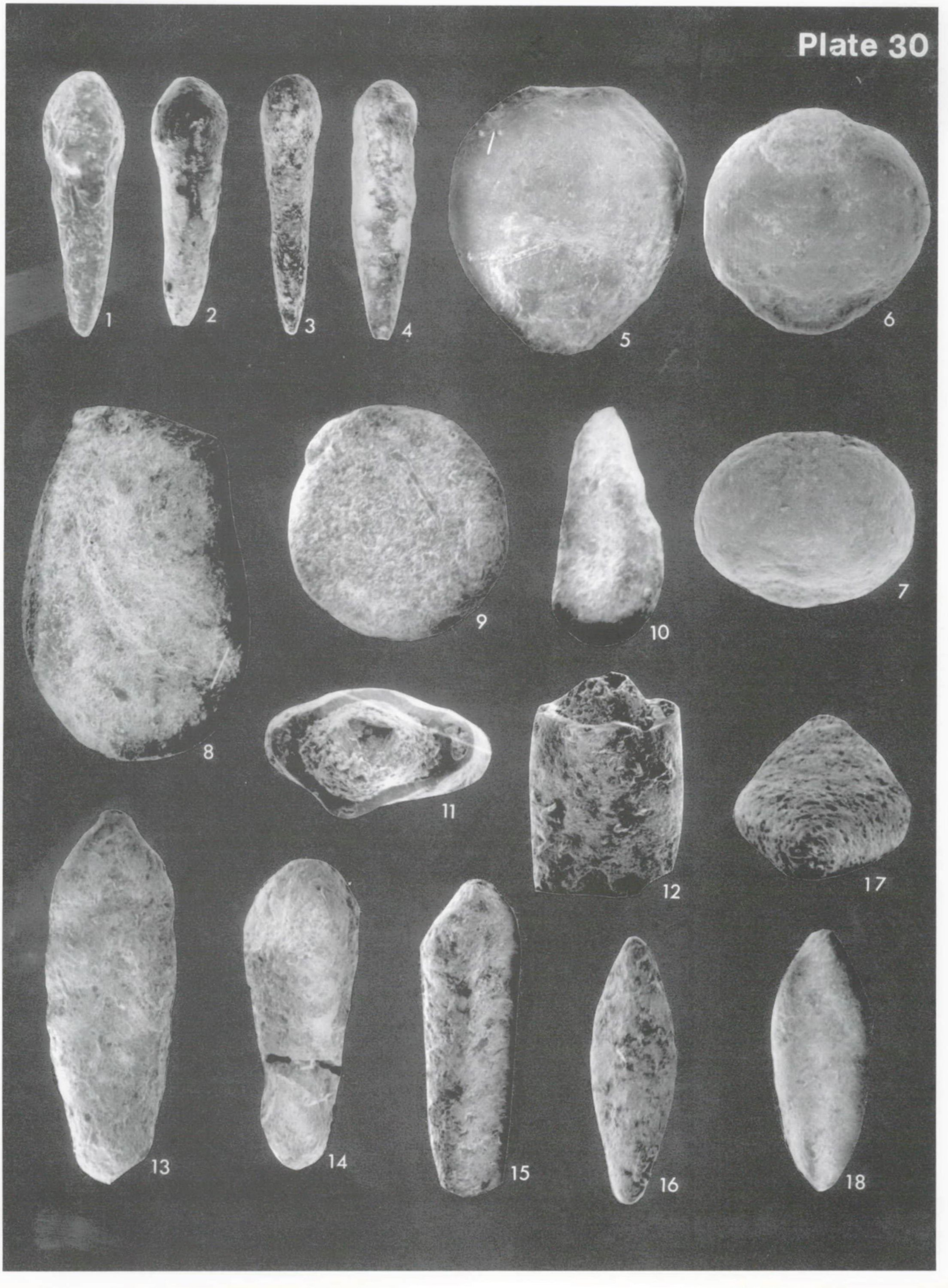
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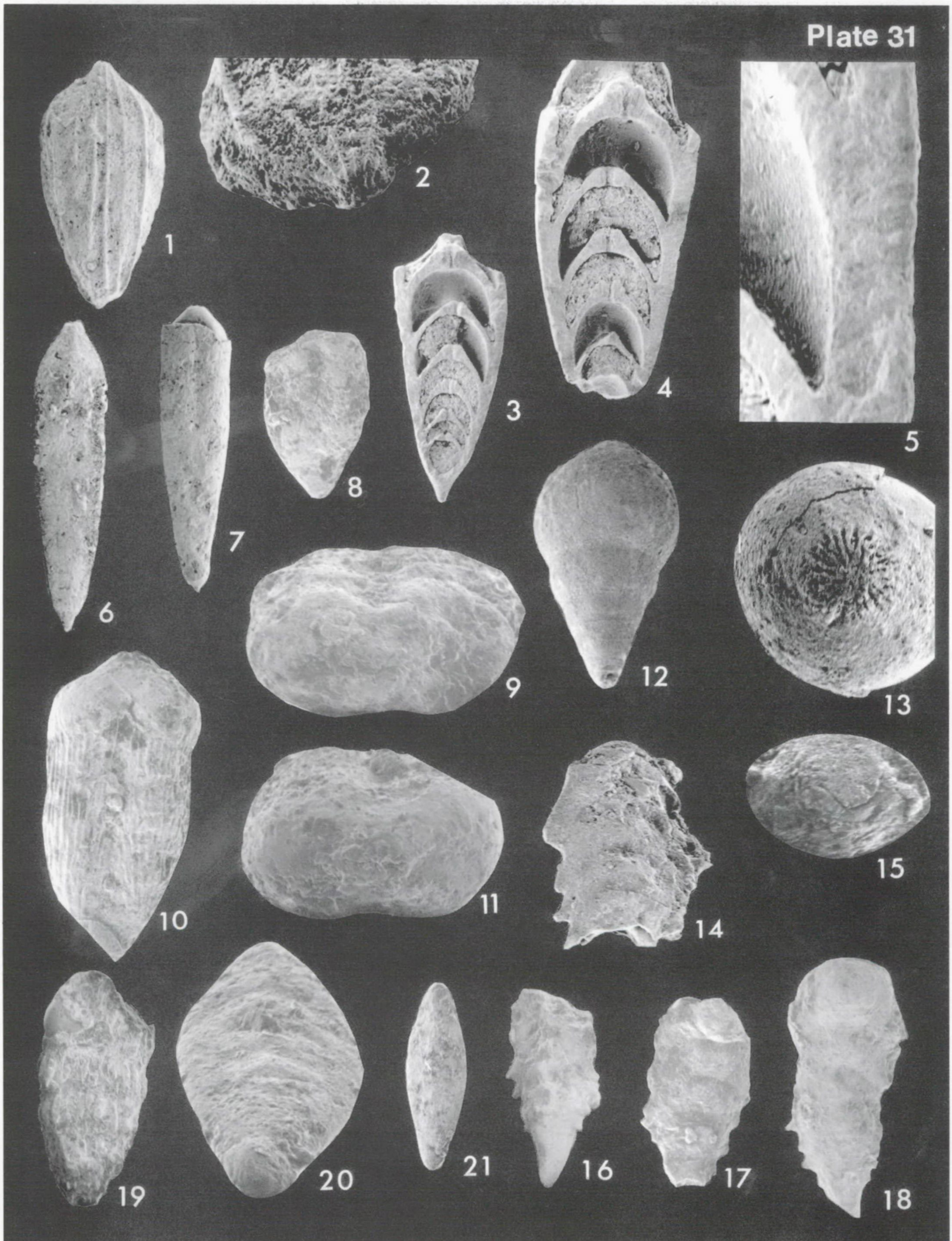
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Plate 33 S.E.M.

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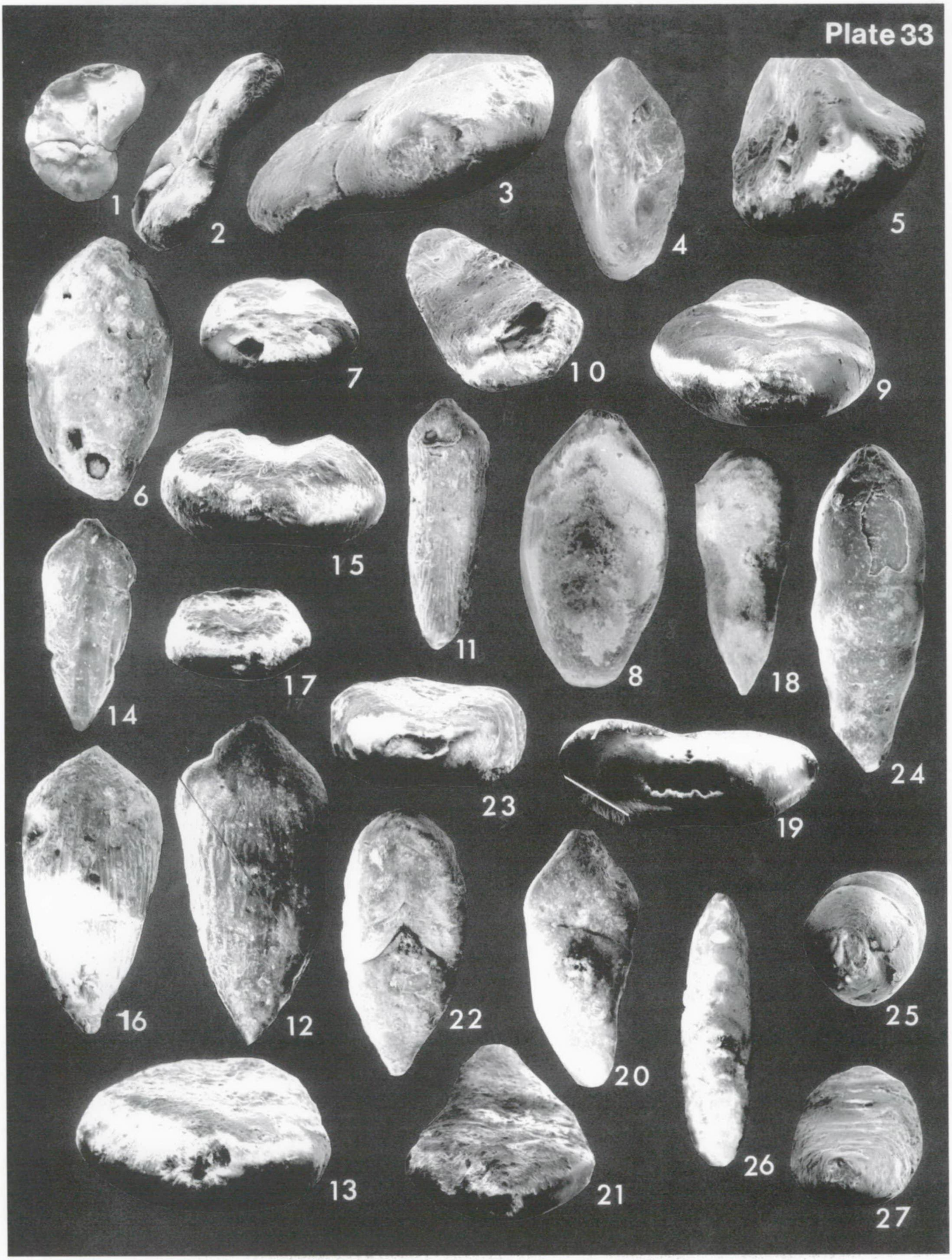
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TERTIARY PALYNOLOGY IN THE MOUNT COOLON AND RIVERSIDE AREAS

J.W. Beeston

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SUMMARY

Palynomorphs recovered from the Suttor Formation at Mount Coolon, and Suttor Formation equivalents from Riverside, central Queensland, correlate with palynofloras from the Murray Basin, South Australia, and from certain strata on the east coast of Queensland, to indicate a late early to early middle Miocene age.

The floras are dominated by *Nothofagidites* spp., but also include a wide range of algae, ferns, gymnosperms, and other angiosperms, particularly Casuarina-related forms, myrtaceiids, proteaceans, as well as localised concentrations of *Rhoipites* spp., and *Haloragacidites suttorensis* sp. nov.

Other newly described species include *Reboulisporites dettmanni*, *Microfoveolatosporis coolonensis*, *Myrtaceidites gloriosus*, and *Margocolporites woodii*.

Species not recorded from Queensland before include *Baculatisporites disconformis* Stover *in* Stover & Partridge 1973, *Verrucosisporites kopukuensis* (Couper) Stover *in* Stover & Partridge 1973, *Beaupreidites verrucosus* Cookson 1950, *Gothanipollis bassensis* Stover *in* Stover & Partridge 1973, *Myrtaceidites rhodamnoides* Martin 1973, ?*Phimopollenites pannosus* (Dettmann & Playford) Dettmann 1973, *Nothofagidites incrassatus* (Cookson) Tulip, Taylor & Truswell 1982, *Cupanieidites reticularis* Cookson & Pike 1953, *Tricolporites retequetrus* Partridge *in* Stover & Partridge 1973, *Ilexpollenites anguloclavatus* McIntyre 1968, *Proteacidites symphyonemoides* Cookson 1950, and *Malvacipollis diversus* Harris 1965 (non Hekel, 1972).

Species not recorded from Australia before comprise *Tricolpites latispinosus* McIntyre 1965, *Ilexpollenites megagemmatus* McIntyre 1968, and forms assignable to the alga, *Tetraporina* Naumova emend. Lindgren 1980, the conifer *Taxodiaceaepollenites*, and the angiosperms, *Pentadesmapites* Ramanujam, Reddy & Sarma 1985, and *Jandufouria* Germeraad, Hopping & Muller 1968.

The correlations extend the ranges of several significant species, including *Helciporites astrus* Partridge *in* Stover & Partridge 1973, and *Tricolpites phillipsii* Stover *in* Stover & Partridge 1973, previously confined to the Eocene, and *Myrtaceidites rhodamnoides* Martin 1973, previously restricted to the Pliocene.

Keywords: Palynology, biostratigraphy, Suttor Formation, Tertiary, Queensland.

Stratigraphic bores GSQ Mount Coolon 1 to 6 were drilled at Mount Coolon, central Queensland, as part of a stratigraphic drilling project to assist the Regional Geological Mapping Project in that area (Grimes & others, 1987)(Figure 1). The bores intersected strata of the Tertiary Suttor Formation, known to cover much of the region with variable thicknesses up to 150m (Grimes & others, 1986). The Formation variably comprises sandstone, siltstone, and claystone, with minor oil shales and diatomite.

Some shaly horizons (interbedded with oil shales) in boreholes GSQ Mount Coolon 5 and 6 were sampled for palynological age determination (Figure 2), and a carbonaceous shale sample from Suttor Creek Formation equivalents located in the Riverside Coal Mine to the east was also examined for comparison.

Hitherto, palynological studies of the Tertiary in Queensland had been mainly confined to the southeast corner of the state and to areas adjacent to the coast: Harris (1965 - Brisbane), Hekel (1972 - Moreton Bay area, eastern central Queensland, Capricorn Basin), Foster (1980 - Hillsborough Basin and Duaringa Basin; 1982 - Yaamba), Dudgeon (1982 - south east Queensland; 1983 - Yaamba), Wood (1986 - Sandy Cape).

MATERIAL AND METHODS

Five core samples and one surface sample were submitted (by K. G. Grimes) for examination, and processed for spores and pollen. The preparation technique involved the following steps:-

1. Approximately 20g of sample were crushed and washed with 10% hydrochloric acid for dissolution of carbonates.

2. Dissolution of mineral matter was achieved using warm concentrated hydrofluoric acid.

3. Complex gel-like fluorides which form during the digestion of the mineral matter were removed by washing with 50% hydrochloric acid.

4. Reduction of the cellulose content of the residue was achieved by acetolysis (following the method of Erdtman, 1960).

5. Humic acids produced during acetolysis were removed by washing with 5% potassium hydroxide.

6. Hot nitric acid was used to oxidise the organic residue.

7. Humic acids produced during oxidation were removed by washing with 5% potassium hydroxide.

8. Residues were screened (100mm) mesh and underwent heavy liquid separation (zinc bromide SG 1.9 and 1.5).

9. Several strew slides of the remaining residue were prepared using glycerine jelly as the mounting medium.

The strew slides were examined using a Zeiss Photomicroscope III (No. 1369) housed at the Geological Survey of Queensland. Low to high yields of well-preserved palynomorphs were recovered from the samples prepared.

All strew slides and residues are housed in the Palynological Collection of the Geological Survey of Queensland.

BIOSTRATIGRAPHY

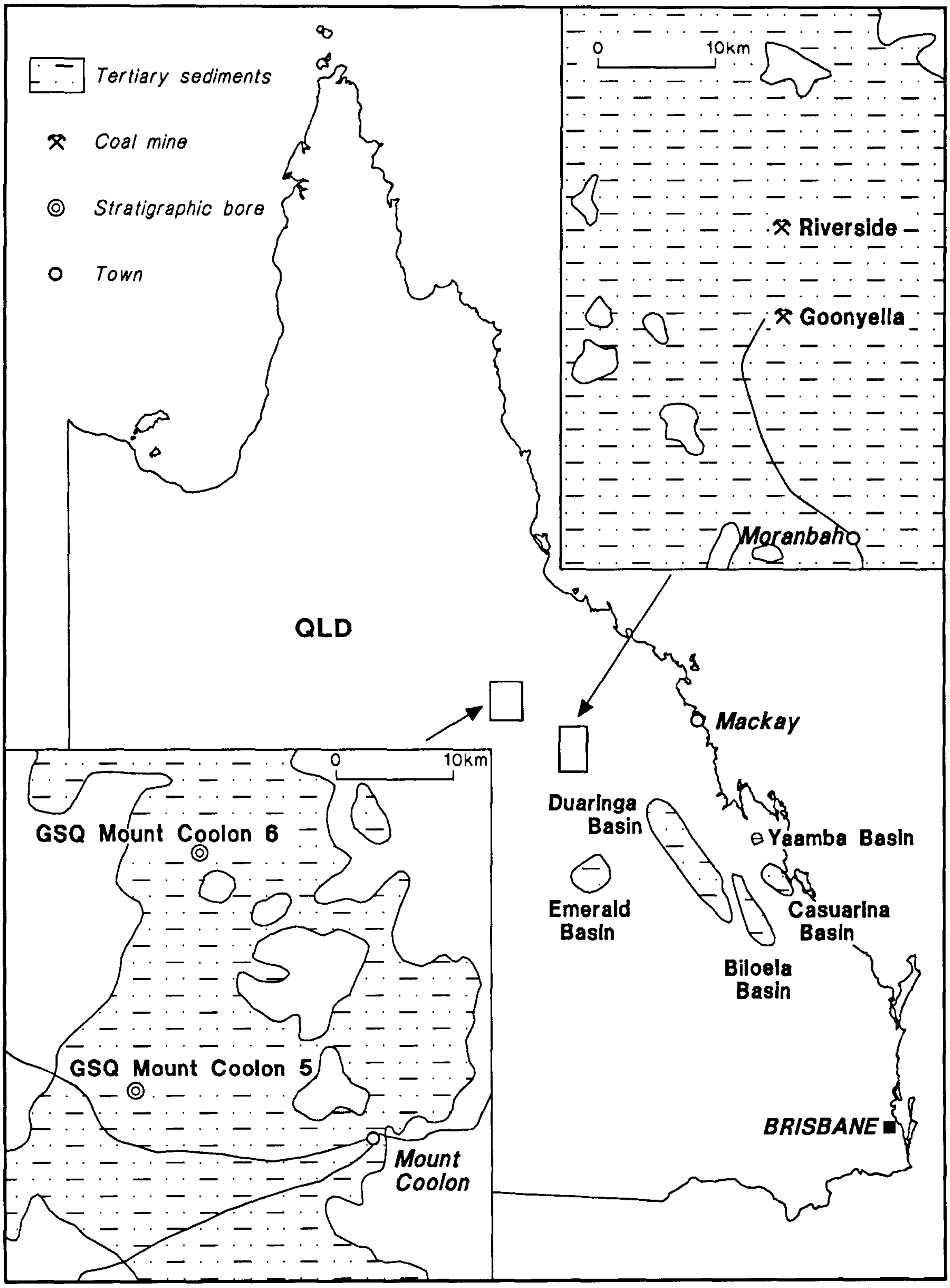
The palynofloras from Mount Coolon and Riverside show numerous similarities, and are considered to be equivalent in age.

Comparisons with other Queensland Tertiary palynofloras, described by Hekel (1972) and Wood (1986) from east coast sediments, based on the foraminiferal zones delineated by Palmieri (1971, 1984), have been made.

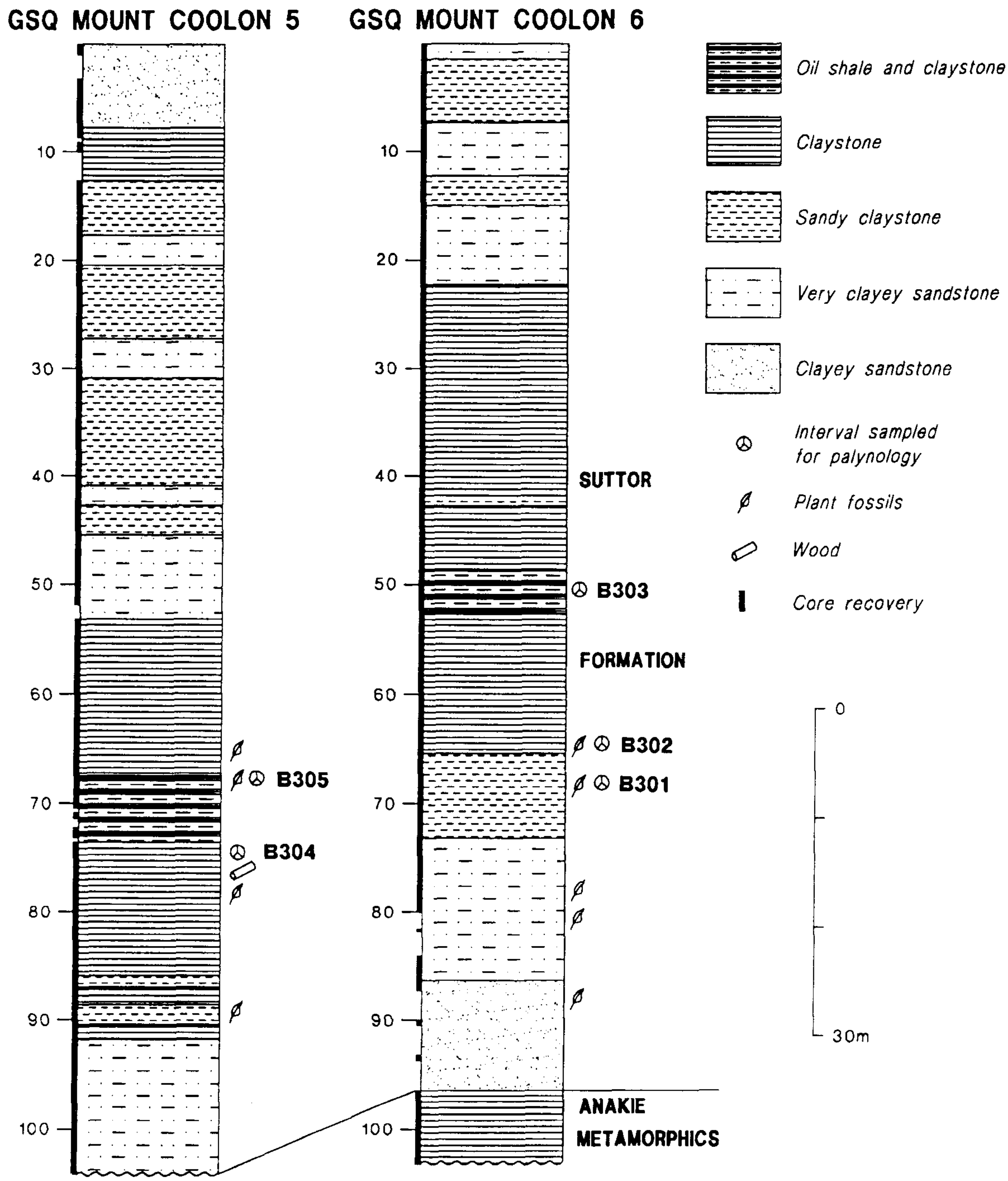
Hekel's early Miocene Unit III is characterised by some of the 'tropical Tertiary' forms, also recorded from Mount Coolon, along with abundant *Nothofagidites*. His Unit IV, ranging from middle to upper Miocene, includes *Acaciapollenites*.

Wood's (1986) palynoflora from Sandy Cape is late Oligocene - early Miocene and contains many species present at Mount Coolon, including the 'tropical Tertiary' indicators.

However, *B. verrucosus* and *P. symphyonemoides* were not recorded at Sandy Cape, suggesting that the palynoflora at Mount Coolon could be younger. These comparisons suggest a late early to early middle Miocene age for Mount Coolon/Riverside.



Text figure 1. Locality map showing the positions of boreholes GSQ Mount Coolon 5 and 6, and Riverside Opencut Coal Mine, central Queensland, from where the Tertiary palynofloral samples were selected.



Text figure 2. Lithologic columns for GSQ Mount Coolon 5 and 6 showing sample locations.

Queensland palynofloras bear little in common with the palynozones recognised in the Gippsland Basin in Victoria (Stover & Evans, 1972). However the latter do contain *Acaciapollenites myriosporites* and *Proteacidites symphyonemoides* in common, giving a correlation with the upper *Proteacidites tuberculatus* zone, further supporting an early Miocene age.

Correlations of Mount Coolon/Riverside with inland palynofloras from the Murray Basin are good, with a wide range of species recognised. (The Murray Basin material is tied to foraminiferal zones outlined by Lindsay (1983)).

They show considerable similarity to an early Miocene assemblage described from Oakvale in the western Murray Basin (Truswell & others, 1985). Both palynofloras are dominated by *Nothofagidites* (42% overall at Mount Coolon / Riverside), common *Casuarina*-like pollen (up to 20% at Mount

Coolon / Riverside), and *Myrtaceaidites* (up to 18% at Mount Coolon / Riverside and up to 48% at Oakvale).

Present also are species of *Margocolporites, Perfotricolporites* and *Malvacearumpollis*, which are considered to be representative of the 'tropical Tertiary'. Biostratigraphically significant species in common with Oakvale include *Acaciapollenites myriosporites* and *Proteacidites symphyonemoides*. Other forms found at Mount Coolon / Riverside, which are also recorded from Oakvale include *Polycolpites* sp. A, and the fresh water dinoflagellate, *Saeptodinium* sp. A.

A palynoflora from Kiandra, New South Wales (Owen, 1988) contains several genera in common with Mount Coolon /Riverside, including numerous *Nothofagidites* spp. (37 to 88%), and lesser proportions of *Haloragacidites (Casuarinidites), Myrtaceaidites* and *Proteacidites*. None of the 'tropical Tertiary' forms are present, nor are *Acacia*-type pollen or *Proteacidites symphyonemoides*. Of note, however, is the presence of *Verrucosisporites kopukuensis* and *Beaupreaidites verrucosus*, which also occur at Mount Coolon / Riverside.

PALAEOENVIRONMENT

Nothofagidites is the dominant genus in palynofloras from Mount Coolon / Riverside. The Riverside sample also contains numerous algae (*Botryococcus* and *Saeptodinium*) and fern spores (mainly *Laevigatosporites*), suggesting a marginal lacustrine environment.

Throughout the Mount Coolon samples, the major variations are influxes in the percentage contents of *Casuarina*-related forms and myrtaceiids, along with local concentrations of *Rhoipides*, proteaceans, and *Haloragacidites suttorensis* sp. nov.

The 'tropical Tertiary' elements including *Perfotricolpites digitatus* Gonzalez Guzman 1967, *Margocolporites woodii* sp. nov. and *Malvacearumpollis mannanensis* Wood 1986, present in both floras, and at Oakvale, Murray Basin. They also include subtropical/warm temperate elements such as *Gothanipollis* spp., *Beaupreadites* spp., *Polycolpites* spp., *Cupanieidites* spp., and *Sapotaceoidaepollenites* spp. (Tulip & others, 1983), suggesting a similarity in climatic conditions. This similarity across such a considerable geographic distance and change in present-day latitude suggests that conditions across eastern/central Australia during the late-Early Miocene may have been quite comparable and stable.

DISCUSSION

Present evidence suggests that time restricted forms from southern Victoria span significantly younger ages in Queensland. Foster (1982) identified 11 species from the Yaamba Basin, which in the Gippsland Basin indicate an Eocene age.

Wood (1986) recognised 4 of these species (*Bankseidites arcuatus* Stover *in* Stover & Partridge 1973, *Propylipollis latrobensis* (Harris) Martin & Harris 1974, *Proteacidites kopiensis* Harris 1972, and *Proteacidites pachypolus* Cookson & Pike 1954), at Sandy Cape, known from foraminiferal evidence to be late Oligocene to early Miocene. All four of these species are present at Mount Coolon - Riverside, as is *Helciporites astrus* Partridge *in* Stover & Partridge, 1973, used by Foster, existing along at Mount Coolon with many forms restricted to the Miocene and younger in the Gippsland Basin.

Significant differences thus exist between floras from Queensland's Tertiary basins and those in some southern basins, particularly the Gippsland Basin. The establishment of a reliable biostratigraphy applicable to Queensland will require the examination of more sequences, including those to which foraminiferal biostratigraphic ages can be applied, as well as rich sequential inland palynofloras from which a wide range of forms can be assessed.

TABLE 1 - Occurrence and concentration of palynomorphs at Mount Coolon and Riverside

	301	302	303	304	305	306
ALGAE						
Botryococcus braunii	.	.	.	.	4	6
Tetraporina sp. cf. T. diagonalis	.	.	.	x	.	.
Saeptodinium sp.	.	.	.	x	1	25
BRYOPHYTES						
Reboulisporites dettmanni	.	.	.	.	.	x
PTERIDOPHYTES						
Laevigatosporites major	2	.	1	.	x	2
Laevigatosporites ovatus	2	.	.	.	.	14
Peromonolites sp. A	.	.	.	.	.	x
Peromonolites sp. B	.	.	.	.	x	x
Peromonolites sp. C	.	.	.	.	.	x
Microfoveolatosporis coolonensis	.	.	.	.	.	x
Polypodiisporites spp.	x	.	1	.	x	x
Cyathidites minor	4	2	x	.	x	x
Cyathidites palaeospora	x	.	.	.	x	x
Cyathidites sp. cf. punctatus	.	.	.	.	.	x
Cyathidites sp. A	.	.	.	.	x	.
Cyathidites sp. B	.	.	.	.	x	x
Cyathidites sp. D	x	.	.	.	.	.
Trilites sp. A	x	.	.	.	.	x
Dictyophyllidites concavus	.	.	.	.	x	.
Dictyophyllidites sp. A	.	.	.	.	.	x
Gleicheniidites circiniidites	.	.	.	.	.	x
Osmundacidites wellmannii	.	.	.	.	.	x
Baculatisporites comaumensis	x	1	.	.	.	.
Baculatisporites disconformis	.	.	.	x	.	x
Verrucosisporites kopukuensis	.	x	.	.	.	.
Verrucosisporites varians	.	.	.	.	x	.
Neoraistrickia sp. A	.	.	.	.	x	.
Rugulatisporites mallatus	x	x	.	.	x	.
Rugulatisporites sp. cf. R. micraulaxus	.	x	.	.	x	.
Rugulatisporites sp. A	.	.	.	.	x	.
Rugulatisporites sp. B	.	.	.	.	x	.
Rugulatisporites sp. C	x	.	.	.	.	.
Crassoretitriletes vanraadshooveni	.	x	x	.	.	.
Crassoretitriletes sp. A	.	.	.	.	.	x
Crassoretitriletes sp. B	.	.	.	.	.	x
Crassoretitriletes sp. C	x	.	.	.	.	.
trilete spore gen. et sp. indet. 1	.	.	.	.	.	x
trilete spore gen. et sp. indet. 2	.	.	.	.	.	x
GYMNOSPERMS						
Podocarpidites ellipticus	4	5	x	14	3	2
Dacrycarpites australiensis	.	x	x	3	1	x
Microcachryidites antarcticus	.	.	x	2	1	x
Lygistepollenites florinii	.	x	x	4	3	x
Araucariacites australis	.	.	x	x	x	x
Dilwynites granulatus	x	1	x	x	5	5
Ephedripites notensis	.	x	.	.	.	.
Taxodiaceaepollenites sp. A	x	.	.	15	x	x
ANGIOSPERMS						
MONOCOLPATE POLLEN						
Arecipites spp.	x	.	x	.	x	x
TRICOLPATE POLLEN						
Beaupreadites verrucosus	.	.	.	.	.	x
Gothanipollis bassensis	x	.	x	.	1	.
Gothanipollis sp. A	.	.	3	.	.	.
Myrtaceidites mesonesus	5	7	x	.	x	x
Myrtaceidites eugeniioides	.	.	3	.	.	.
Myrtaceidites eucalyptoides	1	3	.	.	1	.
Myrtaceidites rhodamnoides	3	2	.	.	.	.
Myrtaceidites verrucosus	1	x	1	.	x	x
Myrtaceidites gloriosus	7	1	.	.	.	.
Tricolpites bathyreticulatus	.	.	.	.	.	x
Tricolpites latispinosus	.	.	.	.	x	.
Tricolpites sp. cf. phillipsii	x	.	.	.	.	.
Tricolpites reticulatus	x	x	.	.	.	.
Tricolpites sp. A	1	.	x	.	.	2
Tricolpites sp. B	.	.	.	.	.	x
Tricolpites sp. C	.	.	.	.	.	x
Rousea sp. A	.	.	.	.	x	.
Rousea sp. B	.	.	x	.	.	.
Rousea sp. C	x	.	.	.	.	.
Striatopollis sp. A	.	.	.	.	.	x
Perfotricolpites digitatus	.	.	1	.	x	x
POLYCOLPATE POLLEN						
?Phimopollenites pannosus	.	.	.	.	x	x
Polycolpites esobalteus	x	.	.	.	.	x

	301	302	303	304	305	306
Polycolpites sp. A	.	.	x	.	.	.
Polycolpites sp. B	.	.	x	.	.	.
Nothofagidites asperus	1	2	x	4	7	1
Nothofagidites brachyspinulosus	2	x	1	x	4	4
Nothofagidites deminutus	.	.	x	.	x	1
Nothofagidites emarcidus/heterus	49	49	9	2	16	17
Nothofagidites falcatus	5	x	2	31	16	10
Nothofagidites incrassatus	x	.	3	12	2	.
TRICOLPORATE POLLEN						
Cupanieidites orthoteichus	1	2	1	.	x	x
Cupanieidites reticularis	.	.	x	.	x	x
Cupanieidites sp. A	.	.	.	.	x	x
Cupanieidites sp. B	.	1	.	.	.	.
Cupanieidites sp. C	.	.	.	.	x	.
Margocolporites woodii	.	x	.	.	x	x
Simpsonipollis sp. A	x	x	.	.	.	x
Ilexpollenites anguloclavatus	x	x	.	.	.	.
Ilexpollenites megagemmatus	x	.	.	.	.	.
Tricolporites prolata	x	.	x	x	x	x
Tricolporites retequetrus	.	x	.	.	x	.
Rhoipites microreticulatus	5	16	x	x	5	3
Rhoipites alveolatus	x	.	.	.	x	.
Rhoipites sp. A	.	x	x	.	x	x
Rhoipites sp. B	.	.	.	.	.	x
?Palaeocoprosmadites spp.	.	.	.	.	x	x
POLYCOLPORATE POLLEN						
Sapotaceoidaepollenites rotundus	.	.	x	.	x	.
Sapotaceoidaepollenites sp. A	x	x	x	x	.	x
Pentadesmapites sp. A	.	.	.	.	x	.
Jandufouria sp. A	.	.	.	.	x	.
BIPORATE POLLEN						
Bankseidites arcuatus	.	.	x	x	x	x
TRIPORATE POLLEN						
Proteacidites sp. cf. differentipollis	.	x	.	.	.	.
Proteacidites kopiensis	.	.	.	.	x	x
Proteacidites pachypolus	.	.	x	.	x	1
Proteacidites simplex	x	3	x	1	x	1
Proteacidites sinulatus	.	x	9	x	x	x
Proteacidites symphyonemoides	x	x	.	.	x	x
Proteacidites variambitus	.	1	.	x	.	.
Proteacidites sp. A	x	.	.	.	x	x
Proteacidites sp. B	x	.	x	.	x	.
Proteacidites sp. C	.	.	1	.	x	.
Proteacidites sp. D	.	x	.	.	.	.
Proteacidites sp. E	.	.	.	.	.	x
Proteacidites sp. F	x	.	.	.	.	.
Proteacidites sp. G	x	.	.	.	.	.
Proteacidites sp. H	.	x	.	.	.	.
Propylipollis annularis	x	.	x	x	x	x
Propylipollis concretus	.	x	x	.	.	x
Propylipollis crassimarginus	1	.	.	.	.	.
Propylipollis intricatus	x	.	.	.	x	x
Propylipollis ivanhoensis	x	1	3	x	x	1
Propylipollis latrobensis	x	.	.	.	x	.
Propylipollis reticuloscabratus	.	x	.	.	.	x
Propylipollis sp. cf. P. reticuloscabratus	.	.	.	.	x	.
Propylipollis robustus	.	x	x	.	.	x
Propylipollis vagexinus	x	.	x	.	x	x
Propylipollis sp. cf. Proteacidites rectomarginus	.	.	x	.	.	.
Propylipollis sp. A	.	.	.	x	x	.
HEXAPORATE POLLEN						
Anacolosidites luteoides	x	.	.	.	.	.
STEPHANOPORATE POLLEN						
Haloragacidites/Casuarinidites spp.	3	2	9	6	20	4
Haloragacidites suttorensis	.	1	37	4	2	.
Helciporites astrus	.	.	4	.	2	.
Malvacipollis diversus	.	.	x	.	x	x
Malvacipollis subtilus	x	.	.	.	x	x
stephanoporate pollen gen. et sp. indet.	x	.	.	.	.	.
POLYPORATE POLLEN						
Echiperiporites sp. A	.	x	x	.	.	.
Malvacearumpollis mannanensis	.	.	x	.	.	x
Periporopollenites sp. cf. vesicus	.	.	.	.	x	x
Roxburghpollis sp. cf. P. bipatterna	.	.	.	.	x	.
APORATE POLLEN						
Inaperturopollenites sp. A	.	.	.	.	x	.
POLLEN RETAINED IN TETRADS						
Bysmapollis sp. A	.	.	.	.	x	.
POLYADS						
Acaciapollenites myriosporites	.	.	.	.	x	x
INCERTAE SEDIS						
Schizophacus sp. A	.	.	.	1	.	.
Schizophacus sp. B	.	.	.	.	x	.

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SYSTEMATIC PALAEONTOLOGY

(The synonymy lists included here generally only feature Queensland material, except in some cases where appropriate material from areas in the south of Australia, or material relevant to new species, is included.)

ALGAE

Genus **Botryococcus** Kützing 1849

Type species: *Botryococcus braunii* Kützing 1849; original designation.

Botryococcus braunii Kützing 1849 (Figure 1)

Genus **Tetraporina** Naumova emend. Lindgren 1980

Type species: *Tetraporina antiqua* Naumova 1950; designated by Potonie 1960.

Tetraporina sp. cf. ***T. diagonalis*** Lindgren 1980 (Figure 2)

Dimensions: Diagonal diameter - 46µm (1 specimen), wall thickness - 1µm increasing to 1.5-2.0µm at corners.

Remarks: The specimen equates to the size specifications of *T. diagonalis*. The wall at the corners of the latter is claimed to be 6µm in thickness but would appear (Lindgren, 1980, page 350, plate IIA) to be merely folded.

Genus **Saeptodinium** Harris 1973

Type species: *Saeptodinium gravattensis* Harris 1973; original designation.

Saeptodinium sp. A (Figure 3)

1965 aff. *Deflandrea* sp. indet.; Harris, p.2, fig. 3.
1973 unidentified microplankton; Martin, p.46, fig.202.
1984 *Saeptodinium* sp.; Truswell, Sluiter & Harris, figs 11B,C.

Remarks: The conspicuously scabrate forms at Mount Coolon differ from *S. gravattensis*, which are laevigate.

BRYOPHYTA

Genus **Reboulisporites** Zamaloa & Romero, 1990

Type species: *Reboulisporites fuegiensis* Zamaloa & Romero, 1990

Reboulisporites dettmanni sp. nov. (Figure 4)

Dimensions: Equatorial diameter - 46(50)60µm (10 specimens), exine -1.0 to 1.5µm distal lumina - 5 to 15µm, proximal lumina - 3 to 6µm; zona -1(2)4µm.

Description: Trilete spores with subcircular amb. Laesurae, slightly sinuous, reaching the equator. Exine 1.0 to 1.5µm thick. Exosporium membranous, reticulate, with thin muri (<1µm wide) and subpolygonal lumina, larger on the distal face, and a thin membranous zona up to 4µm wide.

Derivation of name: Dr M.E.Dettmann, University of Queensland.

Holotype: B306-1,16.4 102.3, Q805.

Remarks: Specimens from Mount Coolon superficially resemble *Rouseisporites reticulatus* Pocock figured by Dettmann (1963, page 97, plate 23 figures 4 to 9, text figure 6D), except that the reticulum is finer on both surfaces, and the grains tend to be smaller.

Rouseisporites sp. (Hekel, 1972, page 4, plate 2, figure 13) and *Rouseisporites* ? sp. A (Foster, 1982, page 3, plate 10 figure 11) differ by having equally sized reticula on both proximal and distal surfaces. *Rouseisporites* sp. (Martin, 1973, page 4, figure 4) and *Rouseisporites* sp. (Truswell & others, 1984, page 281, figures 6S-U) have finer reticula.

Distribution: Suttor Formation equivalents at Riverside Mine, Central Queensland.

Affinity: Zamaloa & Romero (1990) suggest an affinity with the Bryophyta, family Rebouliaceae.

PTERIDOPHYTA

Genus **Laevigatosporites** Ibrahim 1933

Type species: *Laevigatosporites vulgaris* (Ibrahim) Ibrahim 1933.

Laevigatosporites major (Cookson) Krutzsch 1959 (Figure 5)

1972 *Laevigatosporites major* (Cookson) Krutzsch 1959; Hekel, p.5, pl.1 fig.5.

Laevigatosporites ovatus Wilson & Webster 1946 (Figure 6)

Genus **Peromonolites** Couper 1953

Type species: *Peromonolites bowenii* Couper 1953

Peromonolites sp. A (Figure 7)

Dimensions: Length and breadth - 40x29µm (without perispore) (1 specimen).

Remarks: Similar to *Laevigatosporites major*, but with the remains of a thin perispore displaying a large, loosely arranged reticulum, muri <0.5µm in width, lumina up to 12µm in diameter.

Peromonolites sp. B (Figure 8)

Dimensions: Length and breadth - 27x43µm (with perispore); Length and breadth 21x36µm (without perispore). Exine - 1 to 1.25µm, perispore - 3.0 to 3.5µm (3 specimens).

Remarks: The specimens resemble *Peromonolites densus* Harris, 1965, but possess much longer laesurae reaching to the full length of the axis, and finer perispore ornaments, which are foveolate to reticulate.

Peromonolites sp. C (Figure 9)

1972 ?*Peromonolites* sp.; Hekel, p.6, pl. 1 figs 2,3 and 6.

Dimensions: Without perispore - 25x47µm; with perispore - 29x50µm. Exine - 2 to 3µm, perispore - 1.5 to 2µm (1 specimen).

Remarks: The inner body is unornamented, with a short laesurae. The perispore, although degraded, is ornamented with scattered grana, verrucae, and some gemmae. Specimens figured by Hekel are all monolete, yet many related specimens on the same slide (observed by the author) are trilete.

Genus **Microfoveolatosporis** Krutzsch 1959

Type species: *Microfoveolatosporis pseudodentatus* Krutzsch 1959

Microfoveolatosporis coolonensis sp. nov. (Figure 10)

Dimensions: Equatorial diameter (length) - 40(41)44µm(9 specimens); equatorial diameter (breadth) - 29µm (only one specimen measured); polar diameter - 21(27)30µm; exine - 1 to 2µm; diameter of puncta - <0.5µm.

Description: Amb elliptically to straight sided with rounded ends, outline plano-convex in lateral view; aperture monolete, straight with thickened lips, extending 1/2 to 3/4 the length of spore; spore wall two-layered; nexine thin, psilate; sexine with a scabrate to finely reticulate ornament.

Derivation of name: Mount Coolon, central Queensland.

Holotype: Slide B306-1, 15.9 122.8, Q811.

Remarks: *M. coolonensis* differs from the type species in being smaller and possessing a scabrate/reticulate ornament; and from *Microfoveolatosporis* spp. (Playford, 1982) by possessing a finer ornament.

Distribution: Suttor Formation equivalents at Riverside Mine, central Queensland.

Affinity: Playford (1982) indicates that spores of this type are known from some pterophytes and psilophytes.

Genus **Polypodiisporites** Potonié 1933 emend. Khan &Martin 1972

Type species: *Polypodiisporites favus* (Potonié) Potonié 1956

Polypodiisporites spp. (Figure 11)

Remarks: The specimens resemble other material described from the Tertiary of Queensland under a variety of names [*Polypodiisporites* sp. (Hekel, 1972), *Polypodiidites* sp. cf.; *P. inangahuenis* Couper, 1953 (Dudgeon, 1982), *Polypodiisporites speciosus* (Harris) Khan & Martin, 1972; *Polypodiisporites* sp. (Wood, 1986)].

Genus **Cyathidites** Couper, 1953

Type species: *Cyathidites australis* Couper 1953

Cyathidites minor Couper 1953 (Figure 12)

1986 *Cyathidites minor* Couper 1953; Wood, p.7, fig.3.7.

Dimensions: Equatorial diameter - 31 to 40μm (range only).

Cyathidites palaeospora (Martin) comb. nov. (Figure 13)

1972 *Cyathidites minor* Couper 1953; Hekel, p.3, pl.2 fig.4.
1973 *Cyathea palaeospora* Martin 1973; p.7, figs 10-12, 27-29.
1986 *Cyathea palaeospora* Martin 1973; Wood, p.7, fig. 3.8.

Dimensions: Equatorial diameter - 23(34)38μm; exine thickness - 1 to 2μm (thickening slightly radially) (6 specimens).

Cyathidites sp. cf. ***C. punctatus*** (Delcourt & Sprumont) Delcourt, Dettmann Hughes 1963 (Figure 14)

Dimensions: Equatorial diameter - 29μm (1 specimen).

Remarks: The specimen shows similarities with *C. punctatus*, but is thinner walled, and has a roundly triangular amb rather than a concavo-triangular amb.

Cyathidites sp. A (Figure 15)

Dimensions: Equatorial diameter - 38μm; exine thickness - 4.0μm (1 specimen).
Remarks: The exine is thick, particularly on the distal surface, and the laesurae are long and sinuous, extending almost to the equator.

Cyathidites sp. B (Figure 16)

Dimensions: Equatorial diameter - 46,55μm (2 specimens); exine thickness - 1 to 2μm.

Remarks: The two specimens possess ornamentation on the proximal surface which grades from fine reticulate at the pole to scabrate halfway towards the equatorial margin. It also coarsens towards the laesurae, which are straight and extend to 3/4 of the distance to the radius. *Laevigatosporites*? sp. A (Foster, 1982, pl.1 fig.4) shows a similar development of ornament.

Cyathidites sp. D (Figure 17)

Dimenslons: Equatorial diameter - 27μm (1 specimen); exine thickness - 0.5μm.
Remarks: The spore possesses an inner body similar to *Cyathidites minor*. This inner body is enclosed in a thin perispore with an irregular reticulate ornament.

Genus **Trilites** Cookson ex Couper, 1953

Type species: *Trilites tuberculiformis* Cookson ex Couper 1953

Triletes sp. A (Figure 18)

Dimensions: Equatorial diameter - 35μm (1 specimen); exine thickness - 2 to 3μm.

Remarks: The laesurae extend to the margin where the exine is thickened to form prominent projections.

Genus **Dictyophyllidites** Couper emend. Dettmann 1963

Type species: *Dictyophyllidites harrisii* Couper 1958

Dictyophyllidites concavus Harris 1965 (Figure 19)

1982 *Dictyophyllidites concavus* Harris 1965; Foster, p.3, pl.10 fig.12.
1986 *Dictyophyllidites concavus* Harris 1965; Wood, p.7, fig. 5.3.

Dimensions: Equatorial diameter - 36μm (1 specimen).

Remarks: The specimen features thin tori that tend to be crescent shaped.

Dictyophyllidites sp. A (Figure 20)

Dimensions: Equatorial diameter - 21μm (1 specimen); exine thickness - 1μm; tori thickening - 2μm in width.

Remarks: The specimen features thick circumfluent tori.

Genus **Gleicheniidites** Ross ex Delcourt & Sprumont emend. Dettmann 1963

Type species: *Gleicheniidites senonicus* Ross 1949

Gleicheniidites circinidites (Cookson) Dettmann 1963 (Figure 21)

1972 *Gleicheniidites circinidites* (Cookson) Dettmann; Hekel, p.5, pl.2 fig.1.

Dimensions: Equatorial diameter - 32μm (1 specimen); inter-radial crassitudes - 5μm in width; distal tori - 3.5μm in width.

Genus **Osmundacidites Couper** 1953

Type species: *Osmundacidites wellmannii* Couper 1953

Osmundacidites wellmannii Couper 1953 (Figure 22)

Dimensions: Equatorial diameter - 29(32)39μm (3 specimens).

Remarks: Specimens show thickened lips around the suturae.

Genus **Baculatisporites** Thomson & Pflug 1953

Type species: *Baculatisporites primarius* (Wolff) Thomson & Pflug 1953

Baculatisporites comaumensis (Cookson) Potonié 1956 (Figure 23)

1972 *Osmundacidites* sp.; Hekel, p.4, pl.2 fig.10.
1982 *Baculatisporites comaumensis* (Cookson) Potonié 1956; Foster, p.3, pl. 1 fig.5.
1986 *Baculatisporites comaumensis* (Cookson) Potonié 1956; Wood, p.7, fig.5.4.

Dimensions: Equatorial diameter - 56(60)67μm (5 specimens).

Remarks: Cookson's original diagnosis suggested an ornament entirely of bacula. Dettmann (1963) included setulae and clavae, whereas Filatoff (1975) referred to the species as mainly sub-baculate. The specimens from Queensland include spinae and conae, and elements commonly coalesce to form small irregular rugulae.

Baculatisporites disconformis Stover *in* Stover & Partridge 1973 (Figure 24)

Dimensions: Equatorial diameter - 55μm (1 specimen), irregular ornament consisting of grana, rugulae, and pila, up to 3.5μm in height.

Genus **Verrucosisporites** Ibrahim 1933 emend. Smith & Butterworth 1967

Type species: *Verrucosisporites verrucosus* (Ibrahim) Ibrahim 1933.

Verrucosisporites kopukuensis (Couper) Stover *in* Stover & Partridge 1973 (Figure 25)

Dimensions: Equatorial diameter - 74μm (1 specimen).

Remarks: The specimen exhibits an ornament consisting of an irregular assortment of different sized verrucae, gemmae and granulae. This equates to the description for those elements of the species as being from 'the younger end of the range (early Eocene through Miocene)'(Stover & Partridge, 1973).

Verrucosisporites varians Volkheimer 1972 (Figure 26)

Dimensions: Equatorial diameter - 68μm (1 specimen).

Remarks: The ornament consists of widely spaced, irregular verrucae with some elements tending to be sub-baculate.

Genus **Neoraistrickia** Potonié 1956

Type species: *Neoraistrickia truncatus* (Cookson) Potonié 1956

Neoraistrickia sp. A (Figure 27)

Dimensions: Equatorial diameter - 45μm (1 specimen).

Remarks: The specimen differs from *N. egualis* (Cookson & Dettmann) Backhouse 1988 by having a chiefly baculate ornament, and from *N. suratensis* McKellar 1978 by being larger and having finer elements.

Genus **Rugulatisporites** Thomson & Pflug 1953

Type species: *Rugulatisporites quintus* Thomson & Pflug 1953

Rugulatisporites mallatus Stover *in* Stover & Partridge 1973 (Figure 28)

1986 *Rugulatisporites mallatus* Stover *in* Stover & Partridge 1973; Wood, p.7, fig.5.2.

Dimensions: Equatorial diameter - 34(38)40μm (4 specimens).

Remarks: The specimens fall into the lower end of the size range given by Stover & Partridge as 36(42)47μm. They tend to ressemble the specimen figured by Wood which has a slightly more regular ornament than that figured in Stover & Partridge (1973, plate 15 figure 1).

Rugulatisporites sp. cf. ***R. micraulaxus*** Partridge *in* Stover & Partridge 1973 (Figure 29)

Dimensions: Equatorial diameter - 34 to 40μm, exine thickness - 3 to 3.5μm, width of rugae - 1 to 2.5μm.

Remarks: The specimens fit into the size range of *R. micraulaxus* Partridge *in* Stover & Partridge 1973, but the spore wall is slightly thicker, and the rugae considerably wider. In cross-section, the rugae appear verrucate to subpilate.

Rugulatisporites sp. A (Figure 30)

Dimensions: Equatorial diameter - 36μm (1 specimen); ornament up to 4μm in height and 4.5μm in width.

Remarks: This specimen is smaller than *R. mallatus* and the ornament is much coarser. Individual rugae extend from the laesurae margins to the equator, and coalesce in the proximal polar regions adjacent to the laesurae.

Rugulatisporites sp. B (Figure 31)

Dimensions: Equatorial diameter - 30μm (1 specimen); exine thickness - 1μm; rugulae up to 2.5μm in height.

Remarks: The specimen differs from *R. mallatus* by being smaller, and displaying a slightly coarser ornament which is more irregular and more crowded. The trilete mark is sinuous to irregular. In equatorial outline the spore is nearly circular.

Rugulatisporites **sp. C** (Figure 32)

Dimensions: Equatorial diameter - 37μm (1 specimen); exine thickness - 1μm; ornament up to 2μm in height.

Remarks: This specimen differs from *R. mallatus* in having more irregularly shaped rugae, which, in cross-section, appear as vertical or tapered baculae and conae between 1 and 3μm in width.

Genus Crassoretitriletes Germeraad, Hopping & Muller 1968

Type species: *Crassoretitriletes vanraadshooveni* Germeraad, Hopping & Muller 1968

Crassoretitriletes vanraadshooveni Germeraad, Hopping & Muller 1968 (Figure 33)

1972 *Crassoretitriletes vanraadshooveni* Germeraad, Hopping & Muller 1968; Hekel, p.4, pl.2 figs 9 and 12.

1982 *Crassoretitriletes vanraadshooveni* Germeraad, Hopping & Muller 1968; Dudgeon, p.97, pl.2 fig.3.

1982 *Crassoretitriletes vanrandshooveni* Germeraad, Hopping & Muller 1968; Foster, p.3, pl.1 fig.6.

Dimensions: Broken specimens >72μm in diameter. Muri - 2 to 5.5μm in height.

Remarks: Specimens from Queensland assigned to this species range from 53 to 73μm in diameter, with none yet cited in the size range of the type material (up to 101μm). Nevertheless, the coarse, even reticulation is characteristic of the species.

Crassoretitriletes **sp. A** (Figure 34)

Dimensions: Equatorial diameter - 52, 56μm (2 specimens).

Description: Spores trilete, triangular with rounded apices, exine thick, two-layered, reticulate. Ornament coarser on dorsal surface; lumina irregular to polygonal and sometimes rounded, varying in size from 1 to 14μm; muri variable in width from 1 to 3μm. Ornament on proximal surface continuous to the laesurae, rugulate/reticulate, crowded, muri up to 2μm in width. Ornament appears verrucate in cross-section.

Crassoretitriletes **sp. B** (Figure 35)

Dimensions: Equatorial diameter - 52μm (1 specimen); nexine thickness - 1μm, sexine thickness - 2.5μm.

Description: Spore trilete, triangular with convex sides; exine thick, two-layered, outer layer reticulate. Ornament coarse on both surfaces, luminae long, narrow, worm-like, about 1μm wide and between 1 and 12μm long. Muri regular, about 2μm wide. Ornament verrucate in cross-section. Trilete mark long, distinct.

Crassoretitriletes sp. C (Figure 36)

Dimensions: Equatorial diameter - 26μm (1 specimen). Nexine thickness - 1μm, sexine thickness - 2.5μm.

Remarks: Similar to *Crassoretitriletes* sp. B, with lumina more regular, up to 2μm in maximum dimension, and muri up to 2μm in width.

trilete spore gen et sp. indet. 1 (Figure 37)

Dimensions: Equatorial diameter - 19μm (1 specimen).

Description: Spore trilete, amb triangular, sides convex, undulating, which are paralleled by a convoluted distal torus. The laesurae extend to the apices, and are bordered by prominent straight marginal thickenings. Wall thin, psilate.

trilete spore gen. et sp. indet. 2 (Figure 38)

Dimensions: Equatorial diameter- 30μm (1 specimen).

Description: Spore trilete, anb triangular, sides concave, with broadly rounded to quadrate apices giving a geometric appearance. Laesurae long, straight, delicate, extending to the apices. Proximal exine thin, psilate, distal exine up to 4μm in thickness, with an irregular 'honeycomb' texture.

GYMNOSPERMOPHYTA

Genus **Podocarpidites** Cookson ex Couper 1953

Type species: *Podocarpidites ellipticus* Cookson 1947; subsequent designation by Couper, 1953.

Podocarpidites ellipticus Cookson 1947 (Figure 39)

1965 *Podocarpidites ellipticus* Cookson, 1847; Harris, fig.1.7.
1972 *Podocarpidites* sp.; Hekel, p.7, pl.1 figs 11 & 15.
1982 *Podocarpidites* sp.; Foster, p.3, pl.12, figs 5,6
1986 *Podocarpidites ellipticus* Cookson, 1947; Wood, p.7, fig. 5.7.

Genus **Dacrycarpites** Cookson & Pike 1953

Type species: *Dacrycarpites australiensis* Cookson & Pike 1953

Dacrycarpites australiensis Cookson & Pike 1953 (Figure 40)

Genus **Microcachryidites** Cookson ex Couper 1953

Type species: *Microcachryidites antarcticus* Cookson 1947

Microcachryidites antarcticus Cookson 1947 (Figure 41)

1982 *Microcachryidites antarcticus* Cookson 1947; Foster, p.3, pl.10 fig 8.

Genus **Lygistepollenites** Stover & Evans 1973

Type species: *Lygistepollenites balmei* (Cookson) Stover & Evans 1973

Lygistepollenites florinii (Cookson & Pike) Stover & Evans 1973 (Figure 42)

1972 *Dacrydiumites* sp.; Hekel, p.6, pl.1 fig.12.
1982 *Lygistepollenites florinii* (Cookson & Pike) Stover & Evans, 1973; Foster, p.3, pl. 12 figs 4 & 7.

Genus **Araucariacites** Cookson ex Couper 1953

Type species: *Araucariacites australis* Cookson 1947

Araucariacites australis Cookson 1947 (Figure 43)

1972 *Dilwynites granulatus* Harris 1965; Hekel, p.7, pl.1 fig.16.
1982 *Araucariacites australis* Cookson 1947; Foster, p.3, pl. 6 fig.9.
1986 *Araucariacites australis* Cookson 1947; Wood, p.7, fig.6.1.

Genus **Dilwynites** Harris 1965

Type species: *Dilwynites granulatus* Harris 1965

Dilwynites granulatus Harris 1965 (Figure 44)

1965b *Dilwynites granulatus* Harris 1965; Harris, fig.1.12.

Genus **Ephedripites** Bolkhovitina ex Potonié, emend. Krutzsch 1961

Ephedripites notensis (Cookson) comb. nov. (Figure 45)

1957 *Ephedra notensis* Cookson 1957; p.45, pl.9 figs 6-10.
1982 *Ephedra notensis* Cookson 1956 (ortbographic error); Foster, p.3.

Dimensions: Equatorial diameter - 14μm, polar diameter - 35μm (1 specimen).

Remarks: The specimen displays about 8 to 10 ridges, and is indistinguishable from those described by Cookson.

Genus **Taxodiaceaepollenites** Kremp ex Potonié 1958

Type species: *Taxodiaceaepollenites hiatus* Potonié ex Potonié 1958.

Taxodiaceaepollenites sp. A (Figure 46)

Dimensions: Length - 32(36)40μm; breadth - 18(25)29μm (5 specimens).

Description: Non-aperturate body consisting of 'tear-shaped' valves whose inner surfaces join on a line running parallel to, and only a short distance from, the outer margins, to form a single cavity, the enclosing body having a convex 'bellows' outline in cross-section. Wall unstratified, thin (0.5 to 1μm), surface smooth.

Remarks: The 'aperture' shows a distinct tendency to open out so that the two halves are joined only at the extremity. This differs from the type which appears to open only about half way.

ANTHOPHYTA

MONOCOLPATE POLLEN

Genus **Arecipites** Wodehouse, emend. Nichols & others 1973

Type species: *Arecipites punctatus* Wodehouse 1933

Arecipites spp. (Figure 47)

Dimensions: Length - 39(45)53μm, Width - 19(25)31μm (8 specimens).

Remarks: Specimens show distinctively stratified exines, long colpae, and fine reticulate to puncto-reticulate ornaments.

TRICOLPATE POLLEN

Genus **Beaupreaidites** Cookson 1950

Type species: *Beaupreaidites elegansiformis* Cookson 1950

Beaupreaidites verrucosus Cookson 1950 (Figure 48)

Dimensions: Equatorial diameter - 45, 48μm (2 specimens).

Remarks: The thickenings are not as pronounced as on the type material. The specimens equate most favourably with material of the species from the Brunner Coal Measures (Dry River, Takaka, New Zealand; middle to late Eocene) described by Pocknall & Crosbie (1988, page 320, plate XII, 5 and 6) as perforate.

Genus **Gothanipollis** Krutzsch 1959

Type species: *Gothanipollis gothanii* Krutzsch 1959

Gothanipollis bassensis Stover *in* Stover & Partridge 1973 (Figure 49)

Dimensions: Equatorial diameter - 15(19)23μm (4 specimens).

Gothanipollis sp. A (Figure 50)

Dimensions: Equatorial diameter - 15μm (1 specimen).

Remarks: The specimen is convexly triangular with protruding bulbous apical extensions. The exine is about 0.5μm thick and appears psilate, but is obscured by a crowded verrucate coating (perispore?) which is partially unattached from the spore body (through damage).

Genus **Myrtaceidites** Cookson & Pike ex Potonié 1960

Type species: *Myrtaceidites mesonesus* Cookson & Pike designated by Potonié, 1960.

Myrtaceidites mesonesus Cookson & Pike 1954 (Figure 51)

1972 *Myrtaceidites* sp. aff. *M. cugeniioides* Cookson & Pike 1954; Hekel, p.14, pl.4 fig.14.
1982 *Myrtaceidites mesonesus* Cookson & Pike 1954; Foster, p.2, pl.2 fig.3, pl.4 fig.4.

Dimensions: Equatorial diameter - 13(22)28μm (10 specimens).

Remarks: Some of the specimens show a tendency to thickening around the apices, but these thickenings are not as prominent as in *M. eucalyptoides*.

Myrtaceidites eugeniioides Cookson & Pike 1954 (Figure 52)

Dimensions: Equatorial diameter - 14(17)22μm (6 specimens).

Myrtaceidites eucalyptoides Cookson & Pike 1954 (Figure 53)

1972 *Myrtaceidites eucalyptoides* Cookson & Pike 1954; Hekel, p.14, pl.4 fig.5.
1982 *Myrtaceidites eucalyptoides* Cookson & Pike 1954; Dudgeon, p.98, pl.2 fig.11.

Dimensions: Equatorial diameter - 17(21)26μm (7 specimens).

Myrtaceidites rhodamnoides Martin 1973 (Figure 54)

Dimensions: Equatorial diameter - 12(15)22μm (5 specimens).

Remarks: The longicolpate apertures and granular ornament are characteristic of this species.

Myrtaceidites verrucosus Partridge *in* Stover & Partridge 1973 (Figure 55)

1972 *Beaupreaidites* sp.; Hekel, p.15, pl.4, fig.10.
1986 *Myrtaceidites verrucosus* Partridge *in* Stover & Partridge 1973; Wood, p.8, fig.6.2.

Dimensions: Equatorial diameter- 26(30)34μm (10 specimens).

Remarks: The size range is greater than for the material from Bass Strait (12(18)26μm) (Stover & Partridge, 1973) and the ornamentation appears to be generally finer. The specimen from Waterpark Creek figured by Hekel as *Beaupreaidites* sp., at 19μm, conforms to the average size range of the material from Bass Strait, whereas that from Sandy Cape figured by Wood is marginal (27μm). The original diagnosis includes considerable variation, and thus all specimens observed at Mount Coolon/Riverside conform readily to the species.

Myrtaceidites gloriosus sp. nov. (Figure 56)

1972 *Cupanieidites orthotheichus* Cookson & Pike 1954; Hekel (partim.), p.14, pl.4 fig.7.

Dimensions: Equatorial diameter - 13(20)23μm (22 specimens).

Description: Tricolpate pollen, bi-convex, in polar view sub-triangular convex, rounded angle with protruding apices. Parasyncolpate with arcuate to angular colpi, arci distinct. Exine two-layered, endexine thin, smooth, thickening at the apices to form a thickened convex floor; ektexine thin, ornamented, protruding at the apices to form a notched vestibule, a thin roof and unthickened tapering exopore margins. Ornament irregularly rugulate/reticulate confined to the ant-apertural equatorial regions.

Derivation of name: Gloriosus (ostentatious) - latin.

Holotype: B301-3, 12.4, 115.4, Q859.

Remarks: The ornament of *M. gloriosus* sp. nov. is particularly characteristic.

Distribution: Suttor Formation in GSQ Mount Coolon 6.

Affinity: Myrtaceae.

Genus **Tricolpites** Cookson ex Couper 1953

Type species: *Tricolpites reticulatus* Cookson 1947; designated by Couper (1953, p.61)

Tricolpites bathyreticulatus Stanley 1965 (Figure 57)

Dimensions: Equatorial diameter - 26μm (1 specimen).

Remarks: The thin exine, irregular lumina 1 to 2μm in diameter, and thin muri (<0.5μm in width) are characteristic of this species.

Tricolpites latispinosus McIntyre 1965 (Figure 58)

Dimensions: Equatorial diameter - 43μm (1 specimen).

Remarks: The spines on this specimen are not as dense as on New Zealand representatives of the species (McIntyre, 1965).

Tricolpites sp. cf. ***T. phillipsii*** Stover *in* Stover & Partridge 1973 (Figure 59)

Dimensions: Equatorial diameter - 29μm (1 specimen).

Remarks: The amb is slightly more triangular than on *T. phillipsii* and the apertures more prominent. The ornament also appears to be slightly finer.

Tricolpites reticulatus Cookson 1947 (Figure 60)

Dimensions: Equatorial diameter - 31μm (1 specimen).

Tricolpites sp. A (Figure 61)

Dimensions: Equatorial diameter - 21(22)25μm (3 specimens).

Description: Radiosymmetric, isopolar, peroblate; amb circular, sides convex. Colpi short, straight, well defined. Exine thin interaperturally, nexine thickness - 0.5μm, sexine thickness - 0.5μm, thickening towards the aperture to > 1μm, to form a margo-like colpal margin. Ornament scabrate.

Remarks: *Tricolpites* sp. A differs from *Tricolpites* sp. B by being peroblate, smaller, more rounded, and with less prominent apertures.

Tricolpites sp. B (Figure 62)

Dimensions: Equatorial diameter - 32μm (1 specimen), colpal length - 9μm.

Description: Radiosymmetric, isopolar, oblate; amb circular, sides convex protruding in the interapertural region, and marginal to the colpi, which appear partially aspidate. Colpi moderately short, partially gaping, straight, with a moderately ragged margin. Exine thin aperturally; nexine thickness - 0.5μm, thinning slightly towards the apertures, to 0.3μm, continuing across the apertural cavity; sexine thickness - 0.6μm, thickening abruptly to 2.5μm to form a margo-like colpal margin. Ornament scabrate to finely granulate.

Remarks: *Tricolpites* sp. B differs from *T. confessus* Stover *in* Stover & Partridge 1973 by being larger, having shorter colpi with more ragged edges, and by possessing a characteristic thickened aspidate colpal margo.

Tricolpites sp. C (Figure 63)

Dimension: Equatorial diameter - 20μm (1 specimen).

Description: Radiosymmetric, isopolar; amb circular, sides convex; tricolpate, colpi long reaching almost to poles, margins smooth, exine very thin, <0.5μm, structure indistinct. Ornament scabrate to finely granulate.

Remarks: *Tricolpites* sp. C differs from *T. variogranulosus* McIntyre 1965, by having a thinner exine, longer colpi, and a finer, more regular ornament.

Genus **Rousea** Srivastava 1969

Type species: *Rousea subtilus* Srivastava 1969

Rousea sp. A (Figure 64)

Dimensions: Equatorial diameter - 27μm (1 specimen).

Description: Radiosymmetric, isopolar; amb triangular, convex tricolpate, colpi moderately long, reaching halfway to the poles, margins smooth exine thin, <1μm in thickness, structure indistinct. Nexine thin, sexine - 0.5 to 1.0μm in interapertural regions with a coarse reticulum. Lumina rounded to quadrate, around 1μm in diameter, muri straight, from 0.5 to 1μm wide, 0.5μm high, appearing verrucate to baculate in cross-section. The ornament becomes rapidly finer towards the colpi and the apocolpial regions.

Rousea sp. B (Figure 65)

Dimensions: Equatorial diameter- 25μm (1 specimen).

Description: Radiosymmetric, isopolar; amb subtriangular, rounded; tricolpate, colpi moderately long, reaching two-thirds to poles, margins ragged, gaping, bordering a wide nexinal valley. Exine thin, <1μm in thickness, tapering towards the colpate margins. Nexinal body indistinct, psilate. Sexine reticulate to puncto-reticulate, lumina/puncta <0.5μm wide, decreasing towards the colpi and the apocolpal regions.

Rousea sp. C (Figure 66)

Dimensions: Equatorial diameter - 25μm (1 specimen).

Description: Radiosymmetric, isopolar; amb subtriangular, rounded; tricolpate, colpi long, distinct elliptical, each bordered by a wide, distinct margo, outlining a wide nexinal valley. Exine <1μm in thickness, tapering towards the margo, which is wide but thins equatorially, and towards the apocolpia. Nexinal body thin, distinct, psilate. Sexinal ornament reticulate, lumina about 0.5μm wide in the interapertural regions, reducing to <0.5μm towards the colpi and the apocolpia.

Genus **Striatopollis** Krutzsch 1959

Type species: *Striatopollis sarstedtensis* Krutzsch 1969

Striatopollis sp. A (Figure 67)

Dimensions: Equatorial diameter - 20μm (1 specimen); exine thickness - 1μm.

Remarks: The specimen is subrounded in equatorial view, with long slit-like straight colpi and a fine, even striate ornament. The nexine is thin, continuous, while the sexine tapers towards the colpate margins. It differs from other striate species by having a very fine ornament. *Tricolpites* sp. S (Foster, 1982, page 3, plate 2 figure 8) is larger, with a coarser ornament and simple, ragged colpi.

Genus **Perfotricolpites** Gonzalez Guzman 1967

Type species: *Perfotricolpites digitatus* Gonzalez Guzman 1967

Perfotricolpites digitatus Gonzalez Guzman 1967 (Figure 68)

1986 *Perfotricolpites digitatus* Gonzalez Guzman 1967; Wood, p.4, fig.6.9.

Dimensions: Equatorial axis - 27 (44)55μm (21 specimens); polar axis - 34(59)72μm (19 specimens); exine thickness - 1.5(4.0)4.5μm (21 specimens).

Remarks: The specimens conform to the diagnosis of Gonzalez Guzman (1967) and most equate to the size range of the species as discussed by Wood (1986) for Australian specimens, with a few specimens falling below the lower limits observed elsewhere.

POLYCOLPATE POLLEN

Genus **Phimopollenites** Dettmann 1973

Type species: *Phimopollenites pannosus* (Dettmann & Playford) Dettmann 1973

?Phimopollenites pannosus (Dettmann & Playford) Dettmann 1973 (Figure 69)

Dimensions: Equatorial diameter - 26(27)28μm (3 specimens).

Remarks: The poorly preserved specimens show a generally circular amb, a structured exine, and four, unevenly placed, short colpi with irregular margins. Ornamentation ranges from scabrate to finely reticulate. They are similar to *T. pannosus* by bearing four short gaping colpi.

Genus **Polycolpites** Couper 1953

Type species: *Polycolpites clavatus* Couper 1953

Polycolpites esobalteus McIntyre 1968 (Figure 70)

1982 *Polycolpites esobalteus* McIntyre 1968; Foster, p.2, pl.3 fig.3, pl.5 fig.10.

Dimensions: Equatorial diameter - 19(22)24μm (4 specimens).

Polycolpites sp. A (Figure 71)

Dimensions: Polar diameter - 25μm, equatorial diameter - 19(23)26μm (2 specimens).

Description: Irregularly radiosymmetric, isopolar; subprolate to spheroid, amb more or less circular, sides convex; twelve long colpi, reaching almost to poles, margins straight; exine 1μm at equator tapering slightly towards colpate margins, thickening abruptly to 2μm about 5μm from colpate extremities to form a 'crown-like' thickening; exine thin in polar regions, psilate.

Remarks: The thickened exine near the poles distinguishes the specimens from those described by Truswell & others (1984, page 286, figure 7U,V) as *Polycolpites* sp.

Polycolpites sp. B (Figure 72)

Dimensions: 21.5x13.5μm (1 specimen).

Remarks: The rectangular form of this specimen may be a compactional effect. It differs, however, from *P. esobalteus* by its thick exine (2μm).

Genus **Nothofagidites** Erdtman ex Potonié 1960

Type species: *Nothofagidites flemingii* Couper 1953

Nothofagidites asperus (Cookson) Stover & Evans 1973 (Figure 73)

1982 *Nothofagus aspera Cookson* 1959; Dudgeon, p.99, pl. 2 fig.13.
1986 *Nothofagidites asperus* (Cookson) Stover & Evans 1973; Wood, p.8, fig.10.5.

Dimensions: Equatorial diameter - 34(42)49μm (9 specimens).

Nothofagidites brachyspinulosus (Cookson) Harris 1965 Figure 74

1972 *Nothofagidites* sp. aff. *N. brachyspinulosus* (Cookson) Harris, 1965; Hekel, p.10, pl.6 fig.13.
1982 *Nothofagidites brachyspinulosus* (Cookson) Harris, 1965; Foster, p.2, pl.10 fig.3.

Dimensions: Equatorial diameter - 21(22)25μm; colpi - 5 to 7, depth - 1.5 to 3μm; exine thickness - 1 to 2μm (4 specimens).

Nothofagidites deminutus (Cookson) Stover & Evans 1973 (Figure 75)

1972 *Nothofagidites* sp. 2 (partim.); Hekel, p.11, pl.6 figs 4,5.

Dimensions: Equatorial diameter - 25μm (1 specimen), colpi -7, depth - 3μm; exine thickness - 1.5 μm.

Nothofagidites emarcidus (Cookson) Harris 1966 (Figure 76)

1972 *Nothofagidites* sp.1; Hekel, p.10, pl.6 fig.14.
1972 *Nothofagidites suggatei* (Couper) Hekel 1972; Hekel, p.10, pl.6 fig.12.
1972 *Nothofagidites astra* (Couper) Hekel 1972; Hekel, p.10, pl.6 fig.2.
1972 *Nothofagidites mataurensis* (Couper) Hekel 1972; Hekel, p.11, pl.6 figs 1, 3 and 6.
?1972 *Nothofagidites* sp.3; Hekel, p.11, pl.6 fig.11.
1982 *Nothofagus emarcida* Cookson 1959; Dudgeon, p.99, pl.3 fig.1.
1982 *Nothofagidites emarcidus* (Cookson) Harris 1965; Foster, p.2, pl.12 fig.2.
1986 *Nothofagidites emarcidus* (Cookson) Stover & Evans 1973; Wood (incorrect citation), p.8, fig.10.4.

Dimensions: Equatorial diameter - 21(25)31μm (20 specimens); colpi - 5 to 8, depth - 3(3.5)6.5μm; exine thickness - 0.5μm.

Nothofagidites falcatus (Cookson) Hekel 1972 (Figure 77)

1972 *Nothofagidites falcata* (Cookson) Hekel 1972; Hekel, p.11, pl.6 fig.15.
1972 *Nothofagidites* sp.2 (partim.); Hekel, p.11, pl.6 figs 9, 10.

Dimensions: Equatorial diameter - 18(25)29μm; Colpi - 5 to 7, depth - 2.0(4.0)7.0μm; exine thickness - 0.5(1.0)2.0μm (21 specimens).

Nothofagidites incrassatus (Cookson) Tulip, Taylor & Truswell 1982 (Figure 78)

Dimensions: Equatorial diameter - 21(25)30μm; colpi - 6 to 7, depth - 2.0(3.0)5.5μm; exine thickness - 1.0 to 1.5μm (5 specimens).

TRICOLPORATE POLLEN

Genus **Cupanieidites** Cookson & Pike 1954

Type species: *Cupanieidites major* Cookson & Pike 1954, by subsequent designation (Krutzsch,1959).

Cupanieidites orthoteichus Cookson & Pike 1974 (Figure 79)

1972 *Cupaniedities orthotheichus* Cookson & Pike 1954; Hekel (partim.), p. 14, pl.4 fig. 8 and 13 (orthographic error in generic and specific names).

1982 *Cupanieidites orthoteichus* Cookson & Pike 1954; Foster, p.2, pl.2 fig.7.

1986 *Cupanieidites orthoteichus* Cookson & Pike 1954; Wood, p.7, fig.6.5.

Dimensions: Equatorial diameter - 18(23)27µm (10 specimens); exine thickness - 1 to 2µm; polar island variable from absent to 6µm.

Cupanieidites reticularis Cookson & Pike 1954 (Figure 80)

Dimensions: Equatorial diameter - 23(25)28µm (5 specimens); exine thickness -1 to 2µm; polar island variable from absent to 5µm.

Cupanieidites sp. A (Figure 81)

1982 *Cupanieidites* sp. A; Foster, p.2, pl.2 fig.12.

Dimensions: Equatorial diameter - 25(27)29µm; exine thickness - 1µm, nexine thickness - 0.5µm, sexine thickness - 0.5µm; polar island - 3 to 11µm (5 specimens).

Description: Radiosymmetric, isopolar, amb subcircular to subtriangular, tricolporate, apertures incurved; arci faint to distinct, continuous, parasyncolpate, polar islands variable; exine clearly stratified, sexine equal to or greater in thickness than nexine; sexine with prominent striate to dendritic ridged ornament running more or less polar, most pronounced in antapertural equatorial regions.

Remarks: The specimens are all degraded, which makes the species difficult to define. Foster's specimen is more triangular.

Cupanieidites sp. B (Figure 82)

Dimensions: Equatorial diameter - 27µm (1 specimen).

Remarks: The specimen exhibits a particularly fine reticulum which tends to be very uniform over the pollen surface, somewhat reminiscent of Cookson & Pike's description of *C. major*.

Cupanieidites sp. C (Figure 83)

Dimensions: Equatorial diameter - 30µm (1 specimen); exine thickness - 3µ; nexine 1µm, sexine - 2µm.

Description: Radiosymmetric, isopolar, amb triangular sides slightly convex, tricolporate?; arci prominant, parasyncolpate, arcuate; exine thick, stratified, sexine greater in thickness than nexine; sexine ornament reticulate.

Remarks: The thickness of the sexine is characteristic, but it tends to obscure the finer pollen features.

Genus **Margocolporites** Ramanujam ex Srivastava 1969

Type species: *Margocolporites tsukodai* Ramanujam 1966 by subsequent designation of Srivastava, 1969.

Margocolporites woodii sp. nov. (Figure 84)

1982 *Margocolporites vanwijhei* Germeraad, Hopping & Muller 1968; Pocknall, p.266, figs 8 and 9.

1982 *Margocolporites* sp.; Foster (partim), p.2, pl.3 fig.5.

1986 *Margocolporites tricuneatus* Playford 1982; Wood, p.7, fig.6.6.

Dimensions: Equatorial diameter - 34(36)40µm (6 specimens).

Description: Isopolar, oblate, subcircular to slightly angular in polar view, 3-zonimargocolporate; each margocolpus prominent, wide, tapering to a rounded apex before the pole; colpi short; margocolpi bordered by laevigate costa, varying from 1.5 to 2.5µm wide equatorially to 1.0 to 2.0µm wide near the poles, and 0.5 to 2.0µm high; exine 2 to 3µm thick, nexine 1/5 to 1/3 the thickness of the sexine. Surfaces of margocolpi densely baculate/reticulate, elsewhere reticulate, muri 0.5μm wide, lumina irregular, 0.5 to 1μm in width.

Derivation of name: Mr Geoffrey Wood, Santos Limited.

Holotype: A913-3, 4.8 101.9, Q175, (Wood, 1986, figure 6.6).

Remarks: Wood (1986) assigned his specimen (herein chosen as the holotype) to *M. tricuneatus* Playford, 1982. *M. woodii* differs from the New Guinea species by being smaller, with less pronounced costa, and a coarser reticulate ornament on the mesocolpia. It differs from *M. vanwijhei* Germeraad, Hopping & Muller 1968, the latter having margocolpi that are angular or interconnected at the poles, and variable sized reticula on the mesocolpia and apocolpia.

Distribution: Late Oligocene to early Miocene sediments at Sandy Cape (Wood, 1986); Suttor Formation in GSQ Mount Coolon 5 and 6, and Suttor Formation equivalents at Riverside Mine, (this paper).

Affinity: According to Germeraad & others (1968), the genus is related to the Caesalpineaceae.

Genus **Simpsonipollis** Srivastava 1975

Type species: *Simpsonipollis mullensis* (Simpson) ex Srivastava 1975.

Simpsonipollis sp. A (Figure 85)

Dimensions: Equatorial diameter - 17(21)26μm, polar diameter - 21(24)27μm (4 specimens).

Description: Radiosymmetric, isopolar, prolate, tricolporate; colpi wide with costate margins, pores equatorial, distinct, narrow, lalongate; exine striate ?reticulate, fine, longitudinally elongated.

Genus **Ilexpollenites** Thiergart ex Potoni)) 1960

Type species: *Ilexpollenites iliacus* Potoni)) 1960.

Ilexpollenites anguloclavatus McIntyre 1968 (Figure 86)

Dimensions: Diameter, equatorial - 25(26)28μm, polar - 29(33)35μm(4 specimens).

Ilexpollenites megagemmatus McIntyre 1968 (Figure 87)

Dimensions: Equatorial diameter - 25μm (1 specimen).

Genus **Tricolporites** Cookson 1947

Type species: *Tricolporites prolata* Cookson 1947

Tricolporites prolata Cookson 1947 (Figure 88)

Dimensions: Diameter, equatorial - 21(23)26μm, polar - 27(36)41μm (4 specimens).

Tricolporites retequetrus Partridge *in* Stover & Partridge 1973 (Figure 89)

Dimensions: Diameter, equatorial - 31(34)36μm (4 specimens), polar - 40μm (1 specimen); tetrad width - 57μm (polar diameters in tetrad - 31μm).

Genus **Rhoipites** Wodehouse 1933

Type species: *Rhoipites bradleyi* Wodehouse 1933.

Rhoipites microreticulatus (Harris) Wood 1986 (Figure 90)

1972 *'Tricolporites' microreticulatus* Harris 1965; Hekel, p.12, pl.3 figs 7 and 8.
1973 *Tricolporopollenites cooksonii* Martin 1973; p.41, figs 179-181.
1986 *Rhoipites microreticulatus* (Harris) Wood 1986; p.8, fig.6.8.
1986 *Rhoipites cooksonae* (Martin) Wood 1986; p.8, fig.7.2.

Dimensions: Diameter, equatorial - 14(20)28μm, polar - 20(29)45μm (29 specimens).

Remarks: Specimens conforming to the definitions of *R. microreticulatus* and R. *cooksonae* occur in all samples from Mount Coolon. However, many specimens also occur which overlap the boundaries between the two species, and cannot be assigned easily to either. In this paper the two are combined.

Rhoipites alveolatus (Couper) Pocknall & Crosbie, 1982 (Figure 91)

1972 *Tricolpites* sp. 1; Hekel, p.9, pl.4 figs 26 and 27.
1972 *Tricolporites* sp.1; Hekel, p.12, pl.4 fig.29.
?1982 *Margocolporites* sp. (partim) Foster, p.2, pl.10 fig.6.
?1982 *Tricolpites alveolatus* Couper 1953; Foster, p.3, pl.4 fig.5.

Dimensions: Diameter, equatorial - 32, 34, 39μm(3 specimens), polar- 41μm(1 specimen).

Rhoipites sp. A (Figure 92)

Dimensions: Diameter, equatorial - 19 to 34μm, polar - 25 to 29μm (9 specimens).

Remarks: Mostly polar views of what appears to be a subprolate to spherical form of *Rhoipites* with a coarse retipilate ornament, and moderately long colpi.

Rhoipites sp. B (Figure 93)

Dimensions: Equatorial diameter - 34μm (1 specimen).

Remarks: This specimen differs from *Rhoipites* sp. A by having short colpi and a finer retipilate ornament.

Genus **Palaeocoprosmadites** Ramanujam 1966

Type species: *Palaeocoprosmadites arcotense* Ramanujam 1966

?***Palaeocoprosmadites*** spp. (Figure 94)

Dimensions: Equatorial diameter - 17, 24μm (2 specimens).

Remarks: Various specimens of oblate tricolporate forms are present with short colpi and associated folds similar to those described for the genus. Equatorial outline can vary, with ornament commonly varying between scabrate/granulate and psilate.

POLYCOLPORATE POLLEN

Genus **Sapotaceoidaepollenites** Potonié, Thomson & Thiergart ex Potonié 1960

Type species: *Sapotaceiodaepollenites manifestus* (Potonié Potonié 1960.

Sapotaceoidaepollenites rotundus Harris 1972 (Figure 95)

1982 *Sapotaceiodaepollenites rotundus* Harris 1972; Foster, p.3, pl.5 fig2.
1986 *Sapotaceoidaepollenites rotundus* Harris 1972; Wood, p.8 fig.7.4.

Dimensions: Diameter, equatorial- 25(29)30μm, polar - 37(38)40μm (3 specimens).

Sapotaceoidaepollenites sp. A (Figure 96)

1972 *Santaluminidites cainozoicus* Cookson & Pike, 1954; Hekel, p.17, pl.5 figs 10 and 11 (orthographic error in generic epithet).
1982 *Santalumidites cainozoicus* Cookson & Pike, 1954; Foster, p.3, pl.2 figs 4 and 5, pl.5 fig3.

Dimensions: Diameter, equatorial - 14(17)19μm, polar - 22(23)26μm (5 samples).

Genus **Pentadesmapites** Ramanujam, Reddy & Sarma 1985

Type species: *Pentadesmapites neyveliensis* Ramanujam, Reddy & Sarma 1985.

Pentadesmapites sp. A (Figure 97)

Dimensions: Equatorial diameter - 26μm (1 specimen), exine thickness - 2μm.

Description: Pollen tetracolporate, angulaperturate, oblate; colpi long, pointed; ora distinct; exine thick, nexine greater than sexine; sexine psilate.

Remarks: The specimen differs from the type species by being considerably smaller and having thinner walls. The shape of the ora is unknown. The specimen shows some similarities with *Tetracolporites oamaruensis* Couper 1953.

Genus **Jandufouria** Germeraad, Hopping & Muller 1968

Type species: *Jandufouria seamrogiformis* Germeraad, Hopping & Muller 1968.

Jandufouria sp. A (Figure 98)

Dimensions: Equatorial diameter - 29μm (1 specimen).

Description: Single grain, radiosymmetrical, isopolar, oblate, mildly fossaperturate; 4-colporate, colpi about 20μm long extending almost to the poles to form a rectangular apocolpial region; marginate, with slightly sinuous margins and pointed ends, margines 2.5μm wide, prominent in the equatorial regions and thinning towards the apocolpia; apertures obscure. Exine tectate, nexine < 0.5μm in thickness, sexine 1.5μm in thickness, thinning towards the colpi, with a fine reticulate ornament.

Remarks: The genus is described from British Guyana, where it occurs from the base of the *Polypodiisporites usmensis* Zone upwards.

BIPORATE POLLEN

Genus **Banksieaeidites** Cookson ex Couper 1954

Type species: *Banksieaeidites elongatus* Cookson 1950, by subsequent designation, Couper, 1954.

Banksieaeidites arcuatus Stover *in* Stover & Partridge 1973 (Figure 99)

1982 *Banksieaeidites arcuatus* Stover *in* Stover & Partridge 1973; Foster, p.2, pl.11 fig.3.
1986 *Banksieaeidites arcuatus* Stover *in* Stover & Partridge 1973; Wood, p.7, fig.8.2.

Dimensions: Diameter, equatorial - 21(23)27μm , polar - 10(14)16μm(9 specimens).

TRIPORATE POLLEN

Genus **Proteacidites** Cookson ex Couper, 1953 emend. Martin & Harris 1974

Type species: *Proteacidites adenanthoides* Cookson 1950.

Proteacidites sp. cf. ***P. differentipolus*** Dudgeon 1983 (Figure 100)

Dimensions: Equatorial diameter - 38μm (1 specimen).

Remarks: The specimen superficially resembles *P. differentipolus* Dudgeon 1983, but the reticulum is fine on both poles, and remains coarse towards the apertures. There is also a similarity with *P. kopiensis* as figured by Dudgeon (1983, page 353, figure 14), particularly with regard to size and coarseness of ornament, but without the fining of the reticulum in the apertural areas.

Proteacidites kopiensis Harris 1972 (Figure 101)

1982 *Proteacidites* sp. cf. *P. kopiensis* Harris 1972; Foster, p.3, pl.8 fig.2.
1983 *Proteacidites kopiensis* Harris 1972; Dudgeon, p.353, fig.14.
1986 *Proteacidites kopiensis* Harris 1972; Wood, p.8, fig.8.9.

Dimensions: Equatorial diameter - 31, 39μm (2 specimens).

Remarks: Variations in size and regularity of the reticulum, both in the interapertural / equatorial areas and elsewhere, are consistent with those observed in other occurrences of the species as presently recognised.

Proteacidites pachypolus Cookson & Pike 1954 (Figure 102)

1972 *Proteacidites pachypolus* Cookson & Pike 1954; Hekel, p.16, pl.5 fig.12.
1982 *Proteacidites pachypolus* Cookson & Pike 1954; Foster, p.3, pl.4 fig.1.
1982 *Proteacidites* sp. A; Foster, p.3, pl.7 fig.1.
1983 *Proteacidites pachypolus* Cookson & Pike 1954; Dudgeon, p.354, fig.16.

1986 *Proteacidites pachypolus* Cookson & Pike 1954; Wood, p.8, fig.8.10.

Dimensions: Equatorial diameter - 24(32)40µm (5 specimens).

Remarks: Specimens attributed to this species show variations in size, equatorial outline, degree and number of polar thickenings, and coarseness of reticulation.

Proteacidites simplex Dudgeon 1983 (Figure 103)

1983 *Proteacidites simplex* Dudgeon 1983; Dudgeon, p.355, fig.17.
1986 *Proteacidites simplex* Dudgeon 1983; Wood, p.8, fig.8.7.
1986 *Proteacidites subscabratus* Couper 1960; Wood, p.8, fig.8.6.

Dimensions: Equatorial diameter - 16(21)30µm (20 specimens); exine thickness - 1.0(1.5)2.0µm (11 specimens); aperture width - 1.5(2.5)5.5µm (12 specimens).

Remarks: This species has been chosen to include a range of small, foveolate to finely reticulate triporate pollen grains with straight to slightly convex equatorial margins and variable exine thicknesses and apertural openings. They are, nonetheless, simple proteaceous forms which occur rarely to commonly through the samples from Mount Coolon, and conform, more or less, to Dudgeon's description of simple forms from Yaamba.

Proteacidites sinulatus Dudgeon 1983 (Figure 104)

1982 *Proteacidites* sp. cf. *P. reflexus* Partridge *in* Stover & Partridge 1973; Foster, p.3, pl.7 fig.7.
1983 *Proteacidites sinulatus* Dudgeon 1983; Dudgeon, p.355, fig.18.

Dimensions: Equatorial diameter - 24(25)26µm (4 specimens).

Remarks: Specimens show considerable variation, but retain the distinctive interadial exinal thickenings characteristic of the species.

Proteacidites symphyonemoides Cookson, 1950 (Figure 105)

Dimensions: Equatorial diameter - 23(30)37µm (10 specimens).

Proteacidites variambitus Dudgeon 1983 (Figure 106)

1972 *Proteacidites* sp.1; Hekel, p.16, pl.5 figs 14 and 15.
1982 *Proteacidites crassus* Cookson 1950; Foster, p.3, pl.8 fig.3.
1982 *Proteacidites kopiensis* Harris 1972; Foster, p.3, pl.10 fig.10.
1982 *Proteacidites* sp.C; Foster, p.3, pl.8 fig.4.
1983 *Proteacidites variambitus* Dudgeon 1983; Dudgeon, p.357, fig.19.
1986 *Proteacidites variambitus* Dudgeon 1983; Wood, p.8, fig.8.11.

Dimensions: Equatorial diameter - 30(30)31µm (3 specimens).

Remarks: The specimens from Mount Coolon grouped in this species equate to the lower size range of those described by Dudgeon, but the ornamentation pattern conforms to Dudgeon's diagnosis.

Proteacidites sp. A (Figure 107)

Dimensions: Equatorial diameter - 28(33)40µm (9 specimens).

Description: Pollen triporate, sculpture isopolar, amb triangular, sides moderately concave to straight, apices truncate, ragged; pores circular, 3 to 4µm in diameter, with entire margins. Exine stratified, 2µm in thickness, sexine roughly equal to nexine.

Sexine tectate, reticulate, columellate layer about 0.5µm in thickness. Reticulum retipilate, moderately coarse and irregular, lumina large, 1 to 3µm wide, becoming slightly smaller at apices; muri narrow and convolute, about 0.5µm inter-radially.

Remarks: *Proteacidites* sp. A is similar to the *P. grandis* Cookson, 1950, *P. dilwynensis* Harris, 1965, *P. leightonii* Stover *in* Stover & Partridge, 1973, *P. ornatus* Harris, 1965, *P. reticulatus* Cookson, 1950, group by being coarsely reticulate and having truncated apertures. It differs by being smaller, the nearest in size being *P. reticulatus*, which has a much coarser ornament.

Proteacidites sp. B (Figure 108)

Dimensions: Equatorial diameter - 26(28)30µm (9 specimens).

Description: Pollen triporate, sculpture isopolar, amb triangular, sides moderately concave to straight, apices bluntly rounded; pores circular, 2 to 3.5µm in diameter, with entire margins; exine stratified, 2.2µm in thickness, sexine less than half nexine; sexine tectate, reticulate; columellar layer indistinct; reticulum regular, fine, lumina small up to 1µm wide, muri $<$ 0.5µm in thickness.

Remarks: *Proteacidites* sp. B differs from *P. variambitus* by having a finer, more evenly distributed ornament, and a greatly thickened nexinal layer.

Proteacidites sp. C (Figure 109)

Dimensions: Equatorial diameter - 15(20)24µm (6 specimens).

Description: Pollen triporate, sculpture isopolar, and triangular, sides straight to concave, apices truncate to rounded; Pores circular, 2.0 to 3.5µm in diameter, margins slightly to moderately tapered. Exine stratified, 1.0 to 1.5µm in thickness, sexine equal to nexine. Sexine scabrate to psilate, columellar layer absent.

Remarks: I have grouped in this species all simple unornamented forms of *Proteacidites* observed at Mount Coolon/Riverside.

Proteacidites sp. D (Figure 110)

Dimensions: Equatorial diameter - 30µm (1 specimen).

Description: Pollen triporate, sculpture isopolar, amb triangular convex, apices rounded; pores circular, 3.5µm in diameter; exine stratified, 2µm in thickness, sexine less than nexine, tectate, coarsely retipilate. Columellar layer thin. Reticulum comprises pila / bacula / granula, about 0.5µm in width, forming an irregular mesh with lumina up to 2.0µm in width. The ornament is loosely arranged, appearing almost irregularly distributed.

Remarks: The specimen is characterised by its loosely arranged retipilate / granulate ornament. It is distinguished from *P. confragosus* Harris, 1972 by its smaller size, thinner exine, and less dense ornament.

Proteacidites sp. E (Figure 111)

1982 *Proteacidites* sp. D; Foster, p.3, pl.9 fig.1.

Dimensions: Equatorial diameter - 44µm (1 specimen).

Description: Pollen triporate, sculpture isopolar, amb triangular convex, 5µm in diameter; exine stratified, 2µm in thickness, sexine equal in thickness to nexine. Sexine tectate, coarsely foveolate; columellar layer indistinct; foveolae are generally < 0.5µm wide, but crowded, creating a regular reticulum with muri about 1.0µm wide.

Remarks: The specimen is differentiated from *P. simplex* by having coarser, more crowded foveolae and by being larger.

Proteacidites sp. F (Figure 112)

Dimensions: Equatorial diameter - 46, 47µm (2 specimens).

Description: Pollen triporate, sculpture isopolar, amb triangular convex, apices rounded; pores circular, 9µm in diameter; exine stratified, 2µm in thickness; sexine finely but densely granulate.

Remarks: *Proteacidites* sp. F ressembles *Proteacidites sp. cf. P. incurvatus*, but has an even coverage of granula.

Proteacidites sp. G (Figure 113)

Dimensions: Equatorial diameter - 40µm(1 specimen), nexine thickness - 1.5µm, sexine thickness - 0.5µm; aperture width - 10µm.

Remarks: The specimen is smaller than those described by Cookson (1950), Harris (1965) and Stover & Partridge (1972) as *P. curvatus* Cookson 1950.

Proteacidites sp. H (Figure 114)

Dimensions: Equatorial diameter - 44µm (1 specimen); nexine thickness - 1.5µm, sexine thickness - 0.5µm; aperture width - 4.5µm.

Remarks: The specimen is similar to *P.* sp. G, described above, in containing a loose, irregular retipilate ornamentation, but differs by having a convex equatorial margin.

Genus **Propylipollis** Martin & Harris 1974

Type species: *Propylipollis reticuloscabratus* (Harris) Martin & Harris 1974

Propylipollis annularis (Cookson) Martin & Harris 1974 (Figure 115)

1972 *Proteacidites* sp. aff. *P. annularis* Cookson 1950; Hekel, p.16, pl.5, fig.18.
1983 *Propylipollis* sp. cf. *P. annularis* (Cookson) Martin & Harris 1974; Dudgeon, p.345, fig.6.

Remarks: The specimens grouped herein in this species show considerable variation. Some are indistinguishable from those described by Cookson (Figure 115a), while others ressemble those described by Dudgeon (Figure 115b) who suggested that such variations may warrant separation.

Propylipollis concretus (Harris) Martin & Harris 1974 (Figure 116)

1986 *Propylipollis crassimarginus* Dudgeon 1983; Wood, p.8, fig.8.4.

Dimensions: Equatorial diameter - 18(22)26μm (5 specimens).

Remarks: The specimens are smaller than those described by Harris (1972, page 58, figures 48 and 49:-25(28)32μm).

Propylipollis crassimarginus Dudgeon 1983 (Figure 117)

1983 *Propylipollis crassimarginus* Dudgeon, 1983; p.347, fig.8.

Dimensions: Equatorial diameter - 21μm (1 specimen).

Propylipollis intricatus Dudgeon 1983 (Figure 118)

1983 *Propylipollis intricatus* Dudgeon 1983; p.347, fig.9.

Dimensions: Equatorial diameter - 39(43)50μm (9 specimens).

Remarks: The specimens differ from that figured by Dudgeon by being slightly smaller, and less robust. The sides are convex, straight, or concave with protruding apertures.

Propylipollis ivanhoensis (Martin) comb. nov. (Figure 119)

1973 *Proteacidites ivanhoensis* Martin, 1973; Martin, p.29, figs 125 to 127.

Dimensions: Equatorial diameter - 20(24)28μm (17 specimens).

Remarks: The species, originally included in *Proteacidites*, is transferred to *Propylipollis* Martin & Harris, 1974, because of its crassimarginate nature.

Propylipollis latrobensis (Harris) Martin & Harris 1974 (Figure 120)

1972 *Proteacidites latrobensis* Harris 1966; Hekel, p.16, pl.5 fig.13.
1982 *Propylipollis latrobensis* (Harris) Martin & Harris 1974; Foster, p.3, pl.9 fig.4.
1986 *Propylipollis latrobensis* (Harris) Martin & Harris 1974; Wood, p.8, fig.8.8.

Dimensions: Equatorial diameter - 24μm (1 specimen).

Propylipollis sp. cf. ***Proteacidites rectomarginus*** Cookson 1950 (Figure 121)

1983 *Propylipollis* sp. cf. *Proteacidites rectomarginus* Cookson, 1950; Dudgeon, p.349, fig.10.

Dimensions: Equatorial diameter - 38μm (1 specimen).

Propylipollis reticuloscabratus (Harris) Martin & Harris 1974 (Figure 122)

1982 *Propylipollis reticuloscabratus* Harris 1974 (incorrect citation); Dudgeon, p.99, pl.3 fig.8.
1986 *Propylipollis reticuloscabratus* (Harris) Martin & Harris 1974; Wood, p.8, fig.8.12.

Dimensions: Equatorial diameter - 21(26)33μm (4 specimens).

Remarks: Variations in equatorial profile exists, with slight aspidicity in some samples.

Propylipollis sp. cf. ***reticuloscabratus*** (Harris) Martin & Harris 1974 (Figure 123)

Dimensions: Equatorial diameter - 28μm (1 specimen).

Remarks: The specimen differs from *P. reticuloscabratus* in that the apertures protrude more strongly.

Propylipollis robustus Dudgeon 1983 (Figure 124)

1972 *Proteacidites* sp. cf. *P. minimus* Couper; Hekel, p.16, pl.5 fig.9.
1982 *Proteacidites* sp. D; Foster, p.3, pl.9 fig.1.
1983 *Propylipollis robustus* Dudgeon 1983; p.350, fig.11.
1986 *Propylipollis robustus* Dudgeon 1983; Wood, p.8, fig.8.5.

Dimensions: Equatorial diameter - 25(28)32μm (4 specimens).

Propylipollis vagexinus Dudgeon 1983 (Figure 125)

1972 *Proteacidites* sp. aff. *P. granulatus* Cookson 1953; Hekel, p.6, pl.5 fig.17.
1982 *Proteacidites* sp. H; Foster, p.3, pl.7 figs 4 to 6.

Dimensions: Equatorial diameter - 25(30)32µm (3 specimens).

Propylipollis sp. A (Figure 126)

Dimensions: Equatorial diameter - 34, 37, 38µm (3 specimens).

Description: Pollen triporate, sculpture isopolar; amb triangular, sided slightly convex, apices rounded to truncate; pores circular, 4µm in diameter, crassimarginate, with entire margins, encircled by a band of nexine 5µm wide; exine stratified, nexine about 1µm in thickness interradially, abruptly thickening to 1.5µm near pore; sexine about 0.5µm in thickness, finely granulate / reticulate.

Remarks: *Propylipollis* sp. A is characterised by its large, robust size and fine ornament.

HEXAPORATE POLLEN

Genus **Anacolosidites** Cookson & Pike 1954

Type species: *Anacolosidites luteoides* Cookson & Pike 1954; designated by Potoni) 1960.

Anacalosidites luteoides Cookson & Pike 1954 (Figure 127)

Dimensions: Equatorial diameter - 17µm (1 specimen).

Remarks: Ornament scabrate to psilate.

STEPHANOPORATE POLLEN

Genus **Haloragacidites** Couper 1953

Type species: *Haloragacidites trioratus* Couper 1953

Haloragacidites trioratus / H. harrisii / Casuarinidites cainozoicus complex (Figures 128)

Haloragacidites trioratus Couper 1953

1953 *Haloragacidites trioratus* Couper 1953; Couper, p.41, pl.5 fig.50.
1960 *Triorites harrisii* Couper 1953; Couper, p.67, pl.12 fig.3.
1971 *Haloragacidites trioratus* Couper 1953; Mildenhall & Harris, 1971, p.301, figs 1 to 5.

Haloragacidites harrisii (Couper) Mildenhall & Harris 1971

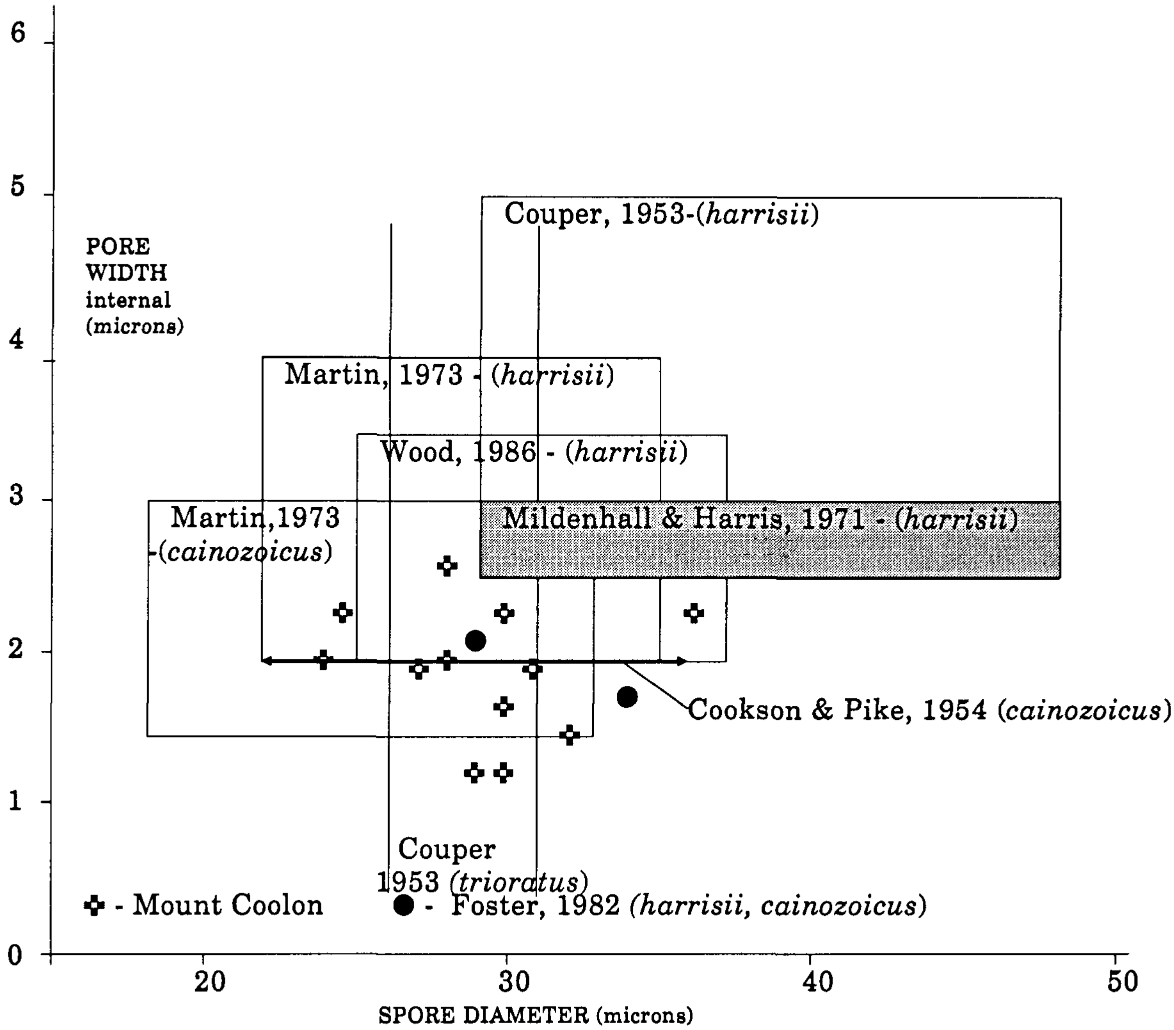
1953 *Triorites harrisii* Couper 1953; Couper, p.61, pl.7 fig.111.
1960 *Triorites harrisii* Couper 1953; Couper, p.67, pl.12 fig.2.
1971 *Haloragacidites harrisii* (Couper) Harris *in* Mildenhall & Harris 1971; Mildenhall & Harris, p.304, figs 8 to 13.
1972 *Triorites harrisii* Couper 1953; Hekel, p.17, pl.5 fig.7.
1973 *Casuarina harrisii* (Couper) Martin 1973; Martin, p.33, figs 147 and 148.
1982 *Triorites harrisii* Couper 1953; Foster, p.3, pl.4 figs 2 and 3.

Casuarinidites cainozoicus Cookson & Pike 1954

1954 *Casuarinidites cainozoicus* Cookson & Pike 1954; Cookson & Pike, p.200, pl.1 figs 1 to 3.
1972 *Casuarinidites cainozoicus* Cookson & Pike 1954; Hekel, p.15, pl.5 fig.5.
1973 *Casuarina cainozoica* (Cookson & Pike) Martin 1973; Martin, p.32, figs 145 and 146.
1982 *Casuarinidites cainozoicus* Cookson & Pike 1954; Foster, p.2, pl.11 fig.1.

Dimensions: Equatorial diameter - 25(29)36µm; pore width (internal) - 1.0(2.0)2.5µm, pore height - 1.5(3.5)5.5µm (15 specimens).

Remarks: Although originally describing *H. trioratus* and *H. harrisii* as separate species (Couper, 1953), Couper later elected to combine them (Couper, 1960). Mildenhall & Harris (1971) re-split them into separate species, at the same time placing *Casuarinidites* into synonomy with *Haloragacidites*, although not formally recombining *C. cainozoicus*. Martin (1973) discussed *H. harrisii* and *C. cainozoicus*, placing them both in *Casuarina* L. She pointed out that the differences between the species are a matter of degree, and that considerable overlap exists, suggesting the only real differences



Text figure 3. Size relationships between ***Haloragacidites trioratus*****,** ***H. harrisii*** **and** ***Casuarinidites cainozoicus*****.**

appearing to be the size of the pore opening, quoting 3 to 5µm for *H. harrisii*. These figures, presumably quoted from Couper's original diagnosis are probably misleading.

From Couper's figures, they would appear to refer to **external** dimensions, not **internal**. In fact, Mildenhall & Harris (1971) quote a pore diameter of 2.5 to 3µm. Text Figure 3 shows the relative size ranges (diameter and pore width) for *H. trioratus*, *H. harrisii* and *C. cainozoicus* from a variety of authors, and includes measurements made in this study on material from Mount Coolon / Riverside, and on Wood's original material from Sandy Cape (Wood, 1986).

The overlap depicted demonstrates that clear distinctions between any of the species are yet to be outlined.

Haloragacidites suttorensis sp. nov. (Figure 129)

1982 *Helciporites astrus auct. non* Partridge *in* Stover and Partridge; Foster, p.2, pl.5 fig.6.

Dimensions: Equatorial diameter - 18(21)25µm; number of pores - 4(6)7; pore diameter (internal) - 1.25(2.5)3.5µm; exine thickness - 0.5µm (15 specimens).

Description: Radiosymmetric, isopolar, stephanoporate; amb circular to sub-poygonal; pores 4 to 7, aspidate, thickened around border; exine thin, <1µm; sculpture granulate.

Derivation of name: Suttor Formation.

Holotype: B303-2, 8.7 102.3, Q926.

Remarks: *Haloragacidites suttorensis* differs from *H. myriophylloides* Cookson & Pike 1954 by being smaller, and having more pores and a thinner exine. The specimen figured by Foster is at the large end of the size range, and has a slightly heavier ornament.

Distribution: Yaamba CPY21, Mount Coolon 5 and 6.

Affinity: Cookson & Pike (1954) suggest similar forms are related to extant genera of the family Haloragaceae.

Genus **Helciporites** Partridge *in* Stover & Partridge 1973

Type species: *Helciporites astrus* Partridge *in* Stover & Partridge 1973; original designation.

Helciporites astrus Partridge *in* Stover & Partridge 1973 (Figure 130)

Dimensions: Equatorial diameter - 16(17)19μm (5 specimens).

Remarks: Specimens referred to this species by Foster (1982) have been herein included in the species *Haloragacidites suttorensis* sp. nov.

Genus **Malvacipollis** Harris 1965, modified by Krutzsch 1966

Type species: *Malvacipollis diversus* Harris 1965 (monotypic when proposed).

Malvacipollis diversus Harris 1965, revised by Stover & Partridge 1973 (Figure 131)

Dimensions: Diameter - 18(22)25μm (3 specimens); exine thickness - 1, 2μm; coni (height) - 1, 2μm, (base) - 2μm; number of pores - 6.

Malvacipollis subtilus Stover *in* Stover & Partridge 1973 (Figure 132)

1972 *Malvacipollis diversus* Harris 1965; Hekel, p.18, pl.6 figs 28, 29.
1982 ?*Malvacipollis diversus* Harris 1965; Dudgeon, p.99, pl.2 fig.10.
1982 *Malvacipollis subtilus* Stover *in* Stover & Partridge 1973; Foster, p.2, pl.11 fig.5.
1982 *Malvacipollis* sp. A; Foster, p.2, pl.11 fig.6.

Dimensions: Equatorial diameter - 19(26)39μm (10 specimens); exine thickness - 1.5μm; spines (height) - 2μm, (base) - 1.5μm; number of pores - 3 to 6.

stephanoporate pollen gen. et sp. indet. (Figure 133)

Dimensions: Equatorial diameter - 18μm (1 specimen).

Description: Pollen ?oblate, circular in polar view, stephanoporate, with 5 equidimensional, equidistant pores, round to oval, with thin, raised lips. Exine thin, stratified, nexine greater than sexine, sexine with a granulate ornament.

PERIPORATE POLLEN

Genus **Echiperiporites** van der Hammen & Wijmstra 1964

Type species: *Echiperisporites akanthos* van der Hammen & Wijmstra 1964; original designation.

Echiperiporites sp. A (Figure 134)

1984 *Echiperiporites* sp.; Truswell & others, p.285, fig.7R to T.

Dimensions: Diameter - 20, 27μm (2 specimens).

Remarks: The specimens have in excess of 15 annulate pores (one of the two has in excess of 30 pores). The ornament consists of more or less evenly scattered fine, short spines. They differ from *Micrantheum spinyspora* Martin, 1973 by the placement of the ornament, the latter being more complexly arranged. The larger specimen may yet prove to be a separate species.

Genus **Malvacearumpollis** Nagy 1962

Type species: *Malvacearumpollis bakonyensis* Nagy 1962

Malvacearumpollis mannanensis Wood 1986

1972 *Malvacearumpollis estelae* (Germeraad, Hopping & Muller) Hekel 1972; Hekel, p.18, pl.6 fig.27.
1982 *Malvacipollis* sp. C; Foster, p.2, pl.11 fig.8.
?1982 *Malvacipollis* sp. A; Dudgeon, p.99, pl.2 fig.9.
1986 *Malvacearumpollis mannanensis* Wood 1986; p.6, figs 9.1 to 9.4.

Dimensions: Diameter - 21(40)56μm (7 specimens); exine thickness - 3 to 5μm; number of apertures - 1 to 6, pore diameter - 3 to 7μm.

Remarks: The specimens from Mount Coolon differ from those described by Wood by being smaller, with commonly thicker walls, a coarser ornament, and smaller, less distinct, and fewer apertures. The variation within the species as presently defined suggests that it may be broken up into a number of species in the future.

Genus **Periporopollenites** Pflug & Thomson in Thomson & Pflug 1953

Type species: *Periporopollenites stigmosus* (Potonié Thomson & Pflug 1953; original designation.

Periporopollenites sp. cf. ***P. vesicus*** Partridge *in* Stover & Partridge 1973 (Figure 136)

Dimensions: Diameter - 20(27)31μm (6 specimens); exine thickness - 1.5 *to* 2.0μm.

Remarks: The specimens are smaller than those described by Partridge (Stover & Partridge, 1973) and the number of pores appears to be generally less.

Genus **Roxburghpollis** Mildenhall & Pocknall 1989

Type species: *Roxburghpollis giganteus* Mildenhall & Pocknall, 1989; original designation.

Roxburghpollis sp. cf. ***Polyporina bipatterna*** Martin 1973 (Figure 137)

Dimensions: Diameter - 35μm (1 specimen); exine thickness - 3μm; pore number - in excess of 12, pore diameter - 1.5μm.

Remarks: The specimen differs from the type species by having a more densely distributed ornament, and smaller pores. It is much larger than those described by Martin (1973) as *Polyporina bipatterna*, and the similarity between its complex ornament and that of Martin's specimens would require further investigation.

APORATE POLLEN

Genus **Inaperturopollenites** Pflug & Thomson *in* Thomson & Pflug 1953

Type species: *Inaperturopollenites dubius* (Potonié & Venitz) ex Thomson & Pflug 1953

Inaperturopollenites sp. A (Figure 138)

Dimensions: Diameter - 50μm (1 specimen).

Remarks: The specimen is a flattened sphere with a thin wall (1μm). Exinal stratification is not evident and the wall surface is smooth.

POLLEN RETAINED IN TETRADS

Genus **Bysmapollis** Partridge *in* Stover & Partridge 1973

Type species: *Bysmapollis emaciatus* Partridge *in* Stover & Partridge 1973

Bysmapollis sp. A (Figure 139)

Dimensions: Diameter of tetrad - 41μm; individual pollen length x breadth - 27x20μm, exine thickness - 3.5μm.

Remarks: The pollen bear some discernible annulate pores which appear to be alligned according to the diagnosis of this genus. The sculpture comprises large gemmae and verrucae located mainly on the equatorial / polar regions. The ornament is coarser and less widely distributed than that on *Triporotetradites* sp. (Truswell & others, 1984).

POLYADS

Genus **Acaciapollenites** Mildenhall 1972 ex Jansonius & Hills, 1976

Type species: *Acaciapollenites myriosporites* (Cookson) Mildenhall 1972 ex Jansonius & Hills, 1976.

Acaciapollenites myriosporites (Cookson) Mildenhall 1972 ex Jansonius & Hills 1976 (Figure 140)

1972 *Polyadopollenites* sp.; Hekel, p.19, pl.6 fig.25.
1982 *Acacia* sp. cf. *A. myriosporites* (Cookson) Partridge 1973; Dudgeon, p.98, pl.3 fig.4 (incorrect citation).
1986 *Acaciapollenites* sp. cf. *A. myriosporites* (Cookson) Mildenhall 1972; Wood, p.7, fig.10.2.

Dimensions: Diameter - 57, 64μm(2 specimens); number of pollen grains per polyad - 16.

INCERTAE SEDIS

Genus **Schizophacus** Pierce 1976

Type species: *Schizophacus rugulatus* (Cookson & Dettmann) Pierce 1976

?***Schizophacus*** sp. A (Figure 141)

Dimensions: Length x breadth - 41(46)52 x 25(31)39μm (7 specimens).

Remarks: Ovoidal bodies with a thick wall (3μm) bearing a coarse undulating foveo/reticulum, lumina between 2 and 3μm in diameter, muri between 2 and 3μm in width, most commonly with the lumina less than the muri.

?***Schizophacus*** sp. B (Figure 142)

Dimensions: Length x breadth - 64x59, 73x63, 76x69μm (3 specimens).

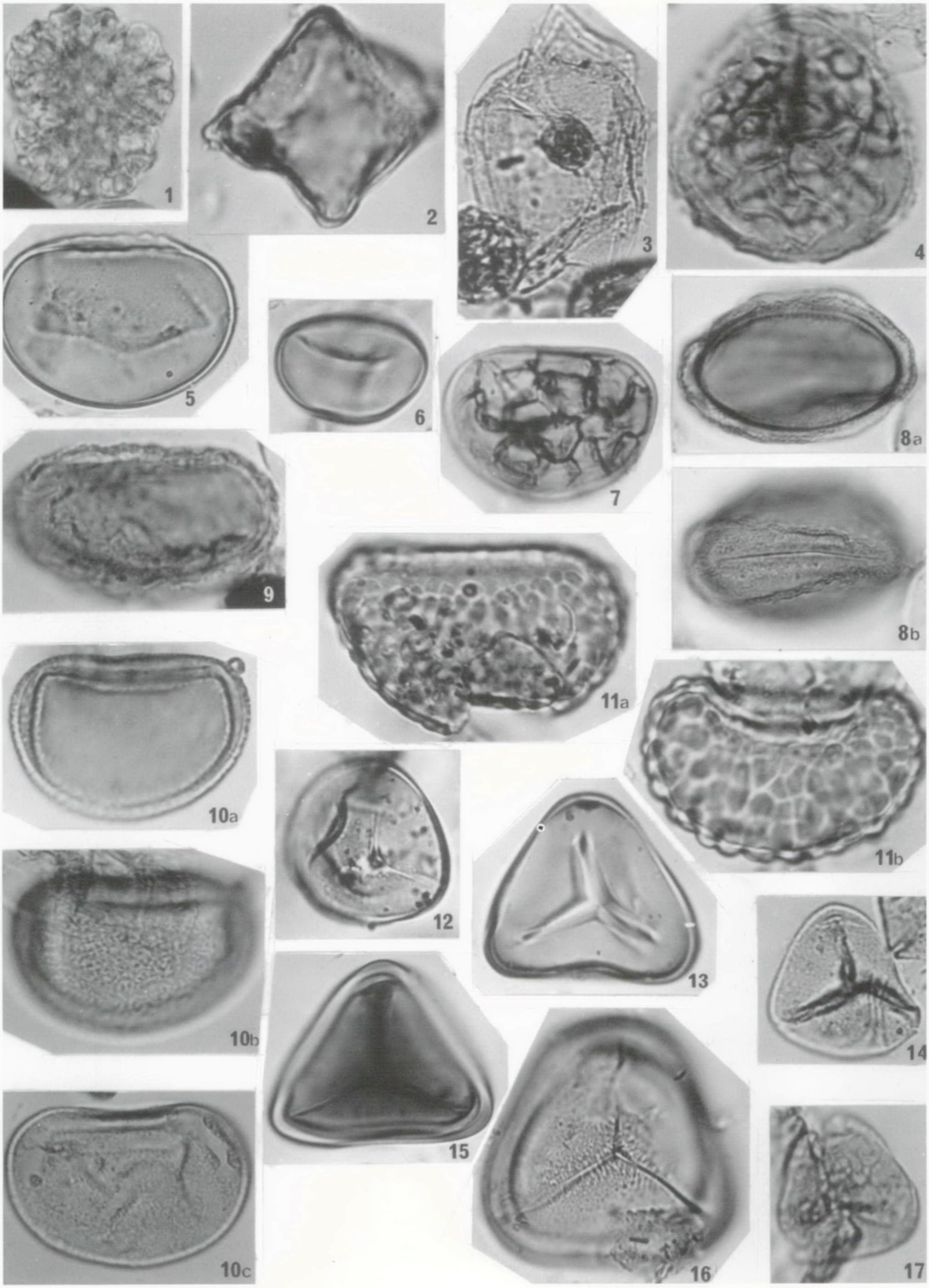
Remarks: Subspherical bodies with a thick wall (4μm) bearing a coarse undulating reticulum, lumina between 4 and 8μm in diameter, muri about 2μm in width.

FIGURE EXPLANATIONS

All figures are from unretouched negatives, and prints are at a magnification of x1000. Specimens are referred to by :
(1) the preparation and slide number;
(2) mechanical stage co-ordinates from a Zeiss Photomicroscope III;
(3) Geological Survey of Queensland Palynological Collection catalogue number, prefixed Q.

Figures 1 to 17

1. *Botryococcus braunii* Kützing 1849. B306/3, 16.5 94.8, Q802.
2. *Tetraporina* sp. cf. *T. diagonalis* Lindgren 1980. B304/1, 23.5 121.9, Q803.
3. *Saeptodinium* sp. B306/1, 7.9 121.3, Q804.
4. *Reboulisporites dettmanni* sp. nov. B306/1, 16.4 102.3, Q805 (Holotype).
5. *Laevigatosporites major* (Cookson) Krutzsch 1959. B306/3, 3.6 91.6, Q806.
6. *Laevigatosporites ovatus* Wilson & Webster 1946. B306/3, 7.0 120.7, Q807.
7. *Peromonolites* sp. A. B306/3, 22.0 118.0, Q808.
8. *Peromonolites* sp. B. B305/1, 16.9 117.0,a.equatorial. b. apertural. Q809.
9. *Peromonolites* sp. C. B306/2, 17.6 112.8, Q810.
10. *Microfoveolatosporis coolonensis* sp. nov. B306/1, 15.9 122.8, a. equatorial. b. external ornament, Q811 (Holotype). c. B306/1, 6.9 100.4, Q812.
11. *Polypodiisporites* spp. a. B305/1, 13.0 97.3, Q813. b. B305/1, 15.8 121.2, Q814.
12. *Cyathidites minor* Couper 1953. B306/3, 5.0 108.8, Q815.
13. *Cyathidites palaeospora* (Martin) comb. nov. B301/2, 5.0 125.7, Q816.
14. *Cyathidites* sp. cf. *C. punctatus* (Delcourt & Sprumont) Delcourt, Dettmann & Hughes 1963. B306/3, 7.2 98.7, Q817.
15. *Cyathidites* sp. A. B305/3, 15.4 103.6, Q818.
16. *Cyathidites* sp. B. B305/3, 11.4 105.5, Q819.
17. *Cyathidites* sp. D. B301/1, 12.1 115.3, Q820.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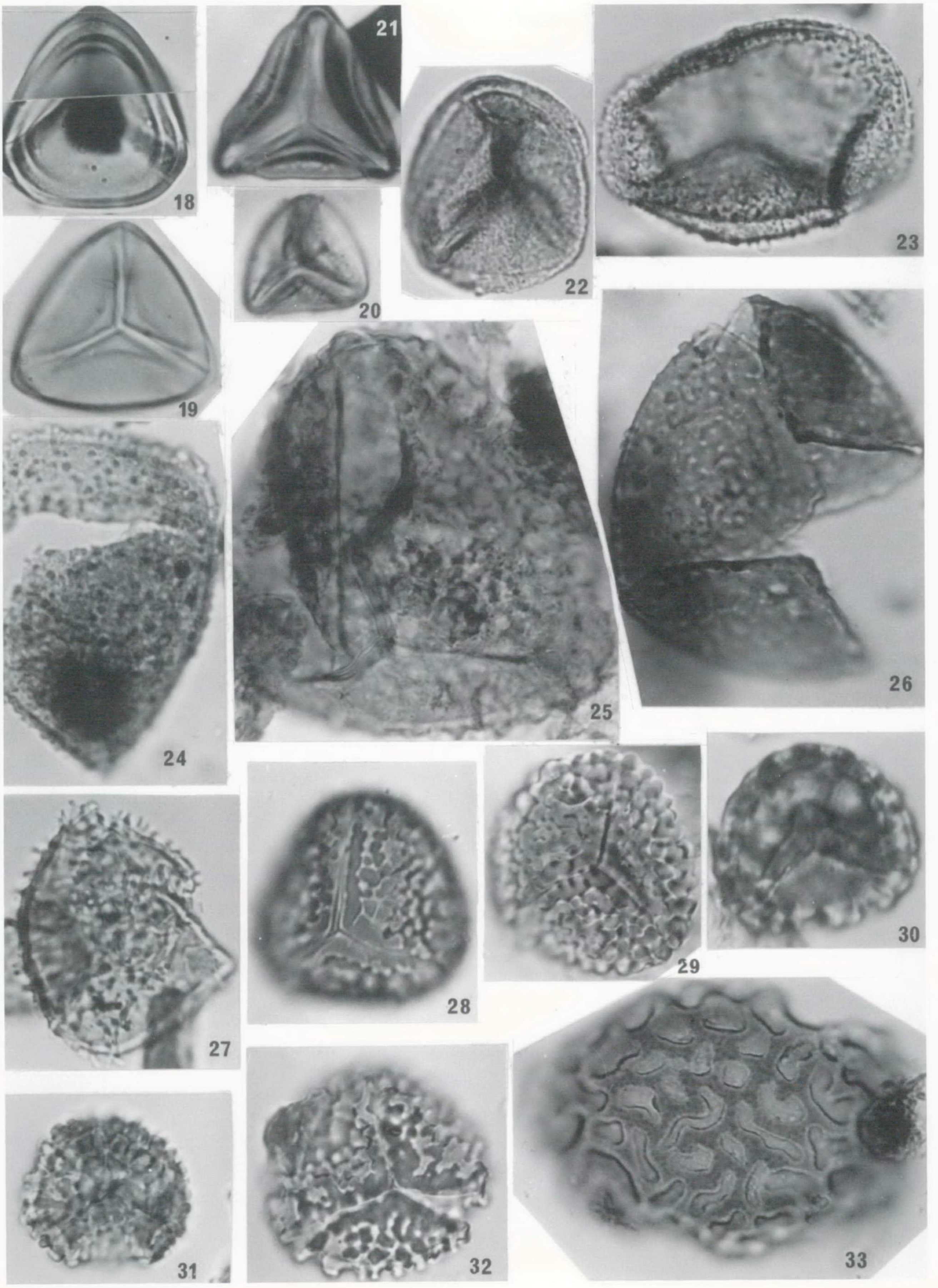
Figures 18 to 33

18. *Trilites* sp. A. B306/2, 10.0 106.2, Q.821
19. *Dictyophyllidites concavus* Harris 1965. B305/3, 18.6 99.1, Q822.
20. *Dictyophyllidites* sp. A. B306/2, 9.0 113.6, Q823.
21. *Gleicheniidites circinidites* (Cookson) Dettmann 1963. B306/1, 15.9 97.6, Q824.
22. *Osmundacidites wellmannii* Couper 1953. B306/1, 19.5 104.1, Q825.
23. *Baculatisporites comaumensis* (Cookson) Potonié 1956. B301/1, 2.1 105.2, Q826.
24. *Baculatisporites disconformis* Stover *in* Stover & Partridge 1973. B304/2, 4.3 106.0, Q827.
25. *Verrucosisporites kopukuensis* (Couper) Stover *in* Stover & Partridge 1973. B302/1, 23.6 124.1, Q828.
26. *Verrucosisporites varians* Volkheimer 1972. B305/1, 15.1 101.8, Q829.
27. *Neoraistrickia* sp. A. B305/1, 21.1 100.7, Q830.
28. *Rugulatisporites mallatus* Stover *in* Stover & Partridge 1973. B305/1, 20.0 109.5, Q831.
29. *Rugulatisporites* sp. cf. *R. micraulaxus* Partridge *in* Stover & Partridge 1973. B305/1, 3.4 107.3, Q832.
30. *Rugulatisporites* sp. A. B305/1, 6.0 94.0, Q833.
31. *Rugulatisporites* sp. B. B305/1, 20.7 100.3, Q834.
32. *Rugulatisporites* sp. C. B301/3, 24.3 117.6, Q835.
33. *Crassoretitriletes vanraadshooveni* Germeraad, Hopping & Muller 1968. B303/1, 17.8 123.3, Q836.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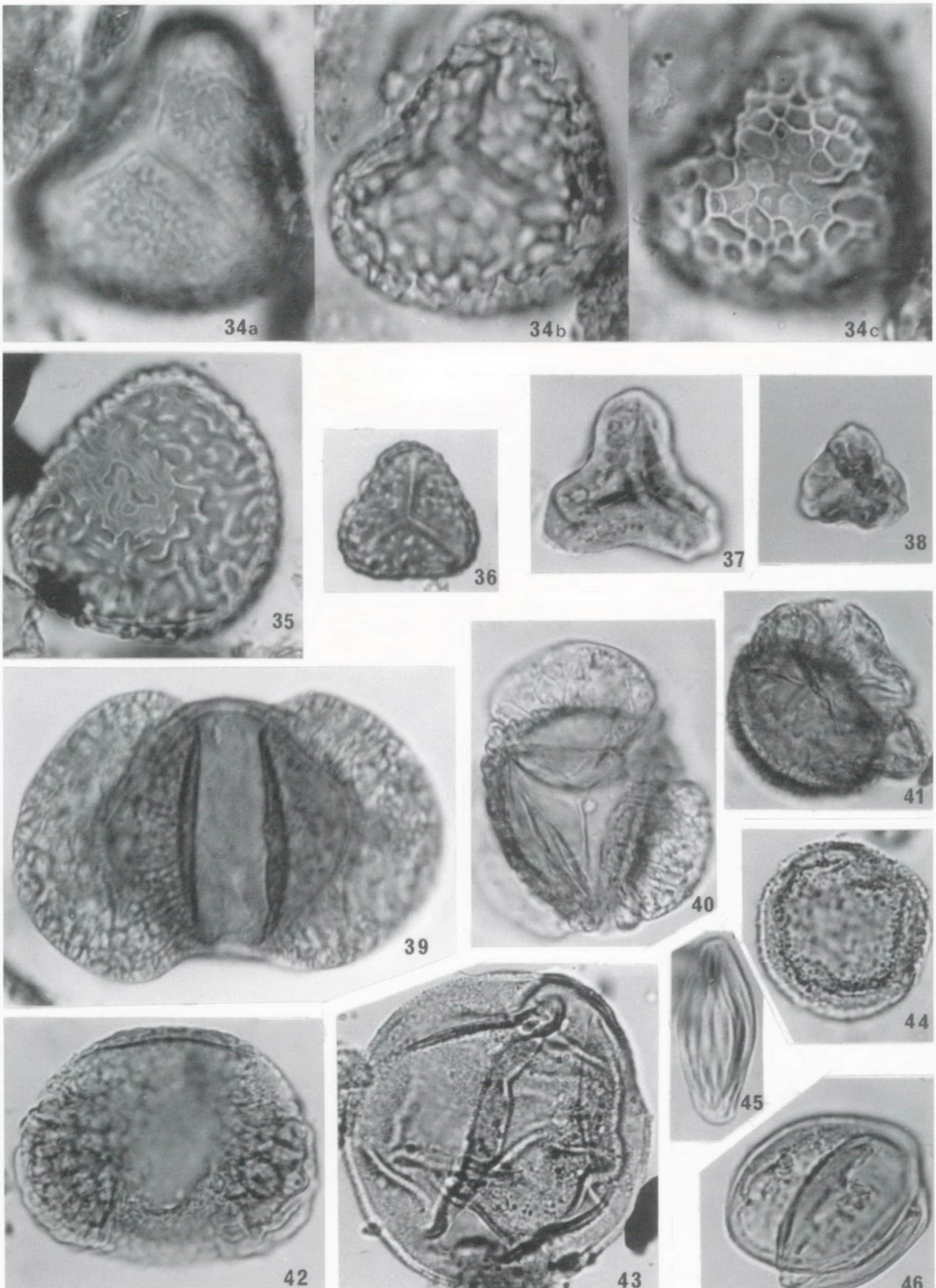
Figures 34 to 46

34. *Crassoretitriletes* sp. A. B306/2, 12.1 118.7, a. proximal. b. equatorial. c. distal., Q837.
35. *Crassoretit: :letes* sp. B. B306/2, 19.1 112.6, Q838.
36. *Crassoretitriletes* sp. C. B301/3, 7.4 97.2, Q839.
37. trilete spore gen et sp. indet 1. B306/1, 4.2 106.3, Q840.
38. trilete spore gen et sp. indet 2. B306/3, 5.5 120.1, Q841.
39. *Podocarpidites ellipticus* Cookson 1947. B304/2, 11.4 126.7, Q842.
40. *Dacrycarpites australiensis* Cookson & Pike 1953. B304/1, 7.0 98.2, Q843.
41. *Microcachryidites antarcticus* Cookson 1947. B304/1, 15.0 122.3, Q844.
42. *Lygistepollenites florinii* (Cookson & Pike) Stover & Evans 1973. B304/1, 19.1 107.0, Q845.
43. *Araucariacites australis* Cookson 1947. B306/3, 6.6 93.2, Q846.
44. *Dilwynites granulatus* Harris 1965. B306/3, 5.0 119.3, Q847.
45. *Ephedripites notensis* (Cookson) comb. nov. B302/1, 3.4 108.7, Q848.
46. *Taxodiaceaepollenites* sp. A. B304/1, 21.5 122.5, Q849.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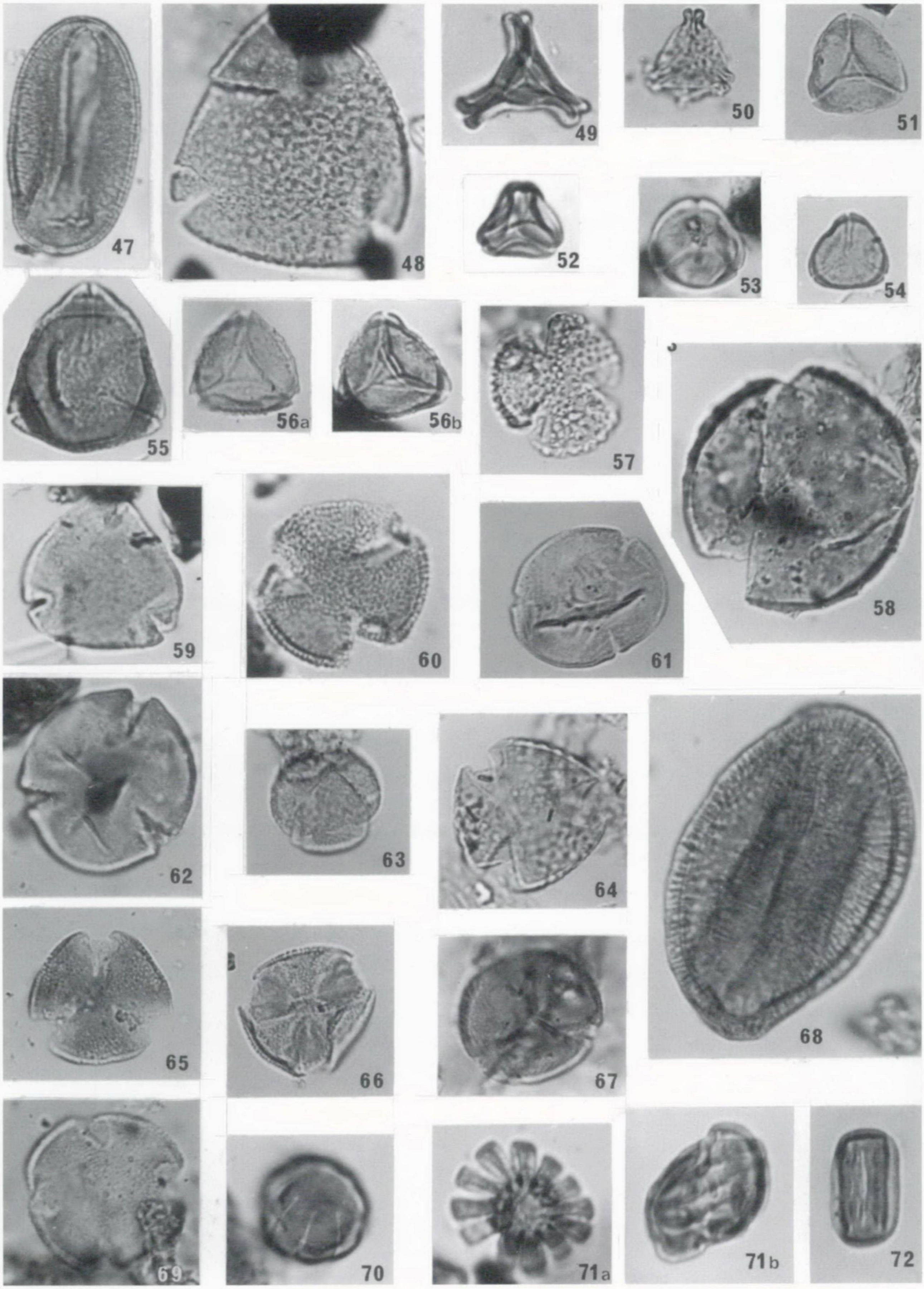
Figures 47 to 72

47. *Arecipites* sp. B303/1, 9.0 118.4, Q850.
48. *Beaupreaidites verrucosus* Cookson 1950. B306/2, 12.1 102.7, Q851.
49. *Gothanipollis bassensis* Stover *in* Stover & Partridge 1973. B305/3, 10.7 111.5, Q852.
50. *Gothanipollis* sp. A. B303/3, 7.8 104.4, Q853.
51. *Myrtaceidites mesonesis* Cookson & Pike 1954. B301/3, 17.2 98.6, Q854.
52. *Myrtaceidites eugeniioides* Cookson & Pike 1954. B303/3, 11.1 101.7, Q855.
53. *Myrtaceidites eucalyptoides* Cookson & Pike 1954. B302/1, 21.3 113.9, Q856.
54. *Myrtaceidites rhodamnoides* Martin 1973. B301/3, 9.7 105.0, Q857.
55. *Myrtaceidites verrucosus* Partridge *in* Stover & Partridge 1973. B302/1, 14.4 114.4, Q858.
56. *Myrtaceidites gloriosus* sp. nov. a. Holotype B301/3, 12.4 115.4, Q859. b. B301/1, 7.2 104.5, Q860.
57. *Tricolpites bathyreticulatus* Stanley 1965. B306/1, 22.4 118.6, Q861.
58. *Tricolpites latispinosus* McIntyre 1965. B305/1, 15.2 110.6, Q862.
59. *Tricolpites* sp. cf. *T. phillipsii* Stover *in* Stover & Partridge 1973. B301/3, 19.3 115.2, Q863.
60. *Tricolpites reticulatus* Cookson 1947. B301/3, 20.2 111.5, Q864.
61. *Tricolpites* sp. A. B303/3, 3.0 117.4, Q865.
62. *Tricolpites* sp. B. B306/2, 12.5 124.6, Q866.
63. *Tricolpites* sp. C. B306/1, 3.5 121.5, Q867.
64. *Rousea* sp. A. B305/1, 11.3 95.4, Q868.
65. *Rousea* sp. B. B303/1, 5.7 121.2, Q869.
66. *Rousea* sp. C. B301/3, 13.2 105.7, Q870.
67. *Striatopollis* sp. A. B306/1, 7.2 108.2, Q871.
68. *Perfotricolpites digitatus* Gonzalez Guzman 1967. B303/1, 22.5 105.9, Q872.
69. ?*Phimopollenites pannosus* (Dettmann & Playford) Dettmann 1973. B306/2, 2.8 106.8, Q873.
70. *Polycolpites esobalteus* McIntyre 1968. B301/3, 16.6 102.8, Q874.
71. *Polycolpites* sp. A. a. B303/1, 5.4 103.2, Q875. b. B303/1, 3.9 107.0, Q876.
72. *Polycolpites* sp. B. B303/2, 5.1 108.8, Q877.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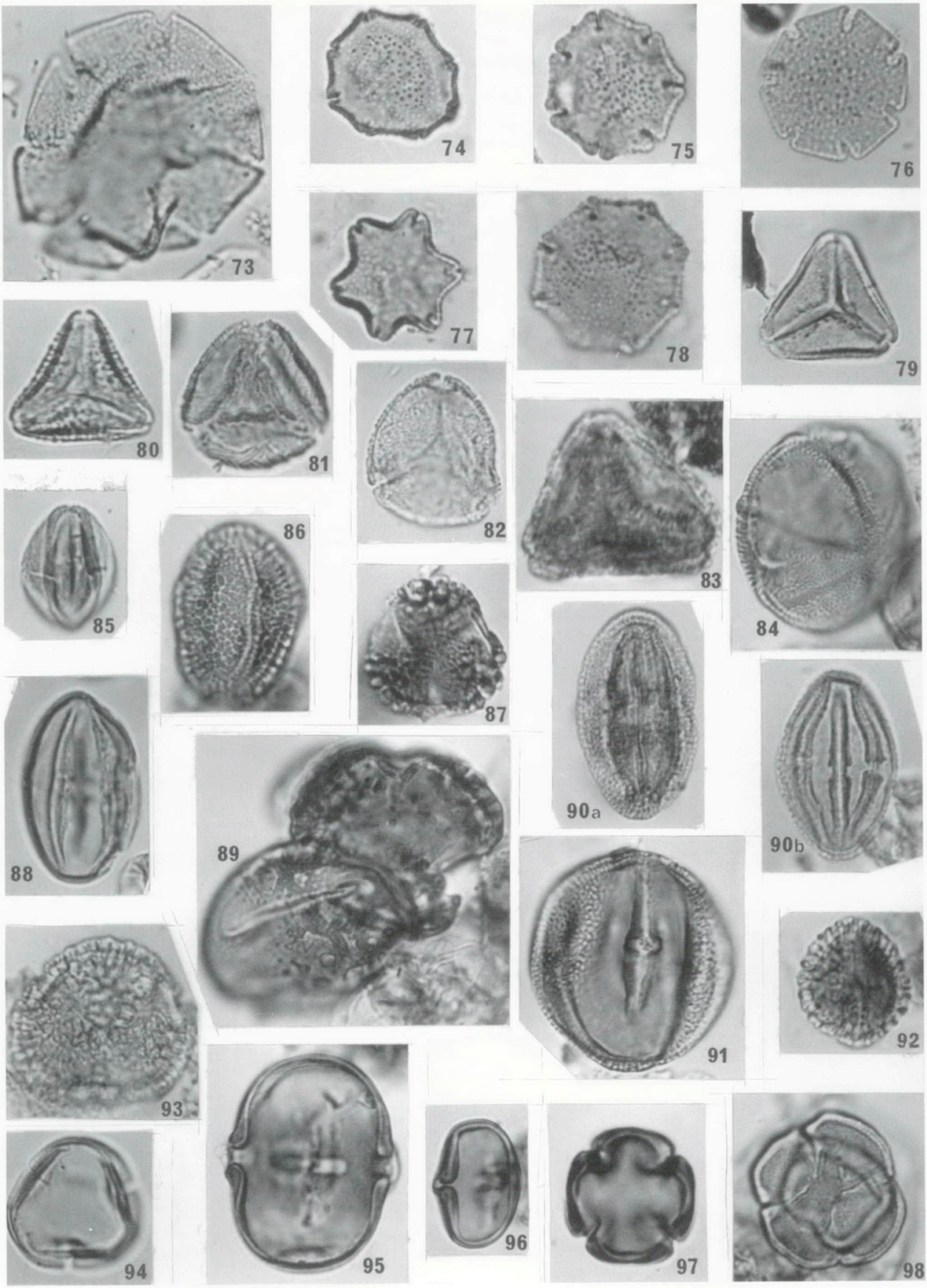
Figures 73 - 98

73. *Nothofagidites asperus* (Cookson) Stover & Evans 1973. B305/3, 11.4 107.0, Q878.
74. *Nothofagidites brachyspinulosus* (Cookson) Harris 1965. B306/1, 6.3 105.7, Q879.
75. *Nothofagidites deminutus* (Cookson) Stover & Evans 1973. B305/1, 2.3 113.8, Q880.
76. *Nothofagidites emarcidus* (Cookson) Harris 1965 / heterus (Cookson) Stover & Evans 1973. B303/1, 3.5 103.6, Q881.
77. *Nothofagidites falcatus* (Cookson) Hekel 1972. B305/3, 5.3 116.5, Q882.
78. *Nothofagidites incrassatus* (Cookson) Tulip, Taylor & Truswell 1982. B305/1, 2.9 112.4, Q883.
79. *Cupanieidites orthoteichus* Cookson & Pike 1954. B301/1, 9.7 101.5, Q884.
80. *Cupanieidites reticularis* Cookson & Pike 1954. B305/1, 3.8 97.6, Q885.
81. *Cupanieidites* sp. A. B305/1, 10.7 119.4, Q886.
82. *Cupanieidites* sp. B. B302/1, 6.9 127.0, Q887.
83. *Cupanieidites* sp. C. B305/1, 16.9 103.6, Q888.
84. *Margocolporites woodii* sp. nov. B305/1, 16.1 118.5, Q889.
85. *Simpsonipollis* sp. A. B301/2, 9.8 111.3, Q890.
86. *Ilexpollenites anguloclavatus* McIntyre 1968. B301/3, 19.0 116.2, Q891.
87. *Ilexpollenites megagemmatus* McIntyre 1968. B301/1, 10.7 99.3, Q892.
88. *Tricolporites prolata* Cookson 1947. B306/1, 22.6 97.1, Q893.
89. *Tricolpites retequetus* Partridge *in* Stover & Partridge 1973. B305/1, 16.9 116.9, two grains in a sporangium, Q894.
90. *Rhoipites microreticulatus* (Harris) Wood 1986. a. B306/1, 15.9 106.2, Q895. b. B301/3, 16.0 115.8, Q896.
91. *Rhoipites alveolatus* (Couper) Pocknall & Crosbie 1982. B305/1, 10.9 98.7, Q897.
92. *Rhoipites* sp. A. B306/1, 12.4 111.5, Q898.
93. *Rhoipites* sp. B. B305/3, 20.3 91.9, Q899.
94. ?*Palaeocoprosmadites* sp. B306/1, 22.4 101.6, Q900.
95. *Sapotaceoidaepollenites rotundus* Harris 1972. B305/1, 14.1 111.1, Q901.
96. *Sapotaceoidaepollenites* sp. A. B306/1, 16.6 107.4, Q902.
97. *Pentadesmapites* sp. A. B305/3, 4.7 110.8, Q903.
98. *Jandufouria* sp. A. B305/1, 20.8 94.5, Q904.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Figures 99 to 114

99. *Banksieaeidites arcuatus* Stover *in* Stover & Partridge 1973. B304/1, 3.5 108.1, Q905.

100. *Proteacidites* sp. cf. *P. differentipolus* Dudgeon 1983. B302/1, 23.1 124.2, a. equatorial. b. polar, Q906.

101. *Proteacidites kopiensis* Harris 1972. B305/1, 20.7 97.0, Q907.

102. *Proteacidites pachypolus* Cookson & Pike 1954. B303/2, 20.8 97.5, Q908.

103. *Proteacidites simplex* Dudgeon 1983. B301/2, 20.8 117.2, Q909.

104. *Proteacidites sinulatus* Dudgeon 1983. B303/2, 20.0 117.3, Q910.

105. *Proteacidites symphyonemoides* Cookson 1950. B306/1, 14.7 125.0, Q911.

106. *Proteacidites variambitus* Dudgeon 1983. B304/2, 22.0 100.1, Q912.

107. *Proteacidites* sp. A. B306/2, 9.4 112.9, Q913. a. polar. b. equatorial. c. opposite polar.

108. *Proteacidites* sp. B. B303/1, 17.6 111.0, Q914.

109. *Proteacidites* sp. C. B303/1, 4.6 111.6, Q915.

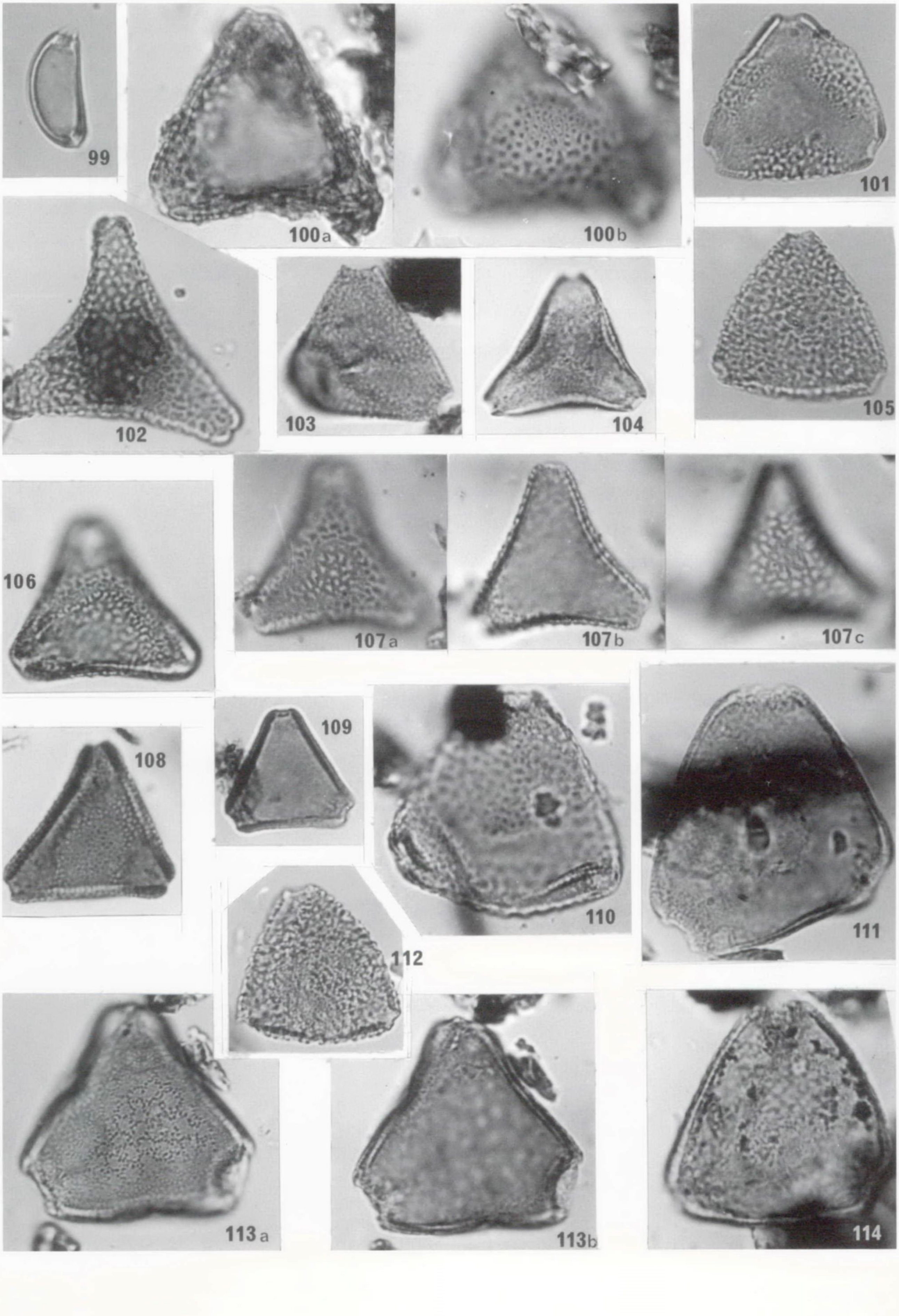
110. *Proteacidites* sp. D. B302/1, 19.2 120.0, Q916.

111. *Proteacidites* sp. E. B306/2, 14.6 105.1, Q917.

112. *Proteacidites* sp. F. B301/3, 9.6 97.8, Q918.

113. *Proteacidites* sp. G. B301/3, 18.0 105.2, a. polar. b. equatorial.Q919.

114. *Proteacidites* sp. H. B302/3, 7.8 118.5, Q920.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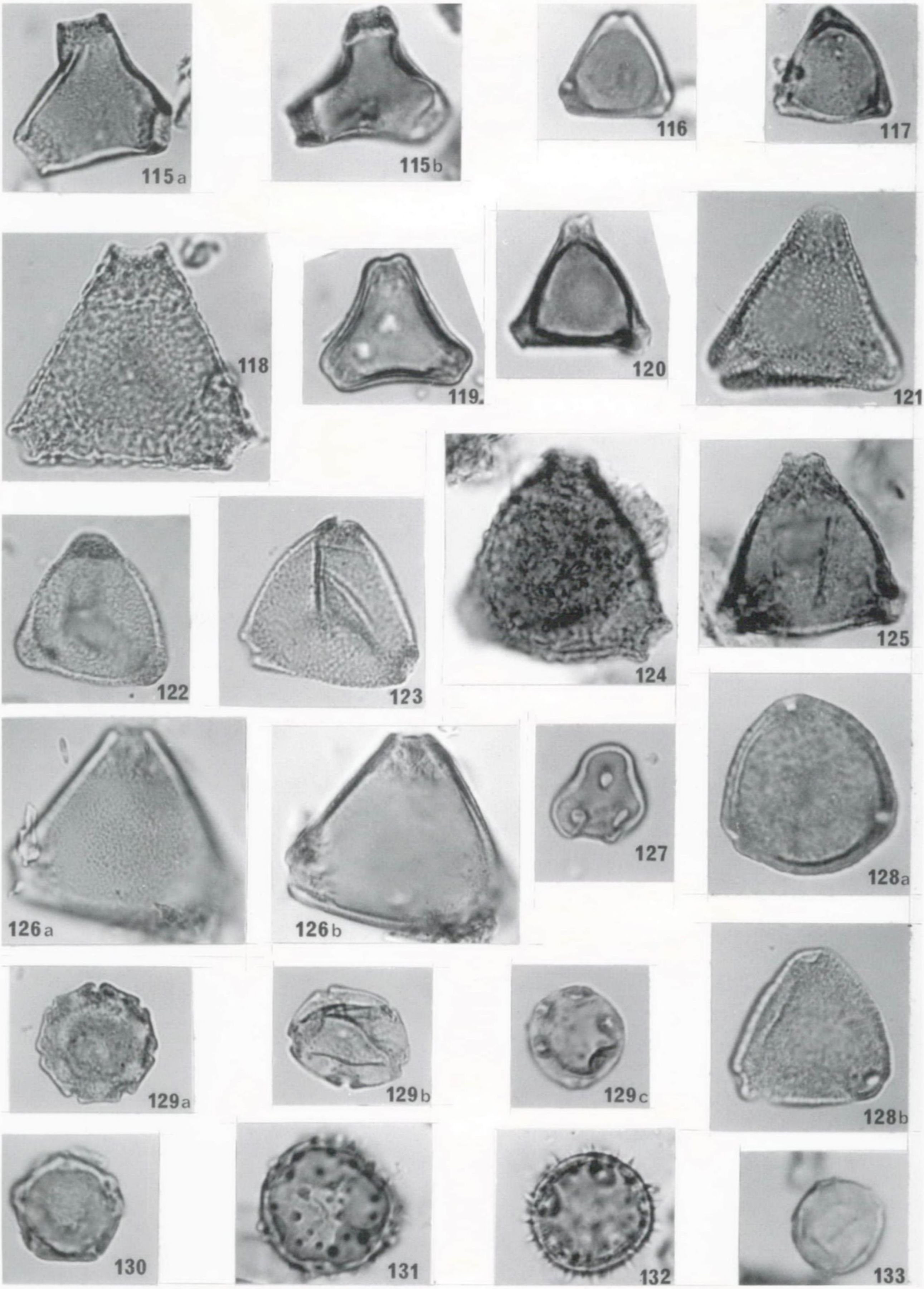
Figures 115 to 133

115. *Propylipollis annularis* (Cookson) Martin & Harris 1974. a. B301/2, 14.2 116.2, Q921. b. B303/1, 5.6 109.0, Q922.
116. *Propylipollis concretus* (Harris) Martin & Harris 1974. B302/1, 24.5 116.5, Q923.
117. *Propylipollis crassimarginus* Dudgeon 1983. B301.1, 12.8 127.3, Q924.
118. *Propylipollis intricatus* Dudgeon 1983. B301/1, 16.1 127.5, Q925.
119. *Propylipollis ivanhoensis* (Martin) comb. nov. B305/1, 13.6 98.4, Q926.
120. *Propylipollis latrobensis* (Harris) Martin & Harris 1974. B301/2, 2.9 111.7, Q927.
121. *Propylipollis reticuloscabratus* (Harris) Martin & Harris 1974. B302/2, 2.2 111.9, Q928.
122. *Propylipollis* sp. cf. *P. reticuloscabratus* (Harris) Martin & Harris 1974. B305/3, 4.9 110.8, Q929.
123. *Propylipollis robustus* Dudgeon 1983. B303/3, 21.4 97.4, Q930.
124. *Propylipollis* sp. cf. *Proteacidites rectomarginus* Cookson 1950. B303/2, 9.0 122.0, Q931.
125. *Propylipollis vagexinus* Dudgeon 1983. B305/1, 8.2 114.0, Q932.
126. *Propylipollis* sp. A. B305/1, 8.0 114.1, a. polar. b. equatorial. Q933.
127. *Anacolosidites luteoides* Cookson & Pike 1954. B301/3, 19.7 98.0, Q934.
128. *Casuarinidites cainozoicus* Cookson & Pike 1954. a. B301/2, 5.2 100.9, Q935. b. B302/2, 5.9 110.8, Q936.
129. *Haloragacidites suttorensis* sp. nov. a. B303/2, 8.7 102.3, Q937 (Holotype), b. B303/2, 9.1 121.8, Q938. c. B303/2, 9.3 121.1, Q939.
130. *Helciporites astrus* Partridge *in* Stover & Partridge 1973. B306/1, 9.9 109.7, Q940.
131. *Malvacipollis diversus* Harris 1965 (revised Stover & Partridge 1973). B305/1, 15.1 93.2, Q941.
132. *Malvacipollis subtilus* Stover *in* Stover & Partridge 1973. B305/3, 17.1 117.5, Q942.
133. stephanoporate pollen gen. et sp. indet. B301/3, 8.0 100.5, Q943.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Figures 134 to 142

134. *Echiperiporites* sp. A. B302/2, 3.4 95.2, Q944.

135. *Malvacearumpollis mannanensis* Wood 1986. a. B303/3, 12.2 123.3, Q945. b. B306/2, 8.2 95.4, Q946.

136. *Periporopollenites* sp. cf. *P. vesicus* Partridge *in* Stover & Partridge 1973. B306/1, 15.9 124.0, a. equatorial. b. external ornament, Q947.

137. *Roxburghpollis* sp. cf. *Polyporina bipatterna* Martin 1973. B305/3, 6.4 109.6, Q948.

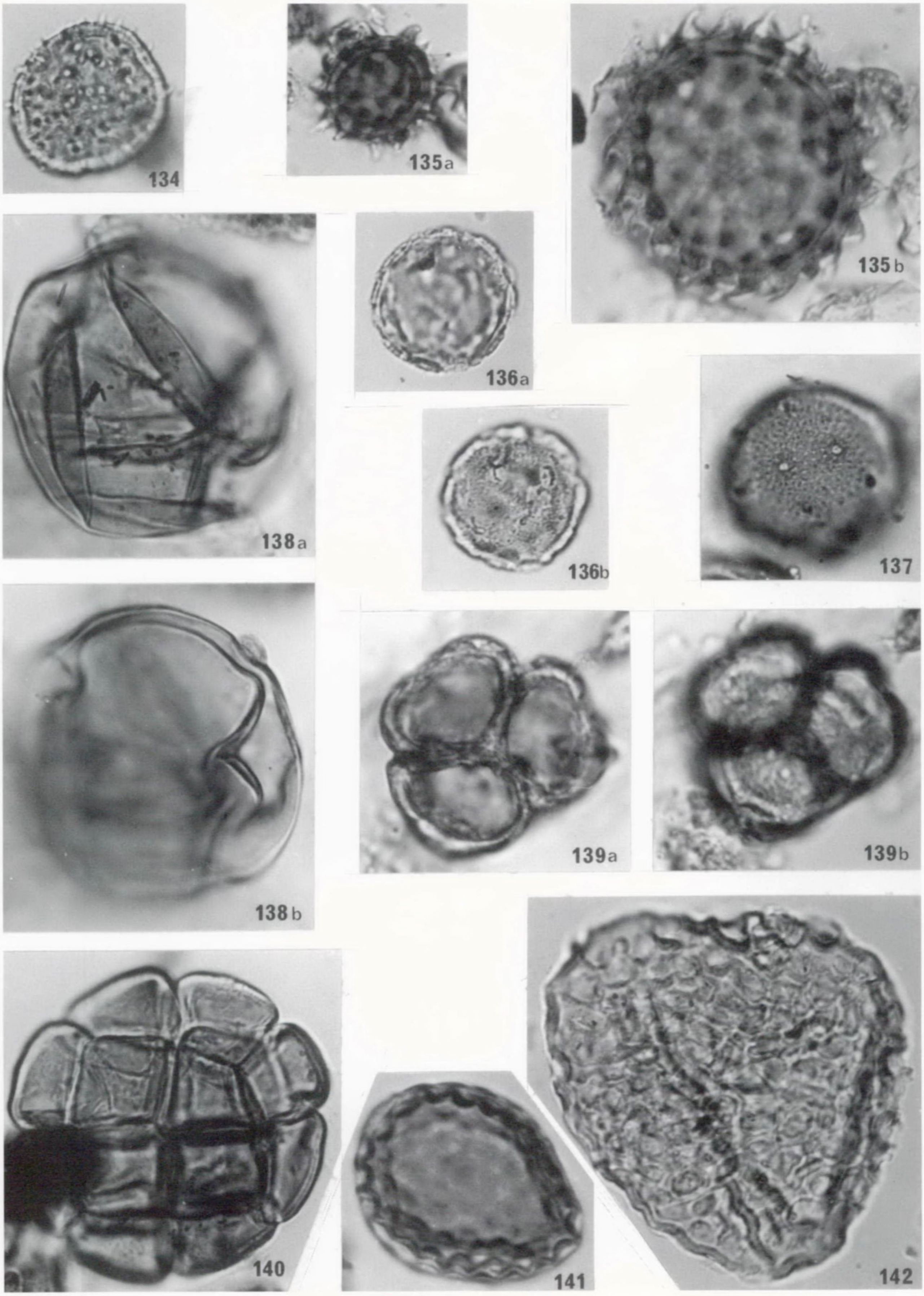
138. *Inaperturopollenites* sp. A. B305/1, 2.2 108.7, Q949.

139. *Bysmapollis* sp. A. B305/1, 21.5 91.0, Q950.

140. *Acaciapollenites myriosporites* (Cookson) Mildenhall, 1972 ex Jansonius & Hills, 1976. B305/1, 22.2 106.7, Q951.

141. *Schizophacus* sp. A. B304/2, 10.0 117.3, Q952.

142. *Schizophacus* sp. B. B305/1, 5.7 91.2, Q953.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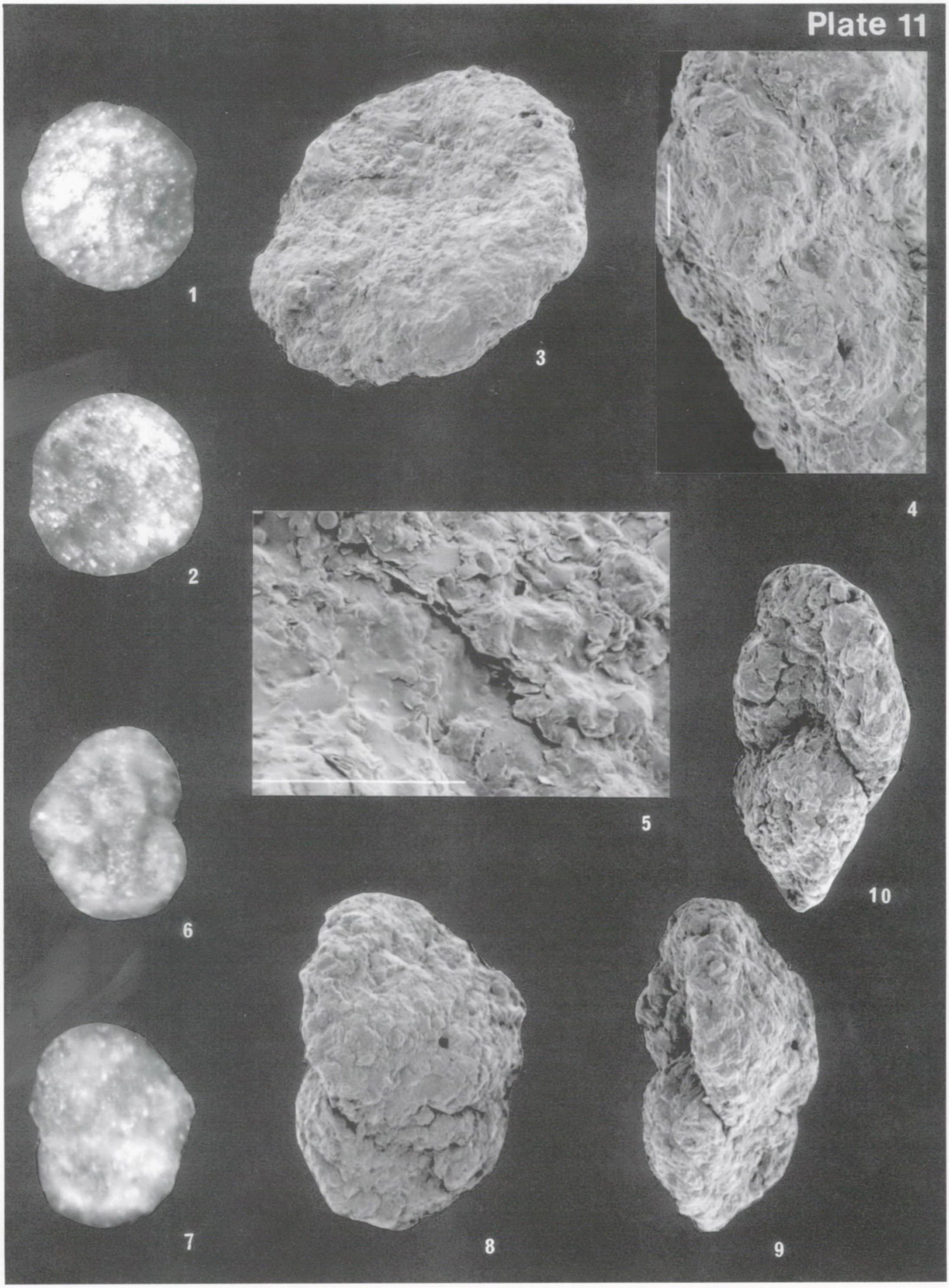
Plate 11
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V. R. Ward, Government Printer, Queensland—1994