GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

BULLETIN 140

MIOSPORE ASSEMBLAGES FROM THE DEVONIAN REEF COMPLEXES, CANNING BASIN, WESTERN AUSTRALIA

by KATHLEEN GREY

DEPARTMENT OF MINES
WESTERN AUSTRALIA

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

BULLETIN 140

MIOSPORE ASSEMBLAGES FROM THE DEVONIAN REEF COMPLEXES, CANNING BASIN, WESTERN AUSTRALIA

by

Kathleen Grey

State Print
Perth, 1992

04531-1

MINISTER FOR MINES
The Hon. Gordon Hill, J.P., M.L.A.

DIRECTOR GENERAL OF MINES
D. R. Kelly

DIRECTOR, GEOLOGICAL SURVEY OF WESTERN AUSTRALIA
Phillip E. Playford

National Library of Australia
Cataloguing-in-publication entry

Grey, Kathleen, 1946-
Miospore assemblages from the Devonian Reef complexes, Canning Basin, Western Australia.

Bibliography.
Includes index.
ISBN 0 7309 4417 4.

1. Palynology—Western Australia—Canning Basin. 2. Spores (Botany, Fossil—Western Australia—Canning Basin
3. Geology—Western Australia—Canning Basin. 4. Canning Basin (W.A.). I. Geological Survey of Western Australia.
II. Title. (Series: Bulletin (Geological Survey of Western Australia); 140).

561.13

ISSN 0085 8137

Copies available from:
The Director
Geological Survey of Western Australia
100 Plain Street
EAST PERTH Western Australia 6004
Ph. (09) 222 3222

CONTENTS

CHAPTER 1. INTRODUCTION

CHAPTER 2. BIOSTRATIGRAPHIC SIGNIFICANCE

CHAPTER 3. SYSTEMATIC PALYNOLOGY

APPENDICES

PLATES

FIGURES

TABLES

ABSTRACT

Devonian palynofloras from the Lennard Shelf area of the Canning Basin, Western Australia are extremely diverse, although generally poorly preserved and sporadically distributed. The miospores can be correlated with zones erected for the Old Red Sandstone Continent of northeastern Canada and northwestern Europe. The taxa studied range from the ***Geminospora lemurata* - *Cymbosporites magnificus*** to ***Vallatisporites pusillites* -*Retispora lepidophyta*** Assemblage Zones (early Givetian to earliest Tournaisian). However, the intermediate ***Auroraspora torquata* - *Grandispora gracilis*** and ***Rugospora flexuosa* - *Grandispora cornuta*** Assemblage Zones have not been recognized because this interval probably coincides with a sample gap corresponding to carbonates of the main reef development.

The miospores indicate that sedimentation marking the beginning of reef development in some parts of the Lennard Shelf had commenced by middle Givetian.

One hundred and forty two miospore taxa have been recorded from the reef complexes in the Pillara and Napier Range areas. Species are distributed among 63 genera, and there are 2 new combinations, *Anapiculatisporites* sp. cf. *A. echinatus* and *Apiculatasporites adavalensis*. About half of the miospores can be assigned to existing taxa, but identification of others remains doubtful.

No new species are described because of limited numbers and poor preservation; instead open nomenclature has been used. Several of these doubtfully assigned forms are probably new species requiring more detailed examination before circumscription. A number of taxa are tentatively assigned to previously described species, but require a fuller investigation which cannot be carried out until more specimens become available.

KEYWORDS: Devonian, Middle Devonian, Late Devonian, Givetian, Frasnian, Famennian, Tournaisian, palynology, miospores, Western Australia, Canning Basin, Lennard Shelf, Napier Range, Pillara Range, Pillara Limestone, Napier Formation, Sadler Limestone, Gogo Formation, Van Emmerick Conglomerate, Virgin Hills Formation, Fairfield Formation.

Chapter 1

Introduction

Background

The current study of Napier and Pillara Range miospores forms part of on-going investigations of the mineral and hydrocarbon potential of Devonian reef complexes of the Canning Basin. Palynological work was carried out by the Geological Survey of Western Australia (GSWA) as part of a joint investigation of the Lennard Shelf area in conjunction with the former Baas Becking Geobiological Laboratory and Curtin University of Technology — formerly Western Australian Institute of Applied Technology (WAIT).

Since 1978, the Mineral Exploration Division of the Broken Hill Proprietary Company Limited (BHP) and the Napier Range Joint Venture Partners (Billiton Australia Limited, the metals exploration division of the Shell Company of Australia; and BHP Minerals) have explored for zinc–lead deposits in the Middle to Late Devonian reef complexes of the Napier and Pillara Range areas (Fig. 1). These studies provided an abundance of continuous core, which was made available by the companies for palynological study.

Limited commercial quantities of petroleum occur in the reefal carbonates (Playford, 1982; Lehmann, 1984; Moors et al., 1984). Small lead–zinc deposits at Narlarla (in the Napier Range) were worked intermittently until 1966 and provided an incentive for later exploration. More recently, potentially economic quantities of lead and zinc were discovered east of Fitzroy Crossing. The Cadjebut Mine, south of the Emanuel Range, is in production; and the Blendevale prospect, in the Limestone Billy Hills, is at an advanced stage of exploration (Murphy et al., 1986).

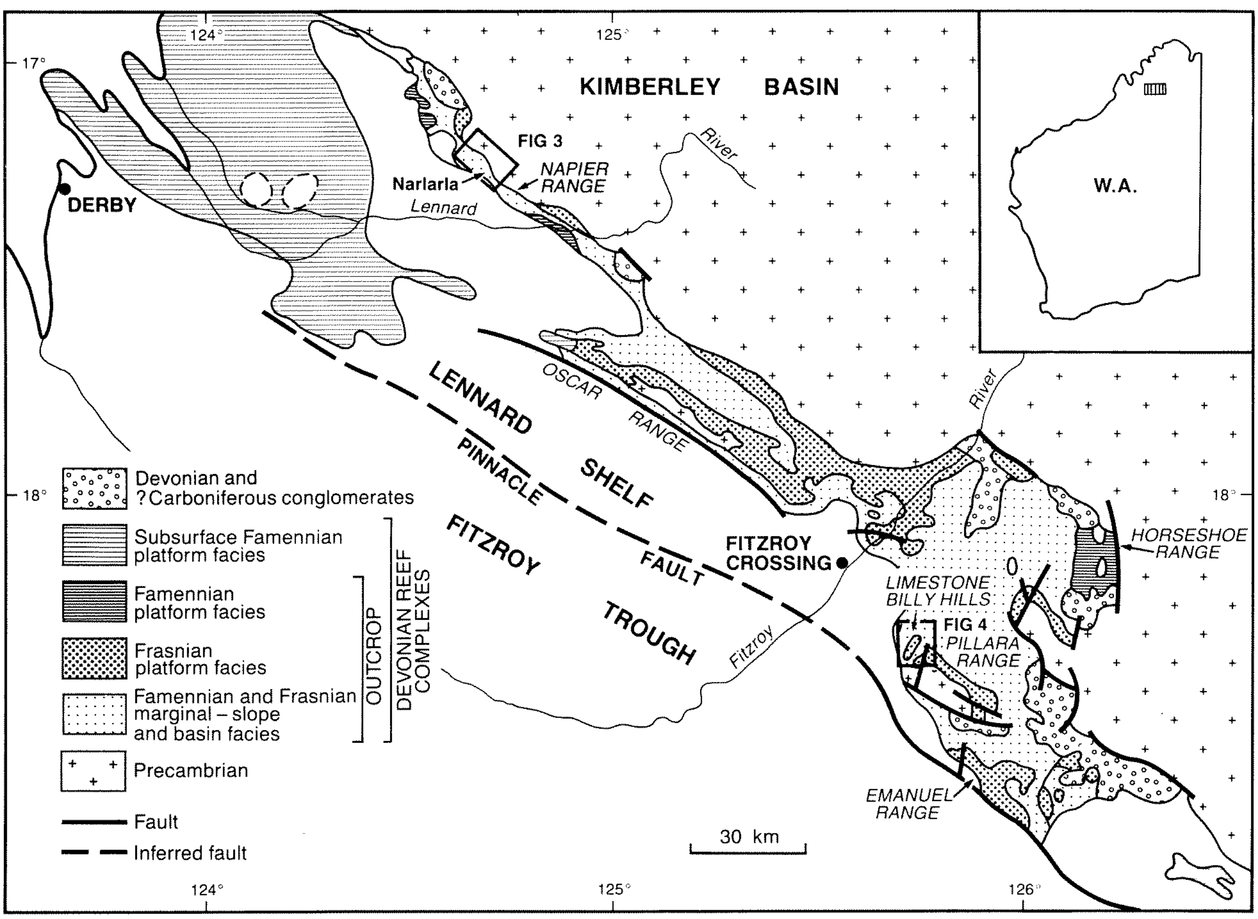
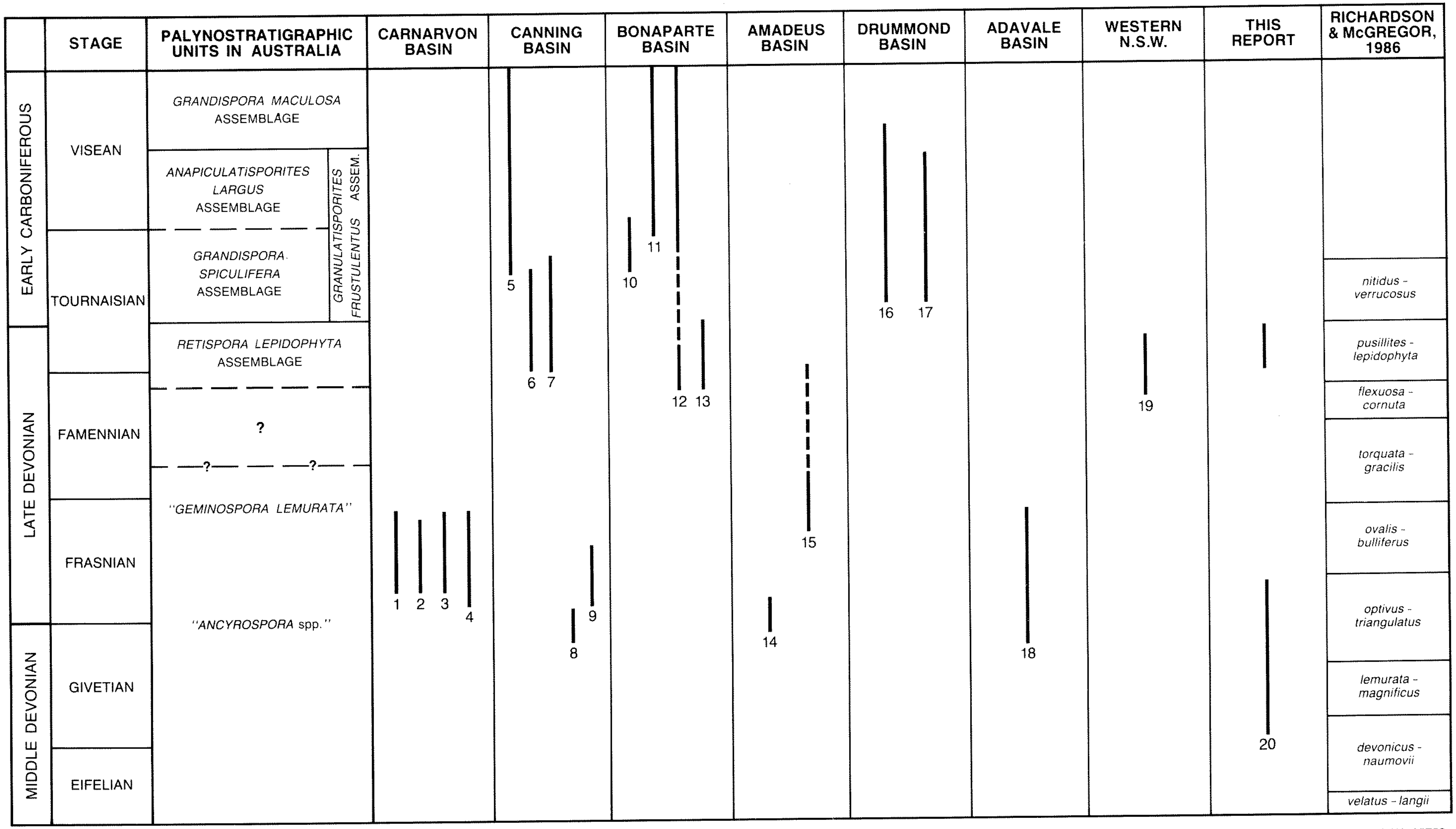


Figure 1. Location and generalized geology of Lennard Shelf and Devonian reef belt, northern Canning Basin, Western Australia.



GSWA 25759

Figure 2. Probable correlation and stratigraphic occurrences of Australian Middle and Late Devonian and Early Carboniferous palynofloras: based on Kemp et al. (1977). Key: 1 — Balme, 1960; 2 — Playford and Dring, 1981; 3 — Playford, 1983; 4 — Balme, 1988; 5 — Balme, 1962; 6 — Balme and Hassell; 1962. 7 — G. Playford, 1976; 8 — Grey, 1974; 9 — Colbath 1990; 10 — Venkatachala, 1964; 11 — Playford, 1971; 12 — Kemp et al., 1977; 13 — Playford, 1982; 14 — Hodgson, 1968; 15 — Playford et. al., 1968; 16 — Playford, 1978; 17 — Playford, 1977; 18 — de Jersey, 1966; 19 — Evans, 1968; 20 — Probable stratigraphic range of units described in this report.

Palynological investigations were aimed at establishing biostratigraphic zonation, particularly for the lower (Middle to Late Devonian) part of the sequence. Miospore studies were based on extensive core sampling of both the Napier Range and Pillara Range prospects carried out in 1982 and 1983. Although approximately 540 samples were processed, preliminary results were generally disappointing because of low recovery rates (Grey, 1981, 1982 a, b, 1983 a–d, 1984). Only a few sporadically distributed samples contained sufficient numbers of adequately preserved miospores to justify further study.

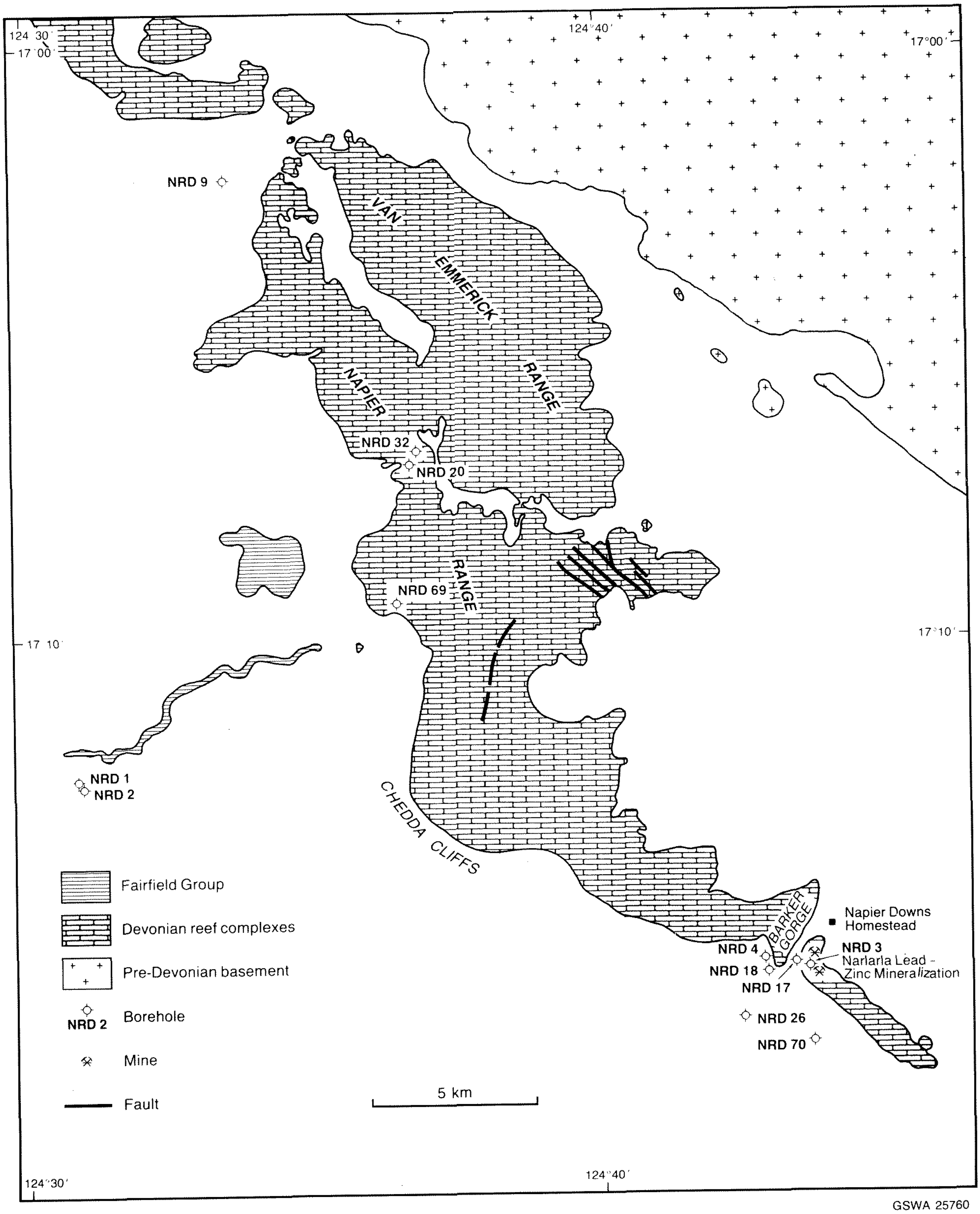


Figure 3. Generalized geological map of Napier Range area showing location of sampled boreholes.

Nineteen boreholes containing the best preserved material (NRD 1, 2, 3, 4, 9, 17, 18, 20, 26, 32, 69, 70; and PD 17, 26, 120, 145, 151, 153, 162) were selected for detailed logging. Studies concentrated on miospore distribution. Partly because of time constraints, and partly because of poor preservation, detailed taxonomic analyses, which would have required the preparation of single-grain mounts and extensive examination of miospore morphologies, were considered to be outside the scope of this study. Acritarchs (Colbath, 1990) are common in some samples; but, with the exceptions of NRD 20, 177.2 m and PD 17, 26.0 m, are rarely well preserved in samples selected for miospore studies.

Many miospores can be readily assigned to taxa that have already been well documented from North America and Europe. These provide a basis for correlation with parts of the zonal schemes proposed for Silurian and Devonian sediments (Richardson and McGregor, 1986; Turnau, 1986; Streel et al. 1987). However, the results reported here should be regarded as preliminary; and continuation of taxonomic studies of some of the better preserved Lennard Shelf samples is desirable. The sequence undoubtedly contains new taxa, here placed in open nomenclature. Moreover, the list of recognized taxa included in this report is by no means exhaustive; and more detailed systematic study is required for some samples, in particular those from NRD 20 and PD 17.

Samples are mainly from the lower (Middle to Late Devonian) part of the sequence. Palynomorphs of this age have been previously recorded in the Canning Basin (Grey, 1974) and briefly noted in several unpublished company reports, but they have never been adequately documented for biostratigraphic purposes. Apart from these minor studies, palynological investigations of the Lennard Shelf sequence (Fig. 2) have concentrated on the latest Devonian and earliest Carboniferous Fairfield Group — the "*Retispora lepidophyta* Assemblage" of Kemp et al. (1977) — which contains a diverse and well-preserved palynoflora (Balme and Hassell, 1962, G. Playford, 1976). This palynoflora can be correlated (Figs 2 and 9) with the ***Vallatisporites pusillites–Retispora lepidophyta*** and ***Verrucosisporites nitidus–Vallatisporites verrucosus*** Assemblage Zones of Richardson and McGregor (1986), and indicates a latest Famennian (Fa2d) to earliest Tournaisian age (Tn1a to Tn1b).

The lower boundary of the "*Retispora lepidophyta* Assemblage" has not been recognized in Western Australia. In the Napier Range area, the presumed base of the assemblage is in reefal carbonates several hundred metres thick. Lithologies in this part of the sequence are unsuitable for sampling, and few palynomorphs have been recovered from the interval.

Argillaceous sediments occur only as silty infills between boulders near the base of the Napier Range reef complexes. Miospores from such horizons are rarely abundant or well preserved, and they provide discordant ages indicative of reworking. The miospores belong to the ***Geminospora lemurata–Cymbosporites magnificus*** and possibly the ***Archaeoperisaccus ovalis–Verrucosisporites bulliferus*** Assemblage Zones of Richardson and McGregor (1986); they suggest (Figs 2, 9) a middle Givetian (F1) to early Frasnian (middle F2) age. This is inconsistent with stratigraphic data and limited acritarch evidence (Colbath, 1990), which indicate a younger sequence. A true age of middle to late Frasnian seems more likely.

The Pillara Range sequence, which comprises interbedded organic-rich carbonates, siltstones, and shales, is almost entirely older than the "*Retispora lepidophyta* Assemblage" (Fig. 2). In general, this sequence shows very low recovery rates and poor preservation. Faulting is extensive. Detailed and continuous stratigraphic control, a prerequisite for palynostratigraphy, is lacking for all boreholes except PD 153. The sequence compares with the (presumably) reworked spores from the lower Napier Range microflora. Miospores representative (Figs 2 and 9) of the ***lemurata–magnificus*** to the ***ovalis–bulliferus*** Assemblage Zones of Richardson and McGregor (1986) are present, and indicate a Middle Givetian (F1) to Middle Frasnian (middle F2) age (Grey, 1991).

Taxa were compared with the known ranges (Fig. 2) of species from the Old Red Sandstone Continent (ORSC) and adjacent regions (Richardson and McGregor, 1986), which are based on studies of sequences from western Europe, North Africa, North America, and European USSR. Grey (1991) reported that miospore studies of the Pillara Range area showed that the onset of sedimentation on the Lennard Shelf was at least as early as the middle Givetian (***lemurata–magnificus*** Assemblage Zone). It is possible that samples from the base of the sequence could be as old as early Givetian, (corresponding to the upper part of Richardson and McGregor's ***Densosporites devonicus–Grandispora naumovii*** Assemblage Zone–fig. 2); but as these samples were barren, this age cannot be substantiated from palynological evidence.

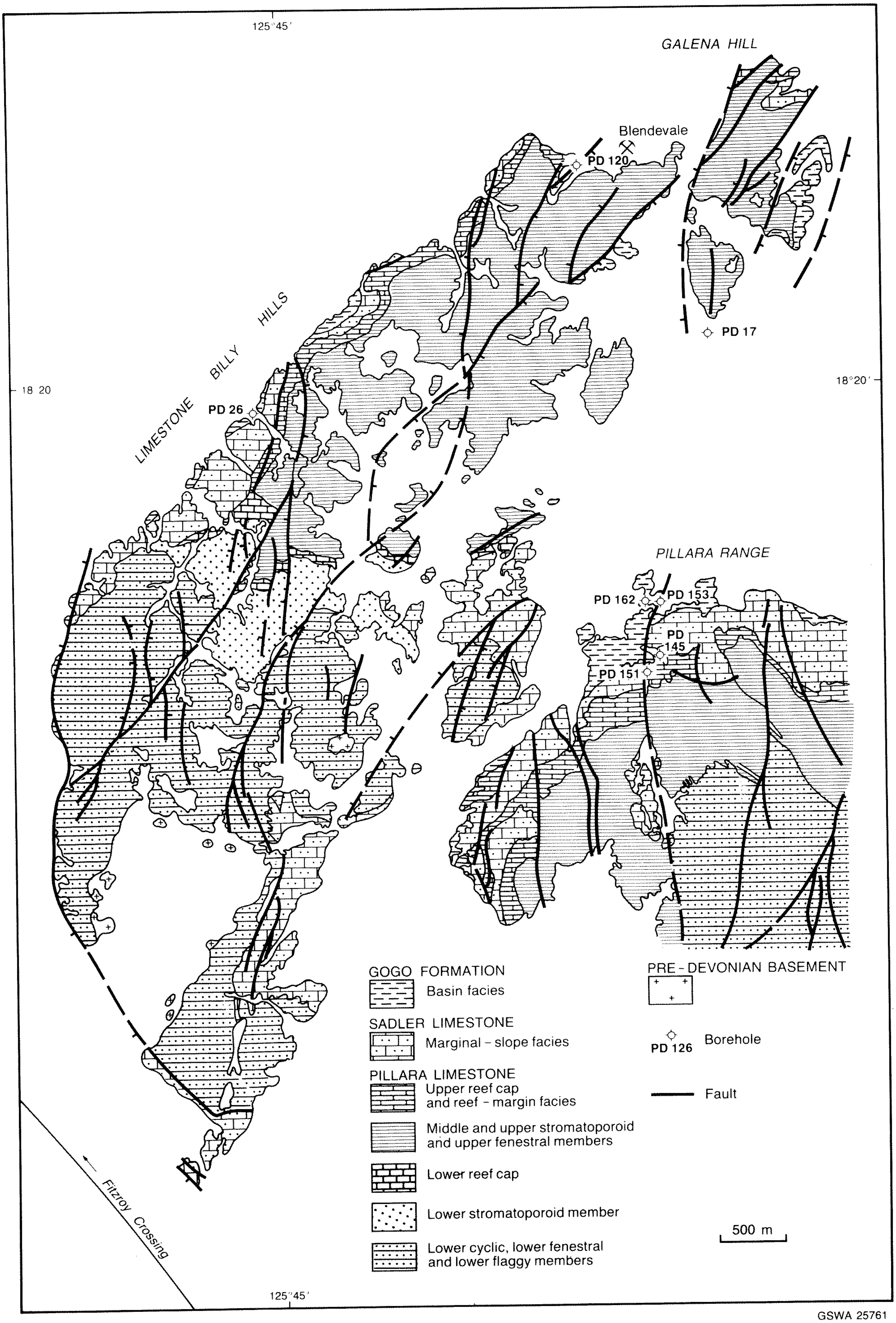
Geological setting

Location

The Napier Range (Fig. 1), about 150 km east of Derby, trends southeasterly and reaches elevations of 100 m above the surrounding plains. It is characterized by a rugged karst topography which restricts access to many areas. Napier Range prospects and drillholes (Fig. 3) are situated near the northwest end of the Napier Range (LENNARD RIVER*).

* 1:250 000 sheet names are printed in full capitals to avoid confusion with like place names.

Figure 4. Generalized geological map of western Pillara Range and Limestone Billy Hills area showing location of sampled boreholes; stratigraphic terminology after Hall (1984), Benn (1984), and Cooper et al. (1984).


125°45′
GALENA HILL
Blendevale
PD 120
PD 17
LIMESTONE BILLY HILLS
PD 26
18 20
18°20′
PILLARA RANGE
PD 162
PD 153
PD 145
PD 151
Fitzroy Crossing
125°45′
GOGO FORMATION
Basin facies
SADLER LIMESTONE
Marginal - slope facies
PILLARA LIMESTONE
Upper reef cap and reef - margin facies
Middle and upper stromatoporoid and upper fenestral members
Lower reef cap
Lower stromatoporoid member
Lower cyclic, lower fenestral and lower flaggy members
PRE - DEVONIAN BASEMENT
PD 126
Borehole
Fault
500 m
GSWA 25761

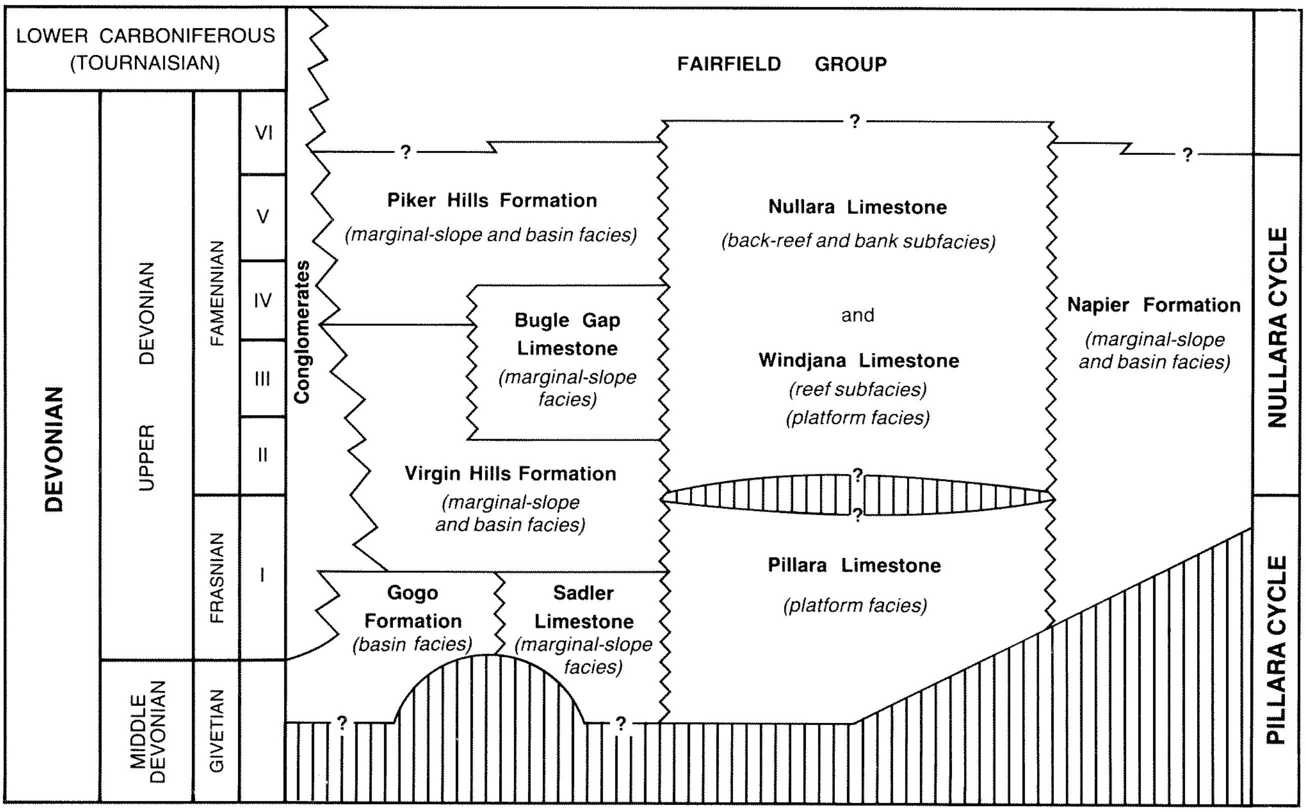


Figure 5. Stratigraphic nomenclature of the reef complexes after Playford (1984).

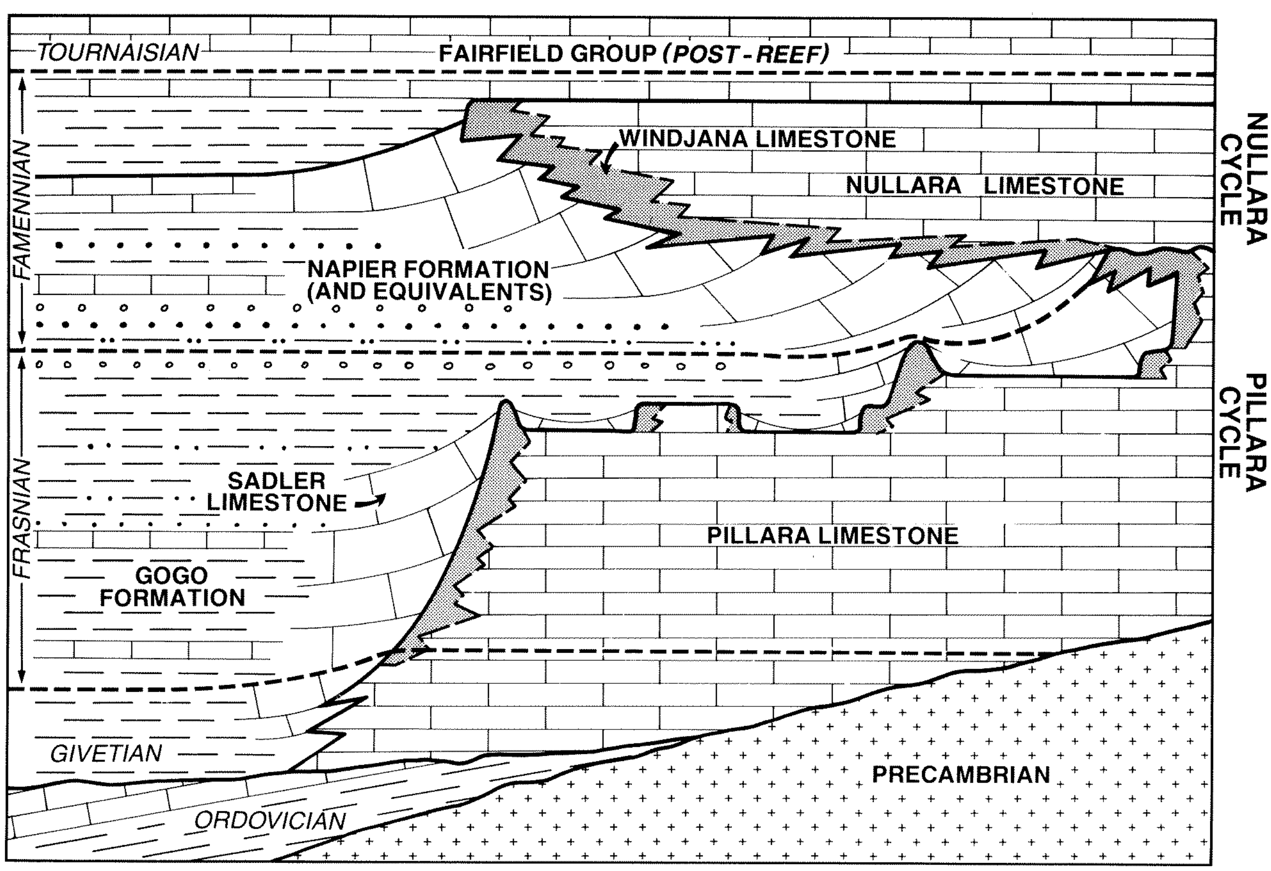


Figure 6. Diagrammatic section illustrating development of the reef complexes through time, and the relationships of stratigraphic units.

The Pillara Range prospects (Fig. 1) are situated about 25 km southeast of Fitzroy Crossing (NOONKANBAH). Exploration drilling (Fig. 4) was mostly concentrated in the vicinity of Limestone Billy Hills (at the northwest end of Pillara Range) and around the Blendevale prospect (in the area between the two ranges); although other drillholes were spaced throughout the Pillara Range and adjacent areas.

Stratigraphy

The Canning Basin Symposium volume (Purcell, 1984) provides a comprehensive review of the exploration history and the current interpretations of regional geology of the Canning Basin. Evolution of the basin was summarized by Forman and Wales (1981), stratigraphy by Towner and Gibson (1983), and a review of the regional geology was given by Yeates et al. (1984). The onshore area of this intracratonic basin, which was initiated as a downwarp in the Ordovician, is more than 430 000 km^2. A major tectonic feature and site of deposition, the Fitzroy Trough, forms a graben along the northern margin of the basin. It is bounded on the northern side by the Lennard Shelf, an area of deposition that overlies a series of tilted fault blocks. Both the Napier Range and the Pillara Range areas are remnants of this carbonate shelf.

Sediments are exposed along the northern margin of the Lennard Shelf as a result of regional post-Permian tilting. They consist of Middle and Late Devonian reef complexes, overlain by shallow-marine deposits of Early Carboniferous age (Playford and Lowry, 1966; P.E. Playford, 1976, 1980, 1981, 1984; Radke, 1976; Druce and Radke, 1979; Towner and Gibson, 1983). Playford and Lowry's model for the reef complexes was revised (Playford, 1980, 1984; Playford et al. 1989) and now incorporates platform, marginal-slope, and basin facies. The platform facies is subdivided into reef-margin, reef-flat, back-reef, and bank subfacies; and the marginal-slope facies into reefal slope, fore-reef and fore-bank subfacies (Fig. 5).

Two periods of reef development (Fig. 6) have been recognized (Playford, 1980)—the Givetian–Frasnian Pillara cycle, and the Famennian Nullara cycle. The cycles represent periods of transgression, which Hurley (1986) points out are closely related to global sea-level curves for the Devonian (Johnson et al., 1985). In early stages, reefs of the Pillara cycle were essentially low-relief banks, with little true reef development (Playford, 1984). However, prominent reef scarps and pinnacle reefs became more common as the rate of subsidence increased towards the end of the Frasnian. Most of the reefs were drowned and partially covered by basinal sediments by the end of the Frasnian. A brief period of partial emergence occurred at the Frasnian–Famennian boundary, marking the termination of the Pillara cycle. The Famennian Nullara cycle was initiated by renewed subsidence; and in contrast with the Pillara cycle, the platform carbonates had well-developed reef margins.

This report uses the reef terminology (Fig. 5) of Playford (1980, 1984; Playford et al. 1989). For the Napier Range area (Table 1), it follows the detailed stratigraphy developed by Billiton Australia Ltd (Buchhorn and Sceney, 1984), except that the Geological Survey of Western Australia (GSWA) terminology has been adopted for a red nodular unit overlying the Pillara reefal slope in the Napier Range. GSWA uses the term "Lower Napier Formation"; whereas in Billiton Australia reports the unit is referred to as "Virgin Hills Formation". General stratigraphic relationships are shown in Fig. 7.

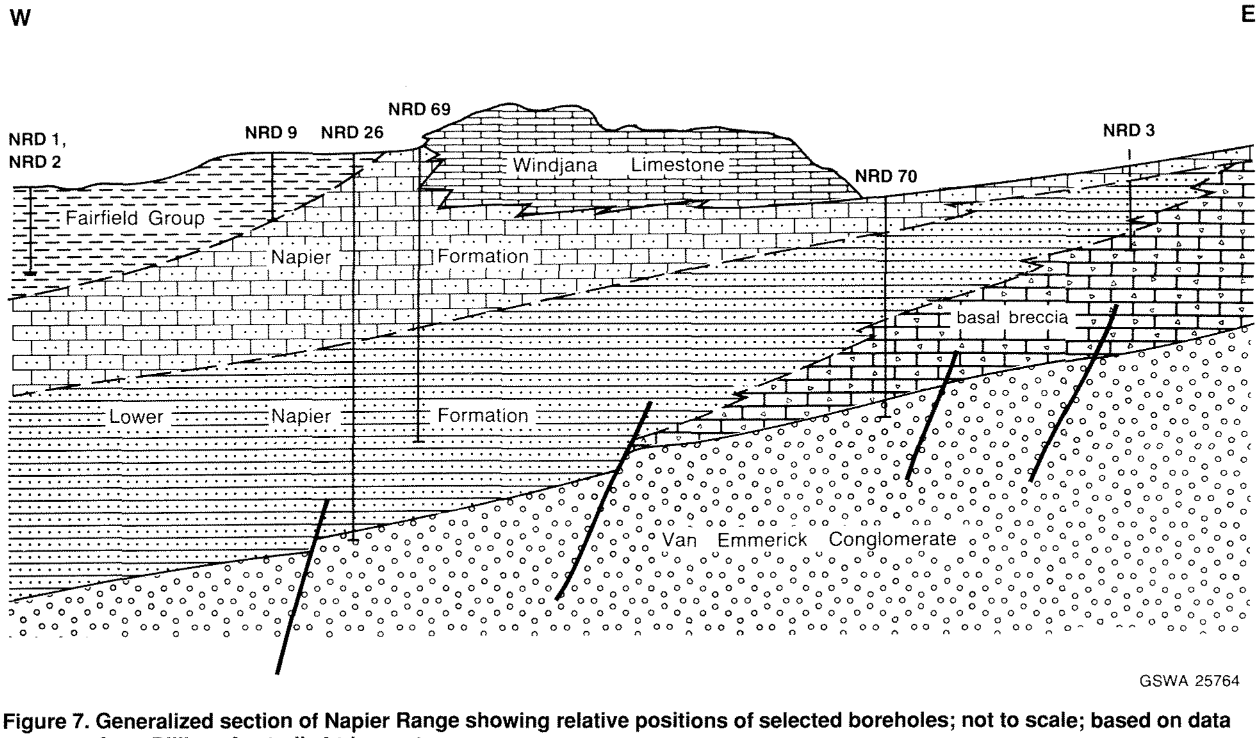


Figure 7. Generalized section of Napier Range showing relative positions of selected boreholes; not to scale; based on data from Billiton Australia Ltd reports.

TABLE 1. NAPIER RANGE STRATIGRAPHY

Stratigraphic unit	*Facies*	*Lithology*
Fairfield Group	Marine	Green mudstone and very fine sandy siltstone, micrinoidal packstone inter-beds
Windjana Limestone	Reef	Abundant stromatactis spar and algal microspar binding; *Renalcis*
Napier Formation	Marginal-slope basin	Arenaceous pelletal grainstone with debris flows; some *Renalcis* reefal binding; *Sphaerocodium*; sponge stromatactis; reefal roll blocks near base; minor dolomitization
Lower Napier Formation	Marginal slope	Red stylobedded silty packstone, contains major roll-block horizons consisting of Pillara reef fragments; dark-red siltstone interbeds; occasional red and green laminated shale; stromatolitic horizons; variably dolomitized; steep depositional dips; = "Virgin Hills Formation" of some Billiton Australia reports
Van Emmerick Conglomerate	Marginal slope	Dolomitic sandstone–conglomerate, commonly altered a and porous

SOURCE: Based on Buchhorn and Sceney (1984)

A section through the Pillara Range area (Fig. 8) shows that sampled boreholes lie mainly near the margins of the reef complexes which form the Limestone Billy Hills and Pillara Range, but some are in the basin separating the two reef complexes. Detailed stratigraphy of the Limestone Billy Hills and Pillara Range areas, summarized in Table 2, is based on the work of Hall (1984), Benn (1984), and Cooper et al. (1984).

These authors recognized a different suite of members for each of the two platform areas, and only tentative correlations were proposed. Cooper et al. (1984) suggested correlation between the Lower Flaggy Member and Lower *Amphipora* Member, between the Lower Fenestral Member and the Lower Fenestral–*Actinostroma* Member, and between Cyclic *Argutastrea* Member and the Lower Cyclic Member (shown as Unit 1 in Table 2). Palynological data are still inadequate to resolve the correlation problems. Comparisons with the Old Red Sandstone Continent zonal scheme (Richardson and McGregor, 1986) show that the ***Contagisporites optivus*** var. ***optivus*–*Cristatisporites triangulatus*** Assemblage Zone is present in samples from Unit 1 in PD 151 from the Pillara Range. However, equivalent units in the Limestone Billy Hills area apparently belong to the older ***lemurata–magnifica*** Assemblage Zone.

Formations sampled for palynomorphs are briefly described below; age assessments are based on evidence from other fossil groups. More detailed descriptions can be found in Playford and Lowry (1966), Playford et al. (1975), Towner and Gibson (1983), and Purcell (1984).

Pillara Cycle

Gogo Formation

The Gogo Formation (Guppy et al., 1958) includes the oldest basin sediments. In the Pillara boreholes, these are shales and siltstones, which vary from light green to dark grey, and are often rich in organic matter. The argillaceous horizons are interbedded with thin limestone and calcareous-nodule horizons.

A fauna of ammonoids, conodonts, nautiloids, tentaculitids, radiolarians, fish, crustaceans, sponge spicules, ostracodes, brachiopods, and gastropods, indicates a possible late Givetian to early Frasnian age (Playford and Lowry, 1966; Towner and Gibson, 1983). Druce (1976) recovered conodonts from outcrop samples which yielded faunas from the Lower, Middle, and Upper *Polygnathus asymmetricus* Zone. These were mainly from the upper part of the Gogo Formation, and indicate a lower Frasnian age for this part of the formation.

Exploration drilling shows that, although the Gogo Formation is poorly exposed, it forms an extensive basin fill (Fig. 8) that is at least 350 m thick. This older part of the Gogo Formation lies between platform carbonates of the Limestone Billy Hills and Pillara Range areas (Benn, 1984; Cooper et al., 1984). Faunas are poorly dated, but miospore evidence suggests a possible middle Givetian age for the oldest sediments.

Sadler Limestone

The Sadler Limestone (Guppy et al., 1958; Playford and Lowry, 1966) is a marginal-slope facies, and comprises calcarenite, calcirudite, megabreccia, and siltstone. A Frasnian age is indicated by brachiopods, ammonoids, conodonts, corals, stromotoporoids, algae, gastropods, and bryozoans, although Playford et al. (1975) suggested that the sequence may extend into the Givetian. Conodont evidence (Druce, 1976) suggests a range from the Upper *Polygnathus asymmetricus* Zone (early Frasnian) to approximately the Givetian–Frasnian boundary.

Pillara Limestone

The Pillara Limestone is a Givetian to late Frasnian platform facies. The name was originally applied to the back-reef sub-facies (Playford and Lowry, 1966), although it also included some reef sub-facies. In recent years, extensive mapping and drilling has shown that the unit consists of back-reef, bank, reef-flat, and reef-margin sub-facies, and also contains sediments transitional to marginal-slope sub-facies, together with patch and pinnacle reef development (Playford, 1980, 1981, 1984; Hurley, 1986; Wallace, 1987,). The Pillara Limestone ranges in age from Givetian to late Frasnian (Playford, 1984).

The unit has been subdivided into members in the Oscar Range (Hurley, 1986) and Geike Gorge areas (Wallace, 1987). However, at present it is not clear whether these members can be recognized in the Pillara Range area. Consequently, the informal subdivisions used by BHP (Hall, 1984; Benn, 1984; Cooper et al., 1984) have been retained for clarity in this report (Table 2, Figs 4 and 8). The unit is primarily dolomite, but it contains minor layers of sandstone and siltstone.

P. E. Playford (1981) gave an age range from late Givetian to late Frasnian. The upper limit of the formation coincides with the world-wide faunal extinction at the Frasnian–Famennian boundary. Miospore evidence in this report indicates that the oldest part of the sequence is probably older than late Givetian (Grey, 1991). A middle Givetian age for the older part of the sequence is supported by other palaeontological evidence as discussed below.

Unpublished, and somewhat limited conodont identifications from borehole PD 26 in the Limestone Billy Hills (Nicoll, 1981) indicated that the lower *Polygnathus asymmetricus* Zone occurs near the top of the borehole.

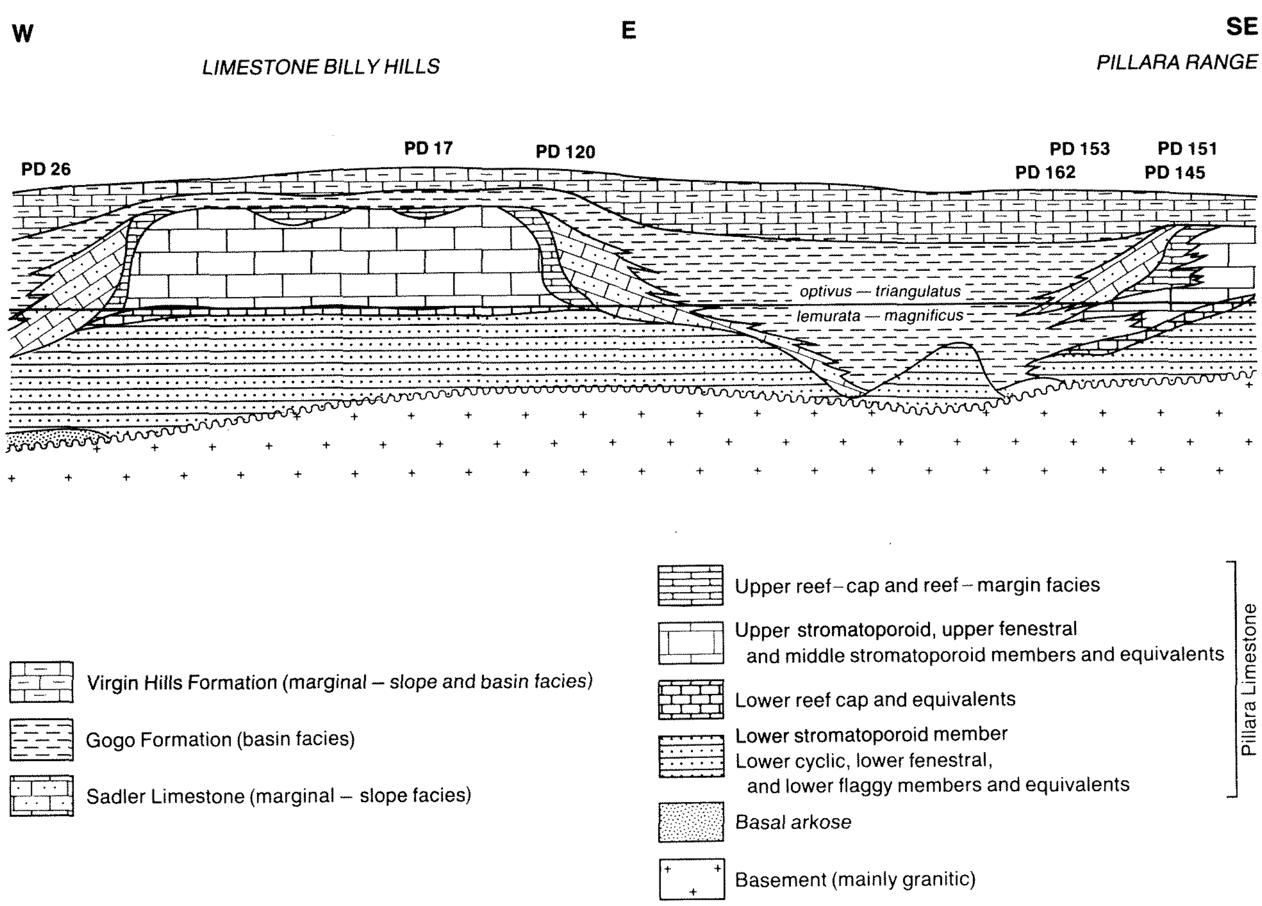


Figure 8. Generalized section of Limestone Billy Hills and Pillara Range showing relative positions of selected boreholes; not to scale; stratigraphic terminology after Hall (1984), Benn (1984), and Cooper et al. (1984).

TABLE 2. COMPARATIVE STRATIGRAPHY OF LIMESTONE BILLY HILLS AND PILLARA RANGE AREA.

Unit	*Limestone Billy Hills*	*Pillara Range*
	Virgin Hills Formation	
	Gogo Formation	Gogo Formation
	Sadler Limestone	Sadler Limestone
	Upper Reef Cap Member	
6	Upper Stromatoporoid Member	Upper *Actinostroma–Stachyoides* Member
5	Upper Fenestral Member	
4	Middle Stromatoporoid Member	
3	Lower Reef Cap Member	
2	Lower Stromatoporoid Member	
		Upper Fenestral-*Actinostroma* Member
1	Lower Cyclic Member	Cyclic *Argutastrea* Member
	Lower Fenestral Member	Lower Fenestral-*Actinostroma* Member
	Lower Flaggy Member	Lower Amphipora Member

SOURCE: Terminology of Hall (1984), Cooper et al.(1984), and Benn (1986). Detailed lithological descriptions of the units are given by the authors listed above.

Sediments approximately 200 m lower belong to either the *varcus* or *ensensis* zone. Undated sediments of the Pillara Limestone extend for at least three or four hundred metres below this and could therefore range into the middle or possibly early Givetian. Conodont ages determined by WAPET (West Australian Petroleum Pty Ltd) also suggest that the formation is likely to be partly Givetian to earliest Frasnian (Read, 1973).

A late Givetian age for the base of the formation was suggested by Playford and Lowry, (1966). This was based on the occurrence of *Stringocephalus fontanus* Veevers 1959, which is known from the oldest part of the Pillara Limestone at Cadjebut Mine (P.E. Playford, personal communication, 1987). However, the genus *Stringocephalus* is no longer thought to be restricted to the latest Givetian, and a middle Givetian age seems more probable (Grey, 1991). Because of the occurrence of *Stringocephalus*, the base of the sequence is unlikely to be older than early Givetian, and a middle Givetian age is more probable. This age is supported by the miospore evidence (Grey, 1991).

Van Emmerick Conglomerate

The Van Emmerick Conglomerate is a poorly sorted fanglomerate and debris-flow conglomerate. Some parts include sandstone bands which contain blocks of reef limestone. Sandstone and rubble horizons near the base of the Napier sequence are tentatively assigned to this unit (referred to as "Van Emmerick Sands" in Billiton Australia reports). Palynological sampling of this sequence was confined to thin, silty partings between limestone blocks. Miospores in these samples are commonly corroded and fragmented, and it is quite probable that reworking has occurred. Reworked miospores would originate from the same sequence from which the blocks were derived, presumably the Pillara Limestone.

Nullara Cycle

Although deposition of the marginal-slope and basin facies — the Virgin Hills and Napier Formations — continued from the Pillara to the Nullara cycles, lithologies suitable for palynological preparation were only found in the Famennian and earliest Tournaisian parts of the sequence, in the Nullara Cycle.

Virgin Hills Formation

The Virgin Hills Formation (Guppy et al., 1958) is a marginal-slope and basinal facies of red limestone, and calcareous siltstone and sandstone. In general, lithologies are unsuitable for palynomorph preservation, but a few samples from PD 153 were productive. Conodonts and ammonoids indicate a middle Frasnian to middle Famennian age (Playford and Lowry, 1966; Druce, 1976, Towner and Gibson, 1983).

Napier Formation

The Napier Formation (Guppy et al., 1958) includes marginal-slope and basin facies; and consists of calcarenite, calcirudite, megabreccia, and terrigenous sediments. Terminology for the red, nodular sequence — referred to as "Virgin Hills Formation equivalent" and "Lower Napier" in Shell Minerals reports, and as "Lower Napier" by GSWA — requires further clarification.

Based on evidence from conodonts, goniatites, brachiopods and foraminifers, the formation is known to range in age from early Frasnian to late Famennian (Playford et al., 1975; Druce, 1976; Towner and Gibson, 1983).

Fairfield Group

The Fairfield Group (Druce and Radke, 1979) overlies the reef complex and consists of interbedded limestone, shale, siltstone and sandstone. Only the lower part of the unit was sampled for this investigation, because comprehensive palynological studies have already been carried out (Balme and Hassell, 1962; G. Playford, 1976). The group ranges from late Famennian to late Tournaisian in age, and contains a fauna of brachiopods, bryozoans, conodonts, ostracodes, solitary corals, and ammonoids (Playford and Lowry, 1966; Druce, 1976; Druce and Radke, 1979; Towner and Gibson, 1983).

Previous palynological studies

Canning Basin

A comprehensive review of Carboniferous and Permian palynological studies in Australia was published by Kemp et al. (1977), and is summarized and updated in Fig. 2. Palynofloras from the Visean upwards are well documented, but many problems remain in sequences older than Tournaisian. Previous palynological assessments (only six publications) of older assemblages in the Canning Basin have been limited in scope (Balme, 1960; Balme and Hassell, 1962; Balme, 1964; Grey, 1974; G. Playford, 1976; Colbath, 1990). In addition, Grey (1991), reported the palynological determination of a mid-Givetian age for the Pillara area boreholes that are here documented in detail.

Balme (1960) gave a preliminary account of both "Upper and Lower Carboniferous" microfloras from the "Laurel Beds", now the Laurel Formation, and from the younger Anderson Formation, both part of the Fairfield Group (Druce and Radke, 1979). Samples were from BMR Laurel Downs 2 borehole, near the northeast margin of the Fitzroy Trough, and WAPET Fraser River 1 borehole on the Dampier Peninsula, western Fitzroy Trough. Taxonomic identifications were to generic level only.

Balme and Hassell (1962) described 31 miospore taxa from the "Fairfield Beds" from the lower part of BMR Laurel Downs 2, together with material from Kimberley Downs 67 Mile, Frome Rocks 2, Stumpys Soak 2, The Sisters 1, and Plum Plains bores. They recognized marked contrasts between the Canning Basin assemblage and spores from the Frasnian Gneudna Formation of the Carnarvon Basin (Balme, 1962), and noted the significance of *Retispora lepidophyta* (Kedo) Playford 1976 (= *Leiozonotriletes naumovae* Balme and Hassell 1962) as an important marker species.

Balme (1964), in a review paper, designated two microfloral assemblages for Devonian - Carboniferous sequences in Australia. The Famennian part of the sequence was referred to the "*Leiozonotriletes* Microflora", and the succeeding "Lower to ?Upper Carboniferous" as the "Lycosporoid Microflora", a reference to *Granulatisporites frustulentus* Balme and Hassell emend. Playford 1976, which Balme equated with lycospores common in European Visean sequences.

G. Playford (1976) also described palynomorphs from the Fairfield Group, from four boreholes (Pickands Mather A.H.2, BMR Lennard River 1, BMR Lennard River 2, and Noonkanbah 4), in the Oscar Range area. He revised Balme and Hassell's (1962) descriptions, and recognized fifty-seven species of miospores and nine of acritarchs. He identified two miospore suites, a latest Devonian (Famennian, Fa2d, to Strunian, Tn1a or early Tn1b) corresponding to Balme's "*Leiozonotriletes* Assemblage", which he renamed the "*Retispora lepidophyta* Assemblage", and a younger, Early Carboniferous (Tournaisian, Tn1b–Tn3) palynoflora, which he called the "*Grandispora spiculifera* Assemblage".

None of the above studies included the earliest occurrence of the "*Retispora lepidophyta* Assemblage", nor the sequence below the latest Famennian. A brief publication (Grey, 1974) illustrated miospores — identified only to generic level — from the Gogo Formation in BMR Noonkanbah 1. The palynoflora from this ?Middle or early Late Devonian part of the sequence is radically different from those previously described from the latest Devonian or early Carboniferous, and is dominated by *Ancyrospora* spp., a robust miospore with conspicuous ornament of anchor-tipped spines.

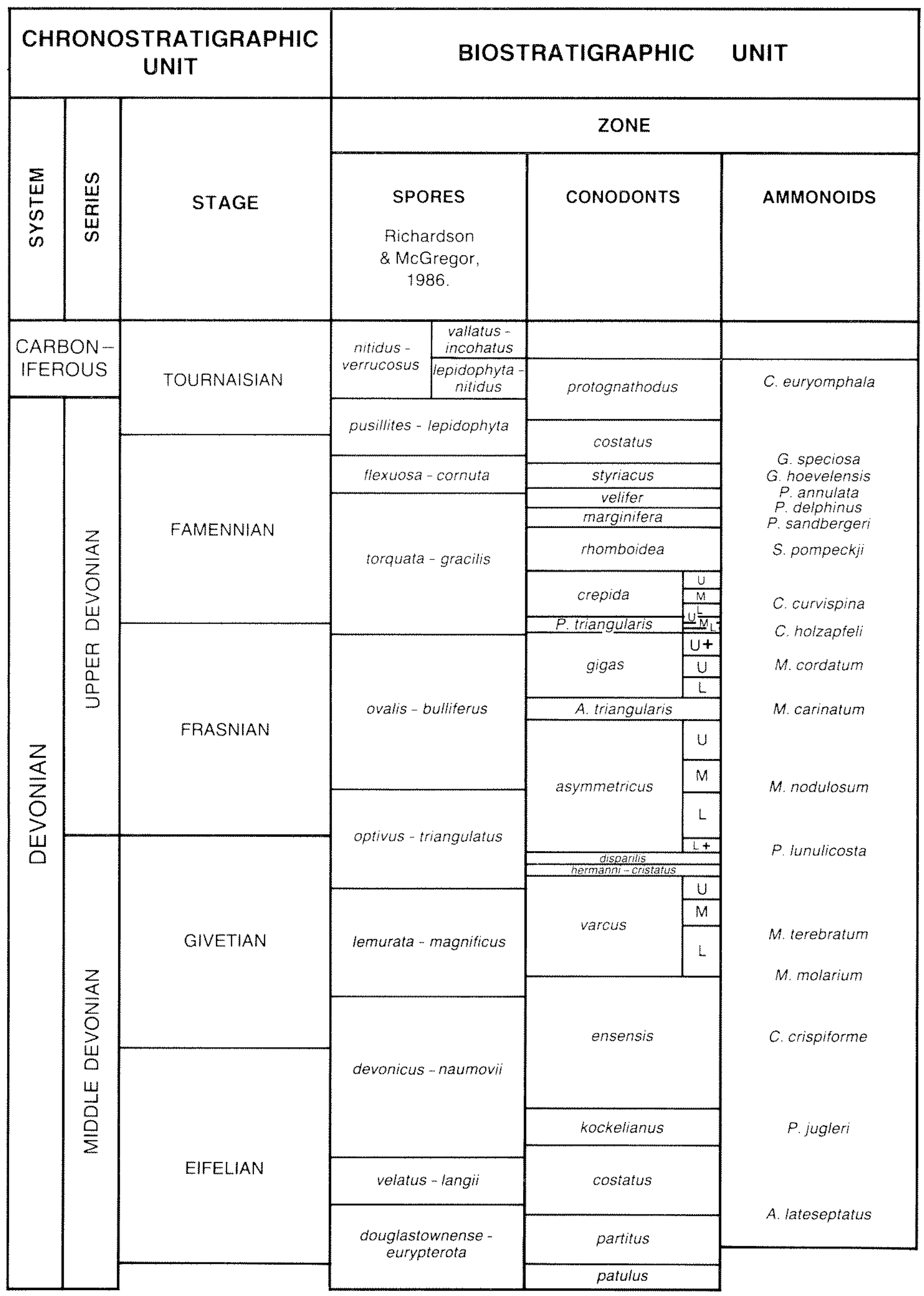
Colbath (1990) examined organic-walled phytoplankton (acritarchs) from Limestone Billy Hills, from the same suite of boreholes used for the present miospore study. He described 74 taxa, many of them new. The phytoplankton data do not provide a diagnostic age for Pillara unit 1, but Colbath suggested a late Givetian–Frasnian age for unit 2 of the Pillara Limestone, and a Frasnian age for Pillara Limestone unit 8 and upper parts of the Sadler Limestone and Gogo Formation. Colbath's results are consistent with the miospore data presented in this study, although only one sample is common to both studies.

Rest of Australia

A few Devonian and Carboniferous palynological palynofloras have been studied elsewhere in Western Australia (Fig. 2). Balme (1962) described a Frasnian palynoflora from the Gneudna Formation of the Carnarvon Basin. This has some elements in common with upper Pillara cycle miospores from the Lennard Shelf (Grey, 1974). Balme (1988) examined new sections from the Carnarvon Basin and suggested correspondence to the upper part of the ***optivus–triangulatus*** Assemblage Zone of Richardson and McGregor (1986). G. Playford (1981) and Playford and Dring (1981) have published detailed systematic studies of acritarchs from the same formation.

Devonian miospores have been recovered from the latest Devonian "Buttons Beds" (now Formation) in the southwest Bonaparte Basin (Playford, 1982). They have also been recognized as reworked fossils in the Cretaceous Otorowiri Siltstone in the northern Perth Basin (Ingram, 1976). Backhouse (1988, p. 31) favoured a source to the north, possibly in the Coolcalalaya Subbasin east of the Urella Fault, or from further north in the Carnarvon Basin. Visean palynofloras have been described from several formations in the Bonaparte Basin (Venkatachala, 1964; Playford, 1971; Playford and Satterthwait, 1985, 1986).

Devonian and Carboniferous palynofloral assemblages described from elsewhere in Australia include: possible Frasnian miospores from the Parke Siltstone, lower Pertnjara Group of the Amadeus Basin, Northern Territory (Hodgson, 1968); a palynoflora older than latest Devonian (i.e. older than Fa2d to Tn1a) from the Brewer Conglomerate in the upper Pertnjara Group (Playford et al., 1976); a Visean palynoflora from the Ducabrook Formation in the Drummond Basin of Queensland (Playford, 1977; 1978); a Middle Devonian palynoflora from the Etonvale Formation in the Adavale Basin (de Jersey, 1966; Price, 1980); and late Devonian and early Carboniferous spores from the Mulga Downs Beds in New South Wales (Evans, 1968). Price et al. (1985) reviewed the distribution of Palaeozoic species in Australia.



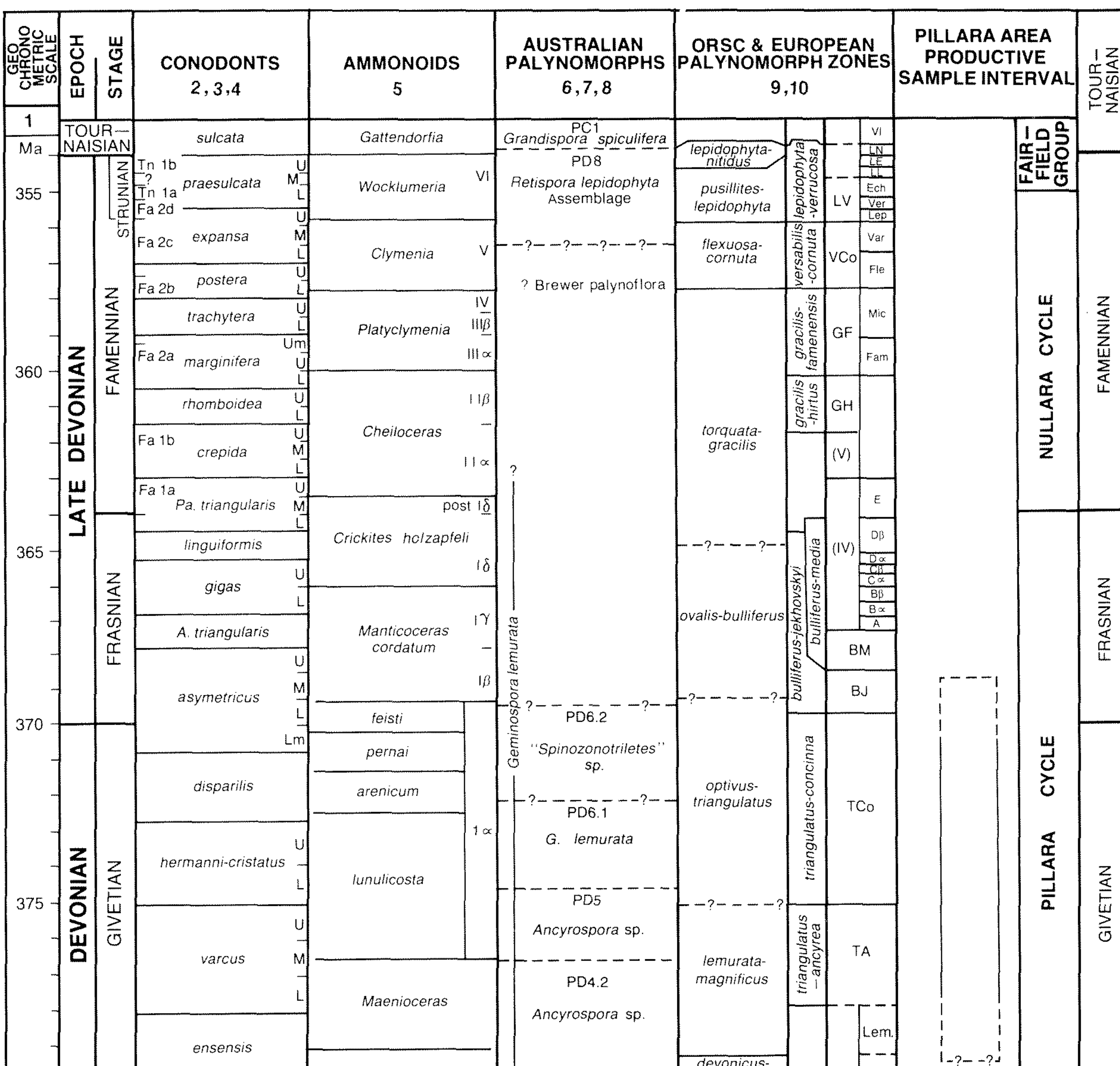
GSWA 25766

Figure 9. Suggested biostratigraphic correlations of Middle and Late Devonian spore assemblage zones of the Old Red Sandstone Continent with standard conodont and ammonoid zones; after Richardson and McGregor (1986).

Two important systematic papers, one reappraising the genus *Geminospora* Balme 1962 (Playford, 1983), and another (Evans, 1970) revising *Perotrilites* Erdtman emend. Evans 1970 and *Diaphanospora* Balme and Hassell emend. Evans 1970, are largely based on Australian specimens.

World-wide

World-wide Devonian correlations, based on palynological zonations, have proved difficult (McGregor, 1979a). Facies variations, floral provinciality, and the lack of precise stratigraphic correlation between regions have contributed to the uncertainties. Problems have to some extent been resolved for northern hemisphere successions. Richardson and McGregor (1986) published a comprehensive zonal scheme for Silurian and Devonian sequences of northern Canada and comparable areas of the Old Red Sandstone Continent in Europe (Fig. 9). This was parallelled by schemes proposed for mainly marine Devonian of eastern European (Turneau, 1986), and for the type Devonian of the Ardennes–Rhenish regions of Western Europe (Streel et al., 1987) (Fig. 10). Of the three schemes available, the one proposed by Richardson and McGregor has the most direct application to Lennard Shelf sequences (Grey, 1991). Many of the key species in the other two schemes have not been recognized in Western Australia, and the zones cannot readily be applied. Consequently the Richardson and McGregor (1986) scheme is followed in this paper. The differences between the palynofloras may be a result of provinciality caused by the regional diversification of macrofloras (McGregor, 1973).



GSWA 25767

Figure 10. Biostratigraphic correlations for the type marine, Middle and Late Devonian of the Ardennes–Rhenish regions; adapted from: 1 — Young (1989); 2 — Ziegler and Sandberg (1984); 3 — Ziegler and Klapper (1985); 4 — Sandberg et al. (1988), 5 — House (1979); 6 — de Jersey (1966); 7 — Price (1980); 8 — Price et al. (1955); 9 — Richardson and McGregor (1986); 10 — Streel et al. (1987).

Richardson and McGregor's (1986) scheme for Silurian and Devonian of the Old Red Sandstone Continent (Fig. 9) is the culmination of over three decades of comprehensive taxonomic studies. Their work is of significance, not only because they provide a wealth of practical detail to aid in recognition of zones, but also because of discussion of criteria used in establishing boundaries. A brief summary of the many papers published is given by McGregor and Camfield (1982) and Richardson and McGregor (1986).

Richardson and McGregor (1986) recognized 19 spore assemblage zones for the Silurian and Devonian. Biozones are based on the following criteria: "two characterizing and widely occurring species after which the zone is named, at least one of which begins at the base of the zone; an association of other species of spores that typically occur together; and for some zones, a major morphological 'event' such as the first appearance of proximal radial muri . . . ".

Streel et al. (1987) criticized Richardson and McGregor's zonal scheme because it mixes Oppel and interval zones. Nevertheless, the assemblage zones used for correlation of the Old Red Sandstone Continent can be readily applied to areas where other precise stratigraphic control is lacking. Publication of Richardson and McGregor's zonal scheme prompted this re-assessment of earlier palynological studies of the Lennard Shelf sequences (Grey, 1981; 1982 a, b; 1983 a–d; 1984). These studies had been inconclusive with regard to a precise age determination for the borehole samples.

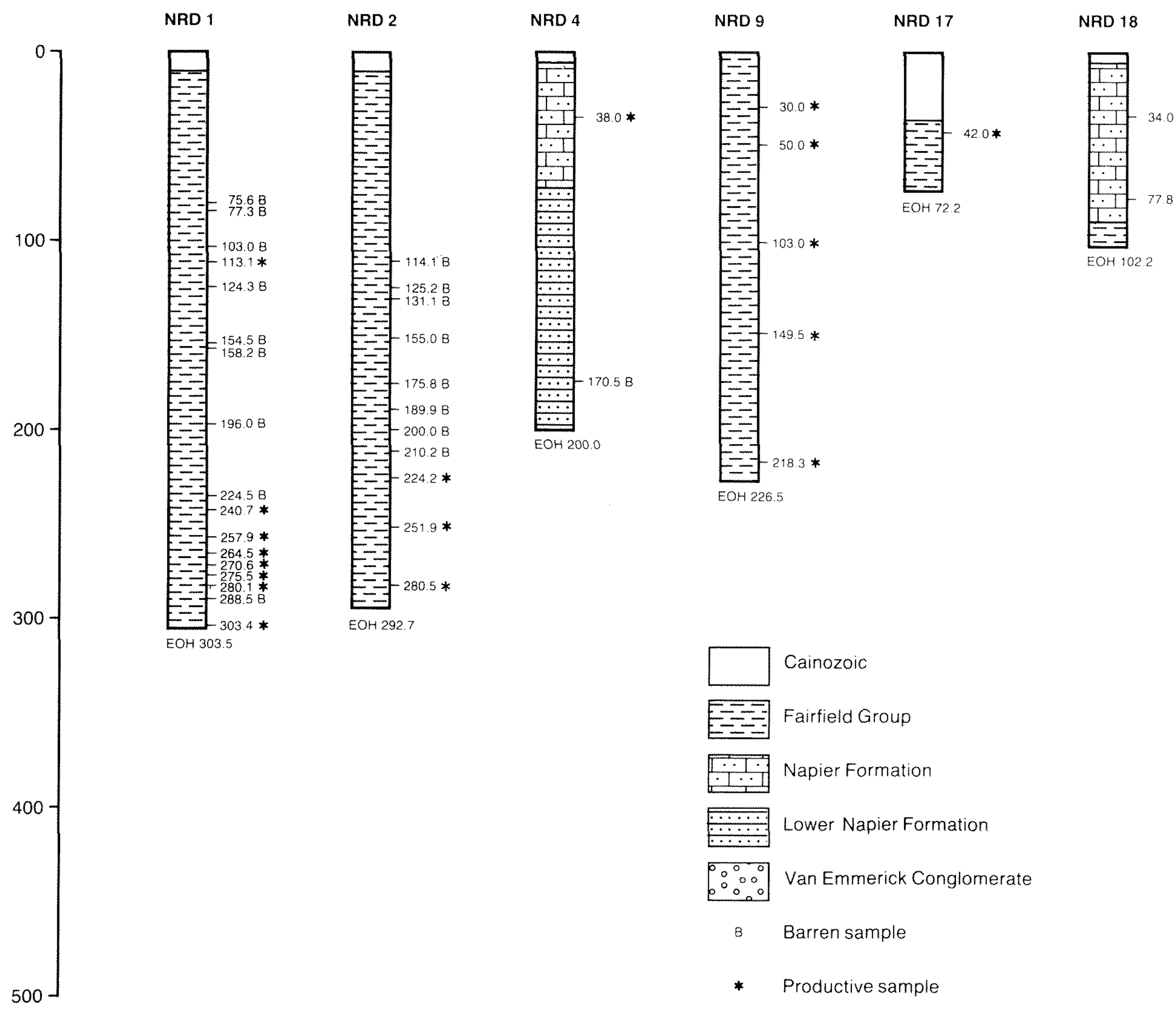


Figure 11. Generalized stratigraphy and sampled horizons from NRD boreholes (stratigraphy based on data from unpublished Billiton Australia Ltd).

Materials and methods

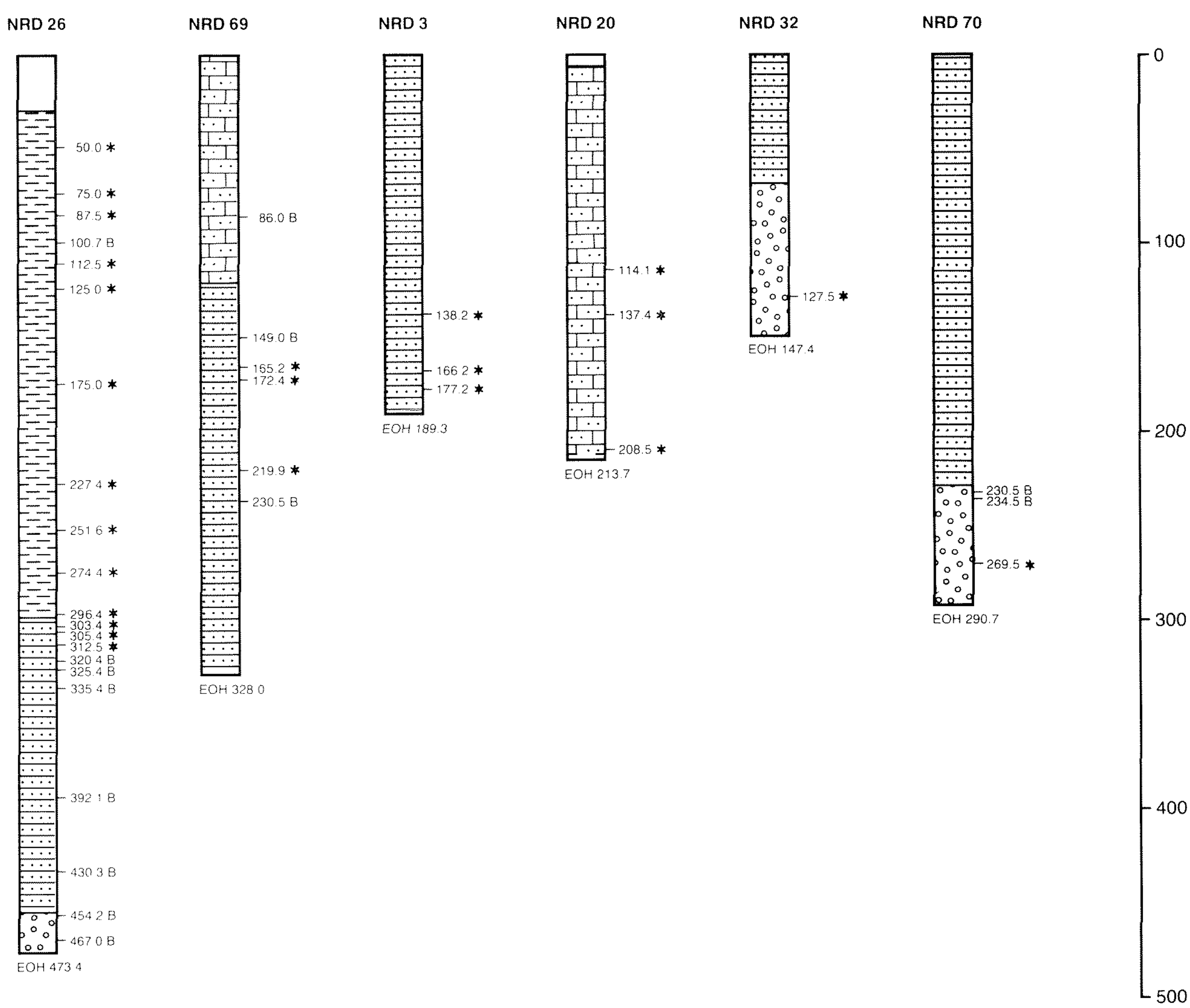
Samples

K. Grey and C. Ringrose sampled Napier and Pillara cores in 1982 and 1983. Samples were collected at irregularly spaced stratigraphic intervals and consisted mainly of dark-grey or green mudstones, siltstones, and shales (lithologies judged most likely to yield palynomorph assemblages). Major sample gaps occur in parts of the sequence that are predominantly carbonate.

Forty-three samples from 12 boreholes (Fig. 11) in the Napier Range area were selected from a total of 128 processed from 32 boreholes. A total of 252 samples from 50 boreholes were processed from the Limestone Billy Hills–Pillara Range area, and a further 158 samples from 43 boreholes in adjacent areas. From these, 46 samples from 7 boreholes (Fig. 12) — all in the Limestone Billy Hills–Pillara Range area — were selected as representative of the Pillara sequence. Precise locations and detailed stratigraphic information for individual boreholes are held by the companies concerned.

Preparation

Extraction and concentration of acid-insoluble microfossils followed conventional laboratory procedures (Phipps and Playford, 1984). Nitric acid was used as the main oxidizing agent; most samples were oxidized for 5–10 minutes. Although some samples, already light in colour, required no oxidation, a few required up to



GSWA 25768

twenty minutes treatment with nitric acid. Residues had a high natural colour and were not stained. Preparations were strew-mounted using polyvinyl alcohol (PVA) as dispersing agent and "Petropoxy" as the mounting medium.

Examination procedures

Only about one-third of all processed samples yielded identifiable miospores. A further third contained indeterminate organic matter of varying quantity, but did not yield palynomorphs. The remainder were barren.

Few of the productive samples were well-preserved. Some produced only one or two identifiable palynomorphs. Many specimens were badly corroded and showed the effects of decomposition, either by abrasion, or by bacterial or fungal attack. Corrosion often gave miospore surfaces a pitted or granulate appearance which was difficult to distinguish from surface sculpture. Other spores were coated in tapetal material, usually consisting of globular fragments of plant material, or possible fungal spores which resemble pila and bacula.

Although recovery rates were generally poor, diverse palynofloras were obtained from some samples (mainly

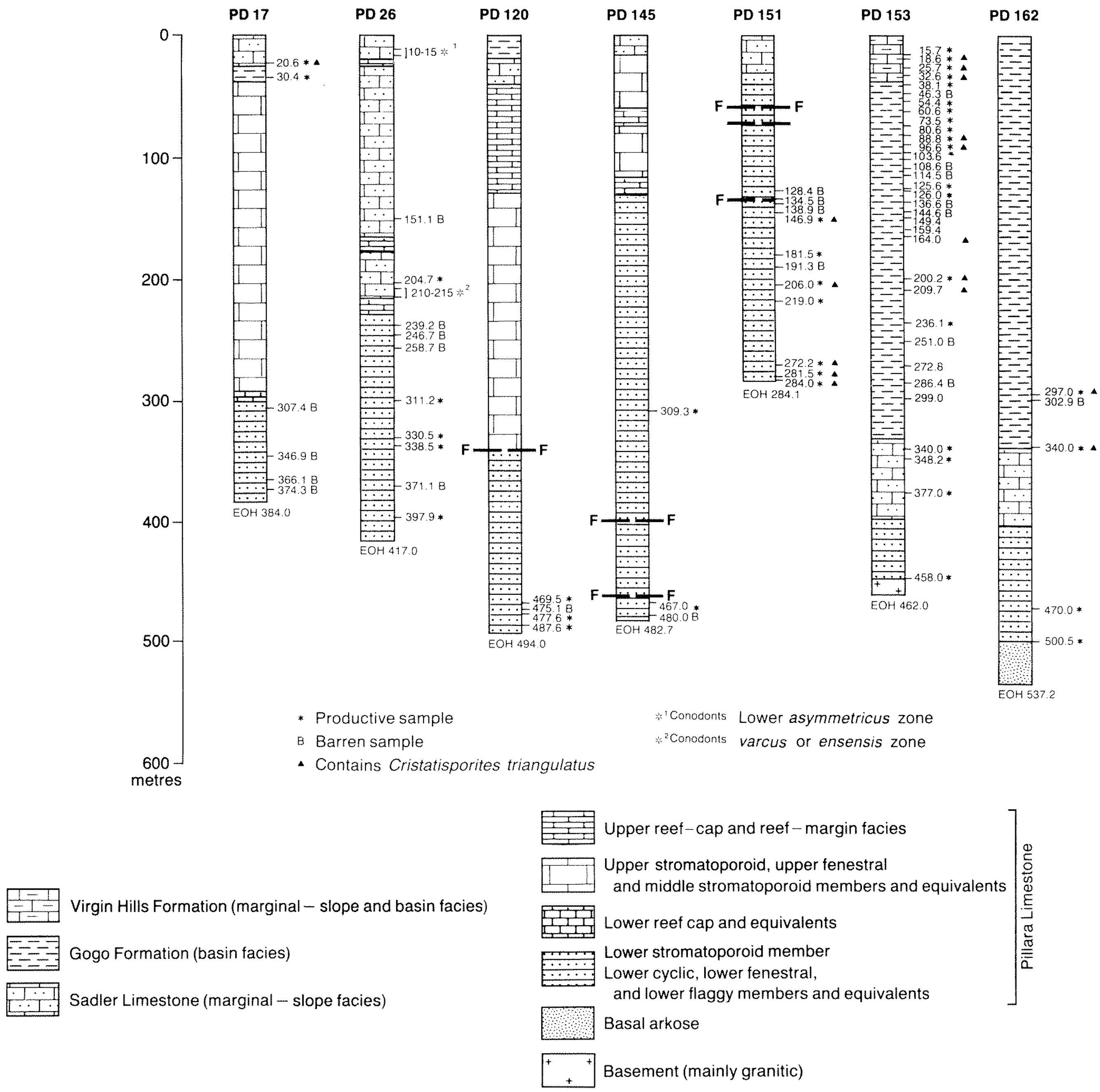


Figure 12. Generalized stratigraphy and sampled horizons from PD boreholes; stratigraphy based on Hall (1984), Benn (1984), Cooper et al. (1984), and unpublished BHP reports.

miospores, with occasional acritarchs, scolecodonts, and chitinozoa).

As a guide to thermal maturation, strew-mounts were made of un-oxidized residues to determine the colour maturation index (CMI). Results were limited because it was impossible to make determinations for a selected species in a continuous section. The few readings obtained which can be considered reliable, indicate a low thermal maturation level (CMI = 2.0–3.5), with temperatures around 80°C and therefore below the oil window. This is consistent with results obtained from Rock-Eval pyrolysis, per cent TOC (total organic carbon) analysis, and gas chromatography carried out on the same suite of samples (Alexander et al., 1983).

Specimens were photographed with a Leitz Orthoplan microscope serial no. 834965 (Palaeontology Section, GSWA). Stage co-ordinates of illustrated specimens are from the mechanical stage of that instrument, and they are listed in Appendix 3. Specimens are deposited in the GSWA Fossil Collection as registered numbers GSWA F47955 to F48043.

Descriptive methods

This report follows the increasingly common practice of arranging palynological taxonomic descriptions alphabetically by genera, rather than by arbitrarily devised suprageneric categories (McGregor and Camfield, 1982). In part this practice was adopted because the alphabetical method is easier to use, and in part it was dictated by the main aims of the project, which were stratigraphic rather than taxonomic.

One hundred and forty-two miospore taxa were recognized during the study. Where possible, specimens were assigned to previously described taxa. However, where morphologic differences of possible taxonomic significance occur, specimens were only tentatively assigned to existing species. This practice was followed particularly for assignments to taxa not previously recorded in Australia. Citations of spore nomenclature, including "?" and "cf." designations are given in the form in which they were originally published. Dimensions are for the maximum equatorial diameter excluding sculpture, except where noted.

Preservation was often too poor to permit confident identification with existing species. In such cases, the convention of the National Museum of Natural History, Washington (Kornicker, 1979) has been used to indicate the degree of precision in identifications. A question mark preceding the binomial indicates that the entire identification is questioned; following the generic assignment, it indicates that the generic assignment is in doubt; and following the trivial name, it indicates that the specific identification is dubious, but generic assignment is correct.

Although some new taxa are undoubtedly present, erection of new species is precluded by poor preservation and the small number of specimens recovered. McGregor and Camfield (1982) cite thirteen or more adequately preserved specimens as the requirement for erection of a new species. None of the potential new taxa from the Lennard Shelf has been observed in sufficient numbers. For the present, such forms are indicated by the use of open nomenclature.

In keeping with the stratigraphic emphasis of this report, synonymy lists have been kept to a minimum. They mainly cite major references which give a more complete synonymy. A few citations indicate minor modifications or recent changes of local significance. Where this report follows a previous uncertain assignment (indicated by "cf." or "?" by the previous authors) the appropriate references are given in the synonymy. A list of the taxa identified is given in the systematic index.

Acknowledgements

This project has only been possible through the co-operation of the companies involved and assistance from their project geologists. In particular, I thank S. Chaku, formerly of Billiton Australia, and various geologists from BHP, especially G. Murphy, M. Hall, A. Milne, and C. Benn. C. Ringrose, formerly of GSWA, collected some of the samples. J. Backhouse, B. Balme, R. Purcell, G. Playford, J. Richardson, and K. Colbath, provided help with various aspects of the palynology. B. Balme read the draft manuscript and made invaluable comments, particularly with regard to the systematics. P.E. Playford advised about the regional stratigraphic setting. I am particularly indebted to D.C. McGregor, Geological Survey of Canada, for critical appraisal of the manuscript after examining the specimens. His comments have been of considerable assistance in both taxonomic and biostratigraphic interpretations.

Chapter 2

Stratigraphic significance of the miospores

Composition of palynofloras

The distribution of miospores in individual boreholes is shown in Appendix 2. The palynofloras belong to two broadly defined, mutually exclusive, groupings (Fig. 2). The younger one corresponds to the latest Devonian and earliest Carboniferous ***pusillites–lepidophyta*** Assemblage Zone of Richardson and McGregor (1986), and the older one is of Middle and Late Devonian age, ranging from the ***lemurata–magnificus*** to the ***optivus–triangulatus*** Assemblage Zones of Richardson and McGregor (1986). The assemblages are separated by a broad sample gap corresponding to development of reefal carbonates. The upper assemblage has already been well documented (Balme and Hassell, 1962; G. Playford, 1976). In the older assemblage, low recovery rates and disparate yields make the palynofloras unsuitable for statistical counts of relative abundances.

Spore to acritarch ratios are variable, and could reflect palaeoenvironmental variations. Because of the vagaries of preservation, they cannot be considered reliable. Well-preserved acritarchs are common in some samples, but distribution is sporadic (Colbath, 1990). A few samples contain a variety of, as yet, unidentified chitinozoans, apparently new species. Scolecodonts are also abundant, but have so far shown only limited application for biostratigraphy (Jansonius and Craig, 1971). The presence of acritarchs, scolecodonts, and chitinozoans, is an indication of predominantly marine conditions. A neritic environment is indicated for samples containing scolecodonts.

The younger Lennard Shelf assemblage is characterized by abundant *Retispora lepidophyta* and *Granulatisporites frustulentus*. It also contains other species previously recorded from the latest Devonian and earliest Carboniferous of Australia. These include *Apiculatisporis morbosus*, *Camptotriletes balmei*, *Crassispora drucei*, *Diaphanospora depressa*, *Diaphanospora perplexa*, *Diaphanospora riciniata*, *Gorgonispora convoluta*, *Hystricosporites porrectus*, *Leiozonotriletes laurelensis*, *Lophozonotriletes triangulatus*, and *Reticulatisporites ancoralis*.

All miospores, with the exception of *Retusotriletes digressus* Playford 1976 and *Grandispora praecipua* Playford 1976, which may have either trilete or, more commonly, monolete laesurae, and *Latosporites* sp. indet., a bilaterally symmetrical, monolete taxon, are radially symmetrical and trilete. Taxa are generally morphologically diverse, and sculpture is variable. However, miospores with large, conical processes and bifurcating tips typical of the Devonian (such as the ancyrospores) have not been recorded except for *Hystricosporites porrectus*. Small, camerate miospores — common in the early Carboniferous — are present. They include *Grandispora*, *Diaphanospora*, *Auroraspora*, and *Retispora*. There are no large camerate miospores.

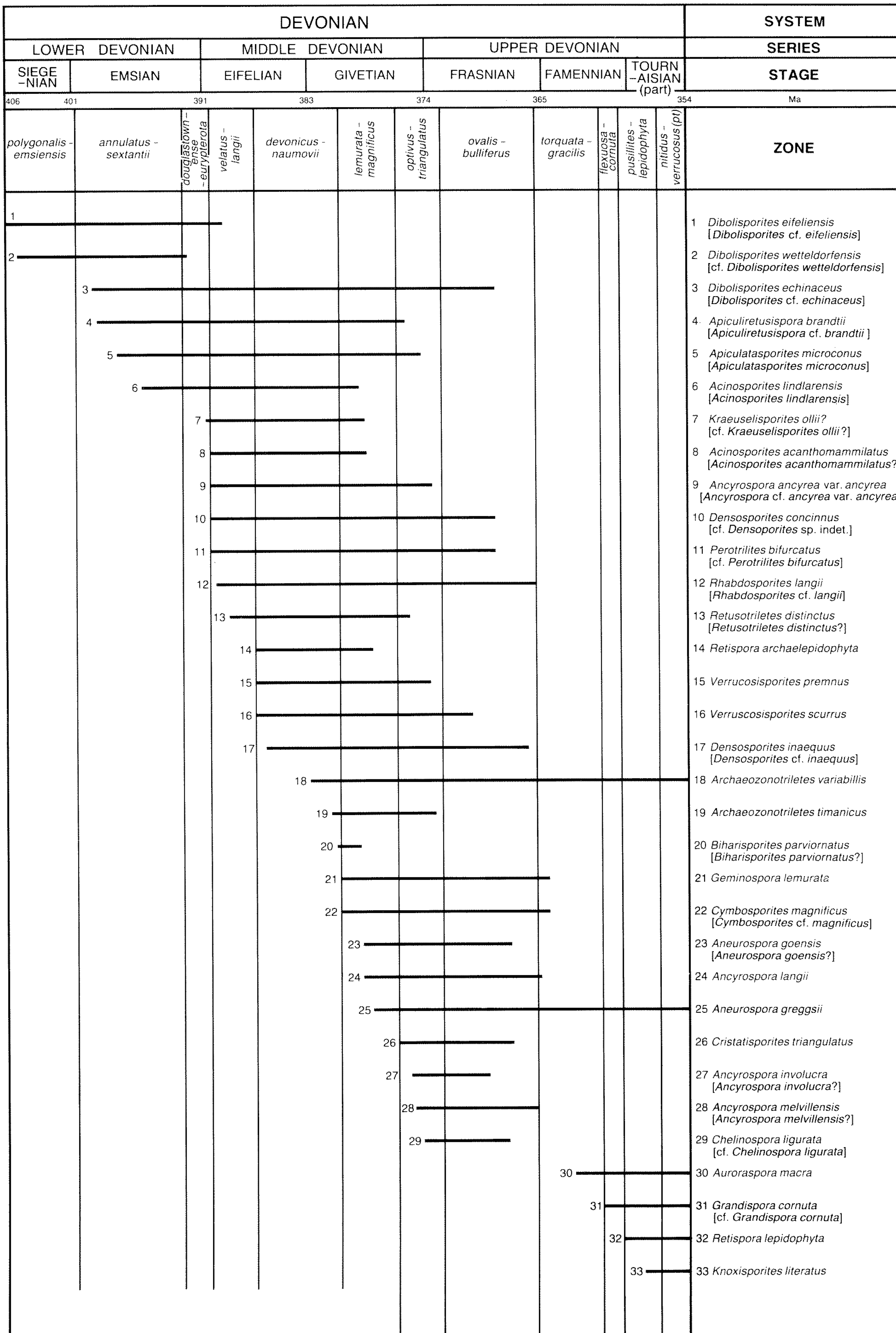
Many taxa are apparently endemic to Australia: for example, *Granulatisporites frustulentus* is a common and persistent species in the Canning Basin (Balme and Hassell, 1962; G. Playford, 1976), but has not been recorded outside Australia. Other taxa are similarly restricted, although species such as *Knoxisporites literatus*, *K. pristinus* and *Auroraspora macra*, are regarded as characteristic of the Old Red Sandstone Continent (Richardson and McGregor, 1986); and *R. lepidophyta* has a widespread geographical distribution (G. Playford, 1976).

By contrast, the older Lennard Shelf assemblage is dominated by robust miospores with anchor-tipped spines, in particular by the genus *Ancyrospora*. Large, camerate miospores are sometimes present. A wide variety of simple, trilete, ornamented miospores, with a sculpture of grana, verrucae, coni, bacula, or spinae, or a mixture of several types of sculpture, are also a significant element of the palynofloras. They include various species of *Acinosporites*, *Anapiculatisporites*, *Apiculatasporites*, *Apiculatisporis*, *Granulatisporites* and *Verrucosisporites*. Radially costate spores of the genus *Emphanisporites* were only rarely observed in the older assemblage. Simple, trilete miospores with well-developed contact faces, such as *Apiculiretusispora* and *Retusotriletes* are common.

Several significant miospores recorded from the Old Red Sandstone Continent (Richardson and McGregor, 1986) apparently do not occur in the Lennard Shelf sequence. In particular, no specimens of *Archaeoperisaccus* (a widespread and distinctive genus, characterized by an extension of the exoexine in the longitudinal plane) have been recognized. This is consistent with McGregor's (1979a, p. 179) contention that the genus is geographically restricted and occurs only in Frasnian sequences north of the palaeoequator. The large, camerate miospore *Contagisporites optivus* var. *optivus* is also absent.

Age

As discussed by Grey (1991), the age of the Lennard Shelf assemblages can best be determined by reference to the zonal scheme (Fig. 13) erected by Richardson and


DEVONIAN
SYSTEM
LOWER DEVONIAN
MIDDLE DEVONIAN
UPPER DEVONIAN
SERIES
SIEGE -NIAN
EMSIAN
EIFELIAN
GIVETIAN
FRASNIAN
FAMENNIAN
TOURN -AISIAN (part)
STAGE
406
401
391
383
374
365
354
Ma
polygonalis - emsiensis
annulatus - sextantii
douglastown - ense - eurypterota
velatus - langii
devonicus - naumovii
lemurata - magnificus
optivus - triangulatus
ovalis - bulliferus
torquata - gracilis
flexuosa - cornuta
pusillites - lepidophyta
nitidus - verrucosus (pt)
ZONE
1 Dibolisporites eifeliensis [Dibolisporites cf. eifeliensis]
2 Dibolisporites wetteldorfensis [cf. Dibolisporites wetteldorfensis]
3 Dibolisporites echinaceus [Dibolisporites cf. echinaceus]
4 Apiculiretusispora brandtii [Apiculiretusispora cf. brandtii]
5 Apiculatasporites microconus [Apiculatasporites microconus]
6 Acinosporites lindlarensis [Acinosporites lindlarensis]
7 Kraeuselisporites ollii? [cf. Kraeuselisporites ollii ?]
8 Acinosporites acanthomammilatus [Acinosporites acanthomammilatus?]
9 Ancyrospora ancyrea var. ancyrea [Ancyrospora cf. ancyrea var. ancyrea]
10 Densosporites concinnus [cf. Densoporites sp. indet.]
11 Perotrilites bifurcatus [cf. Perotrilites bifurcatus]
12 Rhabdosporites langii [Rhabdosporites cf. langii]
13 Retusotriletes distinctus [Retusotriletes distinctus?]
14 Retispora archaelepidophyta
15 Verrucosisporites premnus
16 Verruscosisporites scurrus
17 Densosporites inaequus [Densosporites cf. inaequus]
18 Archaeozonotriletes variabillis
19 Archaeozonotriletes timanicus
20 Biharisporites parviornatus [Biharisporites parviornatus?]
21 Geminospora lemurata
22 Cymbosporites magnificus [Cymbosporites cf. magnificus]
23 Aneurospora goensis [Aneurospora goensis?]
24 Ancyrospora langii
25 Aneurospora greggsii
26 Cristatisporites triangulatus
27 Ancyrospora involucra [Ancyrospora involucra?]
28 Ancyrospora melvillensis [Ancyrospora melvillensis?]
29 Chelinospora ligurata [cf. Chelinospora ligurata]
30 Auroraspora macra
31 Grandispora cornuta [cf. Grandispora cornuta]
32 Retispora lepidophyta
33 Knoxisporites literatus

GSWA 25770

McGregor (1986). Three of their nominal species, *Geminospora lemurata*, *Cristatisporites triangulatus*, and *Retispora lepidophyta*, have been identified in Lennard Shelf assemblages. Forms closely allied to three other nominal species, *Rhabdosporites* sp. cf. *R. langii*, *Cymbosporites* sp. cf. *magnificus*, and cf. *Grandispora cornuta*, also occur. An additional group of about 20 of Richardson and McGregor's characteristic taxa (or closely allied forms) are present (Fig. 13). Because the time ranges of these taxa are restricted, it is possible to calibrate the Western Australian sequences and those of the Old Red Sandstone Continent.

Correlation is further supported by the presence of other species — of lesser biostratigraphic significance, but also previously recorded from the northern hemisphere. Many of these taxa are recorded for the first time from Western Australia.

A few taxa, such as *Granulatisporites frustulentus* and some of the species recently described from the Carnarvon Basin (Balme, 1988) may be endemic to Australia. Some of the Carnarvon Basin taxa, such as *G. lemurata*, *Ambagisporites daedalus*, *Calyptosporites proximocavatus*, *Convolutispora caementosa*, and *Dibolisporites turriculatus*, or forms with close affinities to these species, are also found in the Lennard Shelf sequence. However, the Canning Basin palynoflora seems generally more diverse than that from the Lennard Shelf.

A palynoflora described from the "Ghost River Formation" (now the Yahatinda Formation) of Alberta (McGregor, 1964) provides another interesting comparison. Both the Lennard Shelf sequence and the "Ghost River Formation" contain *Verrucosisporites mucronatus* Streel 1964 and *Retusotriletes biarealis* McGregor 1964. In addition, the "Ghost River Formation" contains *Aneurospora greggsii* (McGregor) Streel 1974, whereas the Lennard Shelf sequence has a form assigned to *A.* sp. cf. *greggsii*. In particular, *R. biarealis* has not been widely reported in the literature, and it is interesting to note that the "Ghost River Formation" assemblage not only occurs in a sequence of similar stratigraphic age to the lower Pillara and Gogo Formations, but has a similar relationship to the Frasnian reef complexes of Alberta (McLaren, 1955; Mountjoy, 1965).

The younger Lennard Shelf assemblage, found in eight NRD boreholes (Appendix 2), can clearly (Fig. 13) be assigned to the *Retispora lepidophyta* Assemblage of G. Playford 1976, and ***pusillites–lepidophyta*** Assemblage Zone of Richardson and McGregor (1986). This zone marks the acme of pseudosaccate spores with foveoreticulate exoexine (*Retispora*), and the widespread occurrence of taxa with vacuolate zona (*Vallatisporites*). Its base is taken at the first appearance of *R. lepidophyta*, and it is Strunian in age — that is, equivalent to the Middle *Bispathodus costatus* Zone to the lower "Lower *Protognathodus* fauna" in terms of the German conodont zones (Richardson and McGregor, 1986). The zone ranges from Fa2d to lower Tn1b (Clayton et al., 1977, p. 6).

Richardson and McGregor (1986) distinguished a possible upper subzone — based on the first appearance of *Hymenozonotriletes explanatus* and *Knoxisporites literatus* — roughly equivalent to the Late Strunian. *K. literatus* is present in all samples of the upper Lennard Shelf assemblage except for some from NRD 1 and 69, but *H. explanatus* has not been recognized. Thus, it would seem that the age of samples from the Nullara cycle is latest Famennian to possibly early Tournaisian. The upper part of the Fairfield Group was not sampled for this project, but previous studies (Balme and Hassell, 1962; G. Playford, 1976) suggested that the sequence ranges upwards into the ***nitidus–verrucosus*** Assemblage Zone of McGregor and Camfield (1986).

Few samples were collected from the immediately underlying sequences, where lithologies were unsuitable; those that were collected, proved barren. Consequently, there is no palynomorph record for the interval between the top of the Famennian and the lower Frasnian in the Lennard Shelf area; and the position of the base of the ***pusillites–lepidophyta*** Assemblage Zone (corresponding approximately to the Middle *Bispathodus costatus* conodont Zone) remains uncertain.

Prior to the Lennard Shelf study, very little was published concerning palynofloras below the "*R. lepidophyta* Assemblage" in Australia; and results have been somewhat inconclusive. Hodgson (1968) described miospores from the Parke Siltstone at the base of the Pertnjara Group, Amadeus Basin, Northern Territory This sequence contains *Geminospora lemurata* and several species of *Ancyrospora*. Hodgson (1968) concluded that the stratigraphic range of *Ancyrospora* was restricted to "late Middle or early Upper Devonian age". In the upper part of the Pertnjara Group, the Brewer Conglomerate contains *G. lemurata*, but *Ancyrospora* is apparently absent (Playford et al., 1976). A Middle Devonian palynoflora containing *Ancyrospora* and *Geminospora* was also recorded from the Etonvale Formation of the Adavale Basin in Queensland (de Jersey, 1966).

Comparisons between the older Lennard Shelf assemblage and the species ranges recorded by Richardson and McGregor (1986), placed further important constraints on its age. In general aspect, spore morphologies clearly indicate a Devonian age. The older Lennard Shelf assemblage contains distally sculptured, patinate spores with thin contact areas, such as *Cymbosporites*; these had appeared by the latest Silurian. Features such as proximal radial muri, and foveolate, verrucate, and apiculate sculpture, are common; these had all appeared by the beginning of the Devonian.

The presence of bifurcate spines restricts the age of the older Lennard Shelf assemblage even more, as these features first appeared in the mid-Emsian (***Grandispora***

Figure 13. Time ranges of selected miospore species common to Old Red Sandstone Continent (Richardson and McGregor, 1986) and Lennard Shelf (this report). Ranges shown are for taxa of the Old Red Sandstone Continent now recorded in Western Australia. Where taxa are not identical, the closest Western Australian equivalent is shown in square brackets.

douglastownense–Ancyrospora eurypterota Assemblage Zone), confirming that the palynofloras can be no older than early Devonian. Ancyrospores, with broad, conical, bifurcate spines are present in nearly all lower Lennard Shelf samples. These forms disappear in the upper ***ovalis–bulliferus*** Assemblage Zone. Features characteristic of spores of late Devonian or younger age are not present. Late Devonian taxa include minutely sculptured, monolete and camerate taxa such as *Archaeoperisaccus*, which first appears in the ***ovalis–bulliferus*** Assemblage Zone; and cingulate spores such as *Knoxisporites*, which have radial and/or concentric thickenings and make their first appearance in the ***Auroraspora torquata–Grandispora gracilis*** Assemblage Zone.

Based on ranges in the northern hemisphere (Richardson and McGregor, 1986), none of the Lennard Shelf taxa are older than mid-Emsian (***Emphanisporites annulatus–Camarozonotriletes sextantii*** Assemblage Zone). Few of the taxa have ranges which extend above the middle ***ovalis–bulliferus*** Assemblage Zone; the exceptions are *Geminospora lemurata*, which may just range into the ***torquata–gracilis*** Assemblage Zone, and the long-ranging *Archaeozonotriletes variabilis*, which extends into the Carboniferous. The sampled sequence is, therefore, certainly no younger than the base of the Famennian.

A few taxa that make their first appearance in the early Devonian are present, or are represented by forms with close affinities. These are generally long-ranging taxa — for example: *Acinosporites lindlarensis*, which ranges into the middle ***lemurata–magnificus*** Assemblage Zone; *Apiculiretusispora brandtii* and *Apiculatasporites microconus*, which range into the ***optivus–triangulatus*** Assemblage Zone; and *Dibolisporites echinaceus*, which extends to the middle ***ovalis–bulliferus*** Assemblage Zone. Other taxa first appear in either the ***Calyptosporites velatus–Rhabdosporites langii*** or ***devonicus–naumovii*** Assemblage Zones, but all range into younger zones: this indicates that the oldest part of the sequence is unlikely to extend below the Eifelian - Givetian boundary and is probably no older than middle Givetian.

Even more conclusive evidence for a middle Givetian age is provided by the presence of *Geminospora lemurata*, which, together with a form similar to, but not identical with, *Cymbosporites magnificus*, occurs throughout the lower Lennard Shelf sequence. These two species first appear at the base of the ***lemurata–magnificus*** Assemblage Zone. Streel et al. (1987) reported a first appearance of *G. lemurata* in the *ensensis* conodont Zone in the Eifel region, and in the upper *varcus* Zone in the Boulonnais area.

Cristatisporites triangulatus first appears at the base of the ***optivus–triangulatus*** Assemblage Zone and ranges to the upper ***ovalis–bulliferus*** Assemblage Zone of Richardson and McGregor (1986). This suggests that at least part of the sequence is late Givetian in age. *C. triangulatus* does not occur in the oldest samples from the Lennard Shelf sequence (Grey, 1991). It is also absent from some productive samples in PD 153 that ought to coincide with the zone; however, these samples contain chitinozoans, and in these samples the absence of *C. triangulatus* may be facies related. In older samples, *C. triangulatus* is consistently absent and there is no evidence to suggest its distribution is facies related.

Streel et al. (1987) placed the first appearance of *Cristatisporites triangulatus* (as *Samarisporites triangulatus*) "in or below the middle *varcus* Zone". Provided that its absence in this lower part of the Lennard Shelf sequence is genuine and not just a product of poor recovery rates, the lower sequence is equivalent to the *ensensis* conodont Zone and is therefore middle to early Givetian.

Several distinctive taxa — such as *Acinosporites acanthomammilatus*, *Archaeozonotriletes timanicus*, *Verrucosisporites premnus* and *V. scurrus* — are present, or have equivalents, in the Lennard Shelf samples. These species have upper ranges either confined to the ***optivus–triangulatus*** Assemblage Zone, or just extending into the ***ovalis–bulliferus*** Assemblage Zone. The older Lennard Shelf assemblage must, therefore, range from the ***lemurata–magnificus*** to the ***optivus–triangulatus*** and possibly into the basal ***ovalis–bulliferus*** Zone. Thus the age of the older Lennard Shelf assemblage is from middle (or possibly early) Givetian to early Frasnian.

Stratigraphic distribution

Stratigraphic distributions of miospores are summarized in Appendix 2; and comparative ranges of selected taxa are shown in Fig. 13. Recorded ranges of Lennard Shelf taxa are tentative because of the lack of either continuous or composite sections which can be used for stratigraphic control. Thus, results of present investigations demonstrate only general trends in miospore distribution.

All samples from NRD 1, 2, 4, 9, 17, 18, and 26, and the upper two samples of NRD 20, can be assigned unequivocally to the ***pusillites–lepidophytus*** Assemblage Zone, which is equivalent to the *Retispora lepidophyta* Assemblage of G. Playford (1976). The presence of *Knoxisporites literatus* and absence of *Hymenozonotriletes explanatus* suggest that samples occur somewhere about the middle of the zone (Richardson and McGregor, 1986).

The age of the palynoflora in NRD 69 is indeterminate. Preservation may play a significant role in taxa distribution in these samples, but *Retispora lepidophyta*, a normally abundant and resistant species, is also absent. It is possible that these samples correlate with the topmost ***Rugospora flexuosa–Grandispora cornuta*** Assemblage Zone. However, only two of the characteristic species, *Auroraspora macra* and cf. *Grandispora cornuta*, have been identified; and in the absence of more conclusive evidence, the samples are assigned to the ***pusillites–lepidophytus*** Assemblage Zone.

From the palynological evidence, the basal Fairfield Group is no older than latest Famennian (Fa2d) in age, and may range into the earliest Tournaisian (Tn1a). Samples from the Napier and "Lower Napier" Formations have similar age constraints on miospore evidence, but are most likely to be latest Famennian.

Palynofloras equivalent to the underlying ***torquata–gracilis*** and, at least the upper part of, the ***ovalis–bulliferus*** Assemblage Zones have not been recognized. None of the taxa which begin their ranges at or near the base of the ***ovalis–bulliferus*** Assemblage Zone are present. The only characteristic taxa for this zone which have been observed are those ranging through from underlying zones. It seems unlikely, therefore, that these two zones are represented in the Lennard Shelf samples.

The presence of these two zones suggests an age ranging from middle (possibly early) Givetian to early Frasnian for units in the Pillara cycle (Grey, 1991). This extends the presumed age of the onset of sedimentation from late to middle Givetian in subcrop areas. These results are consistent with outcrop ages previously determined, and with other limited palynological results obtained from adjacent areas. The upper part also corresponds with the age of the Gneudna Formation of the Carnarvon Basin (Balme, 1988).

A sample from Cadjebut Mine — from the oldest part of the Pillara Formation (P.E. Playford, writt. comm., 1987) — is probably from the ***lemurata–magnificus*** Assemblage Zone and, therefore, middle Givetian in age (Grey, 1987). Previously studied taxa from Noonkanbah 1 samples (Grey, 1974) — from a younger part of the Gogo Formation — were re-assessed. They show that this palynoflora is from the upper ***optivus–triangulatus*** Assemblage Zone and is, therefore, of early Frasnian age.

Samples from the lower Napier Range sequence (NRD 3, 32, 70, and NRD 20, 208.5 m) — mainly from units described as "Van Emmerick Sands" in reports by Shell Minerals — are more problematical, and probably indicate reworking. The unit contains boulders thought to be derived from the underlying Pillara Limestone, and samples were collected from thin, silty partings between boulders.

The palynoflora consists of miospores which range from the ***lemurata–magnificus*** to the ***optivus–triangulatus*** Assemblage Zones — the probable age of the Pillara Limestone. However, the spore age conflicts with limited acritarch evidence from the same samples which, when compared with assemblages elsewhere (Colbath, 1990), appear to be Frasnian in age. Detailed systematic studies of the acritarchs are required to confirm this. In addition, the exine of many spores is corroded — a common feature in reworked samples. It seems probable that the miospores were derived from the underlying middle Givetian to early Frasnian part of the Pillara Limestone, and that they were transported with the fine particles in a debris flow and incorporated in the silty infills between large boulders.

Chapter 3

Systematic descriptions

Genus *ACINOSPORITES* Richardson 1965

Type species: *Acinosporites acanthomammilatus* Richardson 1965 (by original designation).

Acinosporites acanthomammilatus? Richardson 1965

(Pl. 1, figs 1a, b)

? 1965 *Acinosporites acanthomammilatus* Richardson, p. 577, pl. 91, figs 1, 2, text-fig. 6

For additional synonymy see McGregor and Camfield (1982, p. 11)

Dimensions: 2 specimens: 54 and 67 µm.

Remarks: Lennard Shelf specimens are rare, and are not completely identical with the species. A few specimens are assigned to *A. acanthomammilatus*?. Others, which have even fewer features in common, are placed in *A.* sp. cf. *acanthomammilatus*?.

Specimens included in *A. acanthomammilatus*? have some of the verrucae developed on incipient ridges. However, these never develop into the contorted, anastomosing ridges regarded as characteristic of the species by Richardson (1965). The laesurae are obscured by triradiate membranous folds, but these are not well developed, and are only 3–5 µm high. This contrasts with specimens described by McGregor and Camfield (1982), where the folds may be up to 28 µm high at the proximal pole. Some of the verrucae are galeate and tipped with a small spine. Such biform sculpture suggests an intergradation with *Dibolisporites echinaceus*. A zona may be present, but is difficult to determine because of the dense ornament on the specimens available. In this the form resembles *Craspedispora ghadamisensis* Loboziak and Streel 1989. The biform ornament is very similar to that of *C. ghadamisensis* but is larger in the few Lennard Shelf specimens examined. Better preserved and more numerous specimens are needed before this spore can be satisfactorily assigned to a species.

Range: The species has not been recorded previously in Australia, but is present in the Eifelian and Givetian of Canada and Europe (McGregor and Camfield, 1982; Richardson, 1965, Streel et al., 1987). Ranges from the ***velatus–langii*** to ***lemurata–magnificus*** Assemblage Zones of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986).

Occurrence: PD 17, 120, 153.

Acinosporites sp. cf. *A. acanthomammilatus*? Richardson 1965

(Pl. 1, figs 2a–c)

cf. 1965 *Acinosporites acanthomammilatus* Richardson, p. 577, pl. 91, figs 1, 2, text-fig. 6

1974 *Acinosporites* sp. Grey, fig. 61A

For additional synonymy see McGregor and Camfield (1982, p.11)

Dimensions: 26 specimens: 42 (58) 95 µm.

Remarks: For description and comments on *A. acanthomammilatus* see McGregor and Camfield (1982, p. 11). As mentioned above, most Lennard Shelf specimens have only a broad morphological resemblance to *A. acanthomammilatus*. They occasionally show a sculpture of distal ridges bearing spines and poorly developed verrucae, but these are never as well developed as in previously described specimens (Richardson, 1965; McGregor and Camfield, 1982). Some ridges consist of coalesced verrucae, a feature also noted by McGregor and Camfield (1982).

Assignment to *A. acanthomammilatus* is questionable because the diameter is much smaller than that given by either Richardson (1965) or by McGregor and Camfield (1982), and the "concertina-like folds" of Richardson, (1965, p. 577) are absent. Furthermore, the triradiate membranous ridges which obscure the laesurae are poorly developed, and have a maximum height of only 5.5 µm. This contrasts with the well-developed ridges, up to 28 µm high, reported for *A. acanthomammilatus*. In some specimens the ridges are absent altogether. Poorly preserved specimens are difficult to distinguish from corroded *Cristatisporites albus*.

Range: The species has not been recorded previously in Australia, but is present in the Eifelian and Givetian of Canada and Europe (McGregor and Camfield, 1982; Richardson, 1965, Streel et al., 1987), and in the Eifelian and Givetian of the Ghadamis Basin of Tunisia and Libya (Loboziak and Streel, 1989). Ranges from the ***velatus–langii*** to the ***lemurata–magnificus*** Assemblage Zone of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986).

Occurrence: NRD 3; PD 17, 26, 151, 153, 162.

Acinosporites hirsutus? (Brideaux and Radforth 1970) McGregor and Camfield 1982 (Pl. 1, figs 3 to 5)

? 1982 *Acinosporites hirsutus* (Brideaux and Radforth 1970) McGregor and Camfield, p. 11, pl. 1, figs 7, 8, 12, 13; text-fig. 9

For additional synonymy see McGregor and Camfield (1982, p. 11)

Dimensions: 7 specimens: 45 (62) 84 μm.

Remarks: For description and comments see McGregor and Camfield (1982, p. 11). Spores are only tentatively assigned to *A. hirsutus* because they generally lack the membranous triradiate apical prominence which is characteristic of the species. The size range is generally smaller, and sculpture is commonly finer than in most of the previously illustrated specimens. Some specimens resemble the form "gradational to *A. macrospinosus*" illustrated by McGregor and Camfield (1982, Pl. 1, fig. 12). Few spines reach the maximum recorded length of 21 μm; some projections are bulbous to galeate, and some are biform. A few specimens resemble *Dibolisporites* in having biform sculpture.

Range: Not previously recorded in Australia, but present in Canada (McGregor and Camfield, 1982; Brideaux and Radforth, 1970) and Europe (Richardson, 1965; Riegel, 1973; Tiwari and Schaarschmidt, 1975) in the Eifelian and lower Givetian.

Occurrence: PD 145, 151, 153.

Acinosporites lindlarensis? Riegel 1968 (Pl. 1, figs 6 to 8)

? 1968 *Acinosporites lindlarensis* Riegel, p. 89, pl. 19, figs 11–16

For additional synonymies of *A. lindlarensis* see McGregor and Camfield (1976, p. 6; 1982, p. 13)

Dimensions: 37 specimens: 36 (56) 77 μm.

Remarks: For description see McGregor and Camfield (1976, p. 8). Specimens are uncommon, and are poorly preserved in Lennard Shelf samples. They resemble *A. lindlarensis* in overall morphology; but because of the poor preservation, it is difficult to determine which subspecies they belong to. Lennard Shelf miospores have shorter (mostly 3–5 μm) and more sparsely distributed, sculptural elements. Further study may indicate a need to erect a new species, but insufficient specimens are available in the present study.

Range: Not previously recorded in Australia, but present in the Emsian of Canada (McGregor and Camfield, 1976) and in the Emsian to Frasnian of the Ghadamis Basin of Tunisia–Libya (Loboziak and Streel, 1989). *A. lindlarensis lindlarensis* ranges from the ***annulatus–sextantii*** to ***lemurata–magnificus*** Assemblage Zones of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986); and the variety *A. lindlarensis* minor McGregor and Camfield 1976 presumably has a similar distribution, although the upper limit of its range is not known.

Occurrence: NRD 3, 70; PD 17, 153, 162.

Genus *AMBAGISPORITES* Balme 1988

Type species: *Ambagisporites daedalus* Balme 1988 (by original designation).

Ambagisporites daedalus Balme 1988 (Pl. 2, figs 1, 2a, b)

1988 *Ambagisporites daedalus* Balme, p. 134, pl. 7, figs 3–7

Dimensions: 37 specimens: 50 (68) 99 μm.

Remarks: Specimens are very similar to the species described by Balme (1988). The nature of the fovulae is not entirely clear in the Lennard Shelf specimens, and may have been altered by corrosion.

Range: Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988).

Occurrence: NRD 3; PD 17, 26, 151, 153, 162.

Genus *ANAPICULATISPORITES* Potonié and Kremp 1954

Type species: *Anapiculatisporites isselburgensis* Potonié and Kremp 1954 (by original designation).

Remarks: McGregor and Camfield (1982, p. 14) discussed the problems of distinguishing between *Anapiculatisporites* and *Acanthotriletes*, and pointed out that the name *Acanthotriletes* is no longer available for trilete spores because its type species, *Acanthotriletes primigenus* Naumova 1949, is an acritarch (Jansonius *in* Jansonius and Hills, 1967). McGregor and Camfield (1982, p. 14) recommended that trilete spores assigned to *Acanthotriletes* should be referred to *Anapiculatisporites* pending a complete revision of the taxonomy of simple spinose spores. Although *Anapiculatisporites* is generally reserved for spores with distal sculpture only, McGregor and Camfield (1982, p.14) point out that Potonié and Kremp's (1954) diagnosis states that the sculpture of the distal face rarely protrudes at the equator. Species formerly assigned to *Acanthotriletes* can therefore be assigned to *Anapiculatisporites* until the taxonomy of simple spinose spores is reassessed. McGregor and Camfield's suggestion is followed here, necessitating the transfer of *Acanthotriletes* sp. cf. *A. echinatus* to *Anapiculatisporites*.

Anapiculatisporites sp. cf. *Acanthotriletes echinatus* (Hoffmeister, Staplin, and Malloy 1955) of Balme and Hassell 1962 new comb. (Pl. 1, figs 9, 10)

cf. 1955 *Acanthotriletes echinatus* Hoffmeister, Staplin and Malloy: p. 379, pl. 38, figs 1–2.

1962 *Acanthotriletes* sp. cf. *A. echinatus* Hoffmeister, Staplin and Malloy; Balme and Hassell, p. 8, pl. 1, figs 10–11.

Dimensions: 98 specimens: 23 (35) 54 μm. This size range is slightly smaller than the original one cited by Balme and Hassell (1962, p. 8).

Remarks: Because *Acanthotriletes* is no longer available for spore taxa (see previous remarks), this species has to be reassigned. The diagnosis of *Anapiculatisporites* refers to a more or less smooth proximal face. Most species assigned to the genera have at least reduced sculpture on the proximal surface. Despite the fact that Balme and Hassell (1962, p. 8) recorded sculpture on both faces, Lennard Shelf specimens are here placed in *Anapiculatisporites*. This is because some specimens have reduced sculpture on the proximal face, and because no other suitable genus is available. The assignment will need to be re-assessed in any revision of spinose genera (McGregor and Camfield, 1982, p. 14).

Balme and Hassell (1962) commented on the morphological similarities between Lennard Shelf forms and *A. echinatus* Hoffmeister, Staplin and Malloy 1955) from the Upper Mississippian Hardinsburg Formation of Kentucky. They considered Lennard Shelf forms only to have "affinities with" the Kentucky species. From the illustrations of Hoffmeister, Staplin, and Malloy (1955), it seems that *A. echinatus* has slightly coarser sculpture. Examination of type material is required to determine whether the difference is significant. In this report I retain the terminology of Balme and Hassell.

Range: Balme and Hassell (1962) recorded the taxon from Stumpys Soak 2 Borehole near the north-east margin of the Fitzroy Trough, Canning Basin, but reported it rare or absent elsewhere, Late Devonian (Balme and Hassell, 1962).

Occurrence: *A.* sp. cf. *echinatus* is common in nearly all samples from the *R. lepidophyta* Assemblage in the Napier Range boreholes, and is also found below this, although its full range is still not clear. NRD 1, 2, 4, 9, 17, 18, 20, 26, 69.

Anapiculatisporites sp. indet.
(Pl. 1, figs 11 to 13)

Dimensions: 5 specimens: 45 (54) 63 μm.

Description: Trilete spores with rounded triangular amb. Trilete mark, straight to sinuous, simple, or with folds 2 to 5 μm high and wide, usually obscuring the laesurae. Folds commonly extend to the equatorial margin. Contact areas laevigate, scabrate, or, more usually, with conate or spinose sculpture which is reduced in style and distribution on the proximal face. Distal and equatorial regions with narrow-based, tapering spines and cones which are regularly spaced. Equatorial spines up to 7 μm long, others usually shorter, 1–2 μm wide at base. Up to 50 spines visible at equator. Wall 1–2 μm thick.

Remarks: These spores have some similarity to *Anapiculatisporites petilis* Richardson 1965, but have a larger size range, and sculpture is much denser and coarser than in the original diagnosis of the species. Unlike *A. petilis*, sculpture is also present on the proximal face. The folds along the laesurae are generally thicker and the exine is thinner. For these reasons, the Canning Basin specimens are not placed in *A. petilis*, but are possibly a new species. However, only 5 specimens have been recorded, an insufficient number for circumscription.

Range: Not previously recorded in Australia.

Occurrence: NRD 70, PD 17, 153.

Genus *ANCYROSPORA* Richardson 1960 emend. Richardson 1962

1960 *Ancyrospora* Richardson, p. 55.

1962 *Ancyrospora* Richardson emend. Richardson, p. 175.

Type species: *Ancyrospora grandispinosa* Richardson 1960 (by original designation).

Remarks: This report follows the procedure of McGregor and Camfield (1982) in retaining existing nomenclature, pending a revision of all taxa of anchor-spined spores by a working group of the Commission Internationale de Microflore du Paléozoïque (McGregor and Camfield, 1982). Lennard Shelf specimens show considerable intergradation between species, and cannot always be clearly assigned.

Not only do many of the species intergrade, but there is also overlap between genera. Thus some specimens here assigned to *Densosporites* because of a central darkening, could also be assigned to *Ancyrospora*, because of the presence of bifurcate tips.

Ancyrospora sp. cf. *A. ancyrea* (Eisenack 1944) Richardson 1962 var. *ancyrea* Richardson 1962
(Pl. 2, figs 3 to 5)

cf. 1962 *Ancyrospora ancyrea* (Eisenack 1944) Richardson var. *ancyrea* Richardson, p. 177, pl. 25, figs 6, 7; text- figs 5, 6, 9C, 9E, 10B.

1982 *Ancyrospora ancyrea* (Eisenack 1944) Richardson var. *ancyrea* Richardson; McGregor and Camfield, p. 15, pl. 2, fig. 5, 6; text-fig. 14.

Dimensions: 16 specimens 49.5 (85) 171 μm (including sculpture).

Remarks: For description of *A. ancyrea* var. *ancyrea* see McGregor and Camfield (1982, p. 15). Lennard Shelf specimens have a triangular central body and long, parallel-sided processes similar to *A. ancyrea*, but are smaller. Details of the central body are difficult to determine because most specimens are very dark. They are distinguished from specimens of *A. parva* by their narrow processes which have large grapnel tips. Some forms are intermediate. Specimens from the Adavale Basin (de Jersey, 1966) have also been tentatively assigned to *A. ancyrea*. Balme (1988) commented that *A. ancyrea* can be distinguished from *A. langii* because the former has a more extensively developed exoexine on the processes, and because the processes are more or less cylindrical and appear solid. *Hystricosporites blessii* Loboziak and Streel 1989 has longer processes with larger grapnel tips.

Range: Occurs in the Etonvale Formation, Middle to Late Devonian, Adavale Basin, Queensland (de Jersey, 1966). It is wide ranging and characteristic of Eifelian and lower Givetian sediments in Canada (McGregor and Camfield, 1982), and western Europe (Streel et al., 1987). It ranges from the ***velatus–langii*** to the ***lemurata–magnificus*** Assemblage Zones of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986).

Occurrence: NRD 70; PD 17, 26, 153.

Ancyrospora involucra? Owens 1971
(Pl. 2, figs 6a, b)

? 1971 *Ancyrospora involucra* Owens p. 74, pl. 24, figs 5, 6; pl. 25, figs 1, 2; text-fig. 14

Dimensions: One specimen: 78.4 µm.

Remarks: A single specimen, tentatively assigned to *A. involucra*, was observed in Lennard Shelf samples. Several poorly preserved specimens may also belong to this taxon. The Lennard Shelf specimen lacks the well-developed perispore described by Owens (1971), although a membrane partially connecting the processes is visible (Fig. 6b). The processes on Owen's specimens are blunter, less tapered, and usually have a broad tip. The Lennard Shelf specimen has tapering processes commonly capped by a small spine, or a small bifurcation supported on a spine. However, a few processes are shorter and blunter. The mixed nature of processes on the Lennard Shelf specimen may be of sufficient significance to indicate a new species, but more specimens are required for the range of variation to be determined.

Range: Not previously recorded in Australia. Ranges from the middle ***optivus–triangulatus*** to middle ***ovalis–bulliferus*** Assemblage Zones of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986).

Occurrence: NRD 3.

Ancyrospora langii (Taugourdeau-Lantz 1960) Allen 1965
(Pl. 3, figs 1–5)

1965 *Ancyrospora langii* (Taugourdeau-Lantz 1960) Allen, p. 743, pl. 106, figs 5–7.

not 1968 *Ancyrospora amadei* Hodgson, p. 74, pl. 8, fig. 8.

not 1968 *Ancyrospora* sp. cf. *A. simplex* Guennel 1963; Hodgson, p. 75, pl. 8, figs 9–11, text-fig. 1.

not 1974 *Ancyrospora* sp. A Grey, Fig. 61b.

1974 *Ancyrospora* sp. Grey, Fig. 61c.

For additional synonymies see Allen (1965, p.743) and Balme (1988, p. 145).

Dimensions: 50 specimens: 45 (74) 113 µm.

Remarks: Lennard Shelf specimens have similar dimensions to miospores previously described (Taugourdeau-Lantz, 1960; Allen, 1965). The morphology of the grapnel-tipped spines (which taper from a broad base to a very narrow tip capped by a small bifurcation) is identical.

Balme (1988) assigns several species to this taxon, including *A. amadei* Hodgson 1968, *Ancyrospora* sp. cf. *A. simplex* Guennel 1963 of Hodgson 1968 and *A.* sp. A Grey 1974, but does not list *A. parva* de Jersey 1966 in synonymy. De Jersey (1966) published before Hodgson (1968), but was aware of Hodgson's form *A.* sp. cf. *simplex*, and obviously regarded it as being synonymous with *A. parva* (see Remarks for *A. parva*).

A. parva is here retained as a separate species. Many Lennard Shelf species intergrade, but several end members can be recognized. The end members are sufficiently distinctive to be retained as separate species. *A. langii* is restricted to specimens which have tapering spines and small grapnel tips. The spines are interconnected about halfway along their length to form a flange-like structure, and about 40 processes are present.

A. parva has fewer processes (usually about 20, but sometimes as many as 30), and has distinctively vacuolate spines with a broad grapnel tip. *A. amadei* also has about 20 processes and is larger, generally over 100 µm in diameter. *A. longispinosa* Richardson 1962 has very broad grapnel tips supported by straight-sided processes. The spines taper only at the bases and show little interconnection. Tips and processes are often hyaline. *A. parke* Hodgson 1968 is similar to *A. langii*, but has a broader, almost continuous flange, and very short, sometimes hair-like spines with minute grapnel tips.

Range: Apart from the Carnarvon Basin occurrence (Balme, 1988), the species has not been recorded previously in Australia. It is present in the Frasnian of the Boulonnais area of France (Tougourdeau-Lantz, 1960), and the Ghadamis Basin of Libya and Tunisia (Loboziak and Streel, 1989). It ranges from the middle of the ***lemurata-magnificus*** to the base of the ***torquata–gracilis*** Assemblage Zones of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986).

Occurrence: Present in most samples in the Pillara Cycle. NRD 3; PD 26, 120, 145, 151, 153, 162.

Ancyrospora longispinosa? Richardson 1962
(Pl. 4, figs 1–3)

? 1962 *Ancyrospora longispinosa* Richardson, p. 181, pl. 26, figs 1–3, text-fig. 8.

1982 *Ancyrospora longispinosa* Richardson; McGregor and Camfield (1982, p. 17, pl. 3, fig. 2; text-fig. 20).

Dimensions: 7 specimens: 40.5 (59) 88.5 µm.

Remarks: For description see McGregor and Camfield (1982, p. 17). Rare specimens, which resemble *A. longispinosa* by having a pseudoflange and tapering bifurcate processes, occur in the Lennard Shelf samples. However, Lennard Shelf specimens are only tentatively assigned to *A. longispinosa* because their size range is considerably smaller than that recorded by Richardson (1962) and McGregor and Camfield (1982). It differs from *Hystrichosporites blessii* Loboziak and Streel, 1989, in having shorter, tapering processes and a smaller grapnel tip.

Specimens are similar to *A. parva* de Jersey 1966, but have broader grapnel tips and the processes are hyaline between their middle and the termination. (See also comments under *A. langii.*)

Range: Not previously recorded from Australia, but has a widespread distribution in the middle Devonian of Europe and North America (McGregor and Camfield, 1982).

Occurrence: PD 151, 153.

Ancyrospora melvillensis? Owens 1971
(Pl. 4, figs 4a, b)

? 1971 *Ancyrospora melvillensis* Owens, p. 72, pl. 23, figs 5, 6.

Dimensions: Overall dimensions, 4 specimens 98 (163) 216 µm; central body, 2 specimens: 81 and 108 µm.

Remarks: Only a few specimens were observed in Lennard Shelf samples. Several poorly preserved specimens may also belong to this species. The species is distinguished from *A. parva* by its larger size, and by the presence of differentiated sculpture. Elements on the distal surface are shorter and are usually more slender than those around the equator.

Owen's (1971) specimens have a less scalloped flange; and the processes are shorter, less tapered, and have minute bifurcations. Although the Lennard Shelf specimens show some size differentiation of equatorial and polar elements, the range of variation is not as marked as in Owen's specimens, and short and long processes are more randomly distributed in Lennard Shelf specimens. Polar elements in Lennard Shelf specimens are tapering rather than being parallel-sided baculae, as in Owen's Canadian specimens. These differences are probably of sufficient significance to indicate a new species, but more specimens are required before a new taxon can be circumscribed.

Range: Not previously recorded in Australia. Ranges from the middle ***optivus–triangulatus*** to the top of the ***ovalis–bulliferus*** Assemblage Zones of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986).

Occurrence: NRD 3, PD 26, 153, 162.

Ancyrospora parke Hodgson 1968
(Pl. 4, figs 5, 6)

1969 *Ancyrospora parke* Hodgson, p. 73, pl. 8, fig. 7.

Dimensions: Overall dimensions, 63 specimens: 32 (82) 125 µm; central body, 17 specimens: 54 (74) 95 µm.

Remarks: For description see Hodgson (1968, p. 73). The original description of the species was based on a single spore. Similar specimens are common in the Lennard Shelf samples and have tapering spines with broad united bases. They are distinguished from *A. parva* de Jersey 1966 by their more conical and more abundant processes, although forms intermediate between the two are present. Some specimens have almost hair-like processes. (See also comments under *A. langii*). *A. parke* has many features in common with *Densosporites*, but lacks the darkened ring found in the genus.

Range: Pertnjara Formation, Amadeus Basin, Northern Territory, Givetian or Frasnian (Hodgson, 1968).

Occurrence: NRD 3, NRD 70; PD 17, 26, 145, PD 151, PD 153.

Ancyrospora parva de Jersey 1966
(Pl. 5, figs 1 to 4)

1964 *Ancyrospora* sp. cf. *A. simplex* Guennel 1963; Hodgson p. 75, pl. 8, figs 9–11, text fig. 1).

1966 *Ancyrospora parva* de Jersey, pp. 19,20, pl. 7, figs 4–13.

1974 *Ancyrospora* sp. Grey, Fig. 61b.

Dimensions: Overall dimensions, 38 specimens: 121 (87) 50 µm; central body, (9 specimens): 63 (70) 90 µm.

Remarks: For description and comments on this species see Hodgson (1968) and de Jersey (1966, p. 19). Features of the species are difficult to distinguish from de Jersey's illustrations, and the Adavale Basin specimens appear poorly preserved. It is clear that de Jersey had examined better preserved Amadeus Basin specimens — later assigned to *Ancyrospora* cf. *A. simplex* Guennel by Hodgson (1968) — and evidently considered the Adavale and Amadeus Basin spores to be identical. De Jersey's assignment of both sets of specimens to *A. parva* is followed here. Lennard Shelf specimens have the same characteristics as those illustrated by both de Jersey and Hodgson, but show a wider range of variation: a reflection of the larger numbers available for study. In many specimens, the characteristic exoexinal ridges and the folding-back of the intexine in regions adjacent to the trilete mark cannot be distinguished because of poor preservation. Some specimens resemble *Ancyrospora melvillensis* Owens 1971, but examination of type material is required before synonymy can be confirmed.

Ancyrospora parva grades into other forms of *Ancyrospora* present in Lennard Shelf samples, most noticeably *A. langii* (Taugourdeau-Lantz 1960) Allen 1965, *A. parke* Hodgson 1968, and *A.* sp. cf. *A. ancyrea* (Eisenack) Richardson 1962. In this report, spores assigned to *A. parva* have a sub-triangular to sub-circular central body. They have a small diameter compared to many other species of *Ancyrospora* (usually less than 100 µm), and have from 10 to 20 bifurcate processes at the equatorial margin. The bases of the processes are united to form a narrow flange. Each process tapers rapidly into a parallel-sided projection with a grapnel tip. Many specimens have vacuoles or pits at the base of, and extending some distance along, each process. They are distinguished from *A. langii* because the latter has a broader flange and more processes. Some specimens have a dark ring similar to *Densosporites*, but this is not a consistent feature.

Range: Middle and Upper Etonvale Formation, Adavale Basin, Queensland, Middle and Late Devonian (de Jersey, 1966); Pertnjara Formation, Amadeus Basin, Northern Territory, Givetian or Frasnian (Hodgson, 1968).

Occurrence: NRD 3, NRD 70; PD 17, 120, 145, 151, 153, 162.

Genus *ANEUROSPORA* Streel 1964

Type species: *Aneurospora goensis* Streel 1964 (by original designation).

Aneurospora goensis? Streel 1964
(Pl. 5, figs 6, 7)

? 1964 *Aneurospora goensis* Streel, p. 248, pl. 1, fig. 16–20, text-fig. 6.

? 1969 *Aneurospora goensis* Streel; Lele and Streel, p. 95, pl.1, figs 22–26, pl. 2, figs 27, 28.

Dimensions: Only two specimens are sufficiently well-preserved for measurement. Diameter: 37 and 45 µm.

Remarks: Only two well-preserved and several corroded specimens were recorded from Lennard Shelf samples. Although one or two specimens show the typical morphology of the species, most differ from previously described specimens in having a sculpture which is finer and more densely spaced. They also differ from *A. greggsii* in having a slightly smaller size range. The darkened zone delimited by the curvaturae is of uniform width and extends completely around the equatorial margin. In *A. greggsii* the darkened zone is thicker in the region of the trilete mark, and may even be discontinuous.

Range: Not previously recorded in Australia. Early Givetian of eastern Belgium (Streel, 1964; Lele and Streel, 1969). Ranges from the middle ***lemurata–magnificus*** to upper ***ovalis–bulliferus*** Assemblage Zones of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986).

Occurrence: NRD 20, 32. Poorly preserved specimens, probably belonging to *A. goensis* were noted in several samples.

Aneurospora greggsii (McGregor 1964) Streel 1974 *in* Becker et al. 1974
(Pl. 5, fig. 5)

For synonymy see Streel, 1974, p. 24.

Dimensions: Only two specimens are sufficiently well-preserved for measurement. Diameter: 48 and 54 µm.

Remarks: Only two well-preserved and several corroded specimens were recorded from Lennard Shelf samples. However, all show the typical arcuate thickening of the curvaturae characteristic of this species. *A. greggsii* is distinguished from *A. goensis* by the greater thickness of the curvaturae in the radial areas.

Range: Not previously recorded in Australia. Occurs in the Givetian to Frasnian of Alberta (McGregor, 1964) and Givetian to Tournaisian of Belgium (Lele and Streel, 1969; Streel *in* Becker et al., 1974). Ranges from the middle ***lemurata–magnificus*** Assemblage Zone to at least the Early Carboniferous of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986).

Occurrence: NRD 32. Poorly preserved specimens, probably belonging to *A. greggsii* were noted in several samples.

Aneurospora incohata (Sullivan 1964a) Streel 1974 *in* Becker et al. 1974
(Pl. 5, figs 9, 10)

1962 *Retusotriletes* sp. cf. *R. pychovii* Naumova; Balme and Hassell, p. 7, pl. 1, fig. 13.

1964 *Retusotriletes incohatus* Sullivan, p. 1251, pl. 1, figs 5–7.

1974 *Retusotriletes* (al. *Retusotriletes*) *incohata* (Sullivan) Streel *in* Becker et al., p. 24, pl. 16, fig. 4).

Dimensions: 26 specimens: 36 (54) 77 µm.

Remarks: Sullivan (1964a) commented on the possible synonymy of a specimen illustrated by Balme and Hassell (1962), which had an exine only 1 µm thick. Most Lennard Shelf specimens also have thin exines, although they are sometimes up to 2 µm thick. This overlaps the thicknesses recorded by Sullivan; Western Australian specimens can be readily assigned to the species.

Range: Stumpys Soak 2 bore, Canning Basin, Late Devonian (Balme and Hassell, 1962); Tournaisian of Forest of Dean, United Kingdom (Sullivan, 1964a); Famennian to Tournaisian of Belgium (Streel *in* Becker et al., 1974); Hook Head area, Ireland, ?Famennian–Tournaisian to middle Tournaisian (Higgs, 1975).

Occurrence: NRD 1, 2, 9, 17, 18, 20, 26, 69.

Aneurospora sp. indet.
(Pl. 5, fig. 8)

Dimensions: Only one specimen is sufficiently well preserved for measurement. Diameter: 88 µm.

Remarks: A very corroded specimen, which appears to have curvatural thickening. It has some similarity to *A. greggsii*, but is larger.

Range: Not previously recorded in Australia.

Occurrence: NRD 20. Poorly preserved specimens, probably belonging to *A.* sp. cf. *A. greggsii* were noted in several samples.

Genus *APICULATASPORITES* Potonié and Kremp 1956

Type species: *Apiculatasporites spinulistratus* (Loose) Ibrahim 1933 (by original designation).

Remarks: McGregor and Camfield (1982, p. 18) discussed the various interpretations of *Apiculatasporites* and *Apiculatisporis* Potonié and Kremp 1956. These are genera of subcircular, trilete spores, which bear a sculpture of regularly spaced coni. McGregor and Camfield proposed distinguishing the two genera by the height of the majority of the sculptural elements; those between 0.5–1.5 µm being placed in *Apiculatasporites*, and those over 1.5 µm in *Apiculatisporis*. Their suggestion is followed in this report, although in practice the distinction is not always clear.

Apiculatasporites adavalensis (de Jersey 1966) new comb.

(Pl. 5, figs 11, 12)

1966 *Apiculatisporis adavalensis* de Jersey, p. 11, pl. 3, figs 9, 10; pl. 4, figs 1, 2.

1967 *Acanthotriletes* sp. 1 Hemer and Nygreen, pl. 1, fig. 4.

1975 *Acinosporites apiculatus* (Streel) Streel 1967; Tiwari and Schaarschmidt (in part), p. 26, pl. 11, figs 5, 6.

1988 *Apiculatisporis adavalensis* de Jersey; Balme p. 127, pl. 4, figs 13, 14.

Dimensions: 68 specimens: 36 (69) 122 μm.

Remarks: For description see de Jersey (1966, p. 11). Lennard Shelf specimens conform to de Jersey's description. They are here transferred from *Apiculatisporis* because the sculptural elements are too small, being only approximately 1 μm high (de Jersey, 1966). This places them within the range suggested by McGregor and Camfield (1982, p. 18) for *Apiculatasporites*. The specimen illustrated by Tiwari and Schaarschmidt (1975) is apparently trilete. No trilete mark has been distinguished in Lennard Shelf specimens.

Range: Etonvale Formation, Adavale Basin, Queensland, Middle Devonian (de Jersey, 1966); Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988); Jauf Formation, Saudi Arabia, probable Frasnian (Hemer and Nygreen, 1967).

Occurrence: Fairly common throughout the Pillara cycle. NRD 3, 20, 32, 70; PD 17, 26, 120, 145, 151, 153, 162.

Apiculatasporites microconus (Richardson 1965) McGregor and Camfield 1982

(Pl. 6, figs 1, 2)

For synonymy see McGregor and Camfield (1982, p. 19).

Dimensions: 14 specimens: 45 (62) 76.

Remarks: McGregor and Camfield (1982) transferred this species to *Apiculatasporites* because the majority of the sculptural elements are higher than 0.5 μm. Lennard Shelf specimens are rare, and the element size is difficult to determine because of poor preservation. In some specimens, it is slightly coarser than in previous illustrations (Richardson, 1965; McGregor and Camfield, 1982), and the spores are smaller than the stated size range for the species. Nevertheless, the majority of Lennard Shelf specimens can be accommodated within the circumscription of the species.

Range: Not previously recorded from Australia, but occurs in the Middle Devonian of Europe and North America (Richardson, 1965; Streel, 1967; Owens, 1971; McGregor and Camfield, 1982). Ranges from the middle ***annulatus–sextantii*** to middle ***optivus–triangulatus*** Assemblage Zones of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986).

Occurrence: NRD 3; PD 120, 145, 151, 153, 162.

Genus *APICULATISPORIS* Potonié and Kremp 1956

Type species: *Apiculatisporis aculeatus* (Ibrahim 1933) Potonié 1956 (by original designation).

Remarks: See comments about distinguishing this genus from *Apiculatasporites* under "Remarks" for that genus.

Apiculatisporis morbosus Balme and Hassell 1962

(Pl. 6, fig. 5)

1962 *Apiculatisporis morbosus* Balme and Hassell: pp. 7–8, pl. 1, figs 17, 18.

1976 *Apiculatisporis morbosus* Balme and Hassell; Playford, p. 13, pl. 2, figs 1–4.

Dimensions: 54 specimens: 41 (54) 81 μm (including projections).

Remarks: Specimens conform to the description given by Balme and Hassell (1962). Many spores have reduced sculpture on the proximal face. This is a feature characteristic of *Schopfites* Kosanke (1950), which has a laevigate, or mainly laevigate, proximal exine with a mass of distal verrucae. However, G. Playford (1976) re-examined type material, and agreed with Balme and Hassell's assignment to *Apiculatisporis* because the holotype and representative specimens are predominantly conate. Most sculptural elements are greater than 1.5 μm, and therefore the species is retained in *Apiculatisporis*.

G. Playford (1976) commented on the variability of the sculpture, both in size and morphology. The sculpture in many of the specimens examined in the current study closely resembles tapetal material, suggesting that *A. morbosus* is a simple trilete form particularly prone to retaining fragments of the sporangial wall.

Range: Late Devonian in BMR 2 Laurel Downs Bore, Canning Basin (Balme and Hassell, 1962); Famennian or Tournaisian, Fairfield Group, Canning Basin (G. Playford, 1976); various units, Bonaparte Basin, Visean, (Playford, 1971); "Buttons Beds" (now Formation), Bonaparte Basin (Playford, 1982); Mulga Downs Beds, New South Wales (Evans, 1968).

Occurrence: *A. morbosus* is a common form in samples from the *R. lepidophyta* Assemblage. NRD 1, 4, 9, 17, 18, 20, 26, 69.

Genus *APICULIRETUSISPORA* Streel 1964 emend. Streel 1967

Type species: *Apiculiretusispora brandtii* Streel 1964 (by original designation).

Apiculiretusispora sp. cf. *brandtii* Streel 1964
(Pl. 6, figs 3, 4)

cf. 1964 *Apiculiretusispora brandtii* Streel, p. 8, Pl. 1, figs 6–10.

cf. 1973 *Apiculiretusispora brandtii* Streel, *in* McGregor, p. 26, Pl.2, figs 28–30.

cf. 1973 *Apiculiretusispora brandtii* (Streel) 1967, *in* Riegel, p. 84, Pl. 11, figs 7–8.

cf. 1975 *Apiculiretusispora brandtii* Streel 1964, *in* Tiwari and Schaarschmidt, p. 19, Pl. 4, figs 1,2.

Dimensions: 25 specimens: 36 (74) 72 μm.

Remarks: Lennard Shelf specimens correspond to this species in having a circular amb and a sculpture of densely packed cones, but lack the characteristic darkened prominence with a light edging adjacent to the laesurae, and are smaller.

Range: Not previously recorded in Australia. *A. brandtii* and its variants have a widespread distribution in Canada and northern Europe. Ranges from the lower ***annulatus–sextantii*** to the lowermost ***optivus–triangulatus*** Assemblage Zones of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986).

Occurrence: PD 17, 120, 145, 151, 162.

Apiculiretusispora densiconata? Tiwari and Schaarschmidt 1975
(Pl. 6, figs 6, 7)

? 1975 *Apiculiretusispora densiconata* Tiwari and Schaarschmidt, p. 20, pl. 4, fig. 7, pl. 5, figs 1, 2.

For additional synonymy see McGregor and Camfield (1982, p. 19).

Dimensions: 50 specimens: 32 (52) 81 μm.

Remarks: Lennard Shelf specimens are poorly preserved, but the sculpture resembles that described by McGregor and Camfield (1982, p. 19). Specimens are generally smaller than the dimensions given by these authors, and the degree of corrosion precludes positive identification.

Range: Not previously recorded in Australia. Occurs in the Eifelian of Prum Syncline, Germany (Tiwari and Schaarschmidt, 1975); and in the Eifelian and lower Givetian of the Canadian Arctic (McGregor and Camfield, 1982). The Lennard Shelf specimens are probably slightly younger than the previously recorded range.

Occurrence: NRD 20, 70, PD 17, 26, 120, 151, 153.

Apiculiretusispora leberidos McGregor and Camfield 1982
(Pl. 6, figs 8, 9)

1982 *Apiculiretusispora leberidos* McGregor and Camfield, p. 20, pl. 3, figs 8, 11, 12.

Dimensions: 5 specimens: 45 (51) 59 μm.

Remarks: Lennard Shelf specimens conform to the diagnosis of McGregor and Camfield (1982, p. 20), and in particular show the partial loss of sculpture, which seems to be a distinctive feature of this species. They generally lack the interradial darkening observed in the proximal polar areas of Canadian specimens (McGregor and Camfield, 1982, p. 20).

Range: Not previously recorded from Australia. Occurs in the Givetian of Arctic Canada (McGregor and Camfield, 1982).

Occurrence: PD 17, 120, 145, 153, 162.

Apiculiretusispora sp. cf. *A. magnifica* Tiwari and Schaarschmidt 1975
(Pl. 6, figs 10 to 12)

cf. 1975 *Apiculiretusispora magnifica* Tiwari and Schaarschmidt, p. 20, pl. 4, figs. 5, 6; pl. 5, fig. 3

Dimensions: 9 specimens: 54 (96) 158 μm.

Remarks: Lennard Shelf specimens are abundant in some samples, but are badly corroded, and surface areas are finely pitted. Consequently, the specimens lack the smooth contact areas which distinguish the species, and are therefore only tentatively assigned to *A. magnifica*. The specimens apparently conform to the diagnosis of Tiwari and Schaarschmidt (1975) in their size range, circular amb, nature of the trilete mark, and sculpture of short, dense cones. However, some could be badly corroded specimens of other species, e.g. Fig. 10, which are included here, although it may well be a very corroded *Retusotriletes biarealis* McGregor 1964.

Range: Not previously recorded from Australia. The species has so far only been described from the Eifelian of the Prum Syncline of Germany (Tiwari and Schaarschmidt, 1975).

Occurrence: NRD 20, 70.

Apiculiretusispora sp. A Balme 1988
(Pl. 6, fig. 13)

1988 *Apiculiretusispora* sp. A Balme, p. 126, Pl. 4 figs 8–10

Dimensions: Single specimen: 90 μm.

Remarks: Only one specimen is sufficiently well preserved for measurement. Several poorly preserved specimens may also belong to this form. Lennard Shelf specimens resemble the spores illustrated by Balme (1988).

Range: Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988).

Occurrence: PD 151.

Genus *ARCHAEOZONOTRILETES* Naumova 1953 emend. Allen 1965

Type species: *Archaeozonotriletes variabilis* Naumova 1953 emend. Allen 1965 (by original diagnosis).

Archaeozonotriletes timanicus Naumova 1953 (Pl. 7, figs 1 to 5)

For synonymy see McGregor and Camfield (1982, p. 20)

Dimensions: 19 specimens: 36 (48) 90 μm.

Remarks: Lennard Shelf specimens are scarce, but conform to the description given by McGregor and Camfield (1982, p. 20). Loboziak and Streel (1989) have transferred the species *timanicus* to *Chelinospora* because it is ornamented. However, they have not convincingly demonstrated that *Chelinospora* is the most appropriate genus for this form — see discussion about the problems of assigning this species in McGregor and Camfield (1982, p. 20). Until a comprehensive revision of patinate spores has been undertaken, I prefer to follow McGregor and Camfield and retain the species in *Archaeozonotriletes*. Some specimens (figs 1 and 2) appear intermediate to *Lophozonotriletes excisus* Naumova 1953 (pl. 11, fig. 18) because they are distinctly cingulate with predominantly proximate verrucate sculpture.

Range: Not previously recorded from Australia, but is widespread in Europe and North America. Ranges from the top of the ***devonicus–naumovii*** to the ***optivus–triangulatus*** Assemblage Zones of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986).

Occurrence: NRD 3, PD 17, 120, 145, 151, 153, 162.

Archaeozonotriletes variabilis Naumova 1953 emend. Allen 1965 (Pl. 7, figs 6, 7)

For synonymy see McGregor and Camfield (1982, p. 21)

Dimensions: 6 specimens: 36 (41) 50 μm.

Remarks: Only a few specimens were recorded, but these conform to the emended diagnosis of Allen (1965). They can be distinguished from the somewhat similar *Stenozonotriletes* sp. C Playford 1976 because the latter species has laesurae bordered by broad, straight, non-tapering thickenings. The thickenings extend to the inner proximal edge of the patina, where they have rounded terminations.

Range: *Archaeozonotriletes variabilis* was recorded from the Upper Etonvale Formation (Middle to Late Devonian) of the Adavale Basin, Queensland. The species is widespread in Canada and northern Europe, and occurs in the Givetian and Frasnian of the Ghadamis Basin of Libya–Tunisia (Loboziak and Streel, 1989). The species ranges from the middle of the ***devonicus–naumovii*** Assemblage Zone to above the ***nitidus–verrucosus*** Assemblage Zone of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor (1986). The Lennard Shelf variant has a similar range.

Occurrence: PD 17, 153.

Genus *AURORASPORA* Hoffmeister, Staplin, and Malloy 1955 emend. Richardson 1960

Type species: *Auroraspora solisorta* Hoffmeister, Staplin, and Malloy 1955 (by original diagnosis).

Auroraspora macra Sullivan 1968 (Pl. 7, fig. 8)

For synonymy see Playford (1971, p. 49).

Dimensions: 31 specimens: 32 (52) 72 μm.

Range: Fairfield Group, Canning Basin, Famennian or Tournaisian (Playford, 1976); Bonaparte Formation, Tanmurra Formation, and "Milligans Beds" (now Formation), Bonaparte Basin, Visean (Playford, 1971); "Buttons Beds" (now Formation, Bonaparte Basin, latest Devonian (Playford, 1982); Ducabrook Formation, Drummond Basin, Queensland, late Visean (Playford, 1978). The species is widespread in Canada and northern Europe, and ranges from the middle ***torquata–gracilis*** Assemblage Zone to above the ***nitidus–verrucosus*** Assemblage Zone of the Old Red Sandstone Continent and adjacent regions (Richardson and McGregor, 1986).

Occurrence: Present in most samples from the Nullara Cycle of the Napier Range.
NRD 1, 9, 20, 26, 32, 69.

Genus *BACULATISPORITES* Pflug and Thomson 1953 *in* Thomson and Pflug 1953

Type species: *Baculatisporites primarius* (Wolff) Pflug and Thomson 1953 (by original designation).

Baculatisporites semilucensis? (Naumova 1953) McGregor and Camfield 1982 (Pl. 7, figs 9, 10)

? 1982 *Baculatisporites semilucensis* (Naumova 1953) McGregor and Camfield, p. 21, fig. 17, text-fig. 26.

For additional synonymy see McGregor and Camfield (1982, p. 21).

Dimensions: 8 specimens: 41 (54) 68 μm.

Remarks: Several poorly preserved, baculate, Lennard Shelf specimens conform generally to the description of McGregor and Camfield, although the sculpture of Lennard Shelf specimens is slightly coarser and denser, and bacula are only a minor component.

Range: Not previously recorded in Australia. Occurs in northern Europe and Canada, and ranges from the upper Eifelian to lower Givetian of Canada (McGregor and Camfield, 1982).

Occurrence: PD 17, 120, 145, 153, 162.

Genus *BIHARISPORITES* Potonié 1956 emend. Bharadwaj and Tiwari 1970

Type species: *Biharisporites spinosus* Singh *in* Surange, Singh, and Srivastava, 1953.

Biharisporites parviornatus? Richardson 1965 (Pl. 7, figs 11, 12)

? 1965 *Biharisporites parviornatus* Richardson, p. 575, pl. 90, figs 12, 13; text-fig. 5.

1967 *Biharisporites* sp. Hemer and Nygreen, Pl. I, fig. 12.

Dimensions: 2 specimens: 130.5 and 135.0 μm.

Remarks: The two specimens resemble *B. parviornatus* in most features, except for their smaller size (*B. parviornatus* ranges from 208–368 μm). The Lennard Shelf specimens have smooth, finely punctate contact areas. Elsewhere, the sculpture consists of densely packed spines, cones, and tubercules. Elements are sometimes fused at their bases as in *B. parviornatus*. One specimen is proximocavate, with an intexine 78.4 μm in diameter (Pl 7, fig. 12), and to some extent resembles *Calyptosporites stolidotus* Balme 1988.

From the few specimens available, it is not clear whether the Lennard Shelf form is commonly cavate: a second specimen (Pl. 7, fig. 11) is too poorly preserved for this to be determined with certainty. Additional specimens are required before the Lennard Shelf variant can be confidently assigned to either *Biharisporites* or to some other genus.

Range: Not previously recorded in Australia. Probably occurs in the Jauf Formation of Saudi Arabia, late Givetian (Hemer and Nygreen, 1967). *B. parviornatus* has a very restricted range according to Richardson and McGregor (1986), extending only from the topmost ***devonicus–naumovii*** to the lower ***lemurata–magnificus*** Assemblage Zones of the Old Red Sandstone Continent. Confident identification of the species would allow very precise dating of the sequence, and would therefore be of considerable biostratigraphic significance.

Occurrence: PD 162.

Biharisporites sp. indet (Pl. 7, figs 13, 14)

Dimensions: 10 specimens: 126 (166) 216 μm.

Description: Large, trilete spores with oval to rounded subcircular amb showing no preferred orientation. Laesurae 2/3 to 3/4 radius in length, often obscured by exoexinal folding. Prominent, fold-like labra are up to 14 μm high at the pole, but decrease slightly towards the equatorial margins. Exoexine thin, commonly less than 1 μm; no intexine (mesosporoid) observed. Contact areas finely punctate but otherwise free of sculpture. Distal- and proximal-equatorial areas finely punctate, and bearing an ornament of grana and irregularly spaced, widely dispersed bacula. Sculpture is not interconnected at the base. Bacula between 4.0 and 9.0 μm in height; distinctly biform, with a rounded caput up to 9 μm in diameter on a stalked collum about 1μm in diameter and up to 4 μm long.

Remarks: Specimens are too small for inclusion in most described species, although the size range of Lennard Shelf material may have been biased by the use of sieves to remove plant tissue. *B.* sp. A is readily distinguished from most other species by the presence of pila. The specimens most closely resemble *B. submamillarius* McGregor 1960, but differ in being smaller, in lacking a mesosporoid, in having lower labra relative to spore size, and in the nature of the sculpture. Sculpture consists of fused tubercules with a small, tapering spine at the summit in *B. submamillarius*, but is distinctly baculate in *B.* sp. indet.

These miospores undoubtedly represent a new species of *Biharisporites*, but circumscription has not been attempted because only 10 specimens were recorded, and many of the specimens are too dark to allow detailed examination of characteristic features.

Range: The genus ranges from the Devonian to the Triassic. The closest species, *B. submamillarius*, was recorded from the Frasnian of Melville Island, Canada (McGregor, 1960).

Occurrence: NRD 20, 32.

Genus *BROCHOTRILETES* Naumova 1939 ex Naumova 1953

Type species: *Brochotriletes foveolatus* Naumova 1953 (by monotypy).

Brochotriletes textilis (Balme and Hassell 1962) Playford 1976 (Pl. 8, fig. 1)

For synonymy see G. Playford (1976) p. 23.

Dimensions: 6 specimens: 68 (87) 108 μm.

Range: BMR 2 Laurel Downs and Kimberley Downs bores, Canning Basin, Late Devonian (Balme and Hassell, 1962); Fairfield Group, Canning Basin, Famennian or Tournaisian (G. Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982). Also recorded from the Tournaisian of Europe (Mortimer, Chaloner, and Llewellyn, 1970; Sullivan, 1968).

Occurrence: NRD 4, 18, 26.

Genus *CALAMOSPORA* Schopf, Wilson, and Bentall 1944

Type species: *Calamospora hartungiana* Schopf *in* Schopf, Wilson, and Bentall 1944 (by original designation).

Remarks: McGregor and Camfield (1982) discussed problems associated with the circumscription of the genus, and pointed out that many of the species have intergradational characteristics. Several specimens which have the general morphology of the genus *Calamospora* were observed during the present study. Few are of biostratigraphic significance because of the degree of intraspecific variation. No attempt was made to differentiate them into species for this study, except for noting the occurrence of the distinctive forms *Calamospora pannucea* and *C.* sp. cf. *C. microrugosa*.

Calamospora sp. cf. *C. microrugosa* (Ibrahim) Schopf, Wilson, and Bentall 1944 of Balme and Hassell 1962
(Pl. 8, figs 2, 3)

1962 *Calamospora* sp. cf. *C. microrugosa* (Ibrahim) Schopf, Wilson, and Bentall in Balme and Hassell 1962, p. 6, pl. 1, figs 5–7.

Dimensions: 11 specimens: 72 (118) 153 µm.

Remarks: Balme and Hassell (1962) noted that Western Australian specimens have a slightly smaller size range than those in the original diagnosis of the species (Schopf et al., 1944). Specimens observed in the present study conform to Balme and Hassell's description.

Range: Canning Basin, Late Devonian (Balme and Hassell, 1962, p. 6); Ducabrook Formation, Drummond Basin, Queensland, late Visean (Playford, 1978).

Occurrence: Upper part of NRD 26.

Calamospora pannucea Richardson 1965
(Pl. 8, figs 4–6)

1974 *Calamospora* spp. Grey, p. 97.

For additional synonymy see Balme, 1988

Dimensions: 7 specimens: 76 (141) 270 µm.

Remarks: Balme (1988) points out that *C. pannucea* includes a wide size range and morphological variation. Lennard Shelf specimens closely resemble those illustrated by Balme (1988) from the Gneudna Formation. However, no trilete mark has been observed on Lennard Shelf specimens. Balme mentions a similarity with forms previously assigned to *Calamospora* (Balme and Hassell, 1962; Grey, 1974), but does not place them in synonymy. Specimens referred to by Grey (1974) have been re-examined, and are here placed in synonymy. Specimens illustrated by Balme and Hassell (1962) have a thinner exine and are generally smaller. For the moment they are retained in *C.* sp. cf. *C. microrugosa.*

Range: Canning Basin, Late Devonian (Balme and Hassell, 1962, p. 6); Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988); Ducabrook Formation, Drummond Basin, Queensland, late Visean (Playford, 1978); Old Red Sandstone of Scotland, Middle Devonian (Richardson, 1965); Early and Middle Devonian, Gaspé Bay, Canada (McGregor, 1973).

Occurrence: PD 17, 151.

Genus *CALYPTOSPORITES* Richardson 1962

Type species: *Calyptosporites velatus* (Eisenack 1944) Richardson 1962 (by original designation).

Remarks: Authors disagree about whether the genus *Calyptosporites* is really synonymous with *Grandispora* (Richardson, 1960, p. 58, 1965, p. 583; Playford, 1971, p. 45; Riegel, 1973, p. 97; McGregor and Camfield, 1982, p. 43; Richardson and McGregor, 1982, p. 13). The problems will only be resolved by a detailed revision of pseudosaccate spores. *Calyptosporites* is retained here to avoid proposing a new combination based on only a few specimens.

Calyptosporites proximocavatus Balme 1988
(Pl. 9, fig. 1)

1988 *Calyptosporites proximocavatus* Balme, p. 141, pl. 10, figs 1–5.

Dimensions: Two specimens: overall diameter 103 and 135 µm.

Remarks: Balme (1988) assigned Carnarvon Basin forms to a new species because they differ from previously described species of *Calyptosporites* in being proximally cavate and having densely packed, variable sculpture. Balme also commented on their similarity to *Endosporites gilmorensis* de Jersey 1966, which, however, is laevigate to finely granulate. Lennard Shelf specimens are rare, and it is not possible to enlarge on Balme's description.

Range: Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988).

Occurrence: NRD 2, 26.

Calyptosporites stolidotus Balme 1988
(Pl. 9, figs 2–4)

1988 *Calyptosporites stolidotus* Balme, p. 141, pl. 9, figs 8–10.

Dimensions: 6 specimens: overall diameter, 78 (96) 117 µm, central body, 6 specimens, 39 (53) 77 µm.

Remarks: Lennard Shelf specimens resemble those from the Carnarvon Basin described by Balme (1988), but the sculpture is finer and less diverse (commonly 0.5 µm basal diameter and 0.5 µm high compared with a diameter and height of 1–2 µm for Carnarvon Basin specimens). Furthermore, the sculpture is denser, and the size range is smaller. Only a few specimens were recorded from the Lennard Shelf, and for the moment they are treated as morphological variants falling within the range of *C. stolidotus*. More Lennard Shelf specimens are required before consistent differences great enough to justify a new species can be demonstrated.

Occurrence: NRD 70, PD 153.

Calyptosporites sp. cf. *C. stolidotus* Balme 1988
(Pl. 9, figs 5, 6)

cf. 1988 *Calyptosporites stolidotus* Balme, p. 141, pl. 9, figs 8–10.

Dimensions: 7 specimens: overall dimensions 59 (81.7) 101 µm; central body, 6 specimens 26 (31) 39 µm.

Remarks: Lennard Shelf specimens differ from *C. stolidotus*, recorded both from the Carnarvon Basin (Balme, 1988), and in the present study, in having a smaller, dark, central body (approximately 1/3 the total spore diameter) with a finer, denser sculpture.

Occurrence: PD 17, 145, 153.

cf. *Calyptosporites* sp. indet.
(Pl. 9, figs 7 to 9)

Dimensions: 9 specimens: overall diameter 90 (110) 143 μm, diameter of intexine (6 specimens) 42 (53) 62 μm.

Description: Trilete or monolete, cavate miospore, amb subcircular to oval, ovoid shape often exaggerated by compressional folding along central axis. Trilete mark indistinct, usually obscured by folding, and in some specimens could be monolete. Exine thin, proximally attached, laevigate to finely infrapunctate. In addition to the axial fold, two other compression folds generally occur perpendicular to the axis, dividing the spore into thirds. Minor compression folds may also occur. Folds usually taper towards the equatorial margin. Intexine is granulate, thicker than exine, and has poorly defined margins.

Remarks: The generic assignment of this species remains doubtful. It is here placed in *Calyptosporites* because of the close similarity to this genus when specimens are trilete. However, the tendency towards development of monolete forms suggests some affinity with *Archaeoperisaccus* Naumova 1953) Potonié 1958, or *Aratrisporites* Leschik 1956. Detailed systematic studies are required before the genus can be identified.

The characteristic folding pattern distinguishes this Lennard Shelf form from previously described species of *Calyptosporites* and other cavate taxa. It is apparently a new species, but additional specimens are required before the species can be adequately circumscribed. Some specimens here assigned to cf. *Rhabdosporites langii* may also belong in this species (Pl. 25, fig. 9 and 10) — see comments under that taxon.

Occurrence: NRD 70; PD 120, 153.

Genus *CAMAROZONOTRILETES* Naumova 1939 ex Ischenko 1952

Type species: *Camarozonotriletes devonicus* Naumova 1953 (by subsequent designation of Potonié, 1958)

Camarozonotriletes parvus? Owens 1971
(Pl. 9, figs 13, 14)

? 1971 *Camarozonotriletes parvus* Owens, p. 40, pl. 11, figs 1–4.

For additional synonymy see McGregor and Camfield (1982, p. 24).

Dimensions: 19 specimens: 36 (42) 54 μm.

Remarks: The form from the Lennard Shelf has some morphological similarity to that recorded by McGregor and Camfield (1982, p. 24). It is slightly larger, and the interradial reduction of the cingulum is less. Many of the specimens are dark, and details are difficult to distinguish. Better preserved specimens are needed before Lennard Shelf forms can be assigned with confidence. The differences from *C. parvus* may be great enough to indicate a new species. *Camarozonotriletes*? *concavus* Loboziak and Streel 1989 has a narrower cingulum and straight to concave sides.

Range: Not previously recorded from Australia. Eifelian and lower Givetian of Canada (McGregor and Owens, 1966; Owens, 1971; McGregor and Uyeno, 1972; McGregor and Camfield, 1982).

Occurrence: PD 17, 153.

Genus *CAMPTOTRILETES* Naumova emend. Potonié and Kremp 1954

Type species: *Camptotriletes corrugatus* (Ibrahim) Potonié and Kremp 1955 (by subsequent designation of Potonié and Kremp, 1954).

Camptotriletes balmei Playford 1976
(Pl. 9, figs 10 - 12)

For synonymy see G. Playford (1976, p. 21)

Dimensions: 42 specimens: 36 (56) 90 μm.

Range: BMR 2 Laurel Downs bore, Canning Basin, Late Devonian (Balme and Hassell, 1962); Fairfield Group, Canning Basin, Famennian or Tournaisian (Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982).

Occurrence: NRD 1, 2, 4, 9, 17, 18, 20, 26, 69.

Genus *CAMPTOZONOTRILETES* Staplin 1960

Type species: *Camptozonotriletes vermiculatus* Staplin 1960 (by original diagnosis).

Remarks: See Balme (1988) for remarks on this genus.

Camptozonotriletes leptohymenoides Balme 1988
(Pl. 10, figs 1, 2)

1988 *Camptozonotriletes leptohymenoides* Balme, p. 137, pl. 8, figs 1–4.

Dimensions: 4 specimens: 67 (92) 108 μm.

Remarks: Rare Lennard Shelf specimens conform to Balme's (1988) diagnosis. *Grandispora riegelii* Loboziak and Streel 1989 has many similarities with *C. leptohymenoides*, but is smaller in diameter and is reportedly camerate. Obviously, a more detailed taxonomic comparison of Carnarvon Basin and Ghadamis Basin specimens is indicated.

Range: Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988).

Occurrence: NRD 20, 32, 70.

Genus *CHELINOSPORA* Allen 1965 emend. McGregor and Camfield 1976

Type species: *Chelinospora concinna* Allen 1965 (by original designation).

cf. *Chelinospora ligurata* Allen 1965
(Pl. 10, fig. 3)

cf. 1965 *Chelinospora ligurata* Allen, p. 729, pl. 102, figs 1–7.

Dimensions: 2 specimens only suitable for measurement, both 54 µm.

Remarks: Rare Lennard Shelf specimens have some features in common with the diagnosis of Allen (1965), but are too poorly preserved for confident assignment.

Range: Not previously recorded in Australia. Present in Europe (Allen, 1965), and ranges from the ***optivus–triangulatus*** to the middle ***ovalis–bulliferus*** Assemblage Zones of the Old Red Sandstone Continent (Richardson and McGregor, 1982).

Occurrence: NRD 70; PD 145, 162.

Genus *CIRRATRIRADITES* Wilson and Coe 1940

Type species: *Cirratriradites maculatus* Wilson and Coe 1940 (by subsequent designation of Schopf, Wilson, and Bentall, 1944, p. 43).

Cirratriradites impensus Playford 1976
(Pl. 10, figs 4, 5)

For synonymy see G. Playford (1976, p. 35).

Dimensions: 2 specimens: 134 and 106 µm.

Remarks: Both specimens conform to the diagnosis of G. Playford (1976, p. 35).

Range: Fairfield Group, Canning Basin, Famennian or Tournaisian (G. Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982).

Occurrence: NRD 2, 26.

Genus *CLIVOSISPORA* Staplin and Jansonius 1964

Type species: *Clivosispora variabilis* Staplin and Jansonius 1964 (by original diagnosis).

Clivosispora sp. indet.
(Pl. 10, figs 10–13)

Dimensions: 4 specimens: 56 (64) 70 µm.

Description: Spores trilete; amb rounded triangular to subcircular; two-layered. Trilete mark straight. Bordered by thickened (5 to 8.5 µm wide) laesurae commonly with a sculpture of verrucae. Trilete mark 2/3 of spore radius, usually gaping to form a triangular opening. Intexine smooth to scabrate, closely adpressed to outer layer. Exoexine thick, smooth to scabrate; distal surface with low, contiguous verrucae which sometimes extend beyond the equatorial margin on to the proximal face. Verrucae 3 µm high and 5 µm across base.

Remarks: Lennard Shelf specimens are assigned to *Clivosispora* on the basis of their thick exoexine and sculpture of (mainly) distal verrucae, although the contiguous verrucae sometimes form convolute ridges, and the form could perhaps be placed in *Convolutispora*. They differ from other species of *Clivosispora* in having smaller, more numerous verrucae, and in having verrucae bordering the laesurae. Too few specimens were recorded in the present study for a new species to be circumscribed.

Range: The distribution of the specimens in Lennard Shelf samples is consistent with the Givetian to Tournaisian range cited for the genus (Staplin and Jansonius, 1964).

Occurrence: PD 153.

Genus *CONVOLUTISPORA* Hoffmeister, Staplin, and Malloy 1955

Type species: *Convolutispora florida* Hoffmeister, Staplin, and Malloy 1955 (by original designation).

Convolutispora caementosa Balme 1988
(Pl. 10, figs. 8)

1975 *Convolutispora* sp. Grey, fig. 61e.

1988 *Convolutispora caementosa* Balme p. 129, pl. 5, figs 1–3.

Dimensions: 1 specimen: 84 µm

Remarks: This form is rare in Lennard Shelf samples, but is apparently more common in the Carnarvon Basin (Balme, 1988). Only one well-preserved specimen was recorded during the present study, although several poorly preserved miospores have similar morphology. The form was also observed in other Lennard Shelf samples not included in this report.

Range: Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988).

Occurrence: NRD 9, PD 17.

Convolutispora crassata? (Naumova) of McGregor and Camfield 1982
(Pl. 10, fig. 6)

1982 *Convolutispora crassata*? (Naumova) McGregor and Camfield, p. 25, pl. 4, figs 18–20; pl. 18, fig. 23; text-fig. 30.

For additional synonymy see McGregor and Camfield (1982, p. 25).

Dimensions: 18 specimens: 36 (51) 68 µm.

Remarks: Lennard Shelf specimens are morphologically similar to the forms recorded by McGregor and Camfield (1982, p. 25). These authors questioned assignment to *C. crassata* because of difficulties in comparing Canadian specimens with type material. Their comments about the intergradation of *C. crassata*? and *Verrucosisporites scurrus* are supported by the range of variation in the Lennard shelf specimens.

Range: Not previously recorded from Australia. Occurs in the Devonian of the USSR (Naumova, 1953), and in the Eifelian and lower Givetian of Canada (McGregor and Camfield, 1982).

Occurrence: NRD 3, PD 120, 151, 153, 162.

Convolutispora fromensis Balme and Hassell 1962
(Pl. 10, figs 7, 9)

For synonymy see Playford (1976, p. 19).

Dimensions: 52 specimens: 36 (57) 81 µm.

Range: Canning Basin, Late Devonian (Balme and Hassell, 1962); Fairfield Group, Canning Basin, Famennian or Tournaisian (Playford, 1976); Bonaparte Formation, Tanmurra Formation, "Burvill Beds" (now Formation), and "Milligans Beds" (now Formation), Bonaparte Basin, Visean (Playford, 1971); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982); Ducabrook Formation, Drummond Basin, Queensland, late Visean (Playford, 1978).

Occurrence: NRD 1, 2, 4, 9, 17, 18, 26.

Convolutispora paraverrucata McGregor 1964
(Pl. 11, figs 1 to 4)

1964 *Convolutispora paraverrucata* McGregor 1964, p. 17, Pl. II, figs 9 to 11.

1980 *Convolutispora paraverrucata* McGregor 1964; Loboziak and Streel, Pl. 1, fig. 6.

Dimensions: 4 specimens: 42 (60) 78.4 µm.

Remarks: Lennard Shelf specimens compare closely with McGregor's (1964) description. They are readily distinguished from other species of *Convolutispora* present in Lennard Shelf samples by their dense, irregular sculpture.

Range: Ghost River Formation (now Yahatinda Formation), Alberta, Canada, late Givetian to early Frasnian (McGregor, 1964); Calcaire de Blacourt, Boulonnais, France, middle Givetian (Loboziak and Streel, 1980).

Occurrence: PD 120.

Genus *CRASSISPORA* Bhardwaj 1957 emend. Sullivan 1964

Type species: *Crassispora ovalis* (Bhardwaj) Bhardwaj 1957 (by original designation). According to Smith and Butterworth, 1967, p. 237, *C. ovalis* is a junior synonym of *C. kosanke* (Potonié and Kremp) Bhardwaj 1957.

Crassispora drucei Playford 1976
(Pl. 11, figs 5–7)

1976 *Crassispora drucei* Playford, p. 35, pl. 7, figs 1-6.

Dimensions: 61 specimens: (excluding sculpture) 31 (59) 90 µm.

Remarks: Some specimens show features transitional between *C. drucei* and *Hymenozonotriletes scorpius* (Balme and Hassell, 1962) Playford 1976. *Grandispora cornuta* Higgs 1975 is camerate, has sparser and longer spines, and has narrow compression folds, rather than an equatorial crassitude.

Range: Fairfield Group, Canning Basin, Famennian or Tournaisian (Playford, 1976).

Occurrence: NRD 1, 2, 4, 9, 17, 18, 26, 69.

Genus *CRISTATISPORITES* Potonié and Kremp 1954 emend. Butterworth et al. *in* Staplin and Jansonius 1964

For synonymy and comments on emendations see McGregor and Camfield (1982, p. 29).

Type species: *Cristatisporites indignabundus* (Loose) Potonié and Kremp 1954 (by original designation).

Remarks: McGregor and Camfield (1982, p. 29) have discussed the problems of maintaining the distinction between *Cristatisporites* and *Samarisporites* Richardson 1965. They point out that the whole group of ornamented zonate spores require revision, and in the interim place *Samarisporites* in synonymy with *Cristatisporites*. Balme (1988) prefers to retain *Samarisporites* for "Devonian forms with cristate sculptural processes and a zona-like equatorial extension of uncertain structure". However, it is the not the structure of the zona, but the absence of sculpture on the proximal face that distinguishes *Samarisporites* from the proximally sculptured *Cristatisporites* (McGregor and Camfield, 1982). Because, as McGregor and Camfield point out, this distinction is difficult to determine in heavily ornamented specimens, and is taxonomically trivial, I follow their assignment to *Cristatisporites* in this paper.

Cristatisporites albus? (Arkhangelskaya 1963) McGregor and Camfield 1982
(Pl. 11, figs 8–10)

? 1963 *Hymenozonotriletes albus* Arkhangelskaya, p. 26, pl. 11, figs 1–4.

1974 *Samarisporites* sp. Grey, figs. 61p, 61q.

1982 *Cristatisporites albus*? (Arkhangelskaya 1963); McGregor and Camfield, p. 29, pl. 5, figs. 10, 12–16; text-fig. 39.

1966 *Hymenozonotriletes incisus* Naumova 1953; Hemer and Nygreen, p. 53, Table 1; pl. II, figs 9, 10.

Dimensions: 20 specimens: 54 (72) 104 µm.

Remarks: Specimens are similar to *Cristatisporites albus*? described by McGregor and Camfield (1982). These authors described spores which differed from *Cristatisporites albus* Arkhangelskaya in having thicker labra and a smaller size. Canning Basin specimens show a closer resemblance to the McGregor and Camfield specimens than to those of Arkhangelskaya (1953). However, they have a smaller size-range and commonly have a smaller zona than do both the Russian and Canadian forms. Many specimens are badly corroded, but in several of them bacula are a distinct component of the sculpture.

Range: Gogo Formation, Canning Basin (Grey, 1974); Devonian of the USSR (Arkhangelskaya, 1963); ?upper Eifelian and lower Givetian of Canada (McGregor and Camfield, 1981).

Occurrence: NRD 70; PD 17, 26, 151, 153, 162.

Cristatisporites triangulatus (Allen 1965) McGregor and Camfield 1982
(Pl. 12, figs 1–3)

1965 *Samarisporites triangulatus* Allen, p. 716, pl. 99, fig 1–6.

1982 *Cristatisporites triangulatus* (Allen 1965) McGregor and Camfield, p. 29.

1986 *Cristatisporites triangulatus* (Allen 1965) McGregor and Camfield 1982 in Richardson and McGregor, pl. 15, fig. 9.

1988 *Samarisporites triangulatus* Allen 1965; Balme, p. 136, pl. 7, fig. 8–11.

For additional synonymy see Allen (1982) and Balme (1988).

Dimensions: 22 specimens: 36 (40) 50 μm.

Remarks: For comments on generic status see McGregor and Camfield (1982, p. 29). Lennard Shelf specimens show similarities in morphology, but have a slightly smaller size range. Balme (1988) retains this species in *Samarisporites*, arguing that the nature of the zona is unclear, but is possibly two-layered. Lennard Shelf specimens are not sufficiently well preserved for this to be determined. However, as discussed previously, the distinction between *Cristatisporites* and *Samarisporites* is based on the nature of the sculpture, rather than on the nature of the zona. Consequently, I prefer to adopt McGregor and Camfield's (1982) re-assignment of this species to *Cristatisporites*.

Range: Previously recorded in Australia only in the Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988). Ranges from the base of the ***optivus–triangulatus*** to the upper ***ovalis–bulliferous*** Assemblage Zones of the Old Red Sandstone Continent (Richardson and McGregor, 1986). This important and readily distinguished species has a narrow stratigraphic range from the uppermost Givetian to mid-Frasnian, and is widely dispersed (Allen, 1982; Loboziak and Streel, 1989)). A record of its occurrence in the early Givetian (Loboziak and Streel, 1981) has not been substantiated (Balme, 1988). Its range is regarded as being from the Upper *Polygnathus varcus* conodont Subzone, to near the top of the *gigas* conodont zone. Its earliest appearance in the Lennard Shelf boreholes is some distance above the base of the sequence, and this is consistent with limited local conodont data (Nicoll, 1981).

Occurrence: PD 17, 151, 153 above 209.7 m, 162.

Genus *CYCLOGRANISPORITES* Potonié and Kremp 1954

Type species: *Cyclogranisporites leopoldi* (Kremp 1952) Potonié and Kremp 1954 (by original designation).

cf. *Cyclogranisporites* sp. de Jersey 1966
(Pl. 12, fig. 4)

cf. 1966 *Cyclogranisporites* sp. de Jersey, p. 9, pl. 3, fig. 2.

1974 *Cyclogranisporites* sp. Grey, fig. 61f.

Dimensions: 3 specimens: 40 (45) 51 μm

Remarks: Specimens are rarely present in Lennard Shelf samples. Specimens with a circular amb and a sculpture of closely spaced, roundish grana arranged in a regular pattern are tentatively assigned to de Jersey's (1966) taxon. Lennard Shelf specimens recorded here and in Grey (1974) resemble de Jersey's taxon in having a thin exine (1–1.5 μm), and this distinguishes them from *Cyclogranisporites isostictus* Balme 1988, in which the exine is 2–3 μm thick.

They apparently differ from *Apiculatasporites microconus* (Richardson 1965) McGregor and Camfield 1982 in having grana rather than cones, and lack curvaturae. However, the true nature of the sculpture is difficult to determine for Lennard Shelf specimens, which are usually corroded. Both Lennard Shelf specimens, and possibly those of de Jersey (which are difficult to interpret from his illustrations), may belong to *A. microconus*.

Range: Adavale Basin, Queensland, Middle Devonian (de Jersey, 1966); Lennard Shelf, Devonian (Grey, 1974).

Occurrence: NRD 3, PD 26.

Cyclogranisporites sp. A Playford 1976
(Pl. 12, fig. 5)

1976 *Cyclogranisporites* sp. A Playford, p. 11, pl. 1, figs 11–13.

Dimensions: 2 specimens: both 49.5 μm.

Range: Fairfield Group, Canning Basin, Famennian or Tournaisian (Playford, 1976).

Occurrence: NRD 26.

Genus *CYMBOSPORITES* Allen 1965

For synonymy see McGregor and Camfield, 1982, p. 32.

Type species: *Cymbosporites magnificus* (McGregor 1960) McGregor and Camfield 1982 (by original designation).

Cymbosporites catillus Allen 1965
(Pl. 12, figs 11, 12)

Dimensions: 12 specimens: 34 (47) 63 μm.

Remarks: Lennard Shelf specimens conform to the diagnosis given by Allen 1965. They also show some resemblance to *Cymbosporites* sp. cf. *Retusotriletes* *tschibrikovii* Mikhailova 1966 of McGregor and Camfield (1982), but are smaller, have a patina and have only indistinct curvaturae.

Range: The specimens recorded by McGregor and Camfield (1982) occur in the lower Givetian of Canada. *C. catillus* has also been recorded from the Late Givetian to Frasnian of the Ghadamis Basin of Libya–Tunisia (Loboziak and Streel, 1989).

Occurrence: NRD 3; PD 17, 145, 151,153.

Cymbosporites sp. cf. *magnificus* (McGregor 1960) McGregor and Camfield 1982
(Pl. 12, figs 6–8)

cf. 1982 *Cymbosporites magnificus* (McGregor 1960) McGregor and Camfield, p. 32, pl. 6, figs 4, 5; text-fig 42.

For additional synonymy see McGregor and Camfield 1982, p. 32.

Dimensions: 7 specimens: 54 (65) 84 μm.

Remarks: Lennard Shelf specimens are rare, and cannot be unequivocally assigned to *C. magnificus*. Their sculptural elements occur distally and equatorially, and are longer, narrower, and more widely spaced, than in specimens previously described for this species (McGregor, 1960, p. 35; McGregor and Camfield, 1982, p. 32). The size range of *C. magnificus* is also greater and the equatorial region is commonly thicker. Lennard Shelf specimens may well represent a new species, but are here tentatively assigned to *C. magnificus* because this is the species with which they have the closest affinities.

Range: *C. magnificus* has not previously been recorded in Australia. It is widely distributed in Canada and northern Europe, and ranges from the base of the ***lemurata–magnificus*** to the upper ***ovalis–bulliferus*** (and may extend to the lower ***torquata–gracilis***) Assemblage Zones of the Old Red Sandstone Continent (Richardson and McGregor, 1986).

Occurrence: NRD 3; PD 17, 120, 145, 151, 162.

Genus *DENSOSPORITES* Berry 1937 emend. Potonié and Kremp 1954

Type species: *Densosporites covensis* Berry 1937 (by original designation).

Remarks: Several Lennard Shelf specimens are assigned to *Densosporites* because they show some darkening of the inner margin of the zona. The sculpture, however, is sometimes more typical of *Ancyrospora* in having biform tips and a deeply scalloped margin. Additional specimens are required to resolve the problem of generic assignment.

Densosporites sp. cf. *D. inaequus* (McGregor 1960) McGregor and Camfield 1982
(Pl. 12, figs 13, 14)

cf. 1982 *Densosporites inaequus* (McGregor 1960) McGregor and Camfield, p. 35, pl. 7, figs 1–6; text-fig. 48.

For additional synonymy see McGregor and Camfield 1982.

Dimensions: 5 specimens: (excluding sculpture) 56 (78) 112 μm.

Remarks: Occurs sporadically in Lennard Shelf samples. The comparison with *inaequus* is based on the presence of broad-based coni with an attenuated or pointed tip, a feature which is very characteristic of the Lennard Shelf specimens, and which can be compared with Owens, 1971, Pl. XII, fig. 2. However, Lennard Shelf specimens differ from *D. inaequus* in having a more deeply scalloped margin, and processes with divided tips; features not typical of *Densosporites*. They could also be assigned to *Ancyrospora*. Most specimens are intermediate between *D. inaequus*, *D. weatherallensis*, *Ancyrospora langii*, *A. ampulla*, and *A. amadei*.

Range: *D. inaequus* has not been previously recorded in Australia. Lower ***devonicus - naumovii*** to upper ***ovalis–bulliferus*** Assemblage Zones of the Old Red Sandstone Continent (Richardson and McGregor, 1986).

Occurrence: PD 162. Only well-preserved specimens were measured, although poorly preserved specimens were observed in other samples.

Densosporites sp. cf. *D. weatherallensis* McGregor and Camfield 1982
(Pl. 13, figs 1, 2)

cf. 1982 *Densosporites weatherallensis* McGregor and Camfield, p. 35, pl. 7, figs 7–9, 14; text-fig. 49.

Dimensions: 5 specimens: 56 (89) 121 μm.

Remarks: Rare in Lennard Shelf samples. Specimens are sometimes corroded and difficult to identify, and do not always have a distinct dark ring around the inner edge of the zona. The deeply scalloped margin suggests a form intermediate between *Densosporites* and *Ancyrospora*.

Range: *D. weatherallensis* has not previously been recorded in Australia. Upper Eifelian and lower Givetian of Canada (McGregor and Camfield, 1982).

Occurrence: PD 145, 153, 162.

Densosporites sp. indet.
(Pl. 13, fig. 3)

Dimensions: 5 specimens: 41 (50) 59 μm.

Remarks: Several poorly preserved specimens with varying morphology, but clearly showing the annular dark ring characteristic of *Densosporites*, were observed in Lennard Shelf samples (for a discussion of whether this darkening is a cingulum, or a result of compression of the thick exoexine, see McGregor and Camfield, 1982, p. 33). None of the spores is well-enough preserved for accurate determination. One or two show a resemblance to

Densosporites atavus de Jersey 1966; others to *Densosporites concinnus* (Owens 1971) McGregor and Camfield 1982. However, because of the loss of distinguishing characteristics, either through opacity or corrosion, all are included in open nomenclature.

Occurrence: NRD 20.

cf. *Densosporites* sp. indet.
(Pl. 12, figs 9, 10)

Dimensions: 4 specimens: (excluding sculpture) 56 (62) 67 μm.

Remarks: Lennard Shelf specimens resemble forms of *Densosporites concinnus* (Owens 1971) McGregor and Camfield 1982 (p. 34) in having a zona consisting of two parts; an inner, thickened dark ring and an outer, lighter flange-like structure. Sculptural elements are also very similar. However, the darkening is not as prominent as in *D. concinnus* and, unlike Canadian spores, an intexine can be discerned in some specimens. In addition, the ornament is rather deeply indented for *Densosporites*. The generic assignment is therefore doubtful and specimens could also be placed in *Ancyrospora*.

A specimen illustrated as "*Radiatisponospora*" (presumably an orthographical error for *Radiatispinospora* Bharadwaj et al. 1973) *langispinosa* Gao *in* Gao Lianda (1981, Pl. II, fig. 19) is similar to Lennard Shelf specimens, particularly when the sculpture is compared. I have been unable to obtain the diagnosis of *R. langispinosa*, but from the single illustration it seems very similar to cf. *D.* sp. indet. A re-assessment of the genus *Radiatispinospora* is also indicated, to determine whether it should be regarded as a separate genus or as a junior synonym of *Densosporites* or *Ancyrospora*.

Range: Not previously recorded in Australia. Ranges from the base of the ***velatus–langii*** to middle ***ovalis–bulliferus*** Assemblage Zones of the Old Red Sandstone Continent (Richardson and McGregor, 1986).

Occurrence: Only four well-preserved specimens were measured, although poorly preserved specimens were observed in other samples.
PD 17, 153.

Genus *DIAPHANOSPORA* Balme and Hassell 1962 emend. Evans 1970

For synonymy see G. Playford (1976, p. 40).

Type species: *Diaphanospora riciniata* Balme and Hassell 1962 emend. Evans 1970 (by original designation).

Diaphanospora depressa (Balme and Hassell 1962) Evans 1970
(Pl. 13, figs 4, 5)

For synonymy see G. Playford (1976, p. 40).

Dimensions: 17 specimens: 41 (49) 68 μm.

Range: Fairfield Group, Canning Basin, Late Devonian (Balme and Hassell, 1962); Fairfield Group, Canning Basin, Famennian or Tournaisian (Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982); present in the Mulga Downs Beds, western New South Wales, Famennian and Tournaisian (Evans, 1970).

Occurrence: NRD 1, 2, 9, 17, 20, 26.

Diaphanospora perplexa Balme and Hassell 1962 emend. Evans 1970
(Pl. 13, fig. 6)

For synonymy see G. Playford (1976, p. 40).

Dimensions: 35 specimens: 27 (51) 77 μm.

Range: Fairfield Group, Canning Basin, late Devonian (Balme and Hassell, 1962); Fairfield Group, Canning Basin, Famennian or Tournaisian (G. Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982); Brewer Conglomerate, Pertnjara Group, Amadeus Basin, central Australia, latest Devonian (Playford et al., 1976); common in the Mulga Downs Beds, western New South Wales, Famennian and Tournaisian (Evans, 1970).

Occurrence: NRD 1, 2, 4, 9, 17, 18, 20, 26, 69.

Diaphanospora riciniata Balme and Hassell 1962 emend. Evans 1970
(Pl. 13, fig. 7)

For synonymy see G. Playford (1976, p. 41).

Dimensions: 70 specimens: 32 (45) 68 μm.

Range: Fairfield Group, Canning Basin, Famennian and Early Carboniferous (Balme and Hassell, 1962); Fairfield Group, Canning Basin, Famennian or Tournaisian (G. Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982); Brewer Conglomerate, Pertnjara Group, Amadeus Basin, central Australia, late Devonian (Playford et al., 1976); common in the Mulga Downs Beds, western New South Wales, Famennian and Tournaisian (Evans, 1970).

Occurrence: NRD 1, 2, 4, 9, 17, 18, 26.

Diaphanospora sp. Balme and Hassell 1962
(Pl. 13, fig. 8)

1962 *Diaphanospora* sp. Balme and Hassell, p. 22, Pl. 4, figs 8–9.

Dimensions: One specimen: 73 μm.

Remarks: One well-preserved and several poorly preserved specimens correspond to Balme and Hassell's (1962) taxon.

Range: Rare in the Canning Basin, Late Devonian (Balme and Hassell, 1962).

Occurrence: NRD 26.

Genus *DIBOLISPORITES* Richardson 1965 emend. Playford 1976

For synonymy see G. Playford, 1976, p. 14.

Type species: *Dibolisporites echinaceus* (Eisenack 1944) Richardson 1965 (by original designation).

Dibolisporites sp. cf. *D. echinaceus* (Eisenack 1944) Richardson 1965
(Pl. 14, figs 1–4)

cf. 1965 *Dibolisporites echinaceus* (Eisenack 1944) Richardson, p. 568, pl. 89, figs 5,6; text-figs 3B–3D.

For additional synonymy see McGregor (1973, p. 29) and McGregor and Camfield (1982, p. 37).

Dimensions: Three specimens: 81 (101) 126 µm.

Remarks: Rare specimens occur in Lennard Shelf samples and have the dense, mixed sculpture with some biform spines, which is typical of *D. echinaceus*; but Lennard Shelf specimens tend to have a galeate sculpture consisting of a gently tapering spine, usually terminating in a bulb with an attenuated tip. In *D. echinaceus* the ornament is more elongate and terminates in a delicate apical spine. Some specimens resemble *Acinosporites lindlarensis.*

Range: *D. echinaceus* has not been recorded previously in Australia. Ranges from the lower ***annulatus–sextantii*** to the middle ***ovalis–bulliferus*** Assemblage Zones of the Old Red Sandstone Continent (Richardson and McGregor 1986).

Occurrence: PD 26, 120, 153, 162.

Dibolisporites sp. cf. *D. eifelensis* (Lanninger 1968) McGregor 1973
(Pl. 13, figs 9, 10)

cf. 1973 *Dibolisporites eifelensis* (Lanninger 1968) McGregor 1973, p. 31, pl. 3, figs 17–22, 26

For additional synonymy see McGregor (1973, p. 31).

Dimensions: 5 specimens: 45 (63) 86 µm.

Remarks: Lennard Shelf specimens are rare and poorly preserved and only doubtfully referred to this species. In some respects they resemble *Acinosporites hirsutus* (Brideaux and Radforth 1970) McGregor and Camfield 1982, but lack the ridge-like sculpture. Additional specimens are required before the identification can be confirmed, and it seems most probable that a new species is present.

Range: Not previously recorded in Australia. The species ranges from the lower ***Verrucosisporites polygonalis–Dictyotriletes emsiensis*** Assemblage Zone to the middle ***velatus–langii*** Assemblage Zone of the Old Red Sandstone Continent (Richardson and McGregor 1986). An Early Devonian age (i.e. older than Emsian) is not consistent with the presumed age of the Lennard Shelf assemblages.

Occurrence: NRD 70, PD 153, 162.

Dibolisporites quebecensis (McGregor 1973) McGregor and Camfield 1976
(Pl. 14, fig. 7)

For synonymy see McGregor and Camfield (1982, p. 38).

Dimensions: Three specimens: 45 (56) 63 µm.

Remarks: Lennard Shelf specimens are assigned to this species because they have biform spines of similar dimensions to Canadian specimens (McGregor and Camfield, 1982, p. 38). *Dibolisporites* sp. de Jersey 1966 may also belong in *D. quebecensis*, but is too poorly illustrated for positive identification.

Range: Not previously identified in Australia. Eifelian and lower Givetian of Canada (McGregor and Camfield, 1982).

Occurrence: NRD 70.

Dibolisporites sp. cf. *D. turriculatus* Balme 1988
(Pl. 14, figs 5, 6)

1974 *Dibolisporites* sp. Grey, fig. 61h.

cf. 1988 *Dibolisporites turriculatus* Balme, p. 128, pl. 5, figs 10–14.

Dimensions: Thirteen specimens: 83 (102) 158 µm.

Remarks: Lennard Shelf specimens resemble Balme's (1988) species in the nature of the sculpture, although fewer elements have an expanded spheroidal distal termination. Instead they tend to be conical or spheroidal near the base and taper to a spine. In addition, the spores are larger, the elements are more sparsely distributed, and the exine is thinner than in those from the Carnarvon Basin. Further systematic study is required to determine whether these features are sufficiently distinctive to justify a separate species.

D. turriculatus differs from *D. farraginis* McGregor and Camfield 1982 and *D. vegrandis* McGregor and Camfield 1982 in having a more regularly spaced and uniform sculpture of short biform processes.

Range: Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988).

Occurrence: NRD 3, 70; PD 17, 153, 162.

cf. *Dibolisporites wetteldorfensis* Lanninger 1968
(Pl. 14, fig. 8)

cf. 1968 *Dibolisporites wetteldorfensis* Lanninger, p. 127, pl. 22, fig. 17.

For additional synonymy see McGregor 1973, p. 31.

Dimensions: Single specimen: 45 µm.

Remarks: A single specimen is tentatively assigned to this species on the basis of size, presence of folds bordering the trilete mark, and the similarity of sculpture.

Range: Not previously recorded in Australia. Emsian of Germany (Lanninger, 1968); Siegenian to Emsian of Canada, ranging from the ***polygonalis–emsiensis*** to base of ***douglastownense–eurypterota*** Assemblage Zones of the Old Red Sandstone Continent (Richardson and McGregor 1986). The identification is doubtful, and the occurrence of the species in the Lennard Shelf sequence is well outside the range recorded elsewhere.

Occurrence: PD 153.

Genus *DICTYOTRILETES* Naumova 1939 emend. Potonié and Kremp 1955

Type species: *Dictyotriletes bireticulatus* (Ibrahim 1933) Potonié and Kremp 1955 (by subsequent designation of Potonié and Kremp 1955).

Dictyotriletes sp. indet.
(Pl. 14, fig. 9)

Dimensions: Two specimens: 31 and 73 µm.

Remarks: Only two specimens were recorded from the Lennard Shelf samples. Although they show some resemblance to *D. australis* de Jersey 1966, the Lennard Shelf specimens are too poorly preserved for distinguishing characteristics to be determined.

Range: Etonvale Formation, Adavale Basin, Queensland, Middle to Late Devonian (de Jersey, 1966).

Occurrence: NRD 70; PD 151.

Genus *EMPHANISPORITES* McGregor 1961

Type species: *Emphanisporites rotatus* McGregor 1961, p. 3 (by original designation).

Remarks: The name *Radiaspora*, informally proposed by Hoffmeister, Staplin, and Malloy (1955), has previously been used for interadially costate spores from Australia (Balme, 1962; Hodgson, 1968). Only a few specimens were found in Lennard Shelf samples, and at least some appear to have thickenings on the proximal surface. However, with so few specimens available, it is not possible to provide a more positive assessment of the morphology. Balme (1988) has clearly shown that the radial costae of Carnarvon Basin forms are proximal rather than distal. He has consequently placed his specimens in *Emphanisporites* and revised *Emphanisporites darrensis* Hodgson 1968.

Emphanisporites rotatus McGregor 1961
(Pl. 15, figs 1–5)

1968 *Radiaspora darrensis* Hodgson, p. , pl. 8, fig. 5.

For additional synonymy see McGregor (1973, p. 47), McGregor and Camfield (1982) and Balme (1988).

Dimensions: 5 specimens: 51 (59) 68 µm.

Remarks: Lennard Shelf specimens closely resemble both *Emphanisporites rotatus* McGregor 1961 and *Radiaspora darrensis* Hodgson 1968. *Radiaspora* is a *nomen nudum* and the genus is invalid (Jansonius and Hills, 1976). Balme (1988) recognized that the sculpture in Carnarvon Basin specimens was proximal rather than distal, and that a separate genus was not necessary. Specimens observed in the present study are poorly preserved, but in most specimens the radial sculpture is undoubtedly proximally located. McGregor, (1973, p. 47) placed *Radiaspora darrensis* Hodgson in questionable synonymy with *E. rotatus* because of the uncertainty of the position of the sculpture in the Amadeus Basin specimens. Balme (1988) now places the Australian specimens in full synonymy with *E. rotatus*.

Range: Pertnjara Formation, Amadeus Basin, Northern Territory, Givetian or Frasnian (Hodgson, 1968); Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988); Melville Island, Canada, Eifelian and early Givetian (McGregor and Camfield, 1982); widespread distribution in Middle Devonian of Old Red Sandstone Continent.

Occurrence: NRD 3; PD 153, 162.

Genus *ENDOSPORITES* Wilson and Coe 1940

Type species: *Endosporites ornatus* Wilson and Coe 1940 (by subsequent designation of Schopf, Wilson, and Bentall, 1944, p. 45).

Endosporites gilmorensis de Jersey 1966
(Pl. 15, figs 6–8)

1974 *Auroraspora* sp. Grey, fig. 61d.

Dimensions: 50 specimens: 45 (72) 114 µm.

Remarks: Illustrations of this species (de Jersey, 1966) are of poor quality. Specimens conforming to the diagnosis are common in the lower part of the Lennard Shelf sequence. This species also has some similarities with *Calyptosporites biornatus* (Lanninger 1968) Richardson 1974, as illustrated in Richardson and McGregor (pl. 7, fig. 4), but lacks the verrucate sculpture of this species. A fuller investigation of this taxon is indicated.

Range: Etonvale Formation, Adavale Basin, Queensland, Middle and Late Devonian (de Jersey, 1966).

Occurrence: NRD 3, 20, 70; PD 26, 151, 153.

Genus *GEMINOSPORA* Balme 1962 emend. Playford 1983

For synonymy see Playford, 1983, p. 316.

Type species: *Geminospora lemurata* Balme 1962 (by original designation).

Geminospora lemurata Balme 1962 emend. Playford 1983
(Pl. 15, figs 9–13)

For synonymy see Playford, 1983, pp. 316–321, figs 1–9; and Balme, 1988.

Dimensions: 166 specimens: 32 (50) 77 µm.

Remarks: Specimens showing the wide range of morphological variation demonstrated by Playford (1983) are common in the lower part of the Lennard Shelf sequence.

Range: Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1962; 1988); Upper Etonvale Formation, Adavale Basin, Queensland, Frasnian (de Jersey, 1966); Pertnjara Formation, Amadeus Basin, Northern Territory, Givetian or Frasnian (Hodgson, 1968); Brewer Conglomerate, Pertnjara Group, Amadeus Basin, central Australia, Late Devonian (Playford et al., 1976). Ranges from the base of the ***lemurata–magnificus*** to the upper ***ovalis–bulliferous*** and possibly extends into the ***torquata–gracilis*** Assemblage Zones of the Old Red Sandstone Continent (Richardson and McGregor, 1986); Givetian and Frasnian of the Ghadamis Basin of Libya–Tunisia (Loboziak and Streel, 1989).

The widespread geographical and stratigraphical distribution of this species was discussed by Playford (1983). He listed occurrences ranging from "(?early or mid) Givetian to late Frasnian or ?early Famennian". He commented on its abundance in sequences approximating to the Givetian–Frasnian boundary and cited the Gneudna Formation, Carnarvon Basin, as an example where *G. lemurata* is "an extremely plentiful component of the total palynoflora". Although *G. lemurata* is common in both the Pillara Range area and in some samples from the Napier Range area, it never reaches the abundance found in the Gneudna Formation, where it commonly exceeds 85% of the total microflora (B. Balme, 1987, personal communication).

The first appearance of the species marks the base of the ***lemurata–magnifica*** Assemblage Zone of Richardson and McGregor (1986), although, as the authors point out (p. 3), the acme is in the succeeding ***optivus–triangulatus*** Assemblage Zone. Streel et al. (1987) equated the first appearance of *G. lemurata* with the *ensensis* conodont zone in the Eifel region and with the TA Zone, which is within the Upper *varcus* Zone. The first appearance of *Geminospora lemurata* must therefore correspond roughly to the Eifelian–Givetian boundary.

Occurrence: NRD 3, 20, 32, 70; PD 17, 26, 120, 145, 151, 153, 162.

Genus *GORGONISPORA* Urban 1971

Type species: *Gorgonispora convoluta* (Butterworth and Spinner 1967) Playford 1976, which is equivalent to *G. magna* (Felix and Burbridge 1967) Urban 1971. It was originally designated as a type species by Urban (1971, p. 121).

Gorgonispora convoluta (Butterworth and Spinner 1967) Playford 1976
(Pl. 15, figs 14, 15)

For synonymy see G. Playford (1976, p. 31).

Dimensions: 50 specimens: 41 (84) 135 μm.

Remarks: This distinctive species is common in samples in the upper part of the Lennard Shelf sequence.

Range: Fairfield Group, Famennian or Tournaisian (G. Playford, 1976); Ducabrook Formation, Drummond Basin, Queensland, late Visean (Playford, 1978). Mulga Downs Beds, New South Wales, Upper Devonian and Lower Carboniferous (Evans, 1968). Widespread in the Carboniferous of the northern hemisphere; Australian occurrences are clearly somewhat older (G. Playford, 1976, p. 32).

Occurrence: NRD 1, 2, 4, 9, 18, 20, 26, 69.

Genus *GNEUDNASPORA* Balme 1988

Type species: *Gneudnaspora kernickii* Balme 1988 (by original diagnosis).

Remarks: Balme (1988) erected this genus for "proximally hilate, curvaturate, miospores". I am inclined to interpret the nature of the exine and the presence of a hilum as being features more characteristic of an acritarch than a miospore. However, Lennard Shelf specimens are rare; and consequently, I have followed Balme's assignment as a miospore for the moment. Balme (pers. comm., 1988) reports that the 'hilum' is very variable, but that it mainly arises from tetrads. The two species seem to be of biostratigraphic significance.

Gneudnaspora kernickii Balme 1988
(Pl. 16, figs 1, 2)

1988 *Gneudnaspora kernickii* Balme, p. 124, pl. 3, figs 8–14.

Dimensions: 2 specimens: 53 and 98 μm.

Remarks: As for Balme (1988), although the fossil may not be a miospore (see above).

Range: Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988).

Occurrence: PD 17, 162.

Genus *GRANDISPORA* Hoffmeister, Staplin, and Malloy 1955 emend. McGregor 1973

For synonymy see Playford (1971, p. 45)

Type species: *Grandispora spinosa* Hoffmeister, Staplin, and Malloy 1955 (by original designation).

Remarks: For comments on the synonymy and various emendations of this genus see McGregor and Camfield (1982, p. 43). Their assessment of the genus is followed in this report.

Grandispora clandestina Playford 1976
(Pl. 16, figs 3–5)

1976 *Grandispora* sp. nov. Playford et al., p. 240, figs 3D–F.

1976 *Grandispora clandestina* Playford, p. 42, pl. 8, figs 13–17.

Dimensions: 10 specimens: 41 (52) 68 µm.

Range: Fairfield Group, Canning Basin, Famennian or Tournaisian (Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982); Brewer Conglomerate, Pertnjara Group, Amadeus Basin, central Australia, Late Devonian (Playford et al., 1976).

Occurrence: NRD 1, 2, 9, 20, 26.

cf. *Grandispora cornuta* Higgs 1975
(Pl. 16, fig. 6)

cf. 1975 *Grandispora cornuta* Higgs, p. 398, Pl. 4, figs 4–6.

Dimensions: 1 specimen: excluding sculpture 56 µm.

Remarks: The single specimen is similar to the diagnosis given by Higgs (1975), although the intexinal body is less well-defined, the sculpture is sparser, and the spines do not taper as much as in the Irish specimens. More specimens are required to confirm identification.

Range: Not previously recorded from Australia. Old Red Sandstone Facies, Hook Head area, Ireland, ?Famennian–Tournaisian, "*Vallatisporites pusillites–Hymenozonotriletes lepidophytus* Assemblage" (Higgs, 1975). Ranges from the base of the ***flexuosa–cornuta*** Assemblage Zone into the Carboniferous of the Old Red Sandstone Continent (Richardson and McGregor, 1986).

Occurrence: NRD 9.

Grandispora notensis Playford 1971
(Pl. 16, figs 7–9)

For synonymy see Playford (1971, p. 48).

1976 *Grandispora notensis* Playford 1971; Playford, p. 42, pl. 8, figs 12, 24–26, pl. 9, figs 1–3.

Dimensions: 6 specimens: 70 (85) 101 µm.

Range: Fairfield Group, Canning Basin, Famennian or Tournaisian (Playford, 1976); Bonaparte Formation, Tanmurra Formation, and "Burvill Beds" (now Formation), Bonaparte Basin, Visean (Playford, 1971); Ducabrook Formation, Drummond Basin, Queensland, late Visean (Playford, 1978).

Occurrence: NRD 4, 17, 26.

Grandispora praecipua Playford 1976
(Pl. 16, fig. 10)

Dimensions: 60 specimens: 45 (64) 95 µm.

Range: Fairfield Group, Canning Basin, Famennian or Tournaisian (G. Playford, 1976).

Occurrence: NRD 1, 2, 4, 9, 17, 20, 26, 69.

Grandispora sp. indet. Balme 1988
(Pl. 16, figs 11, 12)

? 1967 Forma 6 Hemer and Nygreen, Pl. II, fig. 1.

Dimensions: 12 specimens: 41 (52) 68 µm.

Remarks: A few well-preserved, and several poorly preserved Lennard Shelf specimens resemble Forma 6 of Hemer and Nygreen (1967), and the same form may be present in the Carnarvon Basin (Balme, personal communication, 1988). Although there is a resemblance to *Calyptosporites proximocavatus* Balme 1988, the form more probably represents a new species. Circumscription must wait until more specimens are available to allow detailed assessment of the morphology. Some of the Lennard Shelf specimens could be included in ?*Rhabdosporites* sp. Balme 1988 (pl. 7, fig. 12), but this is difficult to determine because of poor preservation. *Grandispora gabesensis* Loboziak and Streel 1989 has very similar ornament, but is considerably larger.

Range: Possibly occurs in the late Givetian or early Frasnian Jauf Formation of Saudi Arabia (Hemer and Nygreen, 1967).

Occurrence: NRD 3, 20, 32,

Grandispora spp.
(Pl. 16, fig. 13; Pl. 17, figs 1–10)

Dimensions:

sp. A	12 specimens	36 (77) 94 µm
sp. B	1 specimen	68 µm
sp. C	1 specimen	106 µm
sp. D	1 specimen	70 µm
sp. E	5 specimens	43 (49) 66 µm
sp. F	1 specimen	63 µm
sp. G	2 specimens	33 and 35 µm

Remarks: Several specimens with the characteristics of *Grandispora* were recognized in Lennard Shelf samples, but could not be assigned to previously described species. Most were too rare for new species to be circumscribed, but they are illustrated and dimensions are given for future reference. Species B shows some similarity to *Hymenozonotriletes deliquescens* Naumova 1953, and sp. E is seems to be a form intermediate between *Spelaeotriletes resolutus* Higgs 1975 and *S. crustosus* Higgs 1975.

Occurrences:

sp. A	NRD 20, PD 151, 153.
sp. B	PD 153
sp. C	PD 153
sp. D	NRD 20
sp. E	NRD 20
sp. F	NRD 20
sp. G	PD 17.

Genus *GRANULATISPORITES* Ibrahim 1933 emend. Potonié and Kremp 1954

Type species: *Granulatisporites granulatus* Ibrahim 1933 (cited by Schopf, Wilson, and Bentall, 1944).

Granulatisporites frustulentus Balme and Hassell 1962 emend. Playford 1971
(Pl. 17, figs 11, 12)

For synonymy see Playford (1971, p. 13).

1976 *Granulatisporites frustulentus* Balme and Hassell 1962 emend. Playford, p. 12, pl. 1, figs 18–22.

Dimensions: 81 specimens: 23 (34) 59 μm.

Remarks: Specimens recorded in the present study show the wide range of variation described by Playford (1971). *Granulatisporites phillipsi* de Jersey 1966 is apparently distinguished by reduced proximal sculpture. A detailed study of the two forms (outside the scope of the present investigation) is required to determine whether the species can effectively be separated.

Range: Canning Basin, Late Devonian (Balme and Hassell, 1962); Fairfield Group, Canning Basin, Famennian or Tournaisian (Playford, 1976); Bonaparte Formation, Tanmurra Formation, "Milligans Beds" (now Formation) and "Burvill Beds" (now Formation), Bonaparte Basin, Visean (Playford, 1971); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982); Ducabrook Formation, Drummond Basin, Queensland, late Visean (Playford, 1978).

Occurrence: NRD 1, 2, 4, 9, 17, 18, 20, 26, 69.

Granulatisporites phillipsi de Jersey 1966
(Pl. 17, figs 13a, b)

Dimensions: 27 specimens: 28 (42) 72 μm.

Remarks: see remarks under *Granulatisporites frustulentus.*

Range: Etonvale Formation, Adavale Basin, Queensland, Frasnian (de Jersey, 1966).

Occurrence: NRD 3, PD 17, 26, 151, 153.

Genus *HYMENOZONOTRILETES* Naumova 1953 ex Mehta 1944

Type species: *Hymenozonotriletes triangularis* Mehta 1944 (by monotypy).

Hymenozonotriletes scorpius Balme and Hassell 1962 emend. Playford 1976
(Pl. 18, fig. 1–3)

For synonymy see G. Playford 1976, p. 37.

Dimensions: 2 specimens: 63 and 95 μm.

Remarks: This species was rare in the present study. A similarity to *Grandispora cornuta* Higgs 1975 requires further investigation, but is outside the scope of the present investigation. *G. cornuta* can be distinguished because it is camerate and has sparser, and longer, spines.

Range: Common in Laurel Downs bore, rare or absent elsewhere in the Canning Basin, Late Devonian (Balme and Hassell, 1962); Fairfield Group, Canning Basin, Famennian or Tournaisian (G. Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982).

Occurrence: NRD 1, 17, 18.

Genus *HYSTRICOSPORITES* McGregor 1960

Type species: *Hystricosporites delectabilis* McGregor 1960 (by original designation).

Hystricosporites porrectus (Balme and Hassell 1962) Allen 1965
(Pl. 18, figs 4–6)

For synonymy see G. Playford, 1976, p. 34.

Dimensions: 43 specimens: 45 (96) 180 μm.

Range: Common in BMR 2 Laurel Downs bore, rare in Frome Rocks 1 Well, Canning Basin, Late Devonian (Balme and Hassell, 1962); Fairfield Formation, Famennian or Tournaisian (G. Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982); Brewer Conglomerate, Pertnjara Group, Amadeus Basin, central Australia, Late Devonian (Playford et al., 1976).

Occurrence: NRD 1, 2, 4, 9, 17, 18, 26, 69.

Hystricosporites richardsoni de Jersey 1966
(Pl. 19, figs 1, 2)

Dimensions: 3 specimens: 95, 101, and 112 μm.

Remarks: The poorly preserved Lennard Shelf specimens resemble de Jersey's (1966) species in having short processes with tapering sides.

Range: Etonvale Formation, Adavale Basin, Queensland, Middle and Late Devonian (de Jersey, 1966).

Occurrence: NRD 3, PD 145.

Hystricosporites sp. indet.
(Pl. 19, fig. 3)

Dimensions: 1 specimen: 90 μm.

Remarks: *Hystricosporites* with only a few processes. Specimens cannot readily be assigned to any previously described species.

Occurrence: PD 26.

Genus *KNOXISPORITES* Potonié and Kremp 1954 emend. Neves 1961

Type species: *Knoxisporites hageni* Potonié and Kremp 1954 (by original designation).

Knoxisporites literatus (Waltz 1938) Playford 1963
(Pl. 19, figs 5, 6)

For synonymy see Playford (1971, p. 34).

1976 *Knoxisporites literatus* (Waltz p. 38) Playford 1963; G. Playford 1976, p. 26, pl. 5, figs 5–8.

Dimensions: 41 specimens: 41 (76) 104 µm.

Range: Canning Basin, Late Devonian (Balme and Hassell, 1962); Fairfield Group, Famennian or Tournaisian (G. Playford, 1976); Bonaparte Formation, Tanmurra Formation, "Burvill Beds" (now Formation), and "Milligans Beds" (now Formation), Bonaparte Basin, Visean (Playford, 1971); Ducabrook Formation, Drummond Basin, Queensland, late Visean (Playford, 1978). Widespread in Tournaisian and Visean of Europe (Playford, 1971, p. 34 - 35, 1976, p. 27).

Occurrences: NRD 1, 2, 4, 9, 17, 18, 20, 26.

Knoxisporites pristinus Sullivan 1968
(Pl. 19, figs 4, 7)

For synonymy see G. Playford (1976, p. 27).

Dimensions: 7 specimens: 50 (88) 126 µm.

Range: Fairfield Group, Famennian or Tournaisian (G. Playford, 1976). Occurs in the Famennian to earliest Tournaisian in Europe and USA (G. Playford, 1976, p. 28).

Occurrence: NRD 1, 4, 17, 20.

Knoxisporites spp.
(Pl. 19, fig. 8)

Remarks: Several specimens clearly belong to *Knoxisporites*, but are too poorly preserved to be assigned to a species.

Occurrence: Several specimens in the younger part of the sequence.

Genus *KRAEUSELISPORITES* Leschik 1956 emend. Scheuring 1974

Type species: *Kraeuselisporites dentatus* Leschik 1956 (by original designation).

cf. *Kraeuselisporites ollii*? (Chibrikova 1972) McGregor and Camfield 1982
(Pl. 20, figs 1–3)

cf. 1982 *Kraeuselisporites ollii*? (Chibrikova 1972) McGregor and Camfield, p. 52, pl. 14, figs 2–5, 8; text-fig. 83.

For additional synonymy see McGregor and Camfield, 1982, p. 52.

Dimensions: 11 specimens: 41 (76) 95 µm.

Remarks: These specimens are tentatively assigned to *K. ollii*? (Chibrikova 1972) McGregor and Camfield 1982 because of a general resemblance to that taxon. However, the Lennard Shelf specimens lack the distinctive vermiform sculpture of the species. Most of the Lennard Shelf specimens are too dark for details to be clearly distinguished, and the poor preservation precludes accurate identification. Specimens differed from Chibrikova's (1972) specimens because the latter have "more widely spaced, slightly larger sculptural elements". Lennard Shelf specimens conform to the variation recorded by McGregor and Camfield.

Range: Not previously recorded from Australia. *K. ollii* and associated forms occurs in the Devonian of USSR (Arkhangelskaya, 1972; Chibrikova, 1972) and Eifelian and lower Givetian of Canada (McGregor and Camfield, 1982).

Occurrence: NRD 3, 20, PD 145, 153, 162.

Genus *LATOSPORITES* Potonié and Kremp 1954

Type species: *Latosporites latus* (Kosanke 1950) Potonié and Kremp 1954 (by original designation).

Latosporites sp. indet.
(Pl. 20, fig. 4)

1974 *Latosporites* sp. Grey, fig. 61j.

Dimensions: Single specimen: maximum diameter, 63 µm.

Description: Amb oval, maximum diameter 1.5 times minimum diameter. Monolete with laesura parallel to long axis, partly opened, extending 1/2 to 2/3 radius. Intexine laevigate, closely adpressed to exoexine; exoexine scabrate.

Remarks: Insufficient specimens were recorded from the Lennard Shelf samples for the erection of a new species, and only a single specimen is well preserved. *Latosporites* sp. de Jersey 1966 was based on a single specimen and is less oval and has longer laesura.

Occurrence: NRD 20, 137.4 m.

Genus *LEIOTRILETES* Naumova 1939 ex Ischenko 1952

Type species: *Leiotriletes sphaerotriangulus* (Loose 1932) Potonié and Kremp 1955 (by subsequent designation of Potonié and Kremp, 1954).

Leiotriletes liebigensis Hodgson 1968
(Pl 20, fig. 7)

1966 *Leiotriletes* sp. A de Jersey, p. 5, pl. 1, fig. 3.

1968 *Leiotriletes liebigensis* Hodgson 1968, p. 68, pl. 8, fig. 1.

1988 *Leiotriletes liebigensis* Hodgson 1968; Balme, p. 119, Pl. 1, figs 1–4.

Dimensions: Single specimen: 46 µm. Otherwise the species is represented by only a few poorly preserved specimens, unsuitable for measurement because they are mostly folded and corroded.

Range: Pertnjara Formation, Amadeus Basin, Northern Territory, Givetian or Frasnian (Hodgson, 1968); Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988).

Occurrence: PD 153.

Leiotriletes pulvereus Balme and Hassell 1962
(Pl. 20, fig. 8)

Dimensions: 2 specimens: 73 and 77 µm.

Remarks: Specimens conform to the description given by Balme and Hassell (1962, p. 5).

Range: BMR 2 Laurel Downs Bore, Canning Basin, Famennian (Balme and Hassell, 1962); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982).

Occurrence: NRD 1, 26.

Genus *LEIOZONOTRILETES* Hacquebard 1957

Type species: *Leiozonotriletes insignitus* Hacquebard 1957 (by original designation).

Leiozonotriletes laurelensis Balme and Hassell 1962
(Pl. 20, figs 5, 6)

For synonymy see G. Playford, 1976, pp. 44–45.

Dimensions: 47 specimens: 41 (83) 162 µm.

Range: Common in Laurel Downs 2 borehole, rare or absent elsewhere, Canning Basin, Late Devonian (Balme and Hassell, 1962); Fairfield Group, Canning Basin, Famennian or Tournaisian (G. Playford, 1976).

Occurrence: NRD 1, 2, 4, 9, 17, 20, 26, 69.

Genus *LOPHOZONOTRILETES* Naumova 1953 emend. Potonié 1958

Type species: *Lophozonotriletes lebedianensis* Naumova 1953 (by subsequent diagnosis of Potonié, 1958, p. 27).

Lophozonotriletes triangulatus (Ischenko 1956) Hughes and Playford 1961
(Pl. 20, figs 9, 11)

For synonymy see G. Playford, 1976, p. 28.

Dimensions: 13 specimens: 42 (50) 72 µm.

Remarks: G. Playford (1976, p. 28) gives a detailed account of the synonymy and morphology of this species. Specimens recorded in the present study conform to his description.

Range: Common and widespread throughout late Famennian and Tournaisian sediments in Australia and elsewhere (see G. Playford, 1976, p. 28 for details of distribution).

Occurrence: NRD 1, 2, 4, 9, 17, 18, 20, 26.

Lophozonotriletes varionodosus Playford 1982
(Pl. 20, figs 10, 12)

1976 *Lophozonotriletes* sp. A Playford, p. 30, Pl. 5, fig. 9.

1982 *Lophozonotriletes varionodosus* Playford, p. 154, figs. 3j–n.

Dimensions: 4 specimens: 46 (57) 72 µm.

Remarks: Several specimens observed in the present study conform closely to G. Playford's (1976, 1982) descriptions of this form, particularly with regard to the basally contiguous verrucae.

Range: Fairfield Group, Canning Basin, Famennian or Tournaisian (G. Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982).

Occurrence: NRD 1, 18, 69.

Lophozonotriletes sp. indet.
(Pl. 20, figs 13a, b)

Dimensions: 1 specimen: 59 µm.

Description: Trilete miospore with sub-triangular amb. Laesurae arms 2/3 radius, extending to the proximal margin of the cingulum; laesurae straight, simple. Wall, excluding cingulum and sculpture, approximately 1 µm thick, laevigate. Contact areas laevigate. Distal sculpture of contiguous verrucae, up to 10 µm wide and 45 µm high. Some of the verrucae extend onto the distal surface of the cingulum. Cingulum approximately 14 µm wide, laevigate, formed by 4 to 5 large, overlapping lobes, up to 40 µm in basal diameter.

Remarks: This form differs from other species of *Lophozonotriletes* because of the large, lobate cingulum.

In some respects it resembles *Verrucosisporites premnus* Richardson 1965, but the latter has a more diverse sculpture which includes discrete verrucae.

Occurrence: NRD 18.

Genus *MEDUSASPORA* Balme 1988

Type species: *Medusaspora dringii* Balme 1988 (by original designation).

Medusaspora dringii Balme 1988
(Pl. 21, figs 1–3)

1988 *Medusaspora dringii* Balme, p. 143, pl. 11, figs 1–6, text-fig. 4a, b, c.

Dimensions: 11 specimens: overall diameter 48 (74) 101 μm.

Remarks: This miospore is distinguished by the presence of a number of elongate fibrilliform processes. Lennard Shelf specimens conform closely with Balme's (1988) diagnosis. Several have fibrils which divide finely and form a tangled structure similar to those described from the Carnarvon Basin. Others have only a single fibril, which sometimes (Pl. 21, fig. 2) arises from a broad base.

Loboziak and Streel (1989) illustrated a specimen that they called *Auroraspora hyalina* Streel *in* Becker et al., 1974. The body of this specimen shows a close resemblance to *Medusaspora dringii*, but tendrils cannot be identified from the photograph.

Range: Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988).

Occurrence: NRD 3, PD 145, 151.

Genus *MUROSPORA* Somers 1952

Type species: *Murospora kosankei* Somers 1952 (by original designation).

Murospora sp. indet.
(Pl. 21, figs 4, 5)

Dimensions: 9 specimens: 27 (36) 45 μm.

Description: Spores radial, trilete; triangular with rounded apices; sides straight or slightly concave or convex. Laesurae simple, often indistinct; slightly less than spore radius. Cingulum differentiated into two concentric bands, of which the inner band is slightly thicker. Exine thick, laevigate.

Remarks: Lennard Shelf specimens differ from previously described species of *Murospora* in having straight sides. They show some resemblance to *M. conduplicata* (Andrejeva 1941) Playford 1962 and *M. sublobata* (Waltz 1938) Playford 1962, but both these species have irregular margins. There is also a resemblance to *Camarozonotriletes*? *concavus* Loboziak and Streel 1989, but the Lennard Shelf specimens differ in having a very thick cingulum and they are not as strongly concave as *C.*? *concavus*. Lennard Shelf specimens may be a new species, but more examples are required before the morphology can be fully assessed.

Occurrence: PD 151, 153.

Genus *NIKITINISPORITES* Chaloner 1959

Type species: *Nikitinisporites canadensis* Chaloner 1959 (by original designation).

Nikitinisporites spitsbergensis? Allen 1965
(Pl. 21, figs 6, 7)

? 1965 *Nikitinisporites spitsbergensis* Allen, p. 741, pl. 108, figs 1–5.

Dimensions: 2 specimens: overall diameter 405 and 456 μm; central body of 1 specimen 136 μm.

Remarks: This very distinctive megaspore resembles *N. spitsbergensis* Allen 1965 in having a two-layered exine and parallel-sided spines. However, the diagnosis of *N. spitsbergensis* states that the spines narrow abruptly apically, and end in a homogeneous grapnel tip which is never wider than the main shaft of the spine. Although this type of termination is found in some Lennard Shelf spines (Pl 21, fig. 7), others terminate in grapnel tips which are as wide as (or slightly wider than) the spine shaft, a feature more characteristic of *Ancyrospora* than *Nikitinisporites*.

Range: *N. spitsbergensis* was recorded from the Mimer Valley Formation, Spitsbergen, Givetian (Allen, 1965, 1967). McGregor and Camfield (1986, p. 17) refer this sequence to the ***optivus - triangulatus*** Zone.

Occurrence: NRD 3, PD 151.

Genus *PEROTRILITES* Couper 1953 emend. Evans 1970

Type species: *Perotrilites granulatus* Couper 1953 (by original diagnosis.)

cf. *Perotrilites bifurcatus* Richardson 1962
(Pl. 22, figs 1 to 4)

cf. 1962 *Perotrilites bifurcatus* Richardson, p. 174, pl. 25, figs 4, 5; text-fig. 3.

For additional synonymy see McGregor and Camfield, 1982, p. 55.

Dimensions: 7 specimens: 86 (97) 113 μm.

Remarks: Specimens are somewhat variable. Some, but not all, have a folded, diaphanous exoexine which suggests a double zona. This is contrary to the generic description (in which the zona is single layered); but in other respects, most spores (Pl. 22, fig. 1) closely resemble Richardson's (1962) diagnosis. McGregor and Camfield (1982) pointed out that in practice it may be difficult to distinguish *Perotrilites* from *Grandispora*. Until the structure of the zona can be fully established, Lennard Shelf specimens can only be tentatively assigned to *Perotrilites*.

Some of the specimens conform closely to the species diagnosis. However, others have thicker intexines and a more triangular exoexine (Pl. 22, figs 3 and 4), and intermediate forms (Pl. 22, fig. 2) also occur. Most Lennard Shelf specimens have very few sculptural elements which have biform tips. Instead, the sculpture, when present, consists of delicate, closely spaced spinae. McGregor and Camfield (1982) recorded some specimens bearing only undivided spines, but considered this to be the result of preservational alteration. This could also be the case for Lennard shelf specimens, but many spines probably never were biform.

Range: Not previously recorded in Australia. Ranges from the base of the ***velatus–langii*** to middle ***ovalis–bulliferus*** Assemblage Zones of the Old Red Sandstone Continent (Richardson and McGregor, 1986).

Occurrence: PD 151, 153.

Genus *PLANISPORITES* Knox 1950 emend. Potonié 1960

Type species: *Planisporites granifer* (Ibrahim) Knox 1950 (by subsequent designation of Potonié and Kremp, 1954, p. 129).

Planisporites furfuris Balme and Hassell 1962
(Pl. 22, figs 5, 6)

Dimensions: 88 specimens: 36 (62) 86 μm.

Remarks: Specimens conform to the diagnosis of Balme and Hassell (1962, p. 6), but are often poorly preserved and show pitting of the exine and poorly developed sculpture.

Range: BMR 2 Laurel Downs Bore, Canning Basin, Late Devonian (Balme and Hassell, 1962).

Occurrence: NRD 1, 2, 4, 9, 17, 18, 20, 26, 69.

Genus *PUNCTATISPORITES* Ibrahim 1933 emend. Potonié and Kremp 1954

Type species: *Punctatisporites punctatus* (Ibrahim 1932) Ibrahim 1933 (by original designation).

Remarks: Simple, trilete, laevigate to punctate miospores are common in Devonian sediments. Few are of biostratigraphic significance. Only those forms which are readily distinguished and which may have restricted ranges are included in this report.

Punctatisporites etonvalensis de Jersey 1966
(Pl. 22, fig. 7)

Dimensions: 12 specimens: 46 (53) 59 μm.

Remarks: Spores with extended laesurae, and with darkened contact areas, are assigned to de Jersey's (1966) species, although their size range is less than that given in the diagnosis. Identification is based mainly on de Jersey's description because details are not clear in his illustrations.

Range: Etonvale Formation, Adavale Basin, Queensland, Middle and Late Devonian (de Jersey, 1966).

Occurrence: NRD 3, PD 153.

Punctatisporites iterabilis Balme and Hassell 1962
(Pl. 22, fig. 8)

Dimensions: 15 specimens: 36 (48) 63 μm.

Remarks: Specimens conform to the description of Balme and Hassell (1962, p. 5), and generally show the development of tecta and compressional folds.

Range: Canning Basin, Late Devonian (Balme and Hassell, 1962).

Occurrence: NRD 26.

Punctatisporites sp. cf. *P. solidus* Hacquebard 1957 *in* Balme and Hassell 1962
(Pl. 22, fig. 9)

cf. 1957 *Punctatisporites solidus* Hacquebard, p. 308, pl. 1, fig. 13.

1962 *Punctatisporites* sp. cf. *P. solidus* Hacquebard *in* Balme and Hassell, p. 5, pl. 1, fig. 4.

Dimensions: 8 specimens: 45 (55) 81 μm.

Remarks: Balme and Hassell (1962) considered that their Canning Basin specimens differed from *P. solidus* Hacquebard 1957 in having more heavily developed labra. This is also a consistent feature of specimens examined as part of the present study, and may be sufficiently significant to justify the designation of a new species.

Range: Canning Basin, Late Devonian (Balme and Hassell, 1962).

Occurrence: NRD 9, 17, 18, 20, 26.

Punctatisporites spp.
(Pl. 22, fig. 10)

Remarks: Numerous other simple trilete spores can be assigned to *Punctatisporites*, but no attempt has been made to differentiate them as they appear to be of little stratigraphic significance.

Occurrence: Common throughout the Lennard Shelf sequence.

Genus *RAISTRICKIA* (Schopf, Wilson, and Bentall 1944) Potonié and Kremp 1954

Type species: *Raistrickia grovensis* Schopf *in* Schopf, Wilson, and Bentall 1944 (by original designation).

Raistrickia aratra? Allen 1965
(Pl. 22, fig. 11)

? 1965 *Raistrickia aratra* Allen, p. 702, pl. 96, figs 3–4.

Dimensions: 2 specimens: (excluding sculpture) 62 and 73 μm.

Remarks: The sculpture is similar to the mixture of bacula, rugulae, and coni, found in the specimens described by Allen (1965). Specimens are tentatively assigned to this species because of the papillate tips present on many of the spines, and the reduced proximal ornament. However, Lennard Shelf specimens may be intermediate between *R. aratra* and *V. scurrus* (Naumova 1953) McGregor and Camfield 1982. More precise assignment is difficult because of poor preservation.

Range: Not previously recorded in Australia. Upper Mimer Valley Formation of Spitsbergen, Givetian (Allen, 1965). The sequence belongs to the ***optivus–triangulatus*** Assemblage Zone (Richardson and McGregor, 1986, p. 17).

Occurrence: NRD 3; PD 17.

Genus *RETICULATISPORITES* Ibrahim 1933 emend. Potonié and Kremp 1954

Type species: *Reticulatisporites reticulatus* (Ibrahim 1932) Ibrahim 1933 (by original designation).

Reticulatisporites ancoralis Balme and Hassell 1962
(Pl. 22, fig. 12)

For synonymy see G. Playford, 1976, p. 22.

Dimensions: 17 specimens: 50 (80) 108 μm.

Range: Common in BMR 2 Laurel Downs bore, rare or absent elsewhere in the Canning Basin, Late Devonian (Balme and Hassell, 1962); Fairfield Group, Canning Basin, Famennian or Tournaisian (G. Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982).

Occurrence: NRD 1, 2, 9, 17, 18, 26.

Reticulatisporites sp.
(Pl. 22, fig. 13)

1988 *Reticulatisporites* sp. Balme, p. 131, Pl. 6, figs 2, 3.

Dimensions: One specimen: 49.5 μm.

Remarks: The single, poorly preserved, Lennard Shelf specimen appears very similar to Balme's (1988) illustrated specimens from the Carnarvon Basin.

Range: Gneudna Formation, Carnarvon Basin, Middle Devonian (Balme, 1988).

Occurrence: PD 153.

Genus *RETISPORA* Staplin 1960

Type species: *Retispora florida* Staplin 1960 (by original designation).

Retispora archaelepidophyta (Kedo 1955) McGregor and Camfield 1982
(Pl. 23, fig. 1)

For synonymy see McGregor and Camfield 1982, p. 57.

Dimensions: Only one specimen sufficiently well preserved for measurement: overall diameter 58.5 μm.

Remarks: Rare specimens with the simple laesurae, folded exoexine and irregular laminae which are characteristic of this species, are recorded from samples in the lower part of the Lennard Shelf sequence.

Range: Not previously recorded in Australia. Elsewhere ranges from ***devonicus–naumovii*** to middle ***lemurata–magnificus*** Assemblage Zones of the Old Red Sandstone Continent (Richardson and McGregor, 1986).

Occurrence: PD 151.

Retispora lepidophyta (Kedo 1957) Playford 1976
(Pl. 23, fig. 2, 3)

For synonymy see G. Playford, 1976, p. 45.

Dimensions: 93 specimens: 36 (73) 99 μm.

Range: Canning Basin, latest Devonian (Balme and Hassell, 1962); Fairfield Group, Canning Basin, Famennian, or Tournaisian (G. Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982). G. Playford (1976) summarized the widespread geographical distribution of this species and discussed its utility as a stratigraphic marker: it is restricted to strata which range in age from latest Famennian (Fa2d) to earliest Tournaisian (Tn1a and basal Tn1b, i.e. its last appearance coincides approximately with the Devonian - Carboniferous boundary).

The first appearance of this species is used for the base of the ***pusillites–lepidophyta*** Assemblage Zone (Richardson and McGregor, 1986). There is some evidence to suggest that the species may have first appeared earlier in the Famennian (G. Playford, 1976); however, these earlier appearances remain unsubstantiated.

Occurrence: NRD 1, 2, 4, 9, 17, 18, 20, 26.

Genus *RETUSOTRILETES* Naumova 1953 emend. Streel 1974

Type species: *Retusotriletes simplex* Naumova 1953 (by subsequent designation of Potonié, 1958, p. 13).

Retusotriletes actinomorphus Chibrikova 1962
(Pl. 23, fig. 4, 5)

1962 *Leiotriletes* sp. cf. *L. simplex* Naumova; Balme, p. 3, pl. 1, figs 1, 2.

1988 *Retusotriletes actinomorphus* Chibrikova 1962; Balme, p. 121, pl. 1, figs 12–14.

For additional synonymy see Balme 1988.

Dimensions: Single specimen: 47 µm. Others are unsuitable for measurement because of folding.

Remarks: In this report I have followed Balme (1988) and included spores previously assigned to *Leiotriletes*. sp. cf. *L. simplex* to *R. actinomorphus*. In these spores the contact areas occupy most of the proximal face and the curvaturae are imperfect. Lennard Shelf specimens lack the radially disposed striae reported for Canadian and Russian specimens, but this may be a feature of poor preservation. *Leiotriletes* sp. A de Jersey 1966 could possibly be included in this species.

Range: Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1962; Balme, 1988); Early and Middle Devonian of USSR (Chibrikova, 1962); Emsian to Eifelian of Arctic Canada (McGregor, 1973).

Occurrence: NRD 3, 4.

Retusotriletes biarealis McGregor 1964
(Pl. 23, figs 8, 9)

1964 *Retusotriletes biarealis* McGregor, p. 7, pl. I, figs 13 to 15.

Dimensions: 11 specimens: 56 (91) 122 µm.

Description: Spores trilete with rounded or subtriangular amb. Laesurae distinct, simple, straight to slightly sinuous, sometimes with slightly raised labra, rarely more than 1µ high; 2/3–4/5 radius. Contact areas delimited by well-defined curvaturae perfectae, situated entirely on the proximal face and forming a low, narrow ridge, about 1 µm wide. The ridge curves regularly and outlines almost hemispherical contact areas. Contact areas contain a well-defined, usually triangular, polumbra. This is centred on the apical point and extends to the extremities of the laesurae. The polumbra may be lighter at its centre. Wall 1–2 µm thick, laevigate to scabrate.

Remarks: Lennard Shelf specimens do not conform precisely to any of the more common taxa of *Retusotriletes* because of their well-defined hemispherical contact areas, spherical equatorial outline, triangular polumbra, and thin exine. This combination of features is found only in *R. biarealis* McGregor 1964 from the Ghost River Formation (now Yahatinda Formation), Middle Devonian of Alberta. Lennard Shelf specimens are similar in all respects to *R. biarealis*, except that they are frequently laevigate, while *R. biarealis* has scabrate contact areas with slightly radially aligned sculpture (McGregor, 1964).

There are similarities to *R. rotundus* (Streel 1964) Streel 1967, but none of the published descriptions or illustrations of this species feature prominent, smoothly hemispherical curvaturae; more commonly the curvaturae are indistinct, and connections with the laesurae are not visible. *R. rotundus* is not as spherical, the laesurae are usually shorter and compression folds are more common. Some Lennard Shelf forms can be readily assigned to *R. rotundus*, but no forms gradational between *R. rotundus* and R. cf. *biarealis* were recognized.

Retusotriletes dubiosus McGregor 1973 (a species similar to *R. rotundus*) also lacks well-defined curvaturae and a rounded equatorial outline. *Retusotriletes distinctus* Richardson 1965 has a thicker exine, and is not as rounded as *R. biarealis*. The contact areas are usually defined by a thickening in *R. distinctus*, but are simple in *R. biarealis*.

Range: Not previously recorded in Australia. Givetian to Frasnian of Alberta (McGregor, 1964). I am unaware of any other records of this species.

Occurrence: NRD 3, 70; PD 26, 151, 153, 162.

Retusotriletes sp. cf. *R. biarealis* McGregor 1964
(Pl. 23, figs 10, 11)

cf. 1964 *Retusotriletes biarealis* McGregor, p. 7, pl. I, figs 13–15.

Dimensions: 8 specimens: 63 (78) 99 µm.

Remarks: This form has most of the features of *Retusotriletes biarealis* McGregor 1964, but has a rounded rather than a triangular polumbra, and the polumbra does not extend to the tip of the trilete mark.

Range: Not previously recorded in Australia.

Occurrence: PD 26, 151, 153, 162.

Retusotriletes digressus Playford 1976
(Pl. 23, fig. 6)

1976 *Retusotriletes* sp. nov. Playford et al., p. 240, fig. 3H.

1976 *Retusotriletes digressus* Playford, p. 9, pl. 1, figs 1–10.

Dimensions: Two specimens only suitable for measurement: 63 and 72 µm.

Range: Fairfield Group, Canning Basin, Famennian or Tournaisian (Playford, 1976); "Buttons Beds" (now Formation), Bonaparte Basin, latest Devonian (Playford, 1982); Brewer Conglomerate, Pertnjara Group, Amadeus Basin, central Australia, late Devonian (Playford et al., 1976); Ducabrook Formation, Drummond Basin, Queensland, late Visean (Playford, 1978).

Occurrence: NRD 20, 137.4 m; NRD 26.

Retusotriletes distinctus? Richardson 1965
(Pl. 23, fig. 7)

? 1965 *Retusotriletes distinctus* Richardson, p. 565, pl. 88, figs 7–8, text fig. 2.

? 1971 *Retusotriletes distinctus* Richardson 1965; Owens, p. 11, pl. 1, figs 4–5.

? 1988 *Retusotriletes distinctus* Richardson; Balme, p. pl. 2, figs 12–14.

Dimensions: 7 specimens: 50 (72) 90.

Remarks: Richardson (1965) erected this species for subcircular spores with distinctive thickened curvaturae perfectae. The curvaturae project as a wedge at the margins of laterally compressed specimens. The exine is thick; 6 to 15 μm (Richardson, 1965), and between 4.5 and 11 μm (Owens, 1971). Lennard Shelf specimens usually have the characteristic curvaturae, but a thinner exine, (3 to 7 μm), and a smaller size range. The original diagnosis (Richardson, 1965) cites a range from 113–218 μm, and Owens (1971) reports a range between 85 and 115 μm. Consequently Lennard Shelf specimens can only be tentatively assigned to this species.

Both the Scottish (Richardson, 1965) and Canadian (Owens, 1971) specimens have a polumbra around the apical zone in most specimens. Problems in differentiating polumbrate spores are discussed in more detail under *Retusotriletes rotundus*. Polumbrate specimens with thin exines have been excluded from *R. distinctus* in this report.

Balme (1988) suggested that two species, one of them intrapunctate, may be represented in material described so far. The Western Australian specimens, from both the Carnarvon and Canning Basins, are only faintly intrapunctate. They therefore resemble Owen's Canadian material more closely than Richardson's Scottish specimens.

Range: Gneudna Formation, Carnarvon Basin, early Frasnian, (Balme, 1988); Eifelian and early Givetian of Scotland (Richardson, 1965); Frasnian of Arctic Canada (Owens, 1971). Ranges from the middle ***velatus–langii*** to lower ***optivus–triangulatus*** Assemblage Zones of the Old Red Sandstone Continent (Richardson and McGregor, 1986).

Occurrence: NRD 3, PD 120; PD 151, 153, 162.

Retusotriletes punctimedianus Balme 1988
(Pl. 23, figs 12 to 14)

1988 *Retusotriletes punctimedianus* Balme, p. 122, pl. 2, fig 3–5.

Dimensions: 39 specimens: 36 (51) 95 μm.

Remarks: Balme (1988) erected this species for curvaturate spores with a thickish, finely alveolate exine. In this report, I assign Lennard Shelf specimens with these characteristics to Balme's species. Although some specimens (Pl. 23, fig. 12) are similar to Balme's species, others may resemble *Geminospora lemurata* (Pl. 23, fig. 13), or, if they have a darkened equatorial area delimited by curvaturae, are intermediate to *Aneurospora goensis* (Pl. 23, fig. 14).

Range: Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988).

Occurrence: NRD 3, 20, 32, 69, 70; PD 17, 26, 151, 153.

Retusotriletes pychovii Naumova 1953
(Pl. 24, figs 1, 2)

1953 *Retusotriletes pychovii* Naumova var. major Naumova, p. 122, pl. 18, fig. 19.

1962 *Retusotriletes* cf. *R. pychovii* Naumova; Balme 1962.

not 1962 *Retusotriletes* sp. cf. *R. pychovii* Naumova var. major Naumova; Balme and Hassell, p. 7, pl. 1, fig. 13.

1966 *Retusotriletes pychovii* Naumova 1953; de Jersey, 1966, p. 7, pl. 2, fig. 3.

1988 *Retusotriletes pychovii* Naumova 1953; Balme, p. 121, pl. 2, fig. 1–2.

Dimensions: 5 specimens: 42 (52) 59 μm.

Remarks: Previous reports of this species in Australia (Balme, 1962; Balme and Hassell, 1962; de Jersey, 1966) were based on only a few specimens; and the authors felt that the spores could not be compared directly with Naumova's (1953) description and line drawings. More recently McGregor and Camfield (1982) have provided a description and photograph to support their concept of the species, and Australian specimens can be accommodated in their circumscription. In this report I follow Balme (1988), and use *Retusotriletes pychovii* as a general taxon to incorporate laevigate, relatively thick-walled specimens, which have well-developed curvaturae.

Range: Stumpys Soak 2 bore, Canning Basin, Late Devonian (Balme and Hassell, 1962); Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1962; 1988); Etonvale Formation, Adavale Basin, Queensland, Middle and Late Devonian (de Jersey, 1966); widespread in middle and late Devonian sediments throughout the world (Richardson and McGregor, 1986).

Occurrence: PD 17, 120, 151, 153.

Retusotriletes rotundus (Streel 1964) Streel 1967
(Pl. 24, figs 3 - 5)

For synonymy see McGregor (1973, p. 20), McGregor and Camfield (1976, p. 26), and Balme (1988).

Dimensions: 16 specimens: 59 (81) 140 μm.

Remarks: Variations in morphology of this distinctive form have been discussed by McGregor and Camfield (1982, p. 58), and Balme (1988). Their broader concept of the species, which incorporates *R. triangulatus* (Streel 1964) Streel 1967 and *R. goensis* Lele and Streel 1969, is justified by the common occurrence of intermediate forms. However, it raises the issue of whether *R. dubiosus* McGregor 1973 should also be placed in synonymy. From published descriptions (Richardson, 1965; Owens, 1971; McGregor, 1973; McGregor and Camfield, 1976; 1982), the only differences are that, in *R. dubiosus*, the laesurae sometimes extend to the lateral margin, that the wall is slightly thicker, and that specimens are rarely folded and have a slightly larger size range.

Many Lennard Shelf specimens could easily be assigned to either *R. rotundus* or *R. dubiosus*. They can be distinguished from *R. distinctus* by their thinner exine and considerably smaller size. They can also be distinguished from spores here assigned to *R. biarealis* McGregor 1964, because they do not have prominent curvatural ridges or a rigid, circular equatorial outline.

Range: Gneudna Formation, Carnarvon Basin, Frasnian (Balme, 1988). The species is abundant and widespread throughout the world, and is characteristic of Early and Middle Devonian assemblages (Streel, 1964, 1967; McGregor, 1973; McGregor and Camfield, 1976, 1982; Gao, 1981).

Occurrence: NRD 3, 20, 70; PD 17, 120, 145, 153, 162.

Retusotriletes simplex Naumova 1953
(Pl. 24, fig. 6)

Dimensions: 40 specimens: 32 (46) 76 μm.

Remarks: In the present report I have followed de Jersey (1966, p. 7) and have included spores in which the curvaturae form part of an equatorial thickening in this species.

Range: Etonvale Formation, Adavale Basin, Queensland, Middle and Late Devonian (de Jersey, 1966); Middle and Late Devonian of USSR (Naumova, 1953; Chibrikova, 1959).

Occurrence: NRD 3, 20, 32, 70; PD 26, 153, 162.

***Retusotriletes* spp.**

(Pl. 24, fig. 7)

Remarks: Numerous other more or less laevigate, trilete spores, which have distinct contact areas, can be assigned to *Retusotriletes*. No attempt has been made to differentiate them here, as they seem of little stratigraphic significance.

Occurrence: Common throughout the Lennard Shelf sequence.

Genus *RHABDOSPORITES* Richardson 1960

Type species: *Rhabdosporites langii* (Eisenack 1944) Richardson 1960 (by subsequent designation).

Rhabdosporites sp. cf. *R. langii* (Eisenack 1944) Richardson 1960
(Pl. 24, figs 9, 10)

cf. 1960 *Rhabdosporites langii* (Eisenack 1944) Richardson, p. 54, pl. 14, figs 8, 9; text-figs 4, 6B.

For additional synonymy see McGregor and Camfield (1982, p. 59) and Balme (1988).

Dimensions: 2 specimens: overall diameter, both 81 μm.

Remarks: Balme (1988) commented on the smaller size of Carnarvon Basin specimens relative to those from Scotland measured by Richardson (1965). Lennard Shelf specimens are also small, and lack a well-defined trilete mark and distinctly baculate sculpture. The walls of Lennard Shelf specimens have delicate folds, and the wall is more diaphanous than either Scottish, Canadian, or Carnarvon Basin specimens.

Range: Present, but rare, in the Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988); Eifelian to upper Frasnian in Europe and North America; Early to middle Givetian in the Ghadhamis Basin in Libya–Tunisia (Loboziak and Streel, 1989). Ranging from the ***velatus–langii*** to the top of the ***ovalis–bulliferus*** Assemblage Zones of the Old Red Sandstone Continent (Richardson and McGregor, 1986).

Occurrence: PD 17, 151, 153.

?*Rhabdosporites* sp. indet.
(Pl. 24, fig. 8)

Dimensions: 3 specimens: overall diameter 50 (53) 56 μm.

Remarks: A few very small specimens occur in Lennard Shelf samples and may belong to *Rhabdosporites*. Material is too poorly preserved for positive assignment, and the sculpture is not entirely typical of *Rhabdosporites* as it is not baculate, but granulate.

Occurrence: PD 17.

Genus *STENOZONOTRILETES* Naumova 1939 ex Ischenko 1952 emend. Potonié 1958

Type species: *Stenozonotriletes conformis* Naumova 1953 (by subsequent designation of Potonié, 1958).

Stenozonotriletes clarus Ischenko 1958
(Pl. 24, figs 11, 12)

For synonymy see G. Playford, 1976, p. 25.

Dimensions: 9 specimens: 36 (46) 59 μm.

Range: Fairfield Group, Canning Basin, Famennian or Tournaisian (G. Playford, 1976).

Occurrence: NRD 1, 2, 26.

Stenozonotriletes forticulus Balme and Hassell 1962
(Pl. 24, fig. 13)

Dimensions: Single specimen: 76.5 μm.

Range: Kimberley Downs bore, Canning Basin, Late Devonian (Balme and Hassell, 1962).

Occurrence: NRD 1.

Stenozonotriletes simplex Naumova 1953
(Pl. 24, fig. 14)

Dimensions: Single specimen: 48 µm.

Range: A long-ranging and widespread species, but previously recorded in Australia only from the Etonvale Formation, Adavale Formation, Queensland, (de Jersey, 1966).

Occurrence: NRD 4.

Stenozonotriletes sp. C Playford 1976
(Pl. 26, figs 1, 2)

Dimensions: 9 specimens: 45 (72) 104 µm.

Remarks: Specimens conform to the informal category described by G. Playford (1976, p. 26). They are characterized by conspicuous smooth lips. They probably represent a new species, although more specimens are required before the taxon can be circumscribed.

Range: Laurel Formation, Fairfield Group, Canning Basin, Famennian or Tournaisian (G. Playford, 1976).

Occurrence: NRD 1; NRD 26.

Genus *VELAMISPORITES* Bharadwaj and Venkatachala 1962

Type species: *Velamisporites rugosus* Bharadwaj and Venkatachala 1962 (by original designation).

Velamisporites sp. cf. *V. rugosus* Bharadwaj and Venkatachala 1962 of Playford 1971
(Pl. 25, figs 1 to 4)

cf. 1962 *Velamisporites rugosus* Bharadwaj and Venkatachala, p. 25, pl. 4, figs 14–16.

1971 *Velamisporites* sp. cf. *V. rugosus* Bharadwaj and Venkatachala; Playford 1971, p. 53, pl. 18, figs 5, 6.

1988 *Velamisporites* sp. cf. *V. rugosus* Bharadwaj and Venkatachala; Playford and Satterthwait, p. 17, pl. 8, figs 13, 14; pl. 10, fig. 1.

For additional synonymy see Playford (1971) p. 53.

Dimensions: 12 specimens: 72 (122) 185 µm.

Remarks: Some of the Lennard Shelf miospores (fig. 1A, 1B) closely resemble those illustrated by Playford and Satterthwait (1988, pl. 8, fig. 14, pl. 10, fig. 1). Others are more variable (figs 3–4), and are perhaps closer to those illustrated by Playford (1971, pl. 18, figs 5, 6). Playford (1971) and Playford and Satterthwait (1988) discuss the problems of assigning the Australian specimens to species as described by Bharadwaj and Venkatachala (1962). The Lennard Shelf specimens appear quite variable, and this may be true for the Bonaparte Basin forms.

Range: *V. rugosus* occurs in the Early Carboniferous of Spitsbergen (Bharadwaj and Venkatachala, 1962). Australian variants are Late Devonian to Early Carboniferous in age (Playford and Satterthwait, 1988).

Occurrence: NRD 2, 9, 17, 20, 26.

Type species: *Verrucosisporites verrucosus* (Ibrahim) Ibrahim 1933 (by original designation).

Verrucosisporites confertus Owens 1971
(Pl. 26, fig. 3)

1972 *Verrucosisporites* n. sp. McGregor and Uyeno, Pl. IV, fig. 11.

Dimensions: 9 specimens: 50 (68) 104 µm.

Remarks: The Lennard Shelf miospores, like those described by Owens (1971), are characterized by a distinct trilete mark. They also have large verrucae with circular, subcircular, polygonal, or irregular basal outlines, which show occasional basal coalescence, and have either rounded or flattened tops.

Range: Griper Bay Formation, Canada, Frasnian (Owens, 1971).

Occurrence: NRD 3, 32; PD 153, 162.

Verrucosisporites mucronatus Streel 1964
(Pl. 26, figs 4, 5)

1964 *Verrucosisporites mucronatus* Streel 1964, p. 244, Pl. I, fig. 11.

Dimensions: Two specimens: 50 and 77 µm.

Remarks: Rare Lennard Shelf specimens have the rounded equatorial outline and small, regularly distributed verrucae of Streel's (1964) species.

Range: Vesdre Synclinorium, eastern Belgium, early Givetian (Streel, 1964).

Occurrence: PD 120, 162.

Verrucosisporites premnus Richardson 1965
(Pl. 26, figs 6 to 10)

1966 *Lophozonotriletes* sp. 1 Hemer and Nygreen, pl. 2, fig 3.

1974 *Lophozonotriletes* sp. Grey, fig. 61k.

For additional synonymy see McGregor and Camfield, 1982, p. 61.

Dimensions: 31 specimens: 41 (53) 81 µm.

Remarks: Like the Canadian specimens described by McGregor and Camfield (1982, p. 61), the Lennard Shelf miospores show a complete range of variation between *V. premnus*, *V. scurrus* (Naumova 1953) McGregor and Camfield 1982 (Pl. 26, fig. 6), *Convolutispora crassata*? (Naumova 1953) McGregor and Camfield 1982 (Pl. 26, fig. 7), and *Raistrickia aratra* Allen 1965 (Pl. 26, fig. 9).

Range: Not previously recorded in Australia. Late Eifelian to Middle Givetian of the Ghadamis Basin in Libya–Tunisia (Loboziak and Streel 1989). Ranges from the base of the ***devonicus–naumovii*** to the middle of the ***optivus –triangulatus*** Assemblage Zones (Richardson and McGregor, 1986).

Occurrence: NRD 3; PD 17, 26, 145, 151, 153.

Verrucosisporites pulvinatus **de Jersey 1966**
(Pl. 26, figs 11, 12)

Dimensions: 16 specimens: 41 (56) 68 μm.

Remarks: Lennard Shelf specimens show a mixture of discrete and fused verrucae. Verrucae are sometimes fused at the equatorial margin as described by de Jersey (1966, p. 2), and it is debatable whether this species belongs in *Verrucosisporites* or *Convolutispora*. *V. confertus* Owens 1971 resembles *V. pulvinatus* in many features, and may be a junior synonym. The main difference is that sculpture is "reduced or absent on contact faces" in *V. confertus*. Additionally, in *V. pulvinatus* the proximal exine has "flattened sub-hemispherical processes at ends of laesurae", although the remainder of the proximal exine is "thin, laevigate or finely wrinkled". Separations between discrete verrucae are more marked in *pulvinatus*. These distinctions are probably not sufficiently significant to retain two species, but comparison of type material is required to confirm synonymy.

Range: Etonvale Formation, Adavale Basin, Queensland, Middle and Late Devonian (de Jersey, 1966).

Occurrence: NRD 3; PD 26, 153.

Verrucosisporites scurrus **(Naumova 1953) McGregor and Camfield 1982**
(Pl. 27, figs 1 to 5)

1966 ?*Chelinospora* Hemer and Nygreen, pl. 1, fig. 7.

1988 *Verrucosisporites scurrus* (Naumova) McGregor and Camfield, 1982; Balme, p. 130, pl. 5, figs 5–9.

For additional synonymy see McGregor and Camfield, 1982, p. 61.

Remarks: An extreme form (Pl. 27, fig. 2), here assigned to *V. scurrus*, has some biform elements more typical of *Dibolisporites uncatus* (Naumova 1953) McGregor and Camfield 1982. Other specimens, (Pl. 27, figs 4A, 4B) resemble *V. tumulentus* Clayton and Graham 1974, but have broader, higher verrucae.

Range: Gneudna Formation, Carnarvon Basin, early Frasnian (Balme, 1988); Givetian and early Frasnian of the Ghadamis Basin in Libya–Tunisia (Loboziak and Streel, 1989). Widespread in northern Europe and Canada, and ranges from the base of the ***devonicus–naumovii*** to the lower third of the ***ovalis–bulliferus*** Assemblage Zones (Richardson and McGregor, 1986).

Occurrence: NRD 3, 32, 70; PD 17, 26, 120, 151, 153, 162.

Genus and species indet. 1
(Pl. 27, fig. 6)

Dimensions: Single specimen: 54 μm.

Description: Spore trilete with subtriangular amb; corners slightly rounded, interadial margins convex. Trilete mark simple, straight, and extends 2/3 of spore diameter. Spore bordered by a cingulum which is approximately 1/3 spore diameter. Details of the structure are obscured by the crowded ornament, but the cingulum is probably only slightly thicker than the main spore body. Proximal face scabrate with scattered grana. Cingulum and distal surface crowded with spinose and baculate ornament. Sculpture less than 1μm at base and up to 4 μm long. Shorter elements may be conate, longer elements cylindrical, or swelling slightly towards the tip. Elements often biform and usually terminate in a delicate apical spine. Wall thickness cannot be determined because of the dense ornament.

Remarks: As only a single specimen is available, it is difficult to determine the precise morphology of this form. In many features it resembles *Diatomozonotriletes franklinii* McGregor and Camfield, but seems to have a cingulum rather than a fimbriate zona, and the ornament does not diminish in size towards the triangular apices. The ornament is somewhat similar to that of *Acinosporites hirsutus* (Brideaux and Radforth 1970) McGregor and Camfield 1982, although the spore body is distinctly different.

Additional specimens are needed to determine whether this is a new taxon, or merely an aberrant form of an existing species. The single specimen examined is very distinctive, and such spores could be of biostratigraphic significance.

Occurrence: PD 153.

Genus and species indet. 2
(Pl. 27, figs 6)

Dimensions: 4 specimens: 41 (46) 50 μm.

Remarks: Rugulate spore of uncertain affinities. Preservation is generally poor. Amb sub-rounded to sub-triangular; trilete mark distinct, sinuous, with narrow lips extending to equatorial margins. Proximal surface scabrate or granulate; proximal surface with coarse reticulum of rugulae.

Occurrence: PD 120.

Genus and species indet. 3
(Pl. 27, figs 9 to 11)

Dimensions: 3 specimens: 45, 99, and 113 μm.

Description: Trilete camerate miospores; triangular amb with pointed apices and equatorial margin ranging from straight to highly concave (Pl. 27, fig. 10). Central body circular, dark, almost touching amb in interadial areas, but distance between the body and triangular apices is about 1/2 spore diameter. Trilete mark simple, straight, not always distinct; sometimes bordered by narrow lips; extending about 1/2 central body diameter. Central body thick, laevigate. Exoexine very thin, granulate, probably attached to central body only on proximal face, and may be folded, sometimes in a regular pattern (Pl. 27, fig. 8).

Remarks: The three recorded specimens are quite variable in both size and equatorial outline. In spite of the differences the spores seem to belong to the same species, although their affinities are uncertain. They may compare with *Calyptosporites triangulatus* Higgs 1975, but lack the spines present in this species.

Occurrence: NRD 20.

Appendices

Appendix 1

Productive samples, boreholes, and depths

A. Napier Range Area

Borehole No.	*Location*	*Depth* (m)	*Field no.*	*Reg. no.*	*Formation*	*Assemblage*
NRD 1	Napier 1 (oil well)	113.1	72717	F47955	Fairfield	***pusillites–lepidophytus***
		240.7	79120	F47956	Fairfield	***pusillites–lepidophytus***
		257.9	72722	F47957	Fairfield	***pusillites–lepidophytus***
		264.5	79121	F47958	Fairfield	***pusillites–lepidophytus***
		270.6	79122	F47959	Fairfield	***pusillites–lepidophytus***
		275.5	79123	F47960	Fairfield	***pusillites–lepidophytus***
		280.1	79124	F47961	Fairfield	***pusillites–lepidophytus***
		303.4	79125	F47962	Fairfield	***pusillites–lepidophytus***
NRD 2	Napier 1 (oil well)	224.2	79135	F47963	Fairfield	***pusillites–lepidophytus***
		251.9	79136	F47964	Fairfield	***pusillites–lepidophytus***
		280.5	79137	F47965	Fairfield	***pusillites–lepidophytus***
NRD 3	Barker Gorge	138.2	72724	F47966	Van Emmerick Sands	?***lemurata–magnificus***
		166.2	79136	F47967	Van Emmerick Sands	?***lemurata–magnificus***
		177.2	79137	F47968	Van Emmerick Sands	?***lemurata–magnificus***
NRD 4	Barker Gorge	38.0	72726	F47969	Napier	***pusillites–lepidophytus***
NRD 9	Billy Moore Yard	30.0	79142	F47970	Fairfield	***pusillites–lepidophytus***
		50.0	79143	F47971	Fairfield	***pusillites–lepidophytus***
		103.0	72734	F47972	Fairfield	***pusillites–lepidophytus***
		149.5	79144	F47973	Fairfield	***pusillites–lepidophytus***
		218.3	72735	F47974	Fairfield	***pusillites–lepidophytus***
NRD 17	Barker Gorge	42.0	72738	F47975	Fairfield	***pusillites–lepidophytus***
NRD 18	Barker Gorge	34.0	72739	F47976	Fairfield - Napier	***pusillites–lepidophytus***
NRD 20	Area E	114.1	72741	F47977	Napier	***pusillites–lepidophytus***
		137.4	72742	F47978	Napier	***pusillites–lepidophytus***
		208.5	72743	F47979	Van Emmerick Sands	?***lemurata–magnificus***
NRD 26	Barker Gorge	50.0	79101	F47980	Fairfield	***pusillites–lepidophytus***
		75.0	72783	F47981	Fairfield	***pusillites–lepidophytus***
		87.5	79102	F47982	Fairfield	***pusillites–lepidophytus***
		112.5	79103	F47983	Fairfield	***pusillites–lepidophytus***
		125.0	72785	F47984	Fairfield	***pusillites–lepidophytus***
		175.0	72786	F47985	Fairfield	***pusillites–lepidophytus***
		227.4	72787	F47986	Fairfield	***pusillites–lepidophytus***
		251.6	72788	F47987	Fairfield	***pusillites–lepidophytus***
		274.4	72789	F47988	Fairfield	***pusillites–lepidophytus***
		296.4	72790	F47989	Fairfield	***pusillites–lepidophytus***
		303.4	72791	F47990	Lower Napier	***pusillites–lepidophytus***
		305.4	79104	F47991	Lower Napier	***pusillites–lepidophytus***
		312.5	79105	F47992	Lower Napier	***pusillites–lepidophytus***
NRD 32	Area E	127.5	72766	F47993	Van Emmerick Sands	?***lemurata–magnificus***
NRD 69	Wagon Pass	165.2	79112	F47994	Lower Napier	***pusillites–lepidophytus***
		172.4	79111	F47995	Lower Napier	***pusillites–lepidophytus***
		219.9	79115	F47996	Lower Napier	***pusillites–lepidophytus***
NRD 70	Barker Gorge	269.5	79019	F47997	Van Emmerick Sands	?***lemurata–magnificus***

B. Limestone Billy Hills and Pillara Range areas

Borehole No.	Location	Depth (m)	Field no.	Reg. no.	Formation	Assemblage
PD 17	South of Galena Hill	20.6	72350	F47998	Sadler	***optivus–triangulatus***
		30.4	72351	F47999	Sadler	***optivus–triangulatus***
PD 26	Northwest Limestone Billy Hills	204.7	72366	F48000	Sadler	***lemurata–magnificus***
		246.7	72368	F48001	Pillara 2	***lemurata–magnificus***
		311.2	72370	F48002	Pillara 1	***lemurata–magnificus***
		338.5	72372	F48003	Pillara 1	***lemurata–magnificus***
		397.9	72374	F48004	Pillara 1	***lemrrata–magnificus***
PD 120	North end of Limestone Billy Hills	469.5	72408	F48005	Pillara 1	***lemurata–magnificus***
		487.6	72511	F48006	Pillara 1	***lemurata–magnificus***
PD 145	Northwest Pillara Range	309.3	72547	F48007	Pillara 1	***lemurata–magnificus***
		467.0	72548	F48008	Pillara 1	***lemurata–magnificus***
PD 151	Northwest Pillara Range	146.9	72304	F48009	Pillara 2	***optivus–triangulatus***
		181.6	72305	F48010	Pillara 1	***optivus–triangulatus***
		206.0	72307	F48011	Pillara 1	***optivus–triangulatus***
		219.0	72308	F48012	Pillara 1	***optivus–triangulatus***
		272.2	72309	F48013	Pillara 1	***optivus–triangulatus***
		281.5	72310	F48014	Pillara 1	***optivus–triangulatus***
		284.5	72311	F48015	Pillara 1	***optivus–triangulatus***
PD 153	Northwest of Pillara Range	15.7	72553	F48016	Virgin Hills	***optivus–triangulatus***
		18.7	72554	F48017	Virgin Hills	***optivus–triangulatus***
		25.7	72555	F48018	Virgin Hills	***optivus–triangulatus***
		32.6	72556	F48019	Virgin Hills	***optivus–triangulatus***
		54.4	72559	F48020	Gogo	***optivus–triangulatus***
		60.6	72560	F48021	Gogo	***optivus–triangulatus***
		73.5	72561	F48022	Gogo	***optivus–triangulatus***
		80.6	72562	F48023	Gogo	***optivus–triangulatus***
		88.8	72563	F48024	Gogo	***optivus–triangulatus***
		96.6	72564	F48025	Gogo	***optivus–triangulatus***
		103.6	72565	F48026	Gogo	***optivus–triangulatus***
		125.0	72568	F48027	Gogo	***optivus–triangulatus***
		126.0	72569	F48028	Gogo	***optivus–triangulatus***
		149.4	72572	F48029	Gogo	***optivus–triangulatus***
		159.4	72573	F48030	Gogo	***optivus–triangulatus***
		164.1	72574	F48031	Gogo	***optivus–triangulatus***
		200.2	72575	F48032	Gogo	***optivus–triangulatus***
		209.7	72576	F48033	Gogo	***optivus–triangulatus***
		236.1	72577	F48034	Gogo	***lemurata–magnificus***
		272.8	72579	F48035	Gogo	***lemurata–magnificus***
		299.0	72581	F48036	Gogo	***lemurata–magnificus***
		340.0	72582	F48037	Gogo	***lemurata–magnificus***
		348.2	72583	F48038	Gogo	***lemurata–magnificus***
		377.0	72584	F48039	Gogo	***lemurata–magnificus***
		458.0	72585	F48040	Pillara 1	***lemurata–magnificus***
PD 162	Northwest of Pillara Range	279.0	72712	F48041	Sadler - Gogo	***optivus–triangulatus***
		340.0	72713	F48042	Sadler - Gogo	***optivus–triangulatus***
		470.0	72714	F48043	Sadler - Gogo	***optivus–triangulatus***

Appendix 2

Taxonomic records for individual boreholes

(Sample depths in metres)

Borehole: NRD 1

303.4	*280.1*	*275.5*	*270.6*	*264.5*	*257.9*	*240.7*	*113.1*	
x	x	x	x	x	x	x	x	*Anapic.* cf. *echinatus*
....	x	x	x	x	x	....	x	*Aneurospora incohata*
x	x	x	....	x	x	x	x	*Apiculatisporis morbosus*
....	....	....	x	x	x	....	x	*Auroraspora macra*
x	x	x	x	x	x	x	x	*Camptotriletes balmei*
....	....	....	....	x	x	....	x	*Cirratriradites impensus*
x	x	x	x	x	x	x	x	*Convolutispora fromensis*
x	....	x	x	x	x	....	x	*Crassispora drucei*
x	....	....	x	....	x	....	x	*Diaphanospora depressa*
x	x	x	x	x	x	x	x	*Diaphanospora perplexa*
x	x	x	x	x	x	x	x	*Diaphanospora riciniata*
x	x	x	x	....	x	....	x	*Gorgonispora convoluta*
....	....	....	....	....	x	x	....	*Grandispora clandestina*
x	x	x	x	x	x	x	x	*Grandispora praecipua*
x	x	x	x	x	x	x	x	*Granulatisporites frustulentus*
....	....	....	....	....	x	....	....	*Hymenozonotriletes scorpius*
x	....	x	x	x	....	x	x	*Hystricosporites porrectus*
....	....	x	x	....	....	....	x	*Knoxisporites literatus*
....	....	....	....	x	x	....	x	*Knoxisporites pristinus*
....	....	....	....	....	....	x	....	*Leiotriletes pulvereus*
x	x	....	x	x	x	x	x	*Leiozonotriletes laurelensis*
....	....	....	....	x	....	....	....	*Lophozonotriletes triangulatus*
....	....	....	....	....	x	....	....	*Lophozonotriletes varionodosus*
x	x	x	x	x	x	x	x	*Planisporites furfuris*
....	....	....	....	....	x	....	x	*Reticulatisporites ancoralis*
x	x	x	x	x	x	x	x	*Retispora lepidophyta*
....	....	x	....	....	x	....	x	*Stenozonotriletes clarus*
....	....	....	....	....	....	....	x	*Stenozonotriletes forticulus*
....	....	....	....	....	x	....	....	*Stenozonotriletes* sp. C

Borehole: NRD 2

280.5	*251.9*	*224.2*	
x	x	x	*Anapic.* cf. *echinatus*
x	x	x	*Aneurospora incohata*
....	x	....	*Calyptosporites proximocavata*
x	x	x	*Camptotriletes balmei*
....	x	....	*Cirratriradites impensus*
x	x	x	*Convolutispora fromensis*
x	x	x	*Crassispora drucei*
....	x	x	*Diaphanopsora depressa*
x	x	x	*Diaphanospora perplexa*
x	x	x	*Diaphanospora riciniata*
x	x	x	*Gorgonispora convoluta*
x	....	....	*Grandispora clandestina*
x	x	x	*Grandispora praecipua*
x	x	x	*Granulatisporites frustulentus*
....	x	....	*Hymenozonotriletes explanatus*
x	x	....	*Hystrichosporites porrectus*
x	x	x	*Knoxisporites literatus*
x	x	x	*Leiozonotriletes laurelensis*
....	x	....	*Lophozonotriletes triangulatus*
x	x	x	*Planisporites furfuris*
x	x	....	*Reticulatisporites ancoralis*
x	x	x	*Retispora lepidophyta*
x	x	....	*Stenozonotriletes clarus*
x	....	....	*Velamisporites* cf. *rugosus*

Borehole: NRD 3

177.2	*166.2*	*138.2*	
x	....	....	*Acinosporites acanthomammilatus?*
x	....	....	*Acinosporites lindlarensis*
x	....	....	*Ambagisporites daedalus*
x	....	....	*Ancyrospora involucra?*
x	....	x	*Ancyrospora langii*
....	....	x	*Ancyrospora melvillensis?*
x	x	x	*Ancyrospora parke*
x	x	x	*Ancyrospora parva*
x	....	x	*Apiculatasporites adavalensis*
x	....	....	*Apiculatasporites microconus*
x	....	....	*Archaeozonotriletes timanicus*
x	x	x	*Convolutispora crassata?*
x	....	....	*Cymbosporites* cf. *magnificus*
x	....	....	*Cymbosporites catillus*
x	....	x	cf. *Cyclogranisporites* sp. de Jersey
x	....	....	*Dibolisporites* sp. cf. *D. turriculatus*
x	....	x	*Emphanisporites rotatus*
x	....	....	*Endosporites gilmorensis*
x	....	x	*Geminospora lemurata*
x	....	....	*Grandispora* sp. indet.
x	....	x	*Granulatisporites phillipsi*
x	....	....	*Hystricosporites richardsoni*
....	....	x	cf. *Kraeuselisporites ollii?*
x	....	....	*Medusaspora dringii*
x	....	....	*Nikitinisporites spitsbergensis?*
x	x	x	*Punctatisporites etonvalensis*
x	....	....	*Raistrickia aratra?*
x	....	....	*Retusotriletes actinomorphus*
x	....	....	*Retusotriletes biarealis*
x	....	....	*Retusotriletes distinctus*
x	....	....	*Retusotriletes punctimedianus*
x	....	....	*Retusotriletes rotundus*
x	....	....	*Retusotriletes simplex*
x	....	....	*Verrucosisporites confertus*
x	....	....	*Verrucosisporites premnus*
x	....	x	*Verrucosisporites pulvinatus*
x	....	x	*Verrucosisporites scurrus*

Borehole: NRD 4

38.0	
x	*Anapic.* cf. *echinatus*
x	*Retusotriletes incohata*
x	*Apiculatisporis morbosus*
x	*Brochotriletes textilis*
x	*Camptotriletes balmei*
x	*Convolutispora fromensis*
x	*Crassispora drucei*
x	*Diaphanospora perplexa*
x	*Diaphanospora riciniata*
x	*Gorgonispora convoluta*
x	*Grandispora notensis*
x	*Grandispora praecipua*
x	*Granulatisporites frustulentus*
x	*Hystricosporites porrectus*
x	*Knoxisporites literatus*
x	*Knoxisporites pristinus*
x	*Leiozonotriletes laurelensis*
x	*Lophozonotriletes triangulatus*
x	*Planisporites furfuris*
x	*Retispora lepidophyta*
x	*Retusotriletes actinomorphus*
x	*Stenozonotriletes simplex*

Borehole: NRD 17

42.0	
x	*Anapic.* cf. *echinatus*
x	*Aneurospora incohata*
x	*Apiculatisporis morbosus*
x	*Camptotriletes balmei*
x	*Convolutispora fromensis*
x	*Crassispora drucei*
x	*Diaphanospora depressa*
x	*Diaphanospora perplexa*
x	*Diaphanospora riciniata*
x	*Grandispora notensis*
x	*Grandispora praecipua*
x	*Granulatisporites frustulentus*
x	*Hymenozonotriletes scorpius*
x	*Hystrichosporites porrectus*
x	*Knoxisporites literatus*
x	*Knoxisporites pristinus*
x	*Leiozonotriletes laurelensis*
x	*Lophozonotriletes triangulatus*
x	*Planisporites furfuris*
x	*Punctatisporites* sp. cf. *solidus*
x	*Reticulatisporites ancoralis*
x	*Retispora lepidophyta*
x	*Retusotriletes digressus*
x	*Velamisporites* cf. *rugosus*

Borehole: NRD 9

218.3	*149.5*	*103.0*	*50.0*	*30.0*	
x	x	x	x	x	*Anapic.* cf. *echinatus*
x	x	....	....	x	*Aneurospora incohata*
x	x	x	x	x	*Apiculatisporis morbosus*
x	x	x	....	x	*Auroraspora macra*
	x	....	x	....	*Camptotriletes balmei*
x	....	....	....	x	*Cirratriradites impensus*
....	x	....	....	....	*Convolutispora caementosa*
x	....	x	x	x	*Convolutispora fromensis*
x	x	x	x	....	*Crassispora drucei*
x	....	x	....	x	*Diaphanospora depressa*
x	x	x	x	x	*Diaphanospora perplexa*
x	x	x	x	x	*Diaphanospora riciniata*
....	x	x	x	x	*Gorgonispora convoluta*
x	x	....	....	x	*Grandispora clandestina*
x	....	....	....	....	cf. *Grandispora cornuta*
x	x	x	x	x	*Grandispora praecipua*
x	x	x	x	x	*Granulatisporites frustulentus*
....	....	x	x	x	*Hystricosporites porrectus*
x	x	x	x	....	*Knoxisporites literatus*
....	x	x	x	x	*Leiozonotriletes laurelensis*
....	x	x	....	....	*Lophozonotriletes triangulatus*
x	x	x	x	x	*Planisporites furfuris*
x	x	....	....	....	*Punctatisporites* cf. *solidus*
....	x	x	....	....	*Reticulatisporites ancoralis*
x	x	x	x	x	*Retispora lepidophyta*
x	....	....	....	....	*Velamisporites* cf. *rugosus*

Borehole: NRD 18

34.0	
x	*Anapic.* cf. *echinatus*
x	*Aneurospora incohata*
x	*Apiculatisporis morbosus*
x	*Brochotriletes textilis*
x	*Camptotriletes balmei*
x	*Cirratriradites impensus*
x	*Convolutispora fromensis*
x	*Crassispora drucei*
x	*Diaphanospora perplexa*
x	*Diaphanospora riciniata*
x	*Gorgonispora convoluta*
x	*Granulatisporites frustulentus*
x	*Hymenozonotriletes scorpius*
x	*Hystricosporites porrectus*
x	*Knoxisporites literatus*
x	*Lophozonotriletes triangulatus*
x	*Lophozonotriletes varionodosus*
x	*Lophozonotriletes* sp. indet.
x	*Planisporites furfuris*
x	*Punctatisporites* sp. cf. *solidus*
x	*Reticulatisporites ancoralis*
x	*Retispora lepidophyta*

Borehole: NRD 20

208.5	*137.4*	*114.1*	
....	x	x	*Anapic.* cf. *echinatus*
x	....	....	*Aneurospora goensis*?
x	....	....	*Aneurospora* sp. indet.
....	x	x	*Aneurospora incohata*
x	....	....	*Apiculatasporites adavalensis*
	x	x	*Apiculatisporis morbosus*
x	....	....	*Apiculiretusispora densiconata*
x	....	....	*Apiculiretusispora* cf. *magnifica*
....	x	....	*Auroraspora macra*
x	....	....	*Biharisporites* sp. indet.
....	x	x	*Camptotriletes balmei*
x	....	....	*Camptozonotriletes leptohymenoides*
x	....	....	*Densosporites* sp. indet.
....	x	x	*Diaphanospora depressa*
....	x	....	*Diaphanospora perplexa*
x	x	....	*Endosporites gilmorensis*
x	....	....	*Geminospora lemurata*
....	x	....	*Gorgonispora convoluta*
....	x	x	*Grandispora clandestina*
....	....	x	*Grandispora praecipua*
x	....	....	*Grandispora* sp. indet.
....	....	x	*Grandispora* sp. D
x	....	....	*Grandispora* sp. E
x	....	....	*Grandispora* sp. F
....	....	x	*Granulatisporites frustulentus*
....	x	....	*Knoxisporites literatus*
....	....	x	*Knoxisporites pristinus*
x	....	....	cf. *Kraeuselisporites ollii*?
....	x	....	*Latosporites* sp. indet.
....	....	x	*Leiozonotriletes laurelensis*
....	x	....	*Lophozonotriletes triangulatus*
....	x	x	*Planisporites furfuris*
....	x	x	*Punctatisporites* sp. cf. *solidus*
....	x	x	*Retispora lepidophyta*
x	....	....	*Retusotriletes actinomorphus*
....	x	....	*Retusotriletes digressus*
x	....	....	*Retusotriletes rotundus*
x			*Retusotriletes simplex*
....	x	x	*Velamisporites* cf. *rugosus*
x	....	....	Genus and species indet. 3

Borehole: NRD 26

312.5	*305.4*	*303.4*	*296.4*	*274.4*	*251.6*	*227.4*	*175.0*	*125.0*	*112.5*	*87.5*	*75.0*	*50.0*	
x	x	x	x	x	x	x	x	x	x	x	x	x	*Anapic.* cf. *echinatus*
x	....	....	....	....	....	....	....	....	....	x	....	x	*Aneurospora incohata*
x	x	x	x	x	....	....	x	x	x	x	x	x	*Apiculatisporis morbosus*
x	x	x	x	x	....	x	x	x	x	x	....	x	*Auroraspora macra*
x	....	....	....	....	....	....	....	....	x	....	....	x	*Brochotriletes textilis*
....	....	....	....	....	....	x	x	x	x	x	....	x	*Calamospora* cf. *microrugosa*
....	....	....	....	....	....	....	....	x	....	....	....	x	*Calyptosporites proximocavata*
x	x	....	....	x	....	....	x	x	x	x	....	x	*Camptotriletes balmei*
x	x	....	....	....	....	x	x	x	....	....	....	x	*Cirratriradites impensus*
x	x	x	x	x	x	....	x	x	x	x	....	x	*Convolutispora fromensis*
x	x	x	x	x	x	x	x	x	x	x	x	x	*Crassispora drucei*
....	....	....	....	x	x	x	x	x	x	....	....	....	*Cyclogranisporites* sp. A
....	....	....	....	....	....	....	....	....	....	x	....	....	*Densosporites* sp. indet.
....	....	....	....	....	....	x	x	x	x	x	x	....	*Diaphanospora depressa*
x	x	x	x	x	x	x	x	x	x	x	x	x	*Diaphanospora perplexa*
x	x	x	x	x	x	x	x	x	x	x	x	x	*Diaphanospora riciniata*
....	....	....	....	....	....	....	....	x	....	....	....	....	*Diaphanospora* sp. indet.
x	x	....	x	....	x	x	....	x	x	x	....	x	*Gorgonispora convoluta*
x	....	x	....	....	....	x	....	....	x	....	....	....	*Grandispora clandestina*
....	....	....	....	....	....	....	x	....	....	....	....	x	*Grandispora notensis*
....	....	x	x	....	....	x	x	x	x	x	x	x	*Grandispora praecipua*
x	x	x	x	x	x	x	x	x	x	x	x	x	*Granulatisporites frustulentus*
x	x	x	x	x	x	x	x	x	x	x	....	....	*Hystricosporites porrectus*
x	x	x	x	....	x	x	x	x	x	x	....	x	*Knoxisporites literatus*
....	....	....	....	....	....	....	....	....	....	....	....	x	*Leiotriletes pulvereus*
x	x	x	x	....	....	....	x	x	x	x	....	x	*Leiozonotriletes laurelensis*
x	....	....	x	....	....	....	....	x	x	x	....	....	*Lophozonotriletes triangulatus*
x	x	x	x	x	x	x	x	x	x	x	....	x	*Planisporites furfuris*
x	x	....	....	....	....	x	x	....	x	x	x	x	*Punctatisporites iterabilis*
....	....	....	....	....	....	....	x	x	x	x	....	....	*Punctatisporites* sp. *solidus*
x	x	....	....	....	....	....	x	x	x	x	x	x	*Reticulatisporites ancoralis*
x	x	x	x	x	x	x	x	x	x	x	x	x	*Retispora lepidophyta*
....	....	....	....	x	....	....	x	x	....	....	....	....	*Retusotriletes digressus*
x	....	....	....	....	....	....	x	x	....	....	....	x	*Stenozonotriletes clarus*
x	x	....	x	....	....	....	x	....	x	....	....	x	*Stenozonotriletes* sp. C
x	x	....	....	....	....	x	x	x	....	....	....	x	*Velamisporites* cf. *rugosus*

Borehole: NRD 32

127.5	
x	*Aneurospora goensis*?
x	*Aneurospora greggsii*
x	*Apiculatasporites adavalensis*
x	*Auroraspora macra*
x	*Biharisporites* sp. indet.
x	*Camptozonotriletes leptohymenoides*
x	*Geminospora lemurata*
x	*Grandispora* sp. indet.
x	*Retusotriletes punctimedianus*
x	*Retusotriletes simplex*
x	*Verrucosisporites confertus*

Borehole: NRD 69

219.9	172.4	165.2	
x	x	x	*Anapic.* cf. *echinatus*
....	....	x	*Aneurospora incohata*
....	x	....	*Apiculatisporis morbosus*
....	x	x	*Auroraspora macra*
....	x	....	*Camptotriletes balmei*
....	....	x	*Crassispora drucei*
....	x	....	*Diaphanospora perplexa*
....	....	x	*Gorgonispora convoluta*
....	....	x	*Granulatisporites frustulentus*
....	x	....	*Hystricosporites porrectus*
....	....	x	*Leiozonotriletes laurelensis*
....	....	x	*Lophozonotriletes varionodosus*
x	....	x	*Planisporites furfuris*

Borehole: NRD 70

269.5	
x	*Acinosporites lindlarensis*?
x	*Anapiculatisporites* sp.
x	*Ancyrospora* sp. cf. *A. ancyrea*
x	*Ancyrospora parke*
x	*Ancyrospora parva*
x	*Apiculatasporites adavalensis*
x	*Apiculiretusispora densiconata*?
x	*Apiculiretusispora* cf. *magnifica*
x	*Calyptosporites stolidotus*
x	*Calyptosporites* sp. indet.
x	*Camptozonotriletes leptohymenoides*
x	cf. *Chelinospora ligurata*
x	*Cristatisporites albus*?
x	*Dibolisporites* cf. *eifelensis*
x	*Dibolisporites quebecensis*
x	*Dibolisporites* sp. cf. *D. turriculatus*
x	*Dictyotriletes australis*?
x	*Endosporites gilmorensis*
x	*Geminospora lemurata*
x	*Retusotriletes biarealis*
x	*Retusotriletes punctimedianus*
x	*Retusotriletes rotundus*
x	*Retusotriletes simplex*
x	*Verrucosisporites scurrus*

Borehole: PD 17

30.4	*20.6*	
....	x	*Acinosporites acanthomammilatus*?
x	x	*Acinosporites* cf. *acanthomammilatus*
....	x	*Acinosporites lindlarensis*?
....	x	*Ambagisporites daedalus*
....	x	*Anapiculatisporites* sp. indet.
....	x	*Ancyrospora* cf. *ancyrea*
....	x	*Ancyrospora parke*
....	x	*Ancyrospora parva*
....	x	*Apiculatasporites adavalensis*
....	x	*Apiculiretusispora* cf. *brandtii*
....	x	*Apiculiretusispora densiconata*?
....	x	*Apiculiretusispora leberidos*
....	x	*Archaeozonotriletes timanicus*
....	x	*Archaeozonotriletes variabilis*
....	x	*Baculatisporites* cf. *semilucensis*?
....	x	*Calamospora pannucea*
....	x	*Calyptosporites* cf. *stolidotus*
....	x	*Camarozonotriletes parvus*
....	x	*Convolutispora caementosa*
....	x	*Cristatisporites albus*?
....	x	*Cristatisporites triangulatus*
....	x	*Cymbosporites* cf. *magnificus*
....	x	*Cymbosporites* sp. indet.
....	x	cf. *Densosporites* sp. indet.
....	x	*Dibolisporites* cf. *turriculatus*
....	x	*Geminospora lemurata*
....	x	*Gneudnaspora kernickii*
....	x	*Grandispora* sp. G
....	x	*Granulatisporites phillipsi*
....	x	*Raistrickia aratra*?
....	x	*Retusotriletes punctimedianus*
....	x	*Retusotriletes pychovii*
....	x	*Retusotriletes rotundus*
....	x	*Rhabdosporites* cf. *langii*
....	x	?*Rhabdosporites* sp. indet.
....	x	*Verrucosisporites premnus*
....	x	*Verrucosisporites scurrus*

Borehole: PD 26

397.9	*338.5*	*311.2*	*246.7*	*204.7*	
....	x	x	....	....	*Acinosporites acanthomammilatus*?
....	....	x	....	....	*Ambagisporites daedalus*
....	....	....	....	x	*Ancyrospora* sp. cf. *A. ancyrea*
....	....	....	x	x	*Ancyrospora langii*
....	....	....	....	x	*Ancyrospora melvillensis?*
....	....	....	x	x	*Ancyrospora parke*
x	x	x	....	....	*Apiculatasporites adavalensis*
x	x	x	....	....	*Apiculiretusispora densiconata*?
....	x	....	....	....	*Cristatisporites albus*?
....	....	x	....	....	cf. *Cyclogranisporites* sp. de Jersey
....	x	....	....	....	*Dibolisporites* cf. *echinaceus*
....	....	x	....	....	*Endosporites gilmorensis*
x	x	x	x	x	*Geminospora lemurata*
x	x	x	....	....	*Granulatisporites phillipsi*
....	....	x	....	....	*Hystricosporites* sp. indet.
....	....	x	....	....	*Punctatisporites* spp.
....	x	x	....	....	*Retusotriletes biarealis*
....	x	....	....	....	*Retusotriletes* cf. *biarealis*
....	x	....	x	x	*Retusotriletes punctimedianus*
....	....	....	x	x	*Retusotriletes simplex*
....	....	....	....	x	*Verrucosisporites premnus*
....	....	x	....	x	*Verrucosisporites pulvinatus*
....	....	....	x	....	*Verrucosisporites scurrus*

Borehole: PD 120

487.6	469.5	
x	....	*Ancyrospora langii*
x	....	*Ancyrospora parva*
x	x	*Apiculatasporites adavalensis*
x	....	*Apiculatasporites microconus*
x	x	*Apiculiretusispora* cf. *brandtii*
x	....	*Apiculiretusispora densiconata*?
x	....	*Apiculiretusispora leberidos*
x	x	*Archaeozonotriletes timanicus*
x	....	*Baculatisporites* cf. *semilucensis*
x	....	*Calyptosporites* sp. indet.
x	....	*Convolutispora crassata*?
....	x	*Convolutispora paraverrucata*
x	....	*Cymbosporites* cf. *magnificus*
....	x	*Dibolisporites* cf. *echinaceus*
x	x	*Geminospora lemurata*
x	....	*Retusotriletes distinctus*
x	....	*Retusotriletes pychovii*
x	....	*Retusotriletes rotundus*
x	....	*Verrucosisporites mucronatus*
x	....	*Verrucosisporites scurrus*
x	....	Genus and species indet. 1

Borehole: PD 145

467.0	*309.3*	
x	....	*Acinosporites hirsutus*?
x	....	*Ancyrospora langii*
x	....	*Ancyrospora parke*
x	....	*Ancyrospora parva*
x	....	*Apiculatasporites adavalensis*
x	....	*Apiculatasporites microconus*
x	x	*Apiculiretusispora* cf. *brandtii*
x	....	*Apiculiretusispora leberidos*
x	....	*Archaeozonotriletes timanicus*
x	....	*Baculatisporites* cf. *semilucensis*
....	x	*Calyptosporites* cf. *stolidotus*
x	....	cf. *Chelinospora ligurata*
x	....	*Cymbosporites catillus*
x	....	*Cymbosporites* cf. *magnificus*
x	....	*Densosporites* cf. *weatherallensis*
....	x	*Geminospora lemurata*
x	....	*Hystricosporites richardsoni*
....	x	cf. *Kraeuselisporites ollii*?
x	....	*Medusaspora dringii*
....	x	*Retusotriletes rotundus*
....	x	*Verrucosisporites premnus*

Borehole: PD 151

284.5	*281.5*	*272.2*	*219.0*	*206.0*	*181.6*	*146.9*	
x	x	....	x	x	....	x	*Acinosporites acanthomammilatus*?
....	x	....	x	....	....	....	*Acinosporites hirsutus*?
....	x	....	x	x	....	....	*Ambagisporites daedalus*
....	x	....	x	x	x	x	*Ancyrospora langii*
....	x	....	....	....	....	x	*Ancyrospora longispinosa*?
....	x	....	....	....	x	....	*Ancyrospora parke*
x	x	....	....	....	....	x	*Ancyrospora parva*
x	x	x	....	x	....	....	*Apiculatasporites adavalensis*
....	....	....	x	x	x	x	*Apiculatasporites microconus*
x	x	x	....	....	....	....	*Apiculiretusispora* cf. *brandtii*
....	....	....	x	x	....	....	*Apiculiretusispora densiconata*?
....	....	....	....	x	....	....	*Apiculiretusispora* sp. indet.
....	x	....	....	....	....	x	*Archaeozonotriletes timanicus*
....	....	....	x	....	....	....	*Calamospora pannucea*
....	....	....	....	x	....	x	*Convolutispora crassata*?
x	x	x	x	....	....	....	*Cristatisporites albus*?
x	x	x	....	....	....	....	*Cristatisporites triangulatus*
....	....	....	x	x	....	....	*Cymbosporites* cf. *magnificus*
....	....	x	x	....	x	x	*Cymbosporites catillus*
....	....	....	....	....	x	....	*Dictyotriletes* sp. indet.
....	x	....	....	....	x	....	*Endosporites gilmorensis*
x	x	x	x	x	x	x	*Geminospora lemurata*
....	x	x	....	x	....	....	*Grandispora* sp. A
....	....	....	x	x	....	....	*Granulatisporites phillipsi*
....	....	....	x	....	....	....	*Medusaspora dringii*
....	....	....	....	....	....	x	*Murospora* sp. indet.
....	....	....	x	x	....	....	*Nikitinisporites spitsbergensis?*
....	x	....	....	....	....	x	cf. *Perotriletes bifurcatus*
x	....	....	....	....	....	....	*Punctatisporites* sp.
....	....	....	....	x	....	....	*Retispora archaelepidophyta*
x	....	....	....	....	....	....	*Retusotriletes actinomorphus*
....	x	x	....	....	....	....	*Retusotriletes biarealis*
....	x	....	....	....	....	....	*Retusotriletes* cf. *biarealis*
....	x	x	....	....	....	....	*Retusotriletes distinctus*
....	x	x	....	....	....	....	*Retusotriletes punctimedianus*
....	....	....	....	x	....	....	*Retusotriletes pychovii*
....	....	....	....	x	....	....	*Rhabdosporites* cf. *langii*
....	....	....	....	....	....	x	*Verrucosisporites premnus*
....	....	x	x	....	....	x	*Verrucosisporites scurrus*

Borehole: PD 153

458.0	377.0	348.2	340.0	299.0	272.8	236.1	209.7	200.2	164.1	159.4	149.4	126.0	96.6	88.8	80.6	73.5	60.6	54.4	32.6	25.7	18.6	15.7	
....	x	x	....	x	....	x	....	....	....	....	....	....	....	....	....	....	....	....	x	....	x	....	*Acinosporites acanthomammilatus*?
....	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Acinosporites* cf. *acanthomammilatus*
....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	....	x	....	x	....	....	....	*Acinosporites hirsutus*?
....	....	x	....	x	x	....	....	....	....	x	....	x	x	x	....	....	....	....	x	....	....	....	*Acinosporites lindlarensis*?
....	x	x	x	x	x	x	x	x	x	x	x	....	....	....	....	....	....	....	....	....	....	....	*Ambagisporites daedalus*
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Anapiculatisporites* sp. indet.
....	....	....	....	....	....	....	....	x	....	....	....	....	x	x	....	....	....	....	x	....	x	....	*Ancyrospora* sp. cf. *A. ancyrea*
x	x	x	....	x	x	x	x	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Ancyrospora melvillensis*?
....	....	....	....	....	....	....	x	x	....	....	....	....	....	....	....	....	....	....	....	....	x	....	*Ancyrospora langii*
....	....	....	....	....	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Ancyrospora longispinosa*?
x	....	x	....	....	....	x	x	x	x	....	....	....	....	....	....	....	....	....	x	....	x	....	*Ancyrospora parke*
-	....	x	....	....	x	x	....	....	x	....	....	....	x	....	....	....	....	....	....	....	....	....	*Ancyrospora parva*
....	....	x	x	x	x	x	x	x	x	x	x	x	....	x	....	....	....	....	....	....	x	x	*Apiculatasporites adavalensis*
....	x	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Apiculatasporites microconus*
....	x	x	....	....	....	x	x	x	....	x	x	....	x	....	x	....	....	....	x	x	x	....	*Apiculiretusispora densiconata*?
....	x	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Apiculiretusispora leberidos*
....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Archaeozonotriletes timanicus*
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	....	....	*Archaeozonotriletes variabilis*
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Baculatisporites* cf. *semilucensis*
....	....	....	....	....	....	....	....	x	x	x	....	....	....	....	....	....	....	....	....	....	....	....	*Calyptosporites stolidotus*
....	....	....	....	....	....	....	....	x	x	....	x	....	....	....	....	....	....	....	....	....	....	....	*Calyptosporites* cf. *stolidotus*
....	....	....	....	....	....	....	....	....	....	....	....	x	....	....	....	....	....	....	....	....	....	....	*Calyptosporites* sp. indet.
....	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	x	....	*Camarozonotriletes parvus*?
....	x	x	....	....	....	....	x	....	....	....	....	....	....	....	....	....	....	....	x	....	....	....	*Convolutispora crassata*?
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	....	....	*Cristatisporites albus*?
....	x	x	....	....	....	x	....	....	....	....	....	....	....	....	....	....	....	....	x	x	x	....	*Cristatisporites triangulatus*
....	....	....	....	....	....	....	x	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	*Cymbosporites catillus*
x	....	....	....	....	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	x	x	....	cf. *Densosporites* sp. indet.
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	....	....	*Dibolisporites* cf. *echinaceus*
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	*Dibolisporites* cf. *eifelensis*
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Dibolisporites* cf. *D. turriculatus*
....	....	x	....	....	....	x	....	....	....	....	....	....	....	....	x	....	....	....	x	....	....	....	cf. *Dibolisporites wetteldorfensis*
....	....	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	....	....	*Emphanisporites rotatus*
....	....	....	....	....	....	x	....	....	....	....	....	....	x	x	....	....	....	....	x	....	x	....	*Endosporites gilmorensis*
....	....	....	....	x	x	x	x	x	x	x	....		x	x	x	....	....	x	....	x	x	x	*Geminospora lemurata*
....	x	x	x	x	x	x	x	x	x	x	x	x	....	....	....	....	....	....	....	....	x	....	*Grandispora* sp. A
....	....	x	x	x	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Grandispora* sp. B
....	....	....	....	....	....	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Grandispora* sp. C
....	....	x	....	....	....	....	....	....	....	....	....	....	x	....	....	....	....	....	....	....	x	....	*Granulatisporites phillipsi*
....	....	....	....	....	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	cf. *Kraeuselisporites ollii*?

Borehole: PD 153—*Continued*

458.0	377.0	348.2	340.0	299.0	272.8	236.1	209.7	200.2	164.1	159.4	149.4	126.0	96.6	88.8	80.6	73.5	60.6	54.4	32.6	25.7	18.6	15.7	
....	....	x	x	x	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	x	....	*Leiotriletes liebigensis*
....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	....	....	....	....	x	x	x	....	*Murospora* sp. indet.
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	cf. *Perotriletes bifurcatus*
....	....	....	....	....	....	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Punctatisporites etonvalensis*
....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Reticulatisporites* sp. indet.
....	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	*Retusotriletes actinomorphus*
....	....	....	....	....	....	....	....	x	....	....	....	....	....	x	....	....	....	....	x	....	....	....	*Retusotriletes biarealis*
....	....	....	....	....	x	x	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	*Retusotriletes* cf. *biarealis*
....	....	....	....	....	....	x	....	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	*Retusotriletes distinctus*
....	....	....	....	x	x	....	....	....	....	....	....	....	....	x	....	....	....	....	x	....	....	....	*Retusotriletes punctimedianus*
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	....	....	*Retusotriletes pychovii*
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	*Retusotriletes rotundus*
....	....	....	....	....	....	....	....	....	x	....	....	x	....	x	....	x	....	....	x	....	x	x	*Retusotriletes simplex*
x	....	x	x	x	x	x	x	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	*Rhabdosporites* cf. *langii*
....	....	....	....	....	....	x	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	*Verrucosisporites confertus*
....	....	....	....	....	....	....	....	....	....	....	....	....	x	x	....	....	....	....	x	....	x	....	*Verrucosisporites premnus*
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	x	*Verrucosisporites pulvinatus*
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	x	....	x	....	*Verrucosisporites scurrus*
....	x	x	....	....	....	x	x	....	x	....	....	....	....	....	....	....	....	....	x	....	....	....	Genus and species indet. 2

Borehole: PD 162

470.0	*340.0*	*297.0*	
x	x	x	*Acinosporites acanthomammilatus*?
....	....	x	*Acinosporites lindlarensis*
....	x	x	*Ambagisporites daedalus*
x	x	x	*Ancyrospora langii*
....	x	....	*Ancyrospora melvillensis*?
x	x	x	*Ancyrospora parva*
x	x	x	*Apiculatasporites adavalensis*
....	....	x	*Apiculatasporites microconus*
x	....	x	*Apiculiretusispora* cf. *brandtii*
....	....	x	*Apiculiretusispora leberidos*
x	x	x	*Archaeozonotriletes timanicus*
x	x	x	*Baculatisporites* cf. *semilucensis*
....	....	x	*Biharisporites parviornatus*?
....	....	x	cf. *Chelinospora ligurata*
x	x	x	*Convolutispora crassata*?
....	x	x	*Cristatisporites albus*?
....	x	x	*Cristatisporites triangulatus*
x	x	....	*Cymbosporites* cf. *magnificus*
....	x	....	*Densosporites* cf. *inaequus*
....	x	....	*Densosporites* cf. *weatherallensis*
....	....	x	*Dibolisporites* cf. *echinaceus*
....	....	x	*Dibolisporites* cf. *eifelensis*
....	....	x	*Dibolisporites* cf. *D. turriculatus*
....	....	x	*Emphanisporites rotatus*
x	x	x	*Geminospora lemurata*
....	....	x	*Gneudnaspora kernickii*
....	....	x	cf. *Kraeuselisporites ollii*?
x	....	x	*Retusotriletes biarealis*
....	x	x	*Retusotriletes distinctus*
....	x	....	*Retusotriletes rotundus*
....	....	x	*Retusotriletes simplex*
....	....	x	*Verrucosisporites confertus*
....	....	x	*Verrucosisporites mucronatus*
x	....	x	*Verrucosisporites scurrus*

Appendix 3

Register of illustrated specimens

Taxon	*Plate*	*Fig*	*Slide No*	*Co-ordinates*	*Borehole*	*Depth* (m)
Acinosporites acanthomammilatus?	1	1a,b	F47998/1	(30.8–107.6)	PD 17	20.6
Acinosporites cf. *acanthomammilatus*?	1	2a,b,c	F48003/1	(50.3–102.8)	PD 26	338.5
Acinosporites hirsutus?	1	3	F48008/1	(39.9–102.4)	PD 145	467.0
Acinosporites hirsutus?	1	4	F48019/1	(57.8–106.8)	PD 153	32.6
Acinosporites hirsutus?	1	5	F48021/1	(42.8–095.9)	PD 153	60.6
Acinosporites lindlarensis	1	6a,b	F47997/1	(45.8–099.2)	NRD 70	269.5
Acinosporites lindlarensis	1	7	F47997/1	(31.1–109.5)	NRD 70	269.5
Acinosporites lindlarensis	1	8	F47997/1	(45.9–111.7)	NRD 70	269.5
Ambagisporites daedalus	2	1	F47968/1	(42.2–103.9)	NRD 3	177.2
Ambagisporites daedalus	2	2a,b	F47968/4	(62.7–106.0)	NRD 3	177.2
Anapic. cf. *Acanthotriletes echinatus*	1	9a,b	F47995/2	(25.1–111.6)	NRD 69	172.4
Anapic. cf. *Acanthotriletes echinatus*	1	10a,b	F47995/1	(54.7–112.3)	NRD 69	172.4
Anapiculatisporites sp. indet.	1	11	F48017/1	(41.0–102.9)	PD 153	18.6
Anapiculatisporites sp. indet.	1	12	F47998/1	(29.0–109.4)	PD 17	20.6
Anapiculatisporites sp. indet.	1	13a,b	F48019/1	(60.4–097.9)	PD 153	32.6
Ancyrospora cf. *ancyrea*	2	3	F47997/1	(47.7–096.9)	NRD 70	269.5
Ancyrospora cf. *ancyrea*	2	4	F47997/1	(41.2–109.3)	NRD 70	269.5
Ancyrospora cf. *ancyrea*	2	5	F47997/1	(48.8–110.2)	NRD 70	269.5
Ancyrospora involucra?	2	6a,b	F47968/4	(34.4–108.2)	NRD 3	177.2
Ancyrospora langii	3	1a,b	F47968/4	(44.0–096.4)	NRD 3	177.2
Ancyrospora langii	3	2	F47968/4	(33.4–108.2)	NRD 3	177.2
Ancyrospora langii	3	3	F48042/2	(31.0–103.6)	PD 162	340.0
Ancyrospora langii	3	4	F47966/3	(37.2–109.7)	NRD 3	138.2
Ancyrospora langii	3	5	F47968/4	(31.9–097.9)	NRD 3	177.2
Ancyrospora longispinosa?	4	1	F48009/1	(39.4–111.9)	PD 151	146.9
Ancyrospora longispinosa?	4	2	F48033/2	(57.8–101.1)	PD 153	209.1
Ancyrospora longispinosa?	4	3a,b	F48009/1	(60.4–104.4)	PD 151	146.9
Ancyrospora melvillensis?	4	4a,b	F48042/2	(37.2–100.3)	PD 162	340.0
Ancyrospora parke	4	5	F47997/1	(54.5–107.9)	NRD 70	269.5
Ancyrospora parke	4	6a,b	F48008/1	(24.9–097.9)	PD 145	467.0
Ancyrospora parva	5	1	F48008/1	(32.5–095.5)	PD 145	467.0
Ancyrospora parva	5	2a,b	F47998/1	(31.0–111.6)	PD 17	20.6
Ancyrospora parva	5	3	F48014/1	(46.9–095.9)	PD 151	281.5
Ancyrospora parva	5	4	F47966/1	(58.0–093.2)	NRD 3	138.2
Aneurospora goensis?	5	6	F47993/3	(26.9–109.5)	NRD 32	127.5
Aneurospora goensis?	5	7	F47979/2	(63.2–109.5)	NRD 20	208.5
Aneurospora greggsii	5	5	F47993/3	(31.0–109.5)	NRD 32	127.5
Aneurospora incohata	5	9	F47964/1	(42.3–110.0)	NRD 2	251.9
Aneurospora incohata	5	10	F47955/1	(52.0–108.1)	NRD 1	113.1
Aneurospora sp. indet.	5	8	F47979/2	(63.1–109.5)	NRD 20	208.5
Apiculatasporites adavalensis	5	11	F47997/1	(35.1–101.1)	NRD 70	269.5
Apiculatasporites adavalensis	5	12	F47968/4	(42.4–111.2)	NRD 3	177.2
Apiculatasporites microconus	6	1	F48009/1	(38.2–111.2)	PD 151	146.9
Apiculatasporites microconus	6	2	F47968/4	(48.3–110.6)	NRD 3	177.2
Apiculatisporis morbosus	6	5	F47985/2	(40.1–101.0)	NRD 26	175.2
Apiculiretusispora cf. *brandtii*	6	3	F48011/1	(33.1–106.6)	PD 151	206.0
Apiculiretusispora cf. *brandtii*	6	4	F48013/1	(31.8–106.5)	PD 151	272.2
Apiculiretusispora densiconata?	6	6	F47997/1	(43.1–109.3)	NRD 70	269.5
Apiculiretusispora densiconata?	6	7	F47979/1	(59.4–102.6)	NRD 20	208.5
Apiculiretusispora leberidos	6	8	F48008/1	(34.9–102.2)	PD 145	467.0

Register of Illustrated Specimens—*Continued*

Taxon	*Plate*	*Fig*	*Slide No*	*Co-ordinates*	*Borehole*	*Depth* (m)
Apiculiretusispora leberidos	6	9a,b	F48041/1	(53.8–109.3)	PD 162	297.0
Apiculiretusispora cf. *magnifica*?	6	10	F47997/1	(54.6–097.5)	NRD 70	269.5
Apiculiretusispora cf. *magnifica*?	6	11a,b	F47979/1	(48.8–102.3)	NRD 20	208.5
Apiculiretusispora cf. *magnifica*?	6	12	F47979/2	(63.2–112.7)	NRD 20	208.5
Apiculiretusispora sp. A Balme 1988	6	13	F48011/1	(53.9–109.5)	PD 151	206.0
Archaeozonotriletes timanicus	7	1	F47998/1	(57.1–100.8)	PD 17	20.6
Archaeozonotriletes timanicus	7	2	F47998/2	(28.9–107.6)	PD 17	20.6
Archaeozonotriletes timanicus	7	3	F48039/1	(34.8–093.1)	PD 153	377.0
Archaeozonotriletes timanicus	7	4	F48009/1	(39.1–096.9)	PD 151	146.9
Archaeozonotriletes timanicus	7	5	F47968/1	(55.8–096.1)	NRD 3	177.2
Archaeozonotriletes variabilis	7	6	F48019/1	(45.1–110.0)	PD 153	32.6
Archaeozonotriletes variabilis	7	7	F48019/1	(48.9–103.8)	PD 153	32.6
Auroraspora macra	7	8	F47991/1	(45.5–112.9)	NRD 26	305.4
Baculatisporites semilucensis?	7	9	F48006/1	(28.8–102.6)	PD 120	487.6
Baculatisporites semilucensis?	7	10	F48006/1	(24.9–102.3)	PD 120	487.6
Biharisporites parviornatus?	7	11	F48041/1	(40.1–099.0)	PD 162	297.0
Biharisporites parviornatus?	7	12	F48041/1	(51.6–099.9)	PD 162	297.0
Biharisporites sp. indet.	7	13	F47979/2	(37.3–110.3)	NRD 20	208.5
Biharisporites sp. indet.	7	14a,b	F47979/2	(38.4–100.9)	NRD 20	208.5
Brochotriletes textilis	8	1	F47969/1	(31.5–113.6)	NRD 4	38.0
Calamospora cf. *microrugosa*	8	2	F47986/1	(44.4–109.9)	NRD 26	227.4
Calamospora cf. *microrugosa*	8	3	F47984/1	(40.2–111.2)	NRD 26	125.0
Calamospora pannucea	8	4	F47998/1	(40.6–106.7)	PD 17	20.6
Calamospora pannucea	8	5	F47998/1	(24.3–095.4)	PD 17	20.6
Calamospora pannucea	8	6	F47998/1	(37.8–108.7)	PD 17	20.6
Calyptosporites proximocavatus	9	1	F48037/1	(59.0–095.4)	PD 153	340.0
Calyptosporites stolidotus	9	2	F47997/1	(43.1–100.8)	NRD 70	269.5
Calyptosporites stolidotus	9	3	F48032/1	(33.2–096.4)	PD 153	200.2
Calyptosporites stolidotus	9	4	F47997/1	(38.1–105.8)	NRD 70	269.5
Calyptosporites cf. *stolidotus*	9	5	F48380/1	(46.8–098.2)	PD 153	159.4
Calyptosporites cf. *stolidotus*	9	6	F48038/1	(54.9–104.3)	PD 153	200.2
cf. *Calyptosporites* sp. indet.	9	7	F47997/1	(39.5–110.9)	NRD 70	269.5
cf. *Calyptosporites* sp. indet.	9	8	F47997/1	(40.4–099.5)	NRD 70	269.5
cf. *Calyptosporites* sp. indet.	9	9	F47997/1	(51.4–106.1)	NRD 70	269.5
Camarozonotriletes parvus?	9	13	F47998/1	(56.2–111.1)	PD 17	20.6
Camarozonotriletes parvus?	9	14	F48017/1	(64.0–101.4)	PD 153	18.6
Camptotriletes balmei	9	10	F47975/1	(46.4–112.8)	NRD 17	42.0
Camptotriletes balmei	9	11	F47976/2	(56.3–108.9)	NRD 18	34.0
Camptotriletes balmei	9	12	F47969/1	(34.8–109.2)	NRD 4	38.0
Camptozonotriletes leptohymenoides	10	1	F48041/1	(47.3–096.4)	PD 162	297.0
Camptozonotriletes leptohymenoides	10	2	F48041/1	(50.0–108.3)	PD 162	297.0
cf. *Chelinospora ligurata*	10	3	F48008/1	(38.8–103.5)	PD 145	467.0
Cirratriradites impensus	10	4	F47964/1	(36.8–105.6)	NRD 2	251.9
Cirratriradites impensus	10	5	F47984/1	(44.6–102.7)	NRD 26	125.0
Clivosispora sp. indet.	10	10	F48019/1	(54.1–097.8)	PD 153	32.6
Clivosispora sp. indet.	10	11	F48019/1	(56.6–110.1)	PD 153	32.6
Clivosispora sp. indet.	10	12	F48019/1	(60.2–098.0)	PD 153	32.6
Clivosispora sp. indet.	10	13	F48019/1	(47.0–099.6)	PD 153	32.6
Convolutispora caementosa	10	8	F47973/1	(53.1–105.7)	NRD 9	149.5
Convolutispora crassata?	10	6	F47966/2	(28.2–108.2)	NRD 3	138.2
Convolutispora fromensis	10	7	F47959/1	(45.3–096.6)	NRD 1	270.6
Convolutispora fromensis	10	9a,b	F47969/1	(67.2–110.7)	NRD 4	38.0
Convolutispora paraverrucata	11	1	F48005/1	(43.2–096.9)	PD 120	469.5
Convolutispora paraverrucata	11	2	F48005/1	(43.3–096.6)	PD 120	469.5
Convolutispora paraverrucata	11	3	F48017/1	(36.8–109.6)	PD 153	18.6
Convolutispora paraverrucata	11	4	F48005/1	(39.2–103.5)	PD 120	469.5
Crassispora drucei	11	5	F47955/2	(61.1–109.1)	NRD 1	113.1
Crassispora drucei	11	6a,b	F47964/1	(30.1–101.9)	NRD 2	251.9
Crassispora drucei	11	7a,b	F47965/1	(29.0–107.2)	NRD 2	280.5
Cristatisporites albus?	11	8	F84014/1	(42.5–110.9)	PD 151	281.5

Register of Illustrated Specimens—*Continued*

Taxon	*Plate*	*Fig*	*Slide No*	*Co-ordinates*	*Borehole*	*Depth* (m)
Cristatisporites albus?	11	9a,b	F48041/1	(26.9–102.2)	PD 162	297.0
Cristatisporites albus?	11	10	F48003/1	(47.5–110.9)	PD 26	338.5
Cristatisporites triangulatus	12	1	F48014/1	(55.2–110.2)	PD 162	297.0
Cristatisporites triangulatus	12	2	F84041/1	(24.5–095.9)	PD 151	281.5
Cristatisporites triangulatus	12	3	F48019/1	(42.0–111.6)	PD 153	32.6
cf. *Cyclogranisporites* sp.? de Jersey	12	4	F47966/3	(27.5–107.9)	NRD 3	138.2
Cyclogranisporites sp. A Playford	12	5	F47983/1	(38.8–109.3)	NRD 26	112.5
Cymbosporites catillus	12	11	F48019/1	(36.1–111.4)	PD 153	32.6
Cymbosporites catillus	12	12	F48008/1	(31.5–106.8)	PD 145	467.0
Cymbosporites cf. *magnificus*	12	6a,b	F47998/1	(39.9–106.1)	PD 17	20.6
Cymbosporites cf. *magnificus*	12	7	F47998/1	(47.7–101.3)	PD 17	20.6
Cymbosporites cf. *magnificus*	12	8	F47968/2	(47.9–102.6)	NRD 3	177.2
Densosporites cf. *inaequus*	12	13	F48042/1	(51.0–102.5)	PD 162	340.0
Densosporites cf. *inaequus*	12	14	F48042/2	(22.5–108.2)	PD 162	340.0
Densosporites cf. *weatherallensis*	13	1a,b	F48042/1	(38.2–101.7)	PD 162	340.0
Densosporites cf. *weatherallensis*	13	2	F48042/2	(52.3–095.8)	PD 162	340.0
Densosporites sp. indet.	13	3	F47979/1	(67.0–093.4)	NRD 20	208.5
cf. *Densosporites* sp. indet	12	9	F47998/1	(42.6–103.6)	PD 17	20.6
cf. *Densosporites* sp. indet.	12	10	F47998/1	(51.9–108.4)	PD 17	20.6
Diaphanospora depressa	13	4	F47974/1	(59.6–100.1)	NRD 9	218.3
Diaphanospora depressa	13	5	F47957/1	(29.1–110.2)	NRD 1	257.9
Diaphanospora perplexa	13	6	F47957/1	(49.1–112.1)	NRD 1	257.9
Diaphanospora riciniata	13	7	F47964/1	(45.5–100.9)	NRD 2	251.9
Diaphanospora sp. Balme & Hassell	13	8	F47978/1	(36.8–110.6)	NRD 20	137.4
Dibolisporites cf. *echinaceus*	14	1a,b	F48006/1	(42.8–109.3)	PD 120	487.6
Dibolisporites cf. *echinaceus*	14	2	F48041/1	(44.8–095.6)	PD 162	297.0
Dibolisporites cf. *echinaceus*	14	3	F48003/1	(55.2–092.5)	PD 26	338.5
Dibolisporites cf. *echinaceus*	14	4	F48041/1	(44.8–095.6)	PD 162	297.0
Dibolisporites cf. *eifelensis*	13	9	F47997/1	(54.6–105.5)	NRD 70	269.5
Dibolisporites cf. *eifelensis*	13	10a,b	F47997/1	(47.6–108.7)	NRD 70	269.5
Dibolisporites quebecensis	14	7	F48030/1	(53.5–104.9)	PD 153	159.4
Dibolisporites cf. *turriculatus*	14	5	F47968/4	(38.3–095.9)	NRD 3	177.2
Dibolisporites cf. *turriculatus*	14	6a,b	F47968/1	(34.7–109.7)	NRD 3	177.2
cf. *Dibolisporites wetteldorfensis*	14	8	F48019/1	(61.5–105.0)	PD 153	32.6
Dictyotriletes sp. indet.	14	9	F47997/1	(55.9–098.2)	NRD 70	269.5
Emphanisporites rotatus	15	1	F48019/1	(41.5–095.9)	PD 153	32.6
Emphanisporites rotatus	15	2	F47968/4	(41.2–111.4)	NRD 3	177.2
Emphanisporites rotatus	15	3	F48034/2	(32.1–095.1)	PD 153	236.1
Emphanisporites rotatus	15	4	F47968/4	(55.0–112.0)	NRD 3	177.2
Emphanisporites rotatus	15	5	F48041/1	(36.1–104.4)	PD 162	297.0
Endosporites gilmorensis	15	6	F47968/2	(53.1–093.7)	NRD 3	177.2
Endosporites gilmorensis	15	7	F47979/1	(63.2–103.7)	NRD 20	208.5
Endosporites gilmorensis	15	8	F47966/3	(54.5–103.7)	NRD 3	138.2
Geminospora lemurata	15	9	F47998/1	(48.0–104.6)	PD 17	20.6
Geminospora lemurata	15	10	F47979/1	(55.5–105.0)	NRD 20	208.5
Geminospora lemurata	15	11	F47998/1	(47.6–110.6)	PD 17	20.6
Geminospora lemurata	15	12	F47998/1	(42.2–109.5)	PD 17	20.6
Geminospora lemurata	15	13a,b	F47968/4	(61.6–103.4)	NRD 3	177.2
Gorgonispora convoluta	15	14	F47972/1	(42.8–109.4)	NRD 9	103.0
Gorgonispora convoluta	15	15a,b	F47976/2	(57.2–106.6)	NRD 18	34.0
Gneudnaspora kernickii	16	1	F47998/1	(36.9–098.5)	PD 17	20.6
Gneudnaspora kernickii	16	2	F47998/1	(26.4–109.2)	PD 17	20.6
Grandispora clandestina	16	3a,b	F47978/1	(62.2–109.7)	NRD 20	137.4
Grandispora clandestina	16	4a,b	F47965/1	(49.4–108.0)	NRD 2	280.5
Grandispora clandestina	16	5	F47977/2	(37.8–111.1)	NRD 20	114.1
cf. *Grandispora cornuta*	16	6	F47974/1	(63.2–096.7)	NRD 9	218.3
Grandispora notensis	16	7	F47980/1	(30.2–097.3)	NRD 26	50.0
Grandispora notensis	16	8	F47985/1	(44.1–108.2)	NRD 26	175.2
Grandispora notensis	16	9	F47969/1	(47.6–110.5)	NRD 4	38.0
Grandispora praecipua	16	10	F47955/2	(40.7–102.4)	NRD 1	113.1

Register of Illustrated Specimens—*Continued*

Taxon	*Plate*	*Fig*	*Slide No*	*Co-ordinates*	*Borehole*	*Depth* (m)
Grandispora sp. indet.	16	11	F47979/1	(62.3–109.8)	NRD 20	208.5
Grandispora sp. indet.	16	12	F47979/1	(31.9–101.7)	NRD 20	208.5
Grandispora sp. A	16	13	F48033/2	(41.4–111.4)	PD 153	209.1
Grandispora sp. B	17	1	F48011/1	(25.5–098.7)	PD 151	206.0
Grandispora sp. B	17	2	F48033/1	(40.9–112.1)	PD 153	209.1
Grandispora sp. C	17	3	F47977/2	(50.4–102.6)	NRD 20	114.1
Grandispora sp. D	17	4	F47998/1	(33.6–112.1)	PD 17	20.6
Grandispora sp. E	17	5	F47979/2	(33.9–101.5)	NRD 20	208.5
Grandispora sp. E	17	6	F47979/2	(40.4–098.6)	NRD 20	208.5
Grandispora sp. E	17	7	F47979/2	(61.8–112.8)	NRD 20	208.5
Grandispora sp. F	17	8	F47998/1	(27.8–097.9)	PD 17	20.6
Grandispora sp. F	17	9	F47998/1	(26.9–109.6)	PD 17	20.6
Grandispora sp. G	17	10a,b	F84014/1	(30.4–106.4)	PD 151	281.5
Granulatisporites frustulentus	17	11	F47955/2	(63.7–112.6)	NRD 1	113.1
Granulatisporites frustulentus	17	12	F47977NN/2	(32.1–113.1)	NRD 20	114.1
Granulatisporites phillipsi	17	13a,b	F48003/1	(61.8–108.8)	PD 26	338.5
Hymenozonotriletes scorpius	18	1a,b	F47957/1	(62.3–100.9)	NRD 1	257.9
Hymenozonotriletes scorpius	18	2	F47980/1	(34.5–110.0)	NRD 26	50.0
Hymenozonotriletes scorpius	18	3a,b	F47976/2	(36.1–102.0)	NRD 18	34.0
Hystricosporites porrectus	18	4a,b	F47991/1	(59.2–109.7)	NRD 26	305.5
Hystricosporites porrectus	18	5	F47991/2	(39.1–097.4)	NRD 26	305.4
Hystricosporites porrectus	18	6	F47958/1	(53.6–107.5)	NRD 1	264.5
Hystricosporites richardsoni	19	1	F47968/4	(56.9–105.7)	NRD 3	177.2
Hystricosporites richardsoni	19	2	F48008/1	(52.4–104.1)	PD 145	467.0
Hystricosporites sp.	19	3	F48002/1	(49.0–101.2)	PD 26	311.2
Knoxisporites literatus	19	5	F47976/2	(47.6–095.9)	NRD 18	34.0
Knoxisporites literatus	19	6	F47977/2	(67.3–109.5)	NRD 20	114.1
Knoxisporites pristinus	19	4a,b	F47978/1	(55.0–111.0)	NRD 20	137.4
Knoxisporites pristinus	19	7	F47955/2	(37.9–097.0)	NRD 1	113.1
Knoxisporites sp.	19	8	F47955/2	(39.5–093.8)	NRD 1	113.1
cf. *Kraeuselisporites ollii*?	20	1a,b	F47966/1	(54.3–108.6)	NRD 3	138.2
cf. *Kraeuselisporites ollii*?	20	2	F48041/1	(34.4–109.6)	PD 162	297.0
cf. *Kraeuselisporites ollii*?	20	3	F47966/1	(62.8–098.3)	NRD 3	138.2
Latosporites sp. indet.	20	4	F47978/1	(62.8–110.0)	NRD 20	137.4
Leiotriletes liebigensis	20	7	F47986/1	(40.0–108.0)	NRD 26	227.4
Leiotriletes pulvereus	20	8	F47980/1	(49.1–108.4)	NRD 26	50.0
Leiozonotriletes laurelensis	20	5	F47977/1	(46.1–111.4)	NRD 17	42.0
Leiozonotriletes laurelensis	20	6	F47977/2	(44.5–102.8)	NRD 20	114.1
Lophozonotriletes triangulatus	20	9	F47992/1	(42.8–100.8)	NRD 26	312.5
Lophozonotriletes triangulatus	20	11a,b	F47964/1	(28.8–105.7)	NRD 2	251.9
Lophozonotriletes varionodosus	20	10	F47957/1	(64.6–096.1)	NRD 1	257.9
Lophozonotriletes varionodosus	20	12a,b	F47976/2	(33.1–098.4)	NRD 18	34.0
Lophozonotriletes sp. indet.	20	13a,b	F47976/2	(66.7–110.9)	NRD 18	34.0
Medusaspora dringii	21	1a,b	F48012/1	(35.2–111.6)	PD 151	219.0
Medusaspora dringii	21	2	F48008/1	(51.9–102.0)	PD 145	467.0
Medusaspora dringii	21	3	F48008/1	(27.1–106.9)	PD 145	467.0
Murospora sp. indet.	21	4	F48019/1	(45.1–111.6)	PD 153	32.6
Murospora sp. indet.	21	5	F48017/1	(53.4–107.6)	PD 153	18.6
Nikitinisporites spitsbergensis?	21	6a,b	F47966/1	(61.2–102.8)	NRD 3	138.2
Nikitinisporites spitsbergensis?	21	7	F48011/1	(37.7–103.9)	PD 151	206.0
cf. *Perotriletes bifurcatus*	22	1	F48015/1	(43.2–107.8)	PD 151	146.9
cf. *Perotriletes bifurcatus*	22	2	F48015/1	(46.5–104.4)	PD 151	284.0
cf. *Perotriletes bifurcatus*	22	3	F48015/1	(35.5–109.7)	PD 151	284.0
cf. *Perotriletes bifurcatus*	22	4	F48033/2	(53.5–103.9)	PD 153	209.1
Planisporites furfuris	22	5	F47977/2	(67.7–111.6)	NRD 20	114.1
Planisporites furfuris	22	6	F47957/1	(50.1–112.1)	NRD 1	257.9
Punctatisporites etonvalensis	22	7	F47966/3	(30.5–110.3)	NRD 3	138.2
Punctatisporites iterabilis	22	8	F47980/1	(44.0–095.3)	NRD 26	50.0
Punctatisporites cf. *solidus*	22	9	F47977/2	(63.8–108.4)	NRD 20	114.1
Punctatisporites sp.	22	10	F48002/1	(40.4–100.6)	PD 26	311.2

Register of Illustrated Specimens—*Continued*

Taxon	*Plate*	*Fig*	*Slide No*	*Co-ordinates*	*Borehole*	*Depth* (m)
Raistrickia aratra?	22	11	F47968/4	(51.4–096.5)	NRD 3	177.2
Reticulatisporites ancoralis	22	12	F47964/1	(48.9–108.9)	NRD 2	251.9
Reticulatisporites sp. Balme 1988	22	13	F48038/1	(45.3–108.5)	PD 153	348.2
Retispora archaelepidophyta	23	1	F47978/1	(35.9–110.2)	NRD 20	137.4
Retispora lepidophyta	23	2	F47985/1	(26.8–110.2)	NRD 26	175.2
Retispora lepidophyta	23	3	F47980/1	(62.3–096.2)	NRD 26	50.0
Retusotriletes actinomorphus	23	4	F47968/4	(34.5–112.2)	NRD 3	177.2
Retusotriletes actinomorphus	23	5	F47968/1	(59.5–093.9)	NRD 3	177.2
Retusotriletes biarealis	23	8	F47968/1	(55.5–105.4)	NRD 3	177.2
Retusotriletes biarealis	23	9	F47979/1	(46.9–105.7)	PD 151	272.2
Retusotriletes cf. *biarealis*	23	10	F47979/2	(39.9–101.7)	NRD 20	208.5
Retusotriletes cf. *biarealis*	23	11	F48003/1	(66.0–102.0)	PD 26	338.5
Retusotriletes digressus	23	6	F47975/1	(51.0–111.4)	NRD 17	42.0
Retusotriletes distinctus?	23	7	F48006/1	(26.7–104.9)	PD 120	487.6
Retusotriletes punctimedianus	23	12	F47968/4	(43.0–110.4)	NRD 3	177.2
Retusotriletes punctimedianus	23	13	F47979/1	(42.8–109.5)	NRD 20	208.5
Retusotriletes punctimedianus	23	14	F47979/1	(38.1–112.9)	NRD 20	208.5
Retusotriletes pychovii	24	1	F48006/1	(23.2–105.6)	PD 120	487.6
Retusotriletes pychovii	24	2	F47998/1	(27.5–094.6)	PD 151	200.6
Retusotriletes rotundus	24	3	F47979/2	(54.3–101.0)	NRD 20	208.5
Retusotriletes rotundus	24	4	F48006/1	(37.8–102.1)	PD 120	487.6
Retusotriletes rotundus	24	5	F47997/1	(47.6–100.5)	NRD 70	269.5
Retusotriletes simplex	24	6	F47997/1	(47.8–107.0)	NRD 70	269.5
Retusotriletes sp.	24	7	F47979/2	(69.9–105.3)	NRD 20	208.5
Rhabdosporites cf. *langii*	24	9	F48033/2	(29.9–108.3)	PD 153	209.7
Rhabdosporites cf. *langii*	24	10	F47998/1	(38.2–112.0)	PD 17	20.6
?*Rhabdosporites* sp. indet.	24	8	F47998/1	(48.2–097.2)	PD 17	20.6
Stenozonotriletes clarus	24	11	F47955/2	(41.6–093.6)	NRD 1	113.1
Stenozonotriletes clarus	24	12	F47955/2	(47.8–103.2)	NRD 1	113.1
Stenozonotriletes forticulus	24	13	F47955/2	(43.3–101.4)	NRD 1	113.1
Stenozonotriletes simplex	24	14	F47969/1	(42.2–110.9)	NRD 4	38.0
Velamisporites cf. *rugosus*	25	1a,b	F47984/1	(34.4–094.3)	NRD 26	125.0
Velamisporites cf. *rugosus*	25	2	F47965/1	(50.1–097.6)	NRD 2	280.5
Velamisporites cf. *rugosus*	25	3	F47977/2	(53.1–107.3)	NRD 20	114.1
Velamisporites cf. *rugosus*	25	4	F47974/1	(60.9–103.9)	NRD 9	218.3
Stenozonotriletes sp. C Playford	26	1	F47957/1	(54.9–105.1)	NRD 1	257.9
Stenozonotriletes sp. C Playford	26	2	F47991/2	(48.2–104.3)	NRD 26	305.4
Verrucosisporites confertus	26	3	F47968/4	(32.3–106.8)	NRD 3	177.2
Verrucosisporites mucronatus	26	4	F48041/1	(40.4–111.7)	PD 162	297.0
Verrucosisporites mucronatus	26	5a,b	F48006/1	(39.9–111.5)	PD 120	487.6
Verrucosisporites premnus	26	6	F48019/1	(66.8–096.8)	PD 153	32.6
Verrucosisporites premnus	26	7	F47968/4	(60.7–108.1)	NRD 3	177.2
Verrucosisporites premnus	26	8a,b	F48009/1	(36.2–097.4)	PD 151	146.9
Verrucosisporites premnus	26	9	F48019/1	(40.5–103.8)	PD 153	32.6
Verrucosisporites premnus	26	10	F47968/4	(59.2–111.4)	NRD 3	177.2
Verrucosisporites pulvinatus	26	11	F47968/4	(41.4–111.3)	NRD 3	177.2
Verrucosisporites pulvinatus	26	12	F47968/2	(49.7–102.5)	NRD 3	177.2
Verrucosisporites scurrus	27	1	F47966/1	(67.8–109.8)	NRD 3	138.2
Verrucosisporites scurrus	27	2	F47968/2	(39.4–109.3)	NRD 3	177.2
Verrucosisporites scurrus	27	3a,b	F47998/1	(52.1–098.8)	PD 17	20.6
Verrucosisporites scurrus	27	4	F47966/1	(60.4–106.7)	NRD 3	138.2
Verrucosisporites scurrus	27	5a,b	F47998/1	(29.9–105.0)	PD 17	20.6
Genus and sp. indet. 1	27	6	F48019/1	(63.5–108.5)	PD 153	32.6
Genus and sp. indet. 2	27	7	F48006/1	(35.9–103.3)	PD 120	487.6
Genus and sp. indet. 2	27	8	F48006/1	(23.8–094.9)	PD 120	487.6
Genus and sp. indet. 3	27	9	F47979/1	(63.5–101.9)	NRD 20	208.5
Genus and sp. indet. 3	27	10	F47979/2	(54.7–113.2)	NRD 20	208.5
Genus and sp. indet. 3	27	11	F47979/2	(36.2–103.7)	NRD 20	208.5

References

ALEXANDER, R., KAGI, R. I., and ROWLAND, S., 1983, Petroleum geochemistry of Canning and Bonaparte Basins. Western Australian Mineral and Petroleum Research Institute: Report 3, p. 1–39.

ALLEN, K. C., 1965, Lower and Middle Devonian spores of north and central Vestspitsbergen: Palaeontology, v. 8, p. 687–748.

ALLEN, K. C., 1967, Spore assemblages and their stratigraphical application in the Lower and Middle Devonian of north and central Vestspitsbergen: Palaeontology, v. 10, p. 280–297.

ALLEN, K. C., 1973, Further information on the Lower and Middle Devonian spores from Dickson Land, Spitsbergen: Norsk Polar institutt Arbok 1971, p. 43–54.

ARKHANGELSKAYA, A. D., 1963, New species of spores from Devonian deposits of the Russian platform: Trudy VNIGNI, v. 37, p. 18–30, p. 122–153.

BACKHOUSE, J., 1988, Late Jurassic and Early Cretaceous palynology of the Perth Basin, Western Australia: Western Australia, Geological Survey, Bulletin 135.

BALME, B. E., 1960, Notes on some Carboniferous microfloras from Western Australia, *in* Congrès pour l'Avancement des Études de Stratigraphie et de Géologie du Carbonifère, 4th, Heerlen (1958): Maastricht, Compte rendu, v. 1, p. 25–31.

BALME, B. E., 1962, Upper Devonian (Frasnian) spores from the Carnarvon Basin, Western Australia: The Palaeobotanist, v. 9, p. 1–10.

BALME, B. E., 1964, The palynological record of Australian pre-Tertiary floras, *in* Ancient Pacific floras, *edited by* L. M. Cranwell: University of Hawaii Press, p. 49–80.

BALME, B. E., 1988, Palynology of Late Devonian sediments, Carnarvon Basin, Western Australia: Palaeontographica, Abt. B, v. 209, p. 109–160.

BALME, B. E. and HASSELL, C. W., 1962, Upper Devonian spores from the Canning Basin, Western Australia: Micropaleontology, v. 8, p. 1–28.

BECKER, G., BLESS, M. J. M., STREEL, M., and THOREZ, J., 1974, Palynology and ostracode distribution in the Upper Devonian and basal Dinantian of Belgium and their dependence on sedimentary facies: Mededelingen Rijks Geologische Dienst, Nieuwe Serie, v. 25, no. 2, p. 9–99.

BENN, C. J., 1984, Facies changes and development of a carbonate platform, East Pillara Range, *in* The Canning Basin, W.A. — Proceedings of the Canning Basin Symposium, Perth, 1984, *edited by* P. G. Purcell: Perth, Geological Society of Australia–Petroleum Exploration Society of Australia, p. 223–228.

BERRY, W., 1937, Spores from the Pennington coal, Rhea County, Tennessee: American Midland Naturalist, v. 18, p. 155–160.

BHARADWAJ, D. C., 1957, The palynological investigations of the Saar coals (Part I–Morphology of Sporae dispersae): Palaeontographica, Abt. B, v. 101, p. 73–125.

BHARADWAJ, D. C., and TIWARI, R. S., 1970, *Biharisporites* Potonié emend Bharadwaj and Tiwari. Lower Gondwana megaspores — A monograph: Palaeontographica Abt. B, v. 129, p. 1–70.

BHARADWAJ, D. C., TIWARI, R. S., and VENKATACHALA, B. S., 1973. A Devonian mioflora from P'oshi District (Yunnan) China: Palaeobotanist, v. 20, p. 152–169.

BRIDEAUX, W. W. and RADFORTH, N. W., 1970, Upper Devonian miospores from the Escuminac Formation, eastern Quebec, Canada: Canadian Journal of Earth Sciences, v. 7, p. 29–45.

BUCHHORN, I. and SCENEY, P., 1984, Annual Report Napier Range EL04/2, EL04/22, 8.1.83–7.1.84: The Shell Company of Australia Limited Metals Division Report No. 08.2237.NB01 (unpublished).

BUTTERWORTH, M. A. and SPINNER, E., 1967, Lower Carboniferous spores from North-West England: Palaeontology, v. 10, p. 1–24.

CHALONER, W. G., 1959, Devonian megaspores from Arctic Canada: Palaeontology, v. 1, p. 321–332.

CHIBRIKOVA, E. V., 1959, Spores from the Devonian and older rocks of Bashkiria: USSR, Academy of Sciences, Bashkirian Branch, Data on palaeontology and stratigraphy of Devonian and older deposits of Bashkiria, p. 3–116 (in Russian).

CHIBRIKOVA, E. V., 1962, Spores of Devonian terrigenous deposits of western Bashkiria and the western slopes of the southern Urals, *in* Brachiopods, ostracodes and spores of the Middle and Upper Devonian of Bashkiria: USSR, Academy of Sciences, Bashkirian Branch, Institute of Mining Geology, p. 353–476 (in Russian).

CHIBRIKOVA, E. V., 1972, Plant microfossils from the South Urals and Cisuralia: USSR, Academy of Sciences, Bashkirian Branch, Institute of Geology, "Nauka", Moscow, p. 1–191 (in Russian).

CLAYTON, G. and GRAHAM, J.R., 1974, Miospore assemblages from the Devonian Sherkin Formation of south-west County Cork, Republic of Ireland: Pollen et Spores, v. 16, p. 565–588.

CLAYTON, G., HIGGS, K. T., and KEEGAN, J. B., 1977, Late Devonian and Early Carboniferous occurrences of the miospore genus *Emphanisporites* McGregor in southern Ireland: Pollen et Spores, v. 19, p. 415–425.

CLOUD, P. E., Jr., 1942, Terebratuloid Brachiopoda of the Silurian and Devonian: Geological Society of America Special Paper 38, 182 p.

COCKBAIN, A. E., 1985, Carboniferous of Western Australia — A review, *in* Professional Papers for 1983: Western Australia, Geological Survey, Report 14, p. 14–35.

COLBATH, G. K., 1990, Devonian (Givetian–Frasnian) organic-walled phytoplankton from the Limestone Billy Hills reef complex, Canning Basin, Western Australia: Palaeontographica Abt. B, v. 217, p. 87–145.

COOPER R. W., HALL, W. D. M., and STYLES, G. R., 1984, The Devonian stratigraphy of the central Pillara Range, *in* The Canning Basin, W.A. — Proceedings of the Canning Basin Symposium, Perth, 1984, *edited by* P. G. Purcell: Perth, Geological Society of Australia–Petroleum Exploration Society of Australia, p. 229–234.

COUPER, R. A., 1953, Upper Mesozoic and Cainozoic spores and pollen grains from New Zealand: New Zealand, Geological Survey, Palaeontolgical Bulletin 22.

DEFRANCE, M. J. L., 1825–1827, *in* Manuel de malacologie et de conchyliologie, *by* H. M. D. Blainville: Paris/Strasbourg, Levrault, text (1825) viii + 647p., atlas (1827) p. 649–664, 109 pl. .

de JERSEY, N. J., 1966, Devonian spores from the Adavale Basin: Queensland, Geological Survey, Publication 334.

DRUCE, E. C., 1976, Conodont biostratigraphy of the Upper Devonian reef complexes of the Canning Basin, Western Australia: Australia, Bureau of Mineral Resources, Bulletin 158.

DRUCE, E. C. and RADKE, B. M., 1979, The geology of the Fairfield Group, Canning Basin, Western Australia: Australia, Bureau of Mineral Resources, Bulletin 200.

EISENACK, A., 1944, Über einige pflanzliche Funde in Geschieben, nebst Bemerkungen zum Hystrichosphaerideen-problem: Zeitschrift für Geschiebeforschung und Flachlandsgeologie, v. 24, p. 103–124, p. 182–186.

EVANS, P. R., 1968, Upper Devonian and Lower Carboniferous miospores from the Mulga Downs Beds, N.S.W.: Australian Journal of Science, v. 31, p. 45.

EVANS, P. R., 1970, Revision of the miospore genera *Perotrilites* Erdtm. ex Couper 1953 and *Diaphanospora* Balme and Hassell 1962: Australia, Bureau of Mineral Resources, Bulletin 116, p. 65–74.

FELIX, C. J. ,and BURBRIDGE, P. P., 1967, Palynology of the Springer Formation of southern Oklahoma, U.S.A.: Palaeontology, v. 10, p. 349–425.

FORMAN, D. J. and WALES, D. W., 1981, Geological evolution of the Canning Basin, Western Australia: Australia, Bureau of Mineral Resources, Bulletin 210.

GAO LIANDA, 1981, Devonian spore assemblages of China: Review of Palaeobotany and Palynology, v. 34, p. 11–23.

GLENISTER, B. F. and KLAPPER, G., 1966, Upper Devonian conodonts from the Canning Basin, Western Australia: Journal of Paleontology, v. 40, p. 777–842.

GREY, K., 1974, Devonian spores from the Gogo Formation, Canning Basin: Western Australia, Geological Survey, Annual Report 1973, p. 96–99.

GREY, K., 1981, Palynology of PD 153, Pillara Range: Western Australia, Geological Survey, Palaeontological Report 31/1981 (unpublished).

GREY, K., 1982a, Palynology of core samples from BHP Pinnacles prospect ID Boreholes, Canning Basin: Western Australia, Geological Survey, Palaeontological Report 34/1982 (unpublished).

GREY, K., 1982b, Palynology of core samples from Shell Napier Range Prospect, NRD Borehole 26, Canning Basin: Western Australia, Geological Survey, Palaeontological Report 39/1982 (unpublished).

GREY, K., 1983a, Progress report on palynological examinations of core samples from BHP's Pillara prospect (PD boreholes), Canning Basin: Western Australia, Geological Survey, Palaeontological Report 5/1983 (unpublished).

GREY, K., 1983b, Progress report on palynological examinations of core samples from Shell's Narlarla prospect and associated boreholes, Napier Range, Canning Basin: Western Australia, Geological Survey, Palaeontological Report 6/1983 (unpublished).

GREY, K., 1983c, Progress report on palynological examinations of core samples from BHP's miscellaneous prospects (boreholes other than PD series), Canning Basin: Western Australia, Geological Survey, Palaeontological Report 7/1983 (unpublished).

GREY, K, 1983d, Palynology of Pillara Quarry: Western Australia, Geological Survey, Palaeontological Report 8/1983 (unpublished).

GREY, K., 1984, Further palynology of core samples from BHP's miscellaneous prospects (boreholes other than PD series), Canning Basin, Western Australia, Geological Survey, Palaeontological Report 39/1982 (unpublished).

GREY, K., 1987, Palynology of Cadjebut Mine sample, Canning Basin: Western Australia, Geological Survey, Palaeontological Report 17/1987 (unpublished).

GREY, K., 1991, A mid-Givetian miospore age for the onset of reef development on the Lennard Shelf, Canning Basin, Western Australia: Review of Palaeobotany and Palynology, v. 68, p. 37–48.

GUENNEL, G. K., 1963, Devonian spores in a Middle Silurian reef: Grana Palynologica, v. 4, p. 245–261.

GUPPY, D. J., LINDNER, A. W., RATTIGAN, J. H., and CASEY, J. N., 1958, The geology of the Fitzroy Basin, Western Australia: Australia, Bureau of Mineral Resources, Bulletin 36.

HALL, W. D. M., 1984, The stratigraphic and structural development of the Givetian–Frasnian reef complex, Limestone Billy Hills, Western Pillara Range, W.A., *in* The Canning Basin, W.A. — Proceedings of the Canning Basin Symposium, Perth, 1984, *edited by* P. G. Purcell: Perth, Geological Society of Australia–Petroleum Exploration Society of Australia, p. 215–222.

HACQUEBARD, P. A., 1957, Plant spores in coal from the Horton Group (Mississippian) of Nova Scotia: Micropalaeontology, v. 3, p. 301–324.

HEMER, D. O. and NYGREEN, P. W., 1967, Devonian palynology of Saudi Arabia: Review of Palaeobotany and Palynology, v. 5, p. 51–61.

HIGGS, K., 1975, Upper Devonian and Lower Carboniferous miospore assemblages from Hook Head, County Wexford, Ireland: Micropaleontology, v. 21, p. 393–419.

HILL, D. and JELL, J. S., 1970, Devonian corals from the Canning Basin, Western Australia: Western Australia, Geological Survey, Bulletin 121.

HODGSON, E. A., 1968, Devonian spores from the Pertnjara Formation, Amadeus Basin, Northern Territory: Australia, Bureau Mineral Resources, Bulletin 80, p. 65–83.

HOFFMEISTER, W. S., STAPLIN, F. L., and MALLOY, R. E., 1955, Mississippian plant spores from the Hardingsburg of Illinois and Kentucky: Journal of Paleontology, v. 29, p. 327–399.

HOUSE, 1979, Biostratigraphy of the early Ammonoidea, *in* The Devonian System, *edited by* M. R. House, C. T. Scrutton, and M. G. Bassett: Palaeontological Association, London, Special papers in Palaeontology, v. 23, p. 263–280.

HUGHES, N. F. and PLAYFORD, G., 1961, Palynological reconnaissance of the Lower Carboniferous of Spitsbergen: Micropalaeontology, v. 7, p. 27–44.

HURLEY, N. F., 1986, Geology of the Oscar Range reef complex, Canning Basin, Western Australia: University of Michigan, PhD Thesis (unpublished).

IBRAHIM, A. C., 1932, Beschreibung von Sporen formen aus Floz Agir: Neues Jahrbuch Geologie Paläontologie, Abhandlung 67, p. 447–449.

IBRAHIM, A. C., 1933, Sporenformen des Agirhorizontes des Ruhrreviers (Dissertation Thesis, Berlin 1932): Wurzburg, Konrad Trilitsch, p. 1–46.

INGRAM, B. S., 1967, Palynology of the Otorowiri Siltstone Member, Yarragadee Formation: Western Australia, Geological Survey, Annual Report 1966, p. 79–83.

ISCHENKO, A. M., 1952, Atlas of Middle Carboniferous microspores and pollen grains from Donbass: Akademiya Nauk Ukrainsk SSR, Institute Geol. Nauk, Kiev, 83 p. (in Russian).

ISCHENKO, A. M., 1956, Spores and pollen of the Lower Carboniferous of the western continuation of the Donbass and their significance in stratigraphy: Akademiya Nauk Ukrainsk, SSR, Trudy Inst. Geol. Nauk, Ser. Stratig. Paleont., v. 11, p. 1–143. (in Russian).

ISCHENKO, A. M. 1958, Spore-pollen analysis of Lower Carboniferous deposits of the Dneiper–Donetz Basin: Trudy Inst. Geol. Nauk., Kiev, Ser. Stratig. Palaeont., v. 17, 187 p. (in Russian).

JANSONIUS, J. and CRAIG, J. H., 1971, Scolecodonts — I Descriptive terminology and revision of systematic nomenclature — II Lectotypes, new names for homonyms, index of species: Bulletin of Canadian Petroleum Geology, v. 19, p. 251–302.

JANSONIUS, J. and HILLS, L. V., 1976, Genera file of fossil spores and pollen: University of Calgary, Canada, Department of Geology, Special Publication.

JOHNSON, J. G., KLAPPER, G., and SANDBERG, C. A., 1985, Devonian eustatic fluctuations in Euamerica: Geological Society of America, Bulletin, v. 96, p. 567–587.

KEDO, G. I., 1955, Spores of the Middle Devonian of the northeastern Byelorussian SSR: BSSR, Academy of Sciences, Institute of Geological Sciences, Palaeontology, and Stratigraphy, Sbornik 1, p. 5–59 (in Russian).

KEDO, G.I., 1957, Stratigraphy and spore-pollen complexes of the lower horizons of the Carboniferous of the Byelorussian SSR: USSR, Academy of Sciences, Doklady v. 115, p. 1165–1168 (in Russian).

KEDO, G. I., 1963, Spores of the Tournaisian stage of the Pripyat Basin and their stratigraphic significance: Byelorussian SSR, Report Palaeontology Stratigraphy, v. 4, p. 3–121 (in Russian).

KEDO, G. I., NAZARENKO, A. M., NEKRJATA, N. S., RASKATOVA, L. G., SENNOVA, W. F., and TCHIBRIKOVA, E. W., 1971, New spore forms from Famennian beds of the Pripyat Depression, Central districts of the Russian Platform, Volga–Ural gas and oil province and Timan, *in* Palynological Research in Byelorussia and other regions of the USSR, *edited by* Golubtsov: Minsk, Nauka i Technika, p. 172–205. (in Russian).

KEMP, E. M., BALME, B. E., HELBY, R. J., KYLE, R. A., PLAYFORD, G., and PRICE, P.L., 1977, Carboniferous and Permian palynostratigraphy in Australia and Antarctica — A review: BMR Journal of Australian Geology and Geophysics, v. 2, p. 177–208.

KORNICKER, L. S., 1979, The question mark in taxonomic literature: Journal of Palaeontology, v. 53, p. 761.

KOSANKE, R. M., 1950, Pennsylvanian spores of Illinois and their use in correlation: Illinois, State Geological Survey, Bulletin 74, 128 p.

LANNINGER, E. P., 1968, Sporen-Gesellschaften aus dem Ems der SW-Eifel (Rheinisches Schiefergebirge). Palaeontographica, Abt. B, v. 122, p. 95–170.

LEHMANN, P. R., 1984, The stratigraphy, palaeogeography and petroleum potential of the Lower to lower Upper Devonian sequence in the Canning Basin, *in* The Canning Basin, W.A. — Proceedings of the Canning Basin Symposium, Perth, 1984, *edited by* P. G. Purcell: Perth, Geological Society of Australia–Petroleum Exploration Society of Australia, p. 254–275.

LELE, K. M. and STREEL, M., 1969, Middle Devonian (Givetian) plant microfossils from Goé (Belgium): La Société Géologique de Belgique, Annales, v. 92, p. 89–121.

LESCHIK, G., 1956, Die Keuperflora von Neuewelt bei Basel — II Die Iso- und Mikrosporen: Schweizerische Paläontologische Abhandlungen, v. 72, p. 1–70.

LOBOZIAK, S. and STREEL, M., 1969, Miospores in Givetian to lower Frasnian sediments dated by conodonts from the Boulonnais, France: Review of Palaeobotany and Palynology, v. 29, p. 285–299.

LOBOZIAK, S. and STREEL, M., 1989, Middle–Upper Devonian miospores from the Ghadamis Basin (Tunisia–Lybia) — Systematics and Stratigraphy: Review Palaeobotany and Palynology, v. 58, p. 173–196.

LUBER, A. A. and WALTZ, I. E., 1941, Atlas of microspores and pollen of the Paleozoic of USSR: Trudy tsent. nauchno-issled. geologo-razv. inst., v. 139, 107 p. (in Russian with English summary).

MAMET, B. and PLAYFORD, P. E., 1968, Sur la présence de Quasiendothyrinae (Foraminifères) en Australie occidentale (Canning Basin): Société Géologique France, Compte Rendu, Sommaire des Séances, v. 7, p. 229–230.

McGREGOR, D.C., 1960, Devonian spores from Melville Island, Canadian Arctic Archipelago: Palaeontology, v. 3, p. 26–44.

McGREGOR, D.C., 1961, Spores with proximal radial pattern from the Devonian of Canada: Canada, Geological Survey, Bulletin 76, p. 1–11.

McGREGOR, D. C., 1964, Devonian miospores from the Ghost River Formation, Alberta: Canada, Geological Survey, Bulletin 109, p. 1–31.

McGREGOR, D. C., 1973, Lower and Middle Devonian spores of eastern Gaspé, Canada — I Systematics: Palaeontographica, Abt. B, v. 142, p. 1–77.

McGREGOR, D. C., 1979, Spores in Devonian stratigraphical correlation, *in* The Devonian System, *edited by* M. R. House, C. T. Scrutton, and M. G. Bassett: Palaeontological Association, Special Paper 23, p. 163–184.

McGREGOR, D. C. and CAMFIELD, M., 1976, Upper Silurian? to Middle Devonian spores of the Moose River Basin, Ontario: Canada, Geological Survey, Bulletin 263, 63 p.

McGREGOR, D. C. and CAMFIELD, M., 1982, Middle Devonian miospores from the Cape de Bray, Weatherall, and Hecla Bay Formations of northeastern Melville Island, Canadian Arctic: Canada, Geological Survey, Bulletin 348, 105 p.

McGREGOR, D. C. and OWENS, B., 1966, Illustrations of Canadian fossils — Devonian spores of eastern and northern Canada: Canada, Geological Survey, Paper 66-30, p. 1–66.

McGREGOR, D. C. and UYENO, T. T., 1972, Devonian spores and conodonts of Melville and Bathurst Islands, District of Franklin: Canada, Geological Survey, Paper 71–13, p. 1–37.

McLAREN, D. J., 1955, Devonian formations in the Alberta Rocky Mountains between Bow and Athabasca Rivers: Canada, Geological Survey, Bulletin 35, 59 p.

MEHTA, K. R., 1944, Microfossils from a carbonaceous shale from the Pali Beds of the south Rewah Gondwana basin: India, National Academy of Science, Proceedings, v. 14, p. 125–141.

MIKHAILOVA, N. I., 1966, Spores from the Givetian deposits of Rudnyi Altai: Kazakhstan SSR, Academy of Sciences, Satpaev Institute of Geological Sciences, Transactions, v. 17, p. 195–213.

MOORS, H. T., GARDNER, W. E., and DAVIS, J., 1984., Geology of the Blina Oilfield, *in* The Canning Basin, W.A. — Proceedings of the Canning Basin Symposium, Perth, 1984, *edited by* P. G. Purcell: Perth, Geological Society of Australia–Petroleum Exploration Society of Australia, p. 278–283.

MORTIMER, M. G., CHALONER, W. G., and LLEWELLYN, P. G., 1970, Lower Carboniferous (Tournaisian) miospores and megaspores from Breedon Cloud quarry, Leicestershire: Mercian Geologist, v. 3, p. 375–385.

MOUNTJOY, E. W., 1965, Stratigraphy of the Devonian Miette reef complex and associated strata, eastern Jasper National Park, Alberta: Canada, Geological Survey, Bulletin 110, 132 p.

MURPHY, G. C., BAILEY, A., and PARRINGTON, P. J., 1986, The Blendevale carbonate-hosted zinc–lead deposit, Pillara, Kimberley Region, Western Australia — Congress of Mining and Metallurgical Institutions, 13th, Singapore, *edited by* D. A. Berman: Publications, v. 2, p. 173–180.

NAUMOVA, S. N., 1949, Spores of Lower Cambrian: USSR, Academy of Sciences, (Geological Series 60), v. 143, p. 1–204 (in Russian).

NAUMOVA, S. N., 1953, Spore-pollen complexes of the Upper Devonian of the Russian Platform and their stratigraphic significance: Trudy Inst. geol. Nauk, Mosk., (Geol. Ser. 60), v. 143, 204 p. (in Russian).

NEVES, R., 1961, Namurian plant spores from the Southern Pennines, England: Palaeontology, v. 4, p. 247–279.

NICOLL, R. S., 1981, Conodonts from the Pillara Range and Pinnacles area, Canning Basin, WA.: Australia, Bureau of Mineral Resources, Professional Opinion 1981/003 (unpublished).

OWENS, B., 1971, Miospores from the Middle and early Upper Devonian rocks of the western Queen Elizabeth Islands, Arctic Archipelago: Canada, Geological Survey, Paper 70-38, p. 1–157.

PHIPPS, D. and PLAYFORD, G., 1984, Laboratory techniques for the extraction of palynomorphs from sediments: University of Queensland, Department of Geology, Papers, no. 11, p. 1–23.

PLAYFORD, G., 1962, Lower Carboniferous microfloras of Spitsbergen, Part 1: Palaeontology, v. 5, p. 550–618.

PLAYFORD, G., 1963, Lower Carboniferous microfloras of Spitsbergen, Part 2: Palaeontology, v. 5, p. 619–678.

PLAYFORD, G., 1971, Lower Carboniferous spores from the Bonaparte Gulf Basin, Western Australia and Northern Territory: Australia, Bureau Mineral Resources, Bulletin 115.

PLAYFORD, G., 1976, Plant microfossils from the Upper Devonian and Lower Carboniferous of the Canning Basin, Western Australia: Palaeontographica, B, v. 158, p. 1–71.

PLAYFORD, G., 1977, A Lower Carboniferous palynoflora from the Drummond Basin, east-central Queensland: Royal Society of Queensland, Proceedings, v. 88, p. 75–81.

PLAYFORD, G., 1978, Lower Carboniferous spores from the Ducabrook Formation, Drummond Basin, Queensland: Palaeontographica, Abt. B, v. 167, p. 105–160.

PLAYFORD, G., 1981, Late Devonian acritarchs from the Gneudna Formation in the Western Carnarvon Basin, Western Australia: Geobios, v. 14, p. 145–171.

PLAYFORD, G., 1982, A latest Devonian palynoflora from the Buttons Beds, Bonaparte Gulf Basin, Western Australia: BMR Journal of Australian Geology and Geophysics, v. 7, p. 149–157.

PLAYFORD, G., 1983, The Devonian miospore genus *Geminospora* Balme 1962 — A reappraisal based upon topotypic *G. lemurata* (type species): Association of Australasian Palaeontologists, Memoirs, v. 1, p. 311–325.

PLAYFORD, G. and DRING, R. S., 1981, Late Devonian acritarchs from the Carnarvon Basin, Western Australia: Palaeontological Association, London, Special Papers in Palaeontology 27.

PLAYFORD, G. and SATTERTHWAIT, D. F., 1985, Lower Carboniferous (Visean) spores of the Bonaparte Gulf Basin, northwestern Australia, Part 1: Palaeontographica, Abt. B, v. 195, p. 129–152.

PLAYFORD, G. and SATTERTHWAIT, D. F., 1986, Lower Carboniferous (Visean) spores of the Bonaparte Gulf Basin, northwestern Australia, Part 2: Palaeontographica, Abt. B, v. 200, p. 1–32.

PLAYFORD, G. and SATTERTHWAIT, D.F., 1988, Lower Carboniferous (Visean) spores of the Bonaparte Gulf Basin, northwestern Australia, Part 3: Palaeontographica, Abt. B, v. 208, p. 1–26.

PLAYFORD, G., JONES, B. G., and KEMP, E. M., 1976, Palynological evidence for the age of the synorogenic Brewer Conglomerate, Amadeus Basin, central Australia: Alcheringa, v. 1, p. 235–243.

PLAYFORD, P. E., 1976, Devonian reef complexes of the Canning Basin, Western Australia — 25th International Geological Congress: Excursion Guide.

PLAYFORD, P. E., 1980, Devonian "Great Barrier Reef" of the Canning Basin, Western Australia: American Association of Petroleum Geologists, Bulletin 64, p. 814–840.

PLAYFORD, P. E., 1981, Devonian reef complexes of the Canning Basin, Western Australia: Geological Society of Australia, Fifth Australian Geological Convention Field Excursion Guidebook, 64 p.

PLAYFORD, P.E., 1982, Devonian reef prospects in the Canning Basin — Implications of the Blina oil discovery: APEA Journal, v. 22, p. 258–272.

PLAYFORD, P.E., 1984, Platform-margin and marginal-slope relationships in Devonian reef complexes of the Canning Basin. *in* The Canning Basin, W.A. — Proceedings of the Canning Basin Symposium, Perth, 1984, *edited by* P. G Purcell: Perth, Geological Society of Australia–Petroleum Exploration Society of Australia, p. 190–214.

PLAYFORD, P. E. and LOWRY, 1966, Devonian reef complexes of the Canning Basin, Western Australia: Western Australia, Geological Survey, Bulletin 118.

PLAYFORD, P. E., COPE, R. N., COCKBAIN, A. E., LOW, G. H., and LOWRY, 1975, Phanerozoic, Canning Basin, *in* Geology of Western Australia: Western Australia, Geological Survey, Memoir 2, p. 319–368.

PLAYFORD, P. E., HURLEY, N. T., KERANS, C., and MIDDLETON, M. T., 1989, Reefal platform development, Devonian of the Canning Basin, Western Australia: Society of Economic Palaeontologists and Mineralogists, Special Publication 44, p. 187–202.

POTONIE, R., 1958, Synopsis der Gattungen der Sporae dispersae: II Beiheft Geologisches Jahrbuch, v. 31, 114 p.

POTONIE, R. and KREMP, G., 1954, Die Gattungen der paläozoischen Sporae dispersae und ihre Stratigraphie: Geologisches Jahrbuch, v. 69, p. 111–194.

POTONIE, R. and KREMP, G., 1955, Die Sporae dispersae des Rhurkarbons — ihre Morphographie und Stratigraphie mit Ausblicken auf Arten anderer Gebeite und Zeitabschnitte, Teil I: Palaeontographica, Abt. B, v. 98, p. 1–136.

POTONIE, R. and KREMP, G, 1956, Die Sporae dispersae des Ruhrkarbons, Teil II: Palaeontographica, Abt. B, v. 99, p. 85–191.

PRICE, P. L., 1980, Biostratigraphy of the Devonian section from selected wells in A. to P. 232PO, Adavale Basin, Queensland: Mines Administration Pty Ltd, Palynology Facility, Report 208/1 (unpublished).

PRICE, P. L., FILATOFF, J., WILLIAMS, A. J., PICKERING, S. A., and WOOD, G. R., 1985, Late Palaeozoic and Mesozoic palynostratigraphic units: Mines Administration Pty Ltd, Palynology Facility, Report 274/25 (unpublished)

PURCELL, P. G., (editor), 1984, The Canning Basin, W.A. — Proceedings of the Canning Basin Symposium, Perth, 1984: Perth, Geological Society of Australia–Petroleum Exploration Society of Australia,.

RADKE, R. M., 1976, Hierarchical classification and vector ordination in the distinction of limestones in the Fairfield Group, Canning Basin, Western Australia: BMR Journal of Australian Geology and Geophysics, v. 1, p. 63–76.

READ, J. F., 1973, Palaeo-environments and palaeogeography, Pillara Formation (Devonian), Western Australia: Bulletin of Canadian Petroleum Geology, v. 21, p. 344–394.

RICHARDSON, J. B., 1960, Spores from the Middle Old Red Sandstone of Cromarty, Scotland: Paleontology, v. 3, p. 45–63.

RICHARDSON, J. B., 1962, Spores with bifurcate processes from the Middle Old Red Sandstone of Scotland: Palaeontology, v. 5, p. 171–194.

RICHARDSON, J. B., 1965, Middle Old Red Sandstone spore assemblages from the Orcadian Basin, north-east Scotland: Paleontology, v. 7, p. 559–605.

RICHARDSON, J. B. and McGREGOR, D. C., 1986, Silurian and Devonian spore zones of the Old Red Sandstone Continent and adjacent regions: Canada, Geological Survey, Bulletin 364.

RIEGEL, W., 1968, Die Mitteldevon-Flora von Lindlar (Rheinland) — 2 Sporae dispersae: Palaeontographica Abt. B, v. 142, p. 74–104.

RIEGEL, W., 1973, Sporenformen aus den Heisdorf-, Lauch- und Nohn-Schichten (Emsium und Eifelium) der Eifel, Rheinland: Palaeontographica, Abt. B, v. 142, p. 78–104.

SANDBERG, C. A., ZIEGLER, W., DREESEN, R., and BUTLER, J.L., 1988, Late Frasnian mass extinction — Conodont event stratigraphy, global changes, and possible causes: Cour. Forschungsinst. Senckenberg 102, p. 267–307.

RIEGEL, W., 1975, Palynological sequence from lower Emsian to Givetian of the Eifel region: Commission Internationale de Microflore du Paléozoïque, Newsletter 10, p. 6.

SCHEURING, B. W., 1974, *Kraeuselisporites* Leschik and *Thomsonisporites* Leschik — A revision of the type material of two disputed genera: Review of Palaeobotany and Palynology, v. 17, p. 187–203.

SCHOPF, J. M., WILSON, L. R., and BENTALL, R., 1944, An annotated synopsis of Palaeozoic fossil spores and the definition of generic groups: Illinois, State Geological Survey, Report of Investigations 91, 66 p.

SEDDON, G., 1970, Frasnian conodonts from the Sadler Ridge–Bugle Gap area, Canning Basin, Western Australia: Geological Society of Australia, Journal, v. 16, p. 723–753.

SELWOOD, E. B., EDWARDS, R. A., SIMPSON, S., CHESHER, J. A., HAMBLIN, R. J. O., HENSON, M. R., RIDDOLLS, B. W., and WATERS, R. A., 1984, Geology of the country around Newton Abbot — Memoir for 1:50 000 geological sheet 339: British Geological Survey, Memoir (New Series).

SOMERS, G., 1952, A preliminary study of the fossil spore content of the lower Jubilee seam of the Sydney coalfield, Nova Scotia: Halifax, Nova Scotia Foundation, Publication, p. 1–30.

SMITH, A. H. V., 1971, Genus *Verrucosisporites* Ibrahim 1933 emend.: Commission Internationale de Microflore du Paléozoïque, Microfossiles organiques du Paléozoïque 4, Spores p. 35–87.

SMITH, A. H. V. and BUTTERWORTH, M. A., 1967, Miospores in the coal seams of the Carboniferous of Great Britain: Special Papers in Palaeontology, v. 1, 324 p.

STAPLIN, F. L., 1960, Upper Mississippian plant spores from the Golata Formation, Alberta, Canada: Palaeontographica, Abt. B, v. 107, p. 1–40.

STAPLIN, F. L. and JANSONIUS, J., 1964, Elucidation of some Paleozoic densospores: Palaeontographica, Abt. B, v. 114, p. 95–117.

STREEL, M., 1964, Une association de spores du Givétien inférieur de la Vesdre, à Goé (Belgique): Société Géologique de Belgique, Annales, v. 87, p. 1–30.

STREEL, M., 1967, Associations de spores du Dévonien inférieur belge et leur signification stratigraphique: Société Géologique de Belgique, Annales, v. 90, p. 11–53.

STREEL, M., 1974, Similitudes des assemblages de spores d'Europe, d'Afrique du Nord et d'Amérique du Nord au Dévonien terminal: Sci. Geol., Bulletin 27, p. 25–38.

STREEL, M., HIGGS, K., LOBOZIAK, S., RIEGEL, W., and STEEMANS, P., 1987, Spore stratigraphy and correlation with faunas and floras in the type marine Devonian of the Ardennes–Rhenish regions: Review Palaeobotany and Palynology, v. 50, p. 211–229.

SULLIVAN, H. J., 1964a, Miospores from the Lower Limestone Shales (Tournaisian) of the Forest of Dean Basin, Gloucestershire: 5th Congrès international de stratigraphie et de géologie du Carbonifère, Paris, 1963, Compte Rendu, v. 3, p. 1249–1259.

SULLIVAN, H. J., 1964b, Miospores from the Drybrook Sandstone and associated measures in the Forest of Dean basin, Gloucestershire: Palaeontology, v. 7, p. 351–392.

SULLIVAN, H. J., 1968, A Tournaisian spore flora from the Cementstone Group of Ayrshire, Scotland: Palaeontology, v. 11, p. 116–131.

SURANGE, K. R., SINGH, P., and SRIVASTAVA, P. N., 1953, Megaspores from the west Bokaro coalfield (lower Gondwana) of Bihar: Palaeobotanist, v. 2, p. 2–17.

TAUGOURDEAU-LANTZ, J., 1960, Sur la microflore du Frasnien inférieur de Beaulieu (Boulonnais): Review Micropaléontologie , v. 3, p. 144–154.

THOMSON, P. W. and PFLUG, H., 1953, Pollen und Sporen des mitteleuropaischen Tertiars — Gesamtübersicht über die stratigraphisch und paläontologisch wichtigen Formen: Palaeontographica, Abt. B, v. 94, p. 1–138.

TIWARI, R. S. and SCHAARSCHMIDT, F., 1975, Palynological studies in the Lower and Middle Devonian of the Prum Syncline, Eifel (Germany): Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft, v. 534, p. 1–129.

TOWNER, R. R. and GIBSON, D. L., 1983, Geology of the onshore Canning Basin, Western Australia: Australia, Bureau of Mineral Resources, Bulletin 215, 51 p.

TURNAU, E., 1986, Lower to Middle Devonian spores from the vicinity of Pionki (central Poland): Review of Palaeobotany and Palynology, v. 46, p. 311–354.

URBAN, J. B., 1971, Palynology and the Independence Shale of Iowa: Bulletin of American Paleontology, v. 60, p. 103–189.

Van VEEN, P.M., 1981, Aspects of Late Devonian and Early Carboniferous palynology of southern Ireland, V — The change in composition of palynological assemblages at the Devonian–Carboniferous boundary: Review of Palaeobotany and Palynology v. 34, p. 67–97.

VEEVERS, J. J., 1959, Devonian brachiopods from the Fitzroy Basin, Western Australia: Australia, Bureau Mineral Resources, Bulletin 45, 220 p.

VENKATACHALA, B. S., 1964, Lower Carboniferous miospores from the Bonaparte Gulf Basin, Australia: The Palaeobotanist, v. 12, p. 109–114.

WALLACE, M. W., 1987, Sedimentology and diagenesis of Upper Devonian carbonates, Canning Basin, Western Australia: University of Tasmania, PhD Thesis (unpublished).

WILSON, L. R. and COE, E. Z., 1940, Descriptions of some unassigned plant microfossils from the Des Moines Series of Iowa. American Midland Naturalist, 23, 182–186.

YEATES, A. N., GIBSON, D. L., TOWNER, R. R., and CROWE, R. W. A., 1984, Regional geology of the onshore Canning Basin, *in* The Canning Basin, W.A. — Proceedings of the Canning Basin Symposium, Perth, 1984, *edited by* P. G. Purcell: Perth, Geological Society of Australia–Petroleum Exploration Society of Australia, p. 23–55.

YOUNG, G. C., 1989, Australian Phanerozoic timescales — Devonian biostratigraphic chart and explanatory notes: Australia, Bureau of Mineral Resources, Record 1989/34.

ZIEGLER, W. and KLAPPER, G., 1985, Stages of the Devonian system: Episodes, v. 8, p. 104–109.

ZIEGLER, W. and SANDBERG, C. A., 1984, Palmatolepis-based revision of the upper part of standard Late Devonian conodont zonation: Geological Society of America, Special Paper 196, p. 179–194.

Plate 1

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Acinosporites acanthomammilatus? Richardson 1965

Fig.	1	a	proximal view (MF)
	1	b	proximal view (LF)

Acinosporites sp. cf. *A. acanthomammilatus*? Richardson 1965

Fig.	2	a	distal view (LF)
	2	b	distal view (MF)
	2	c	distal view (HF)

Acinosporites hirsutus? (Brideaux and Radforth 1979) McGregor and Camfield 1982

Fig.	3		distal view (MF)
	4		proximal view (MF)
	5		proximal view (MF)

Acinosporites lindlarensis? Riegel 1968

Fig.	6	a	proximal view (HF)
	6	b	proximal view (LF)
	7		proximal view (MF)
	8		distal view (MF)

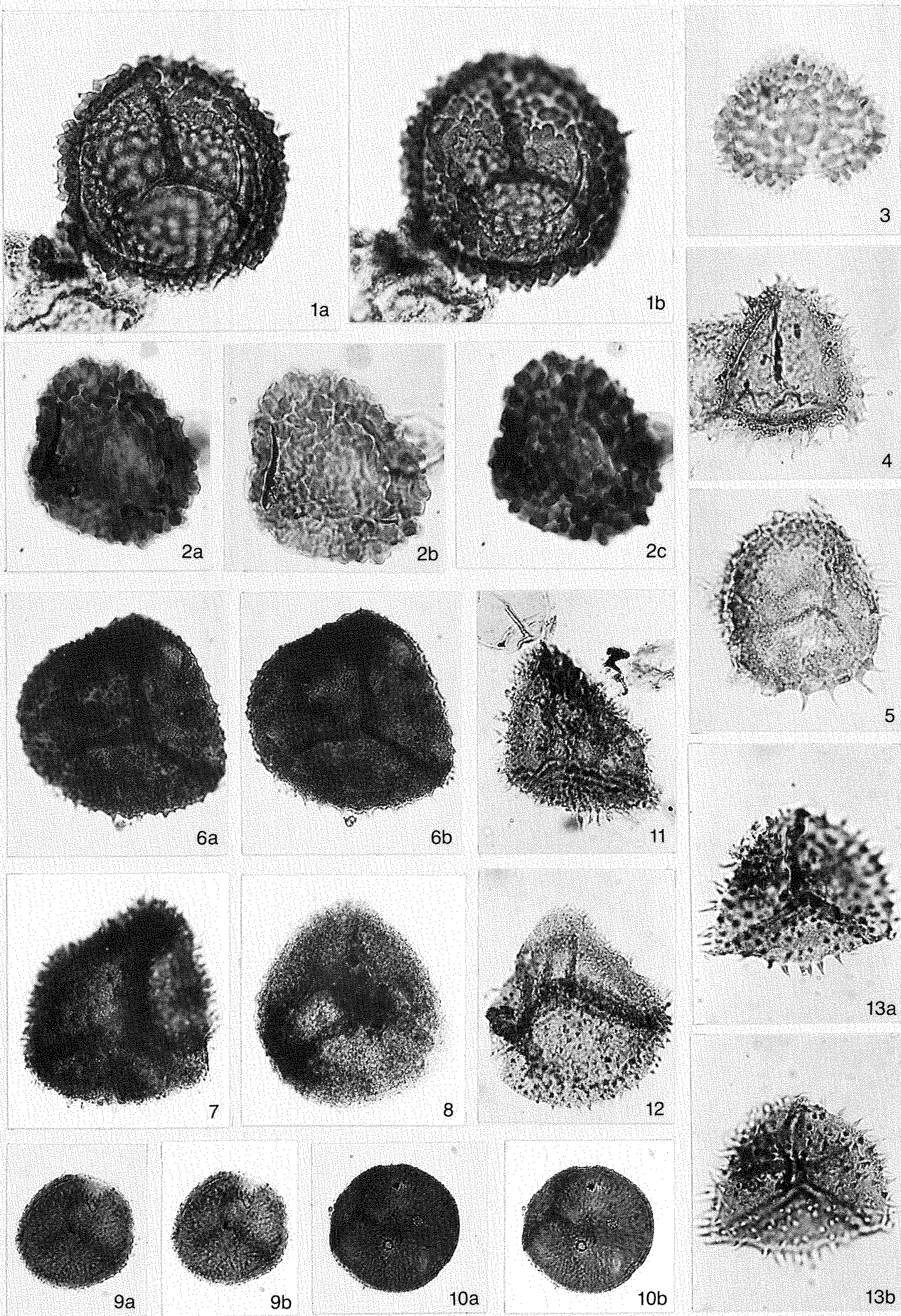
Anapiculatisporites sp. cf. *A. echinatus* (Hoffmeister, Staplin and Malloy 1955) new comb.

Fig.	9	a	distal view (HF)
	9	b	distal view (MF)
	10	a	proximal view (MF)
	10	b	proximal view (HF)

Anapiculatisporites sp. indet.

Fig.	11		proximal view (MF)
	12		distal view (MF)
	13	a	distal view (HF)
	13	b	distal view (LF)

PLATE 1



GSWA 25730

Plate 2

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Ambagisporites daedalus Balme 1988

Fig.	1		proximal view (HF)
	2	a	distal view (HF)
	2	b	distal view (LF)

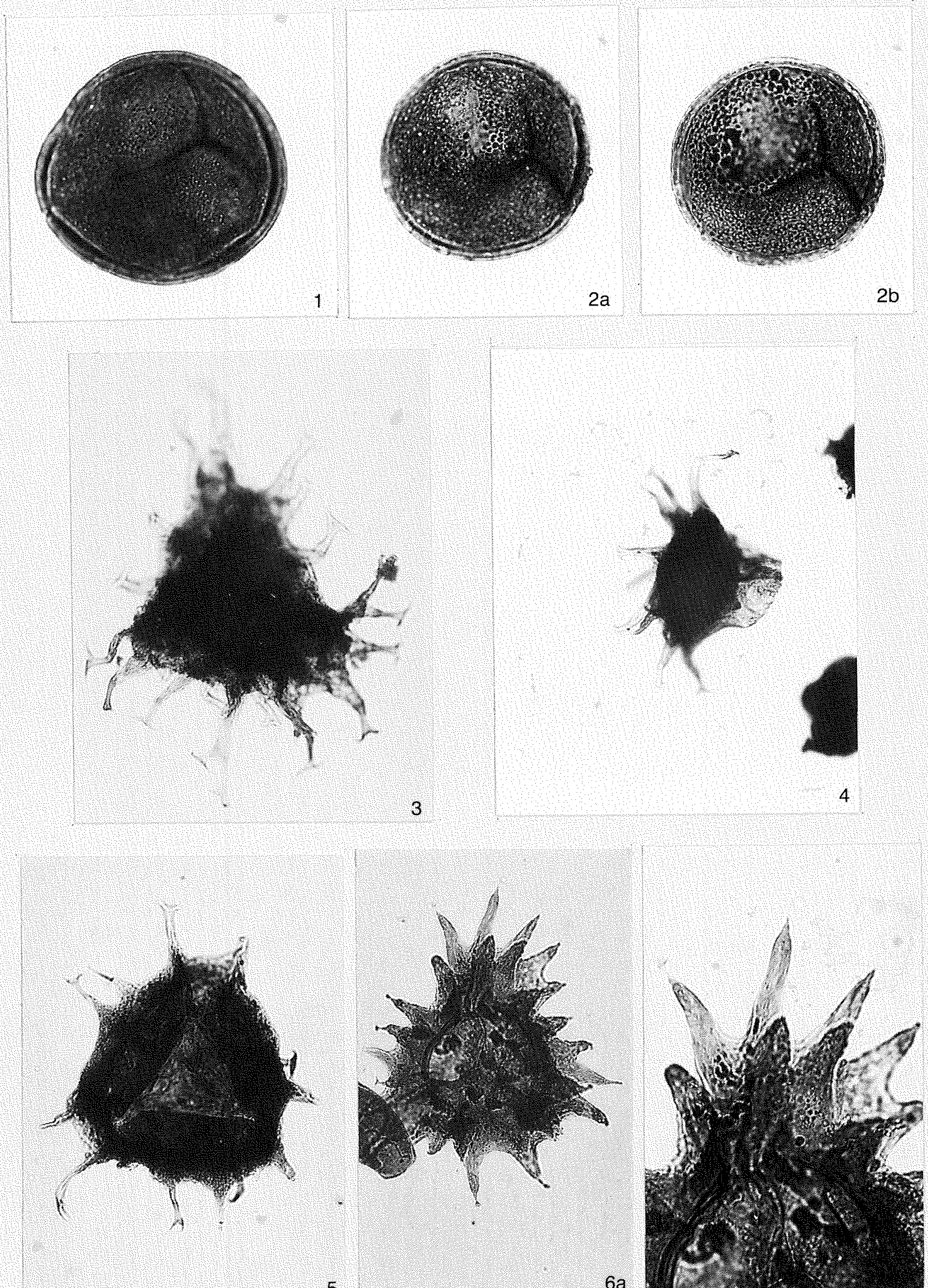
Ancyrospora sp. cf. *A. ancyrea* (Eisenack 1944) Richardson 1962 var. *ancyrea* Richardson 1962

Fig.	3	distal view (MF)
	4	lateral view (MF)
	5	proximal view (MF)

Ancyrospora involucra? Owens 1971

Fig.	6	a	proximal view (MF)
	6	b	detail of ornament, (X 1200)

PLATE 2



GSWA 25731

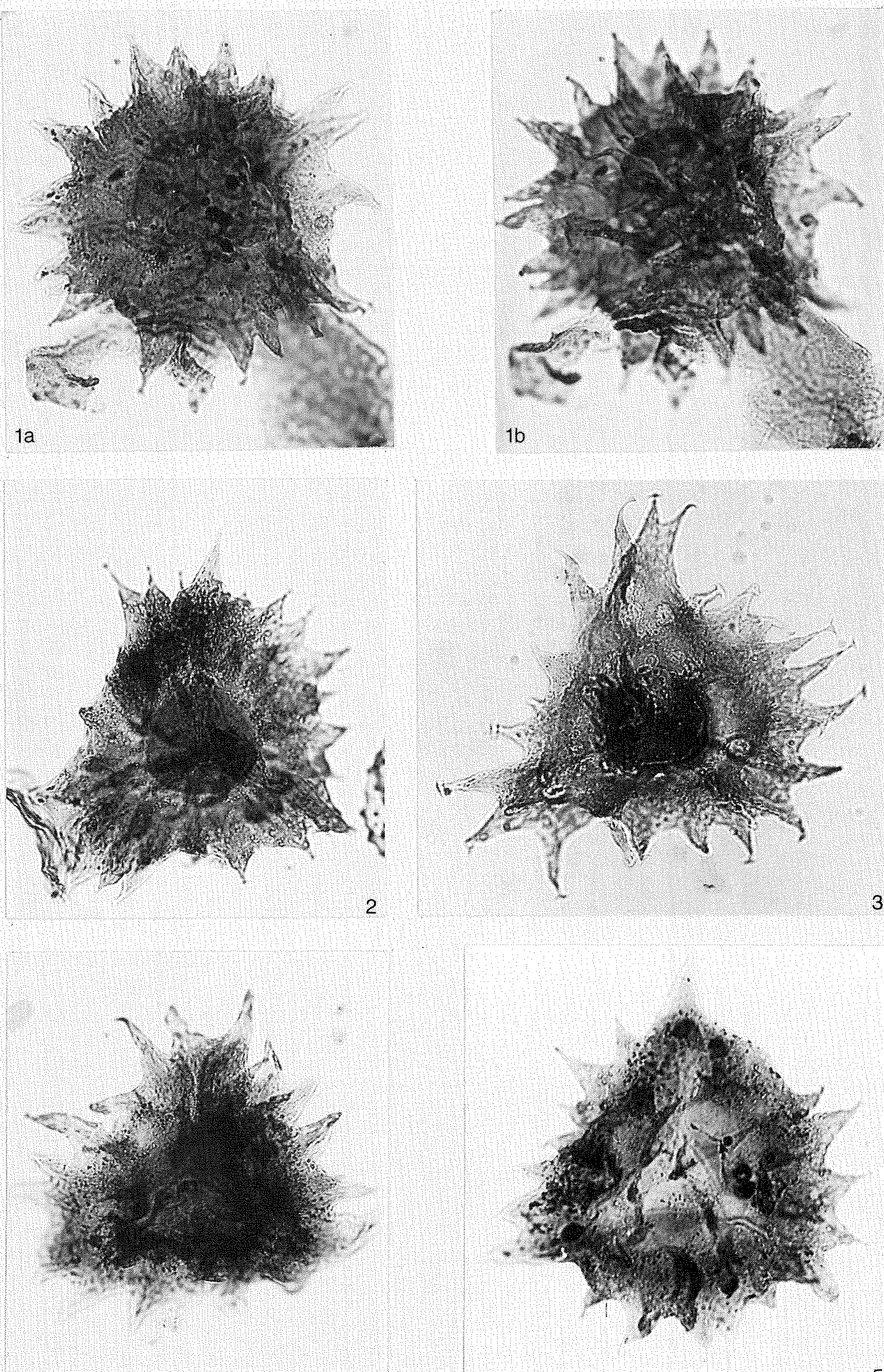
Plate 3

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Ancyrospora langii (Taugourdeau-Lantz 1960) Allen 1965

Fig.	1	a	distal view (MF)
	1	b	distal view (LF)
Fig.	2		proximal view (MF)
Fig.	3		distal view (MF)
Fig.	4		proximal view (MF)
Fig.	5		distal view (LF)

PLATE 3



GSWA 25732

Plate 4

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Ancyrospora longispinosa? Richardson 1962

Fig.	1		distal view (LF)
Fig.	2		distal view (MF)
Fig.	3	a	proximal view (MF)
	3	b	proximal view (LF)

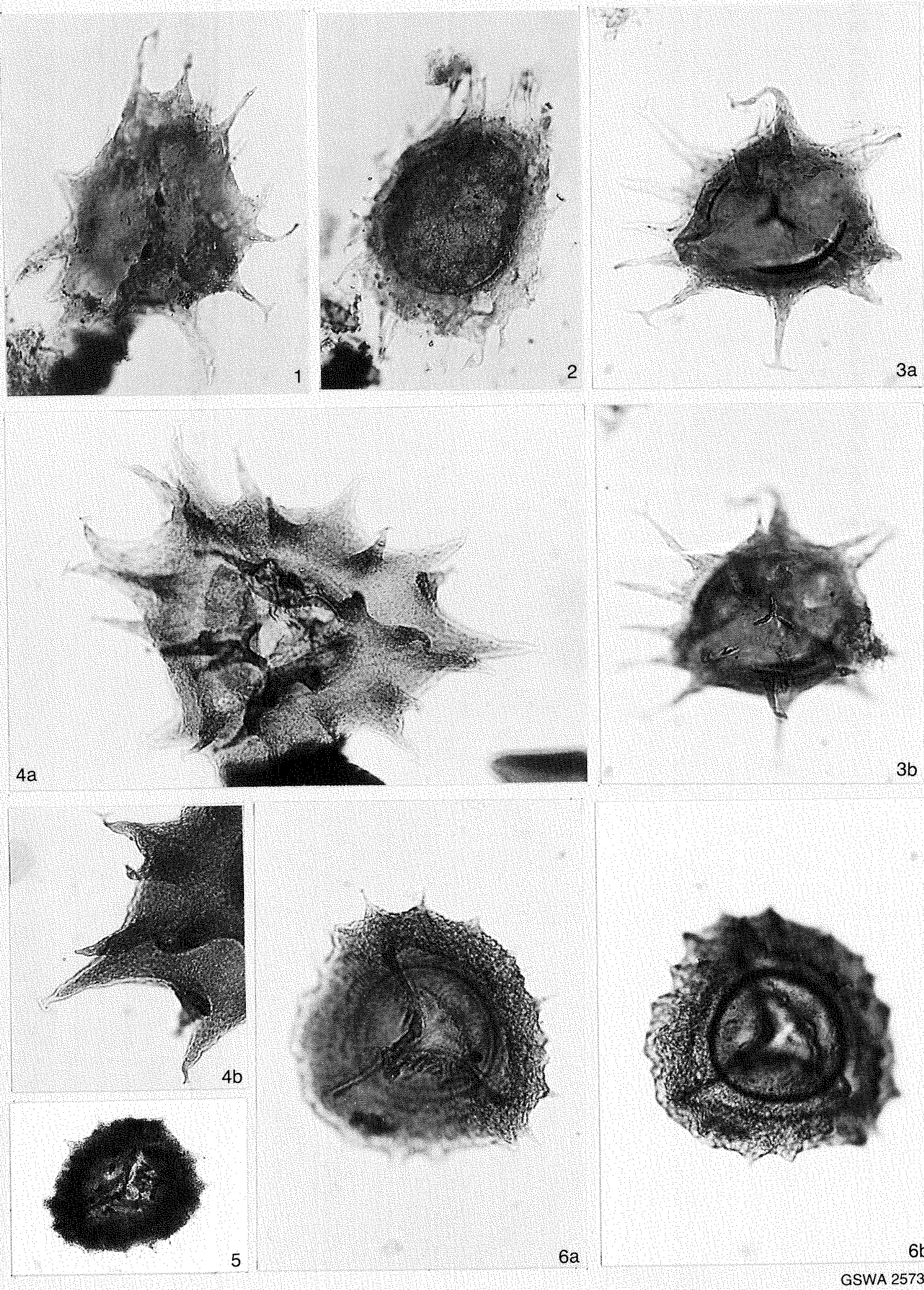
Ancyrospora melvillensis? Owens 1971

Fig.	4	a	proximal view (MF)
	4	b	proximal view (MF), detail of ornament

Ancyrospora parke Hodgson 1968

Fig.	5		proximal view (MF), x 250
Fig.	6	a	proximal view (HF)
	6	b	proximal view (LF)

PLATE 4



GSWA 25733

04531-7

Plate 5

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Ancyrospora parva de Jersey 1966

Fig.	1		proximal view (MF)
Fig.	2	a	proximal view (MF)
	2	b	proximal view (LF)
Fig.	3		lateral view (MF), x 300
Fig.	4		distal view (MF)

Aneurospora goensis? Streel 1964

Fig.	6	proximal view (HF)
Fig.	7	distal view (HF)

Aneurospora greggsii (McGregor 1964) Streel, in Becker and others, 1974

Fig.	5	distal view (MF)

Aneurospora sp. indet.

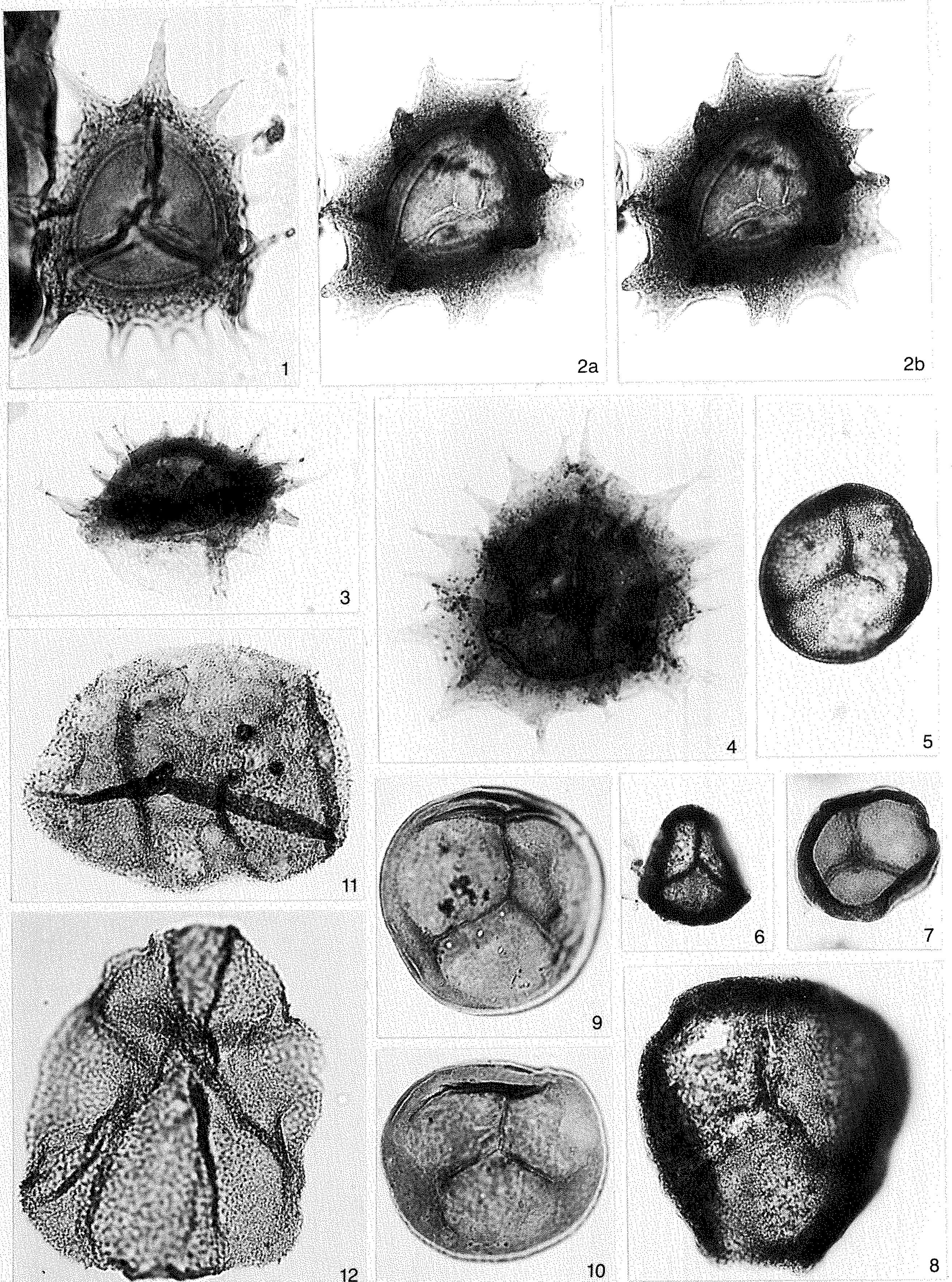
Fig.	8	proximal view (MF)

Aneurospora incohata (Sullivan 1964) Streel in Becker and others 1974

Fig.	9	proximal view (HF)
Fig.	10	proximal view (MF)

Apiculatasporites adavalensis (de Jersey 1966) new comb.

Fig.	11	? view (HF)
Fig.	12	? view (MF)



GSWA 25734

Plate 6

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Apiculatasporites microconus (Richardson 1965) McGregor and Camfield 1982

Fig.	1		? view (MF)
Fig.	2		proximal view (HF)

Apiculatisporis morbosus Balme and Hassell 1962

Fig.	5		proximal view (HF)

Apiculiretusispora sp. cf. *A. brandtii* Streel 1964

Fig.	3		? view (MF)
Fig.	4		proximal view (HF)

Apiculiretusispora densiconata? Tiwari and Schaarschmidt 1975

Fig.	6		proximal view (MF)
Fig.	7		proximal view (MF)

Apiculiretusispora leberidos McGregor and Camfield 1982

Fig.	8		distal view (LF)
Fig.	9	a	distal view (HF)
	9	b	distal view (LF)

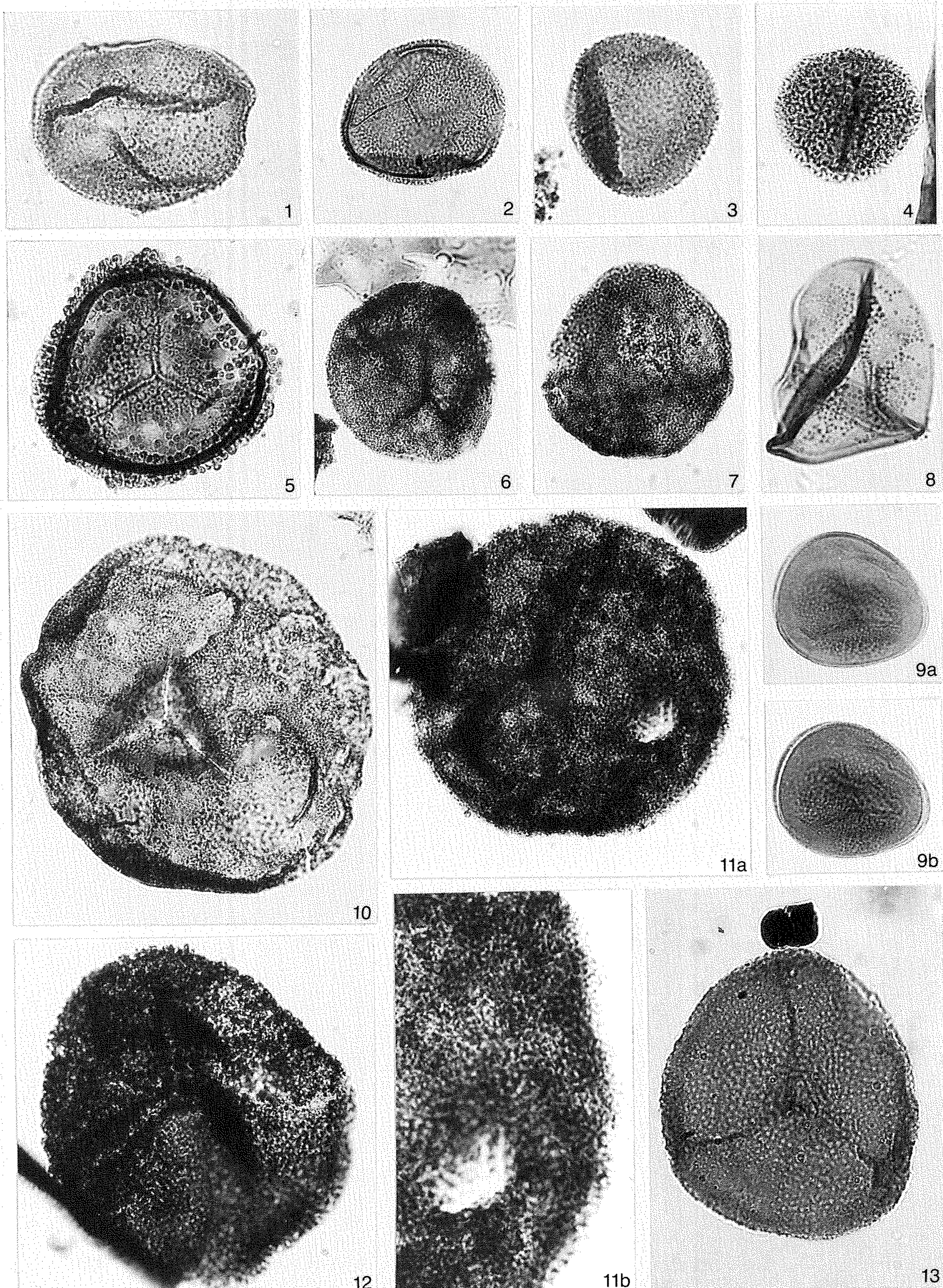
Apiculiretusispora sp. cf. *A. magnifica* Tiwari and Schaarschmidt 1975

Fig.	10		proximal view (LF)
Fig.	11	a	distal view (MF)
	11	b	distal view (MF), detail of ornament (X1200)
Fig.	12		distal view (MF),

Apiculiretusispora sp. A Balme 1988

Fig.	13		distal view (MF)

PLATE 6



GSWA 25735

Plate 7

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Archaeozonotriletes timanicus Naumova 1953

Fig.	1	proximal view (MF)
Fig.	2	proximal view (MF)
Fig.	3	proximal view (LF)
Fig.	4	distal view (MF)
Fig.	5	distal view (HF)

Archaeozonotriletes variabilis Naumova 1953 emend. Allen 1965

Fig.	6	proximal view (MF)
Fig.	7	proximal view (MF)

Auroraspora macra Sullivan 1968

Fig.	8	proximal view (MF)

Baculatisporites semilucensis? (Naumova 1953) McGregor and Camfield 1982

Fig.	9	distal view (HF)
Fig.	10	distal view (LF)

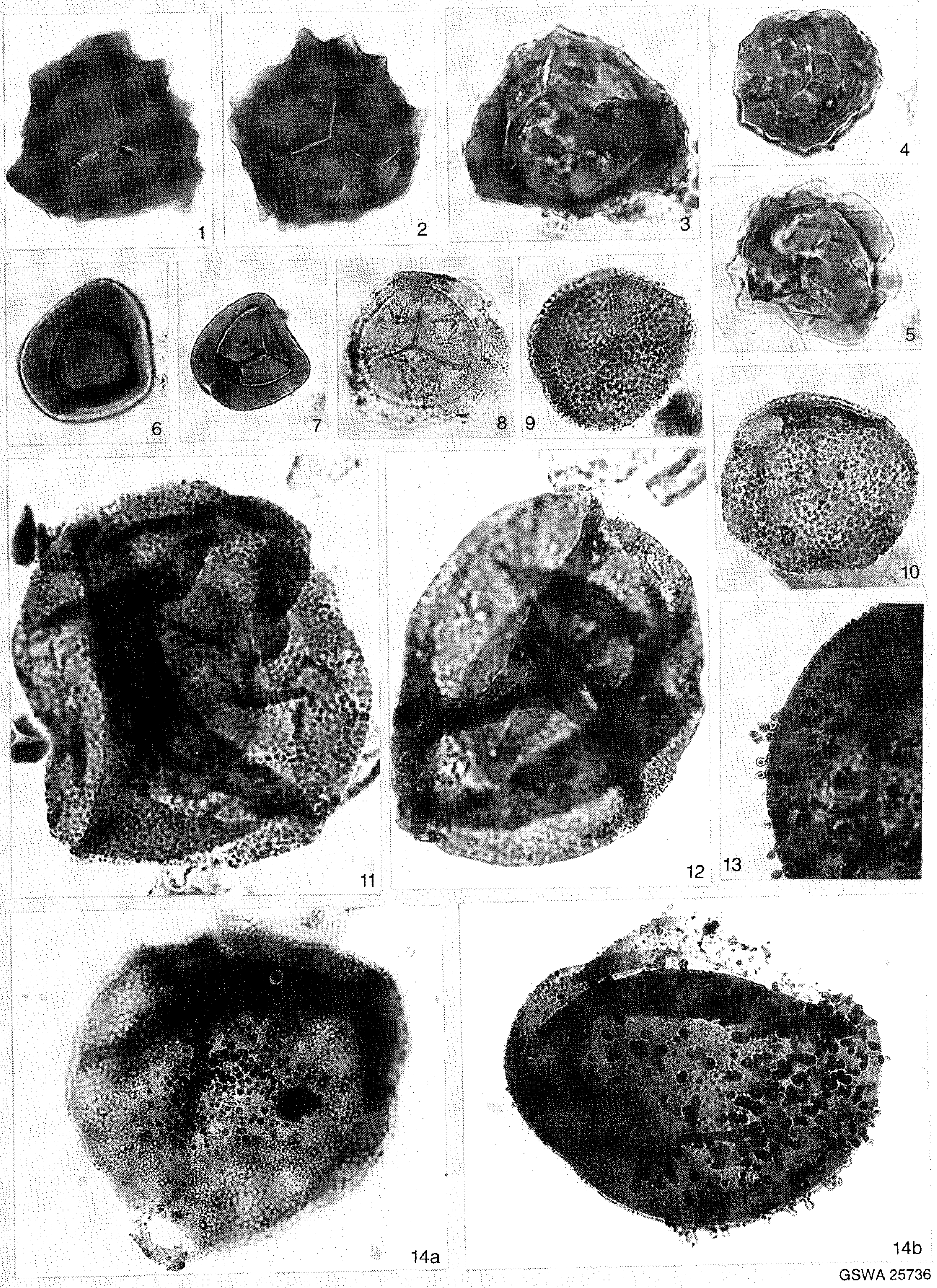
Biharisporites parviornatus? Richardson 1965

Fig.	11	? view (MF), X 500
Fig.	12	distal view (LF), X500

Biharisporites sp. indet.

Fig.	13	distal view (MF), X 400
Fig.	14 a	? view (MF), X 400
	14 b	detail of ornament in Fig. 14a, X 500

PLATE 7



GSWA 25736

Plate 8

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Brochotriletes textilis (Balme and Hassell 1962) Playford 1976

Fig.	1	distal view (HF)

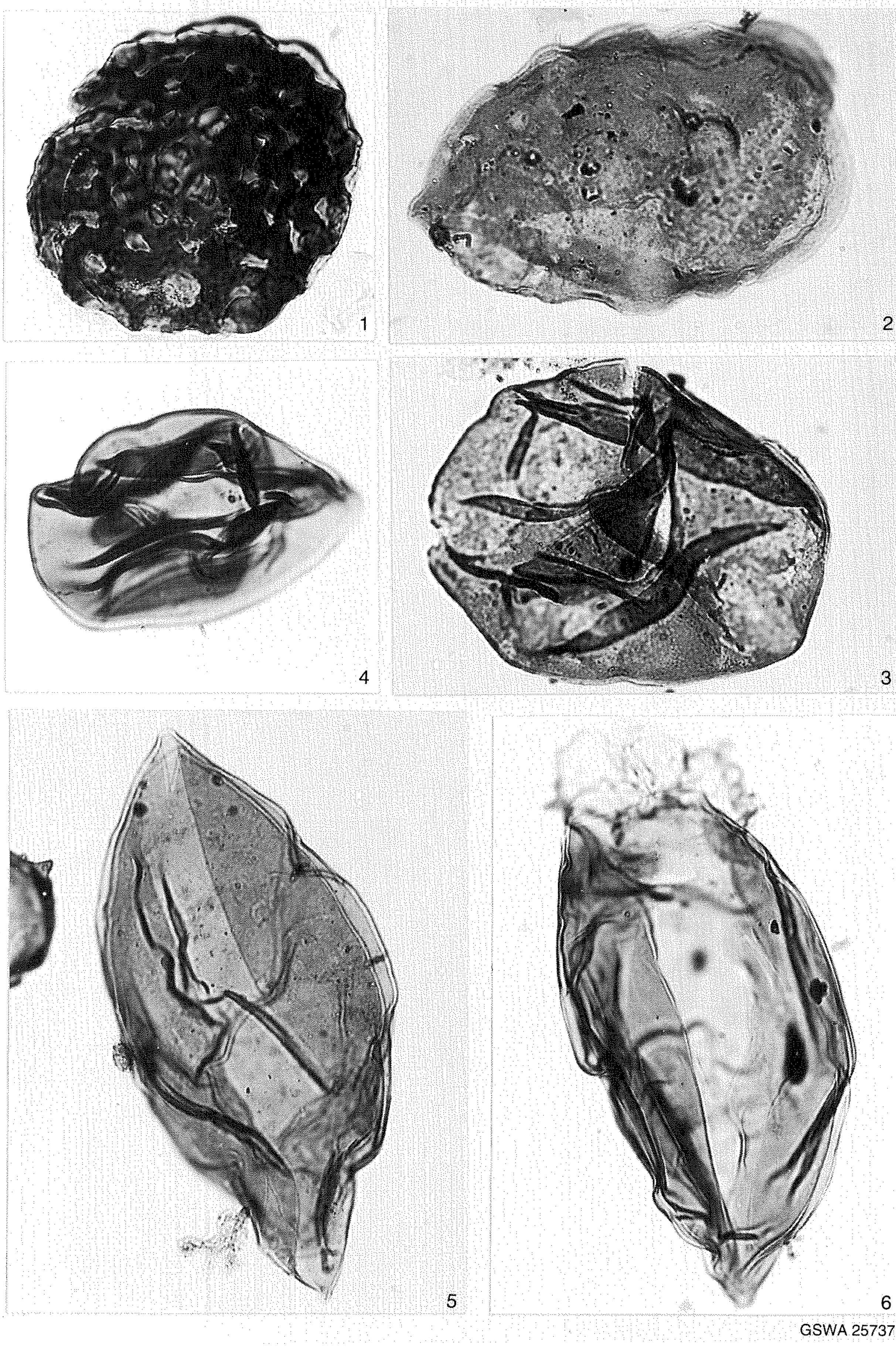
Calamospora sp. cf. *C. microrugosa* (Ibrahim) Schopf, Wilson, and Bentall 1944 of Balme and Hassell 1962

Figure	2	? view (MF)
Fig.	3	distal view (LF)

Calamospora pannucea Richardson 1965

Fig.	4	? view (MF)
Fig.	5	? view (MF)
Fig.	6	? view (MF)

PLATE 8



GSWA 25737

Plate 9

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Calyptosporites proximocavatus Balme 1988

Fig.	1	proximal view (MF)

Calyptosporites stolidotus Balme 1988

Fig.	2	proximal view (MF)
Fig.	3	? view (MF)
Fig.	4	? view (MF)

Calyptosporites sp. cf. *C. stolidotus* Balme 1988

Fig.	5	? view (MF)
Fig.	6	? view (MF)

cf. *Calyptosporites* sp. indet.

Fig.	7	? proximal view (MF)
Fig.	8	proximal view (MF)
Fig.	9	distal view (MF)

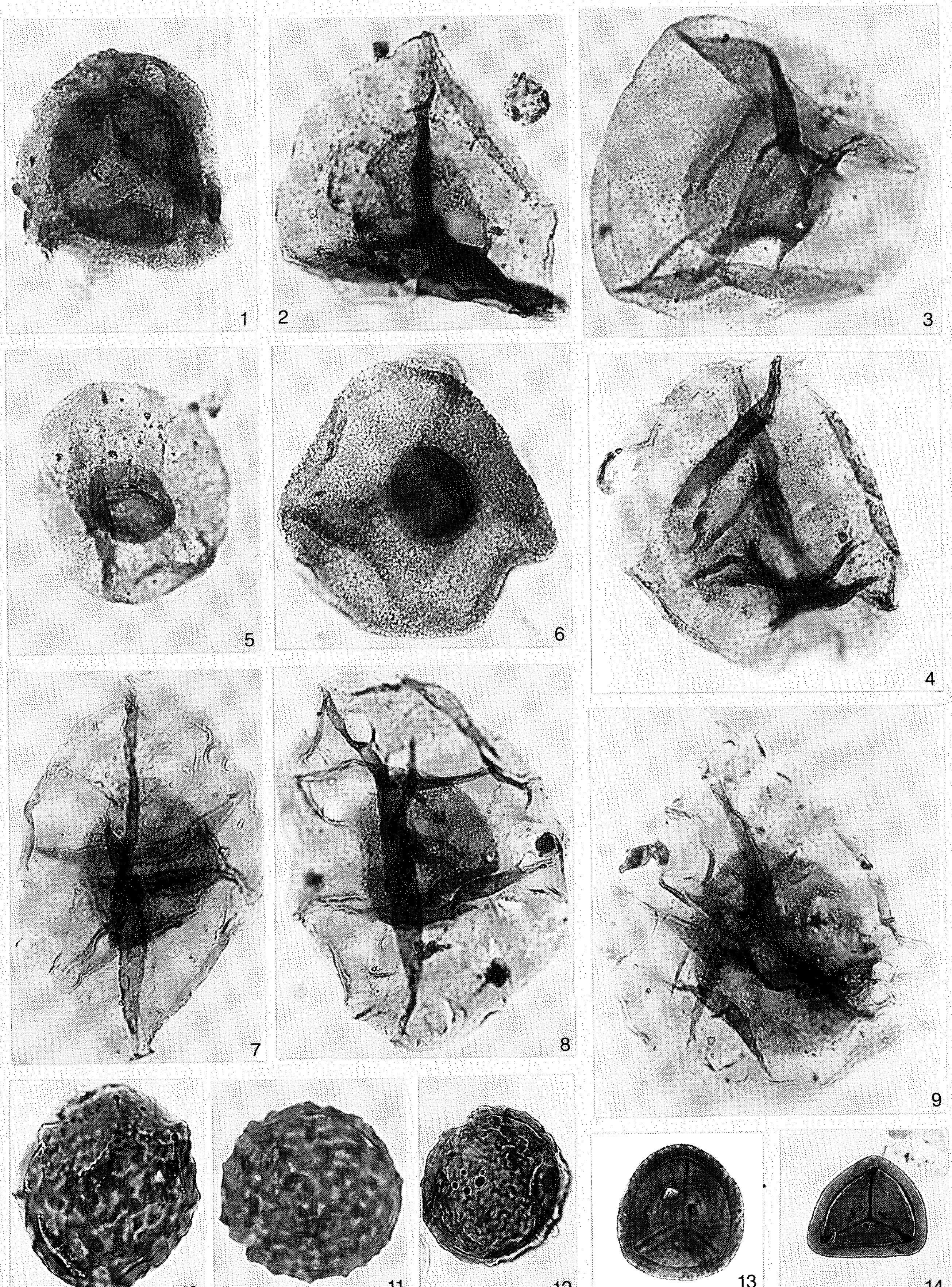
Camarozonotriletes parvus? Owens 1971

Fig.	13	distal view (MF)
Fig.	14	proximal view (MF)

Camptotriletes balmei Playford 1976

Fig.	10	lateral view (MF)
Fig.	11	distal view (MF)
Fig.	12	lateral view (MF)

PLATE 9



GSWA 25738

Plate 10

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Camptozonotriletes leptohymenoides Balme 1988

Fig.	1	proximal view (MF)
Fig.	2	proximal view (MF)

cf. *Chelinospora ligurata* Allen 1965

Fig.	3	? view (MF)

Cirratriradites impensus Playford 1976

Fig.	4	distal view (MF)
Fig.	5	proximal view (LF)

Clivosispora sp. indet.

Fig.	10	distal view (MF)
Fig.	11	proximal view (MF)
Fig.	12	distal view (MF)
Fig.	13	proximal view (MF)

Convolutispora caementosa Balme 1988

Fig.	8	lateral view (HF)

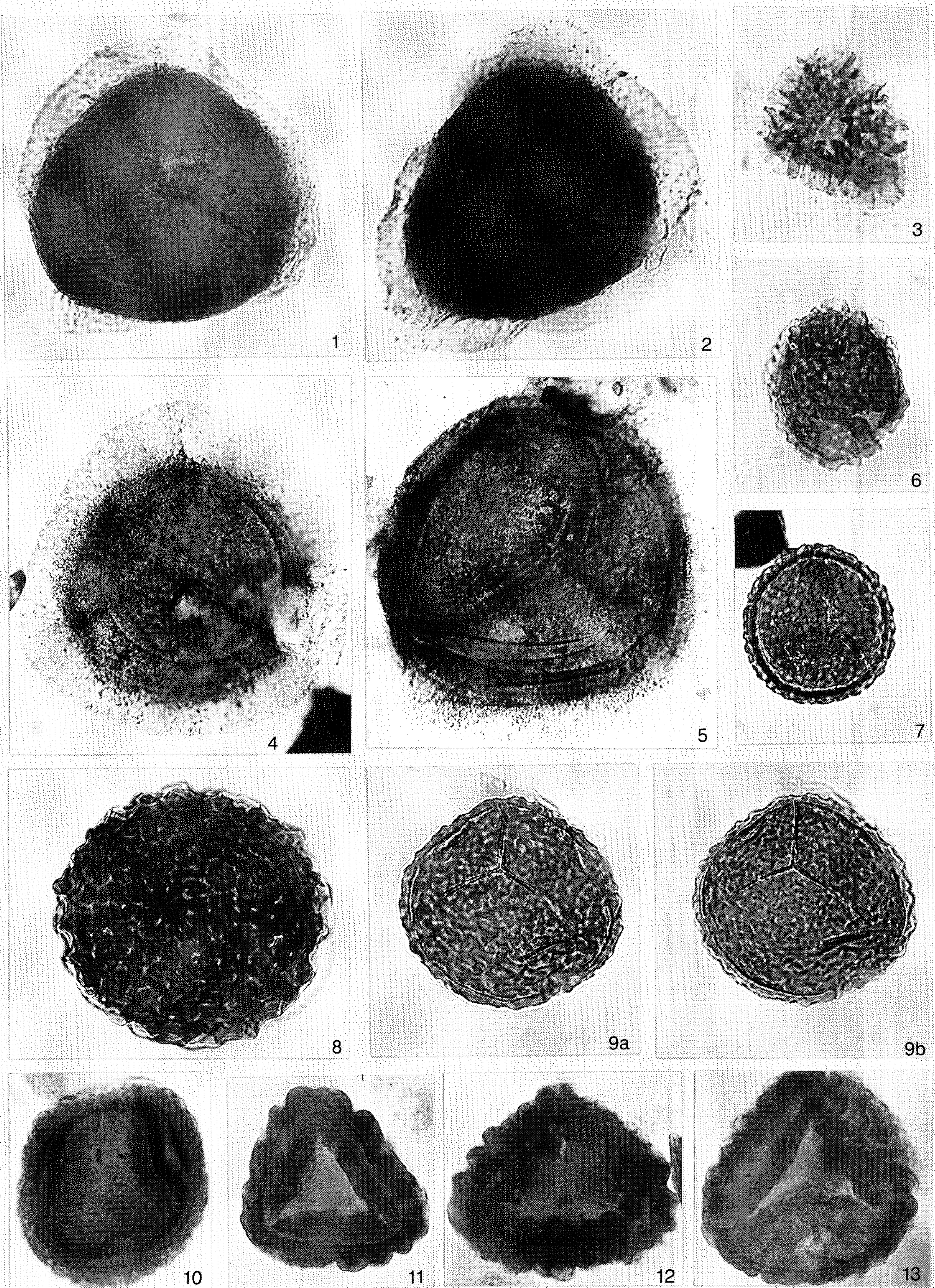
Convolutispora crassata? (Naumova) of McGregor and Camfield 1982

Fig.	6	distal view (MF)

Convolutispora fromensis Balme and Hassell 1962

Fig.	7	proximal view (LF)
Fig.	9 a	proximal view (LF)
	9 b	proximal view (HF)

PLATE 10



GSWA 25739

Plate 11

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Convolutispora paraverrucata McGregor 1964

Fig.	1		? view (MF)
Fig.	2		proximal view (MF)
Fig.	3		proximal view (MF)
Fig.	4		lateral view (MF)

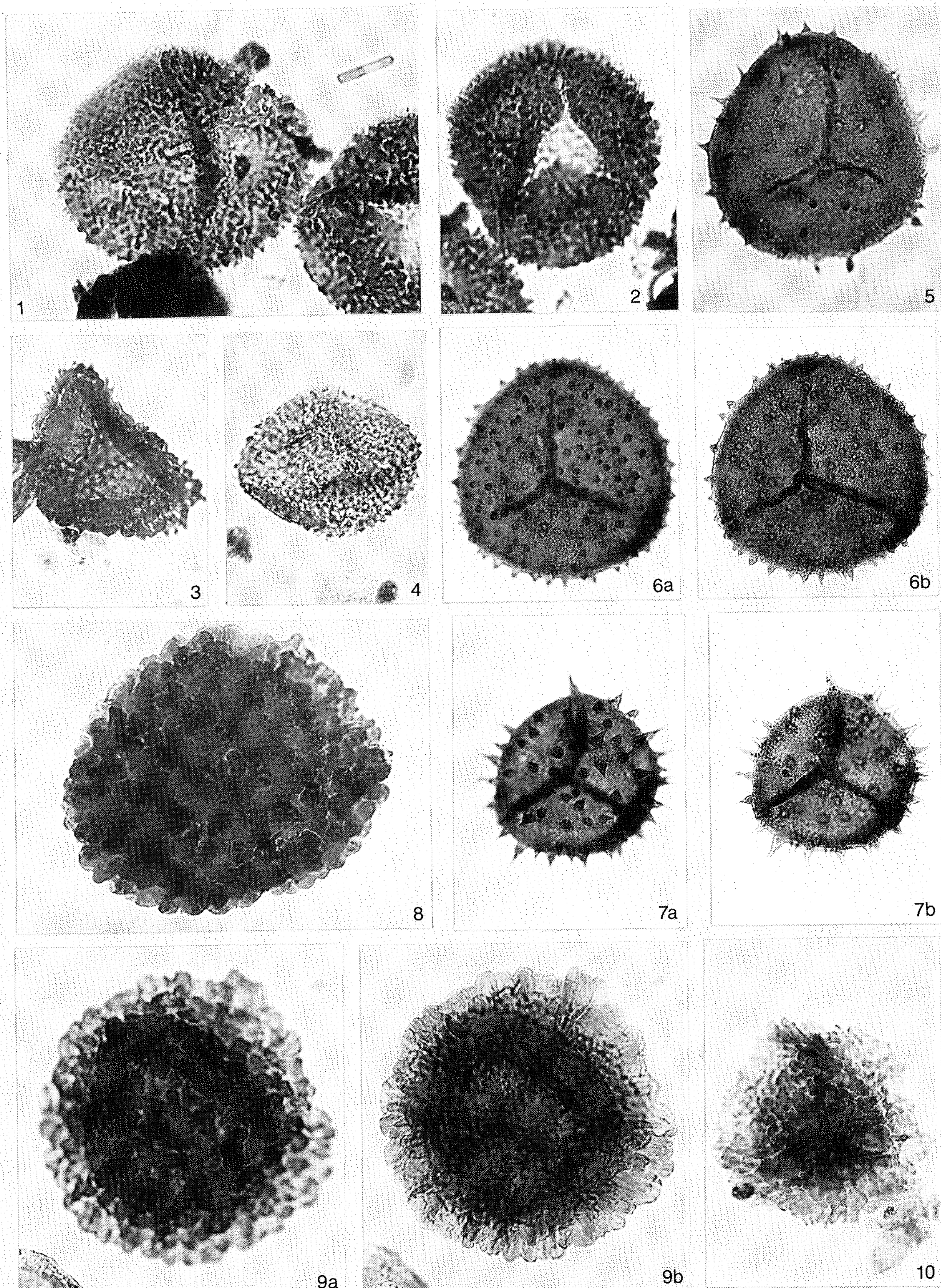
Crassispora drucei Playford 1976

Fig.	5		proximal view (MF)
Fig.	6	a	proximal view (MF)
	6	b	proximal view (HF)
Fig.	7	a	proximal view (LF)
	7	b	proximal view (HF)

Cristatisporites albus? (Arkhangelskaya 1963) McGregor and Camfield 1982

Fig.	8		distal view (HF)
Fig.	9	a	distal view (LF)
	9	b	distal view (MF)
Fig.	10		distal view (MF)

PLATE 11



GSWA 25740

Plate 12

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Cristatisporites triangulatus (Allen 1965) McGregor and Camfield 1982

Fig.	1	distal view (HF)
Fig.	2	proximal view (HF)
Fig.	3	proximal view (MF)

cf. *Cyclogranisporites* sp. de Jersey 1966

Fig.	4	? view (MF)

Cyclogranisporites sp. A Playford 1976

Fig.	5	distal view (HF)

Cymbosporites sp. cf. *C. magnificus* (McGregor 1960) McGregor and Camfield 1982

Fig.	6 a	distal view (HF)
	6 b	distal view (LF)
Fig.	7	proximal view (MF)
Fig.	8	proximal view (MF)

Cymbosporites sp. indet.

Fig.	11	? view (LF)
Fig.	12	proximal view (LF)

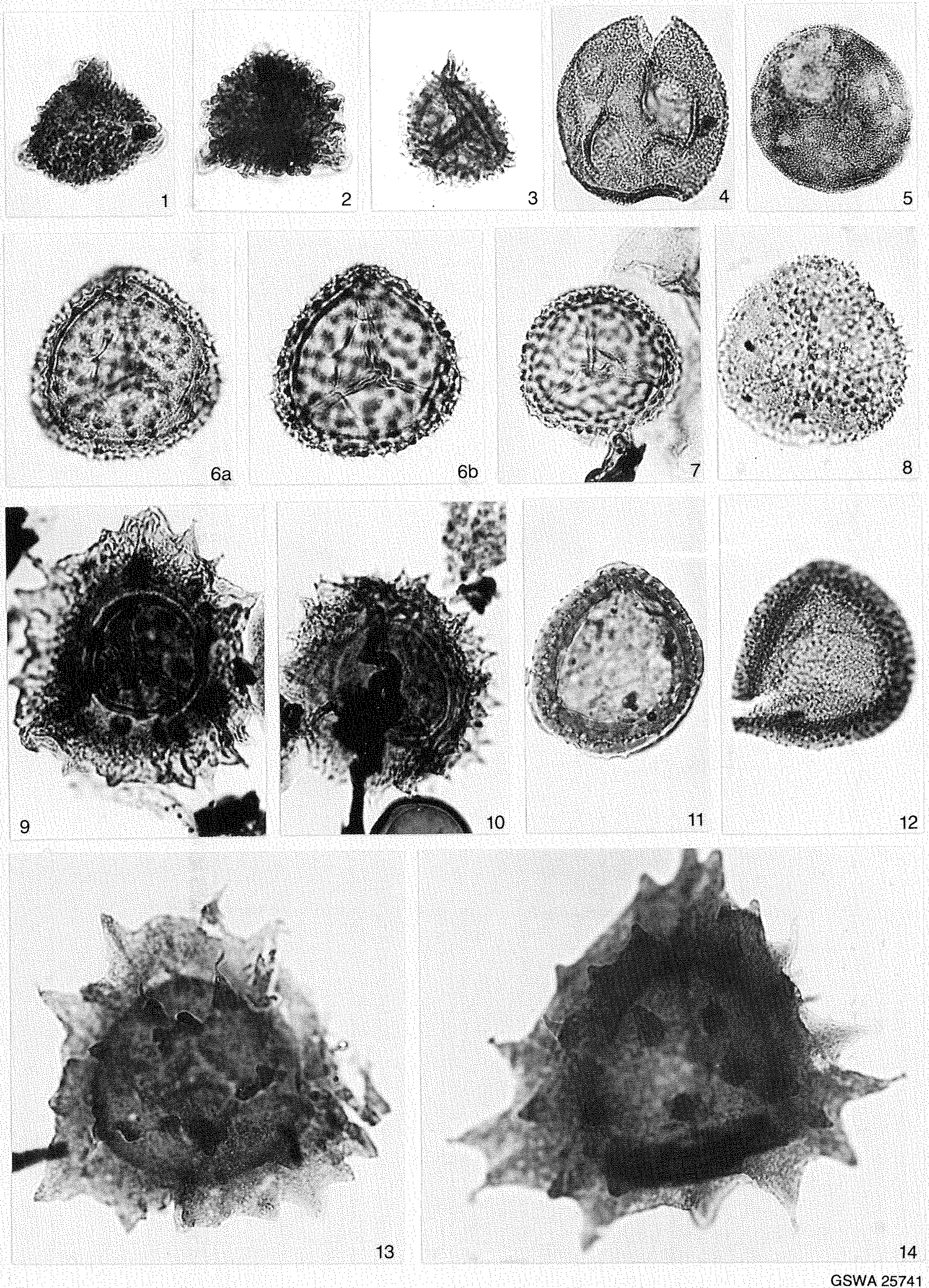
cf. *Densosporites* sp. indet.

Fig.	9	proximal view (LF)
Fig.	10	distal view (MF)

Densosporites sp. cf. *D. inaequus* (McGregor 1960) McGregor and Camfield 1982

Fig.	13	distal view (LF)
Fig.	14	proximal view (LF)

PLATE 12



GSWA 25741

04531-8

Plate 13

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Densosporites sp. cf. *D. weatherallensis* McGregor and Camfield 1982

Fig.	1	a	distal view (MF)
	1	b	distal view (LF)
Fig.	2		proximal view (MF)

Densosporites sp. indet.

Fig. 3 ? view (MF)

Diaphanospora depressa (Balme and Hassell 1962) Evans 1970

Fig.	4	distal view (LF)
Fig.	5	distal view (LF), corroded specimen

Diaphanospora perplexa Balme and Hassell 1962 emend. Evans 1970

Fig. 6 distal view (MF)

Diaphanospora riciniata Balme and Hassell 1962 emend. Evans 1970

Fig. 7 proximal view (MF)

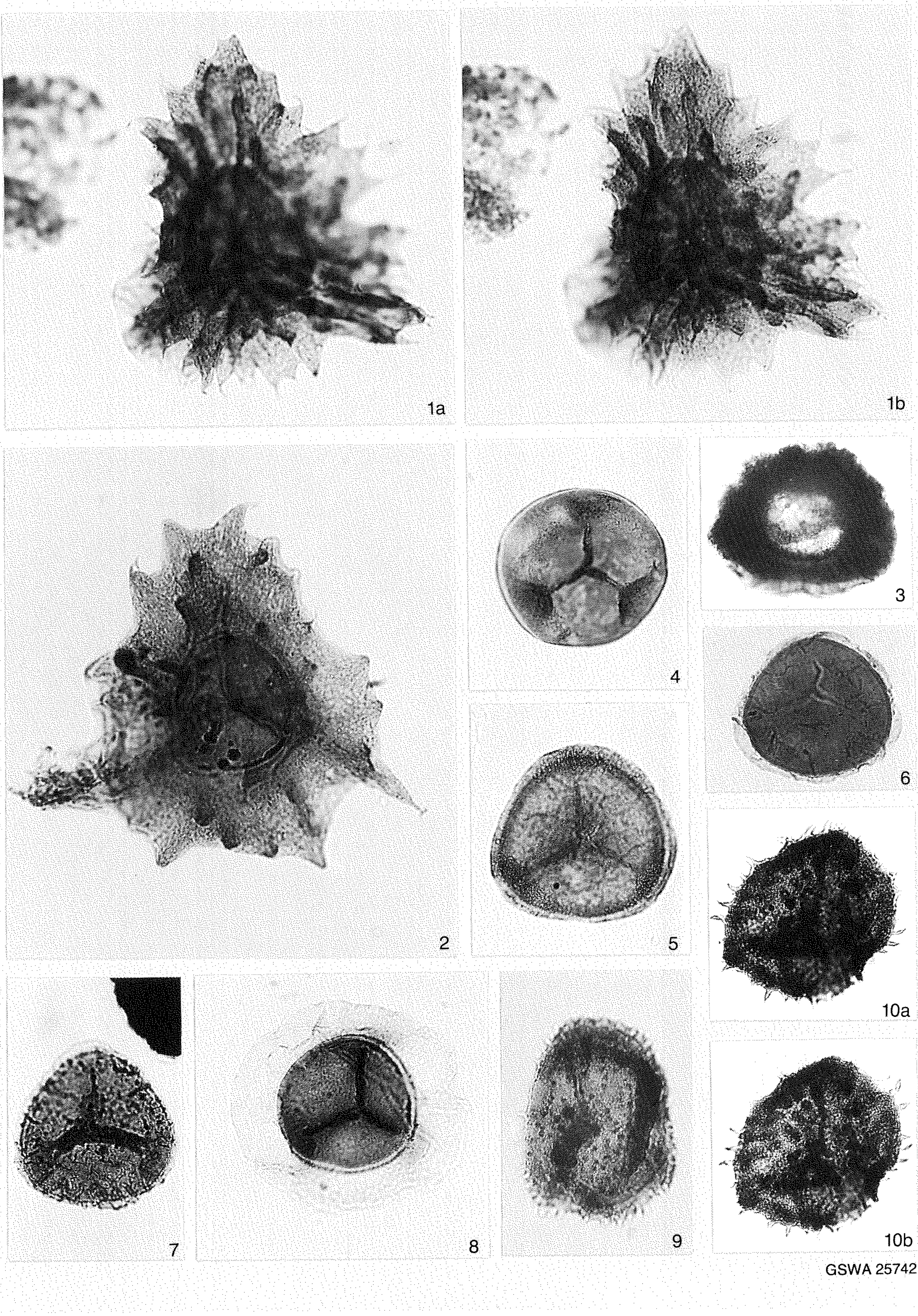
Diaphanospora sp. Balme and Hassell 1962

Fig. 8 proximal view (HF)

Dibolisporites sp. cf. *D. eifelensis* (Lanninger 1968) McGregor 1973

Fig.	9		? view (MF)
Fig.	10	a	distal view (HF)
	10	b	distal view (LF)

PLATE 13



GSWA 25742

Plate 14

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Dibolisporites cf. sp. *D. echinaceus* (Eisenack 1944) Richardson 1965

Fig.	1	a	distal view (MF)
	1	b	detail of ornament in 1a
Fig.	2		distal view (MF)
Fig.	3		? view (MF)
Fig.	4		proximal view (LF)

Dibolisporites quebecensis McGregor 1973; McGregor and Camfield 1976

Fig.	7		distal view (MF)

Dibolisporites sp. cf. Balme 1988

Fig.	5		distal view (MF)
Fig.	6	a	distal view (HF)
	6	b	distal view (LF)

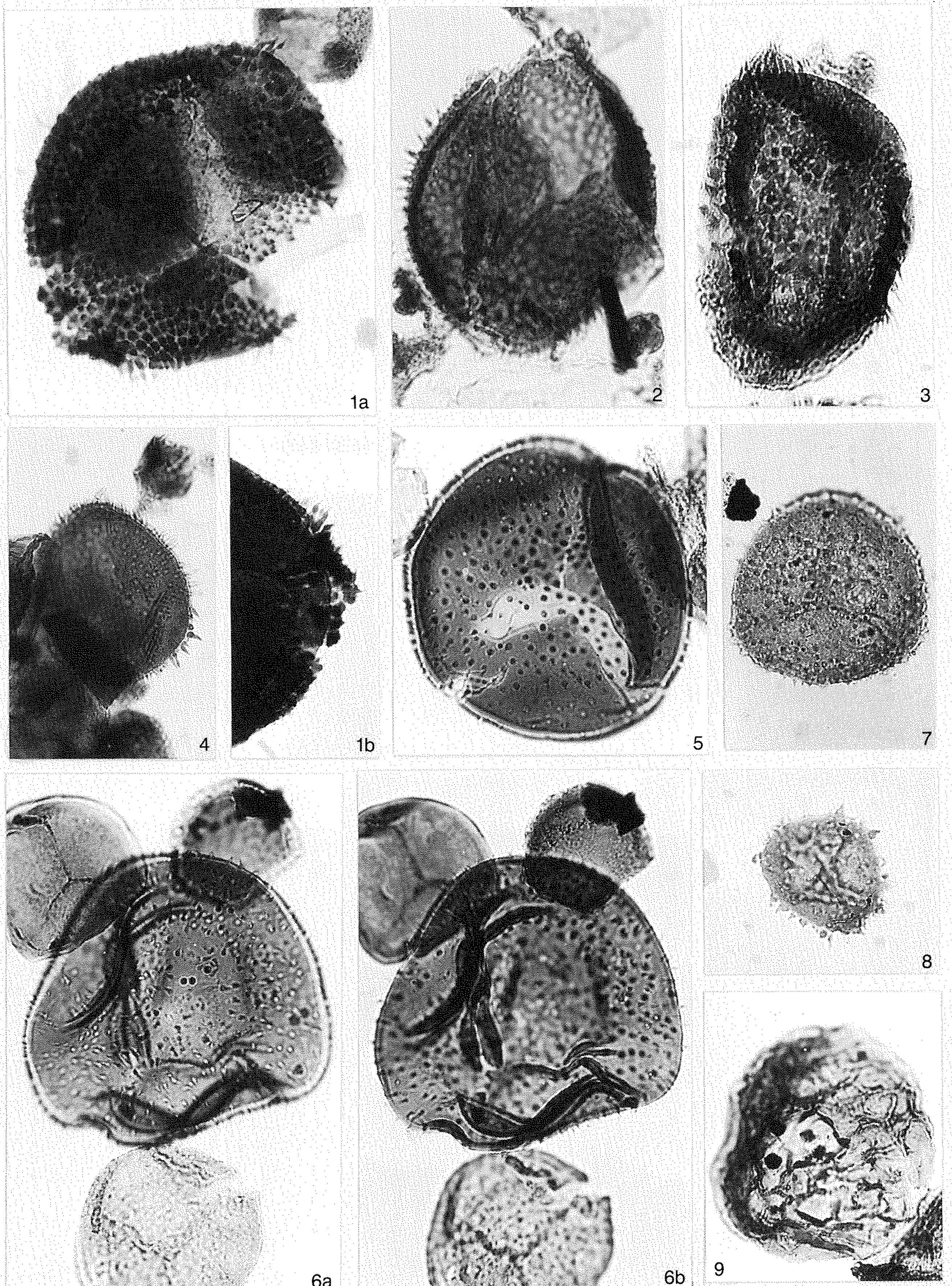
cf. *Dibolisporites wetteldorfensis* Lanninger 1968

Fig.	8		proximal view (MF)

Dictyotriletes sp. indet.

Fig.	9		? view (MF)

PLATE 14



GSWA 25743

Plate 15

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Emphanisporites rotatus McGregor 1961

Fig.	1		proximal view (HF)
Fig.	2		distal view (LF)
Fig.	3		proximal view (MF)
Fig.	4		proximal view (HF)
Fig.	5		proximal/lateral view (HF)

Endosporites gilmorensis de Jersey 1966

Fig.	6		? view (MF)
Fig.	7		proximal view (MF)
Fig.	8		proximal view (MF)

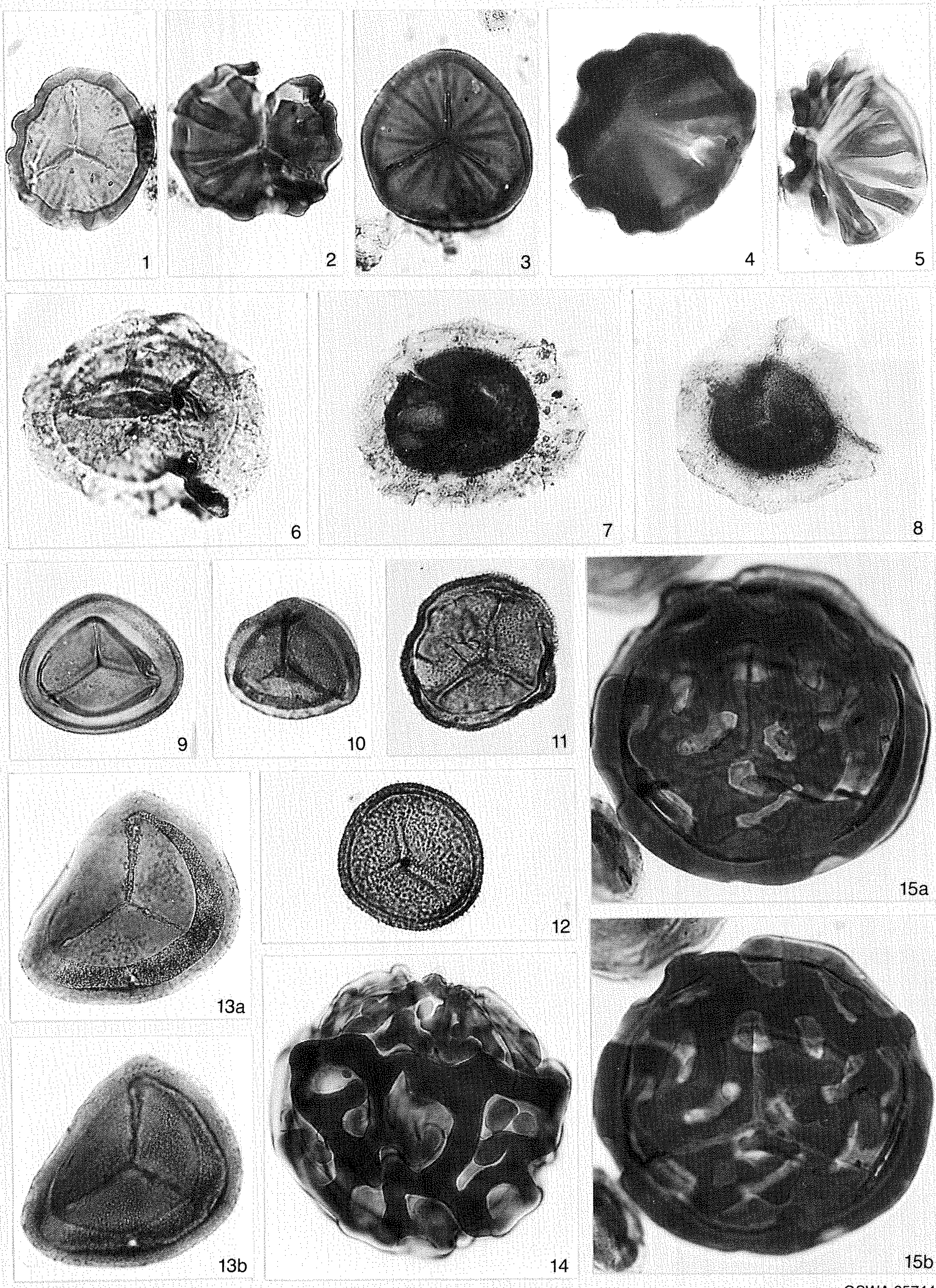
Geminospora lemurata Balme 1962 emend. Playford 1983

Fig.	9		distal view (HF)
Fig.	10		proximal view (MF)
Fig.	11		proximal view (MF)
Fig.	12		distal view (MF)
Fig.	13	a	distal view (HF)
	13	b	distal view (MF)

Gorgonispora convoluta (Butterworth and Spinner 1967) Playford 1976

Fig.	14		distal view (HF)
Fig.	15	a	distal view (HF)
	15	b	distal view (LF)

PLATE 15



GSWA 25744

Plate 16

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Gneudnaspora kernickii Balme 1988

Fig.	1		distal view (MF)
Fig.	2		proximal view (MF)

Grandispora clandestina Playford 1976

Fig.	3	a	distal view (HF)
	3	b	distal view (LF)
Fig.	4	a	distal view (HF)
	4	b	distal view (LF)
Fig.	5		distal view (HF)

cf. *Grandispora cornuta* Higgs 1975

Fig.	6		proximal view (MF)

Grandispora notensis Playford 1971

Fig.	7		proximal view (HF)
Fig.	8		proximal view (LF)
Fig.	9		proximal view (LF)

Grandispora praecipua Playford 1976

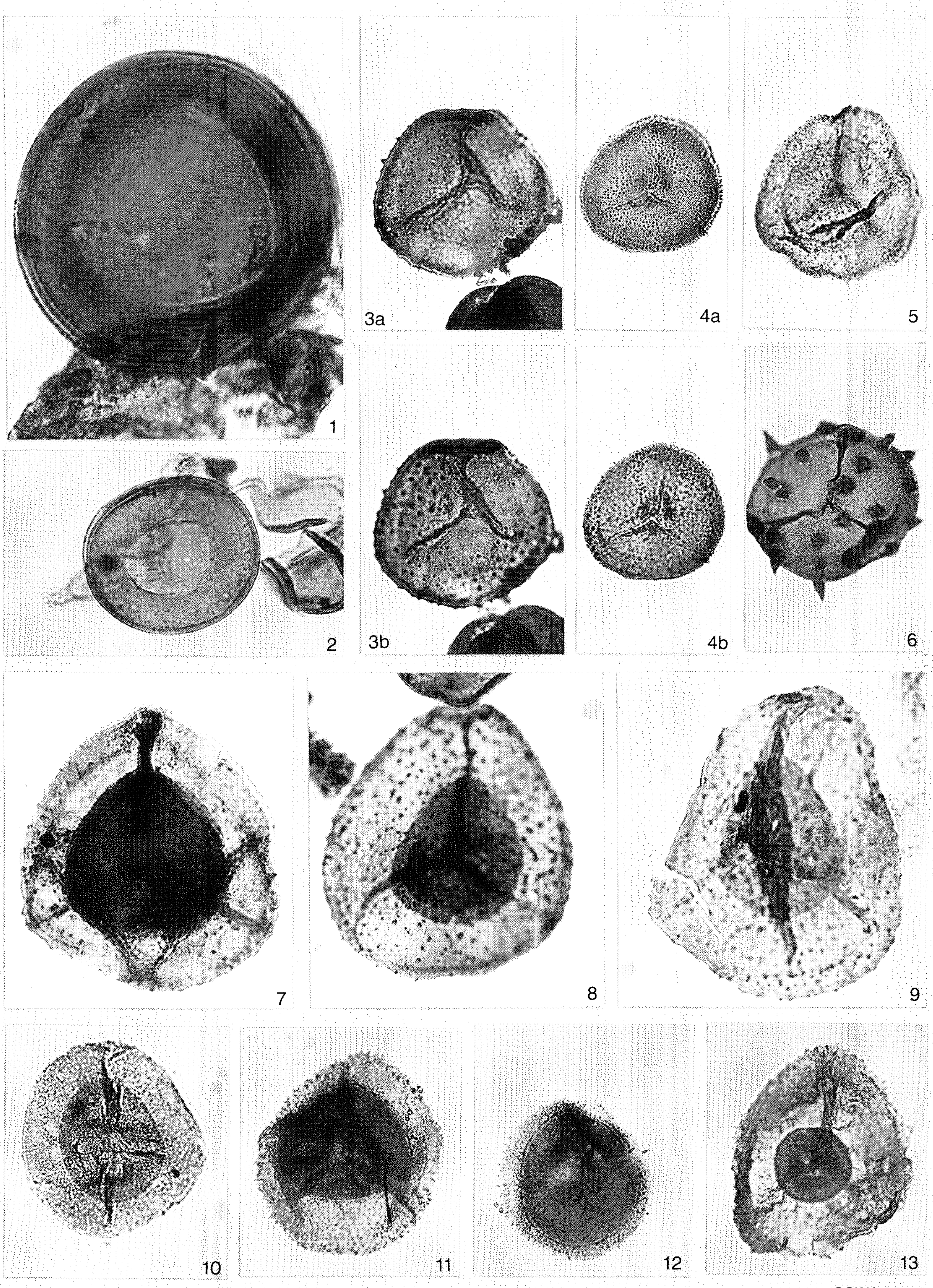
Fig.	10		proximal view (LF)

Grandispora sp. indet. Balme 1988

Fig.	11		distal view (LF)
Fig.	12		distal view (MF)

Grandispora sp. A

Fig.	13		proximal view (MF)



GSWA 25745

Plate 17

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Grandispora sp. B

Fig.	1		? view (MF)
Fig.	2		distal view (MF)

Grandispora sp. C

Fig.	3		distal view (MF)

Grandispora sp. D

Fig.	4		proximal view (MF)

Grandispora sp. E

Fig.	5		proximal view (MF)
Fig.	6		proximal view (MF)
Fig.	7		proximal view (MF)

Grandispora sp. F

Fig.	8		distal view (MF)
Fig.	9		proximal view (MF)

Grandispora sp. G

Fig.	10	a	distal view (HF)
	10	b	distal view (LF

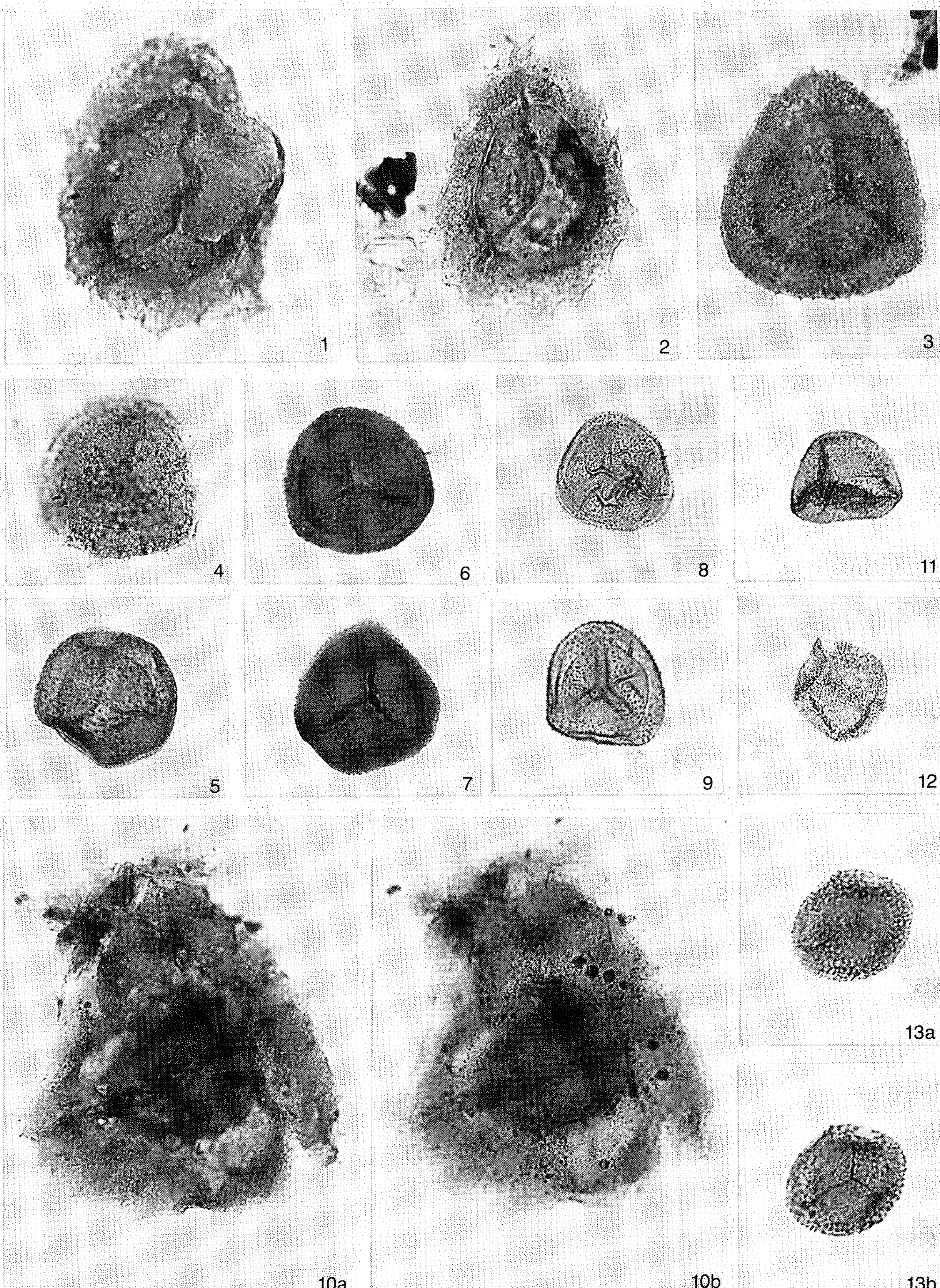
Granulatisporites frustulentus Balme and Hassell 1962 emend. Playford 1971

Fig.	11		proximal view, (HF)
Fig.	12		? view (MF)

Granulatisporites phillipsi de Jersey 1966

Fig.	13	a	proximal view (LF)
	13	b	proximal view (HF)

PLATE 17



GSWA 25746

Plate 18

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

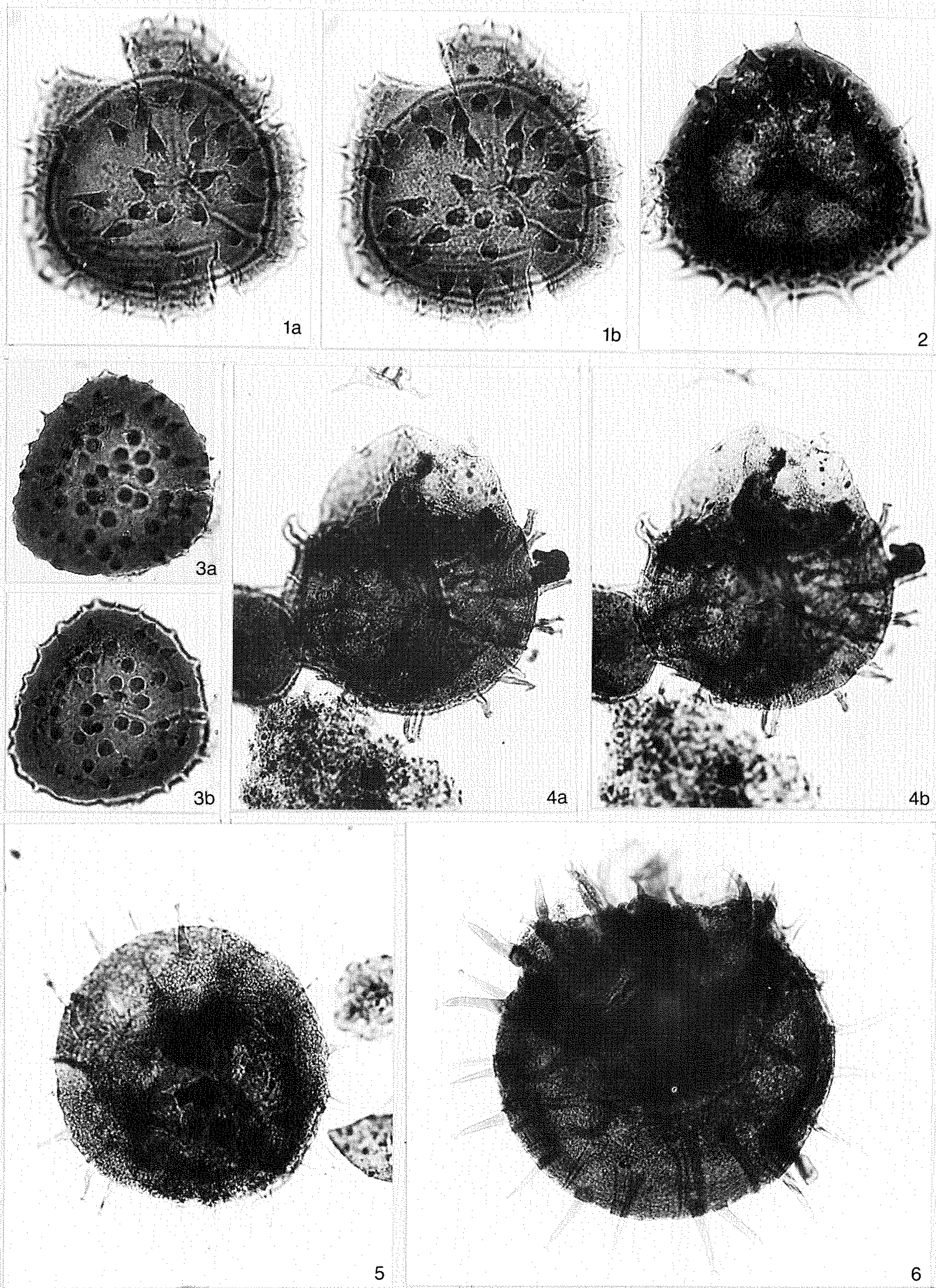
Hymenozonotriletes scorpius Balme and Hassell 1962 emend. Playford 1976

Fig.	1	a	distal	view	(HF)
	1	b	distal	view	(LF)
Fig.	2		proximal	view	(MF)
Fig.	3	a	distal	view	(HF)
	3	b	distal view (LF)		

Hystricosporites porrectus (Balme and Hassell 1962) Allen 1965

Fig.	4	a	lateral	view	(HF)
	4	b	lateral	view	(LF)
Fig.	5		?	view	(MF)
Fig.	6		lateral view (LF)		

PLATE 18



GSWA 25747

Plate 19

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Hystricosporites richardsoni de Jersey 1966

Fig.	1		? view (LF)
Fig.	2		distal view (MF)

Hystricosporites sp. indet.

Fig.	3		? view (MF)

Knoxisporites literatus (Waltz 1938) Playford 1963

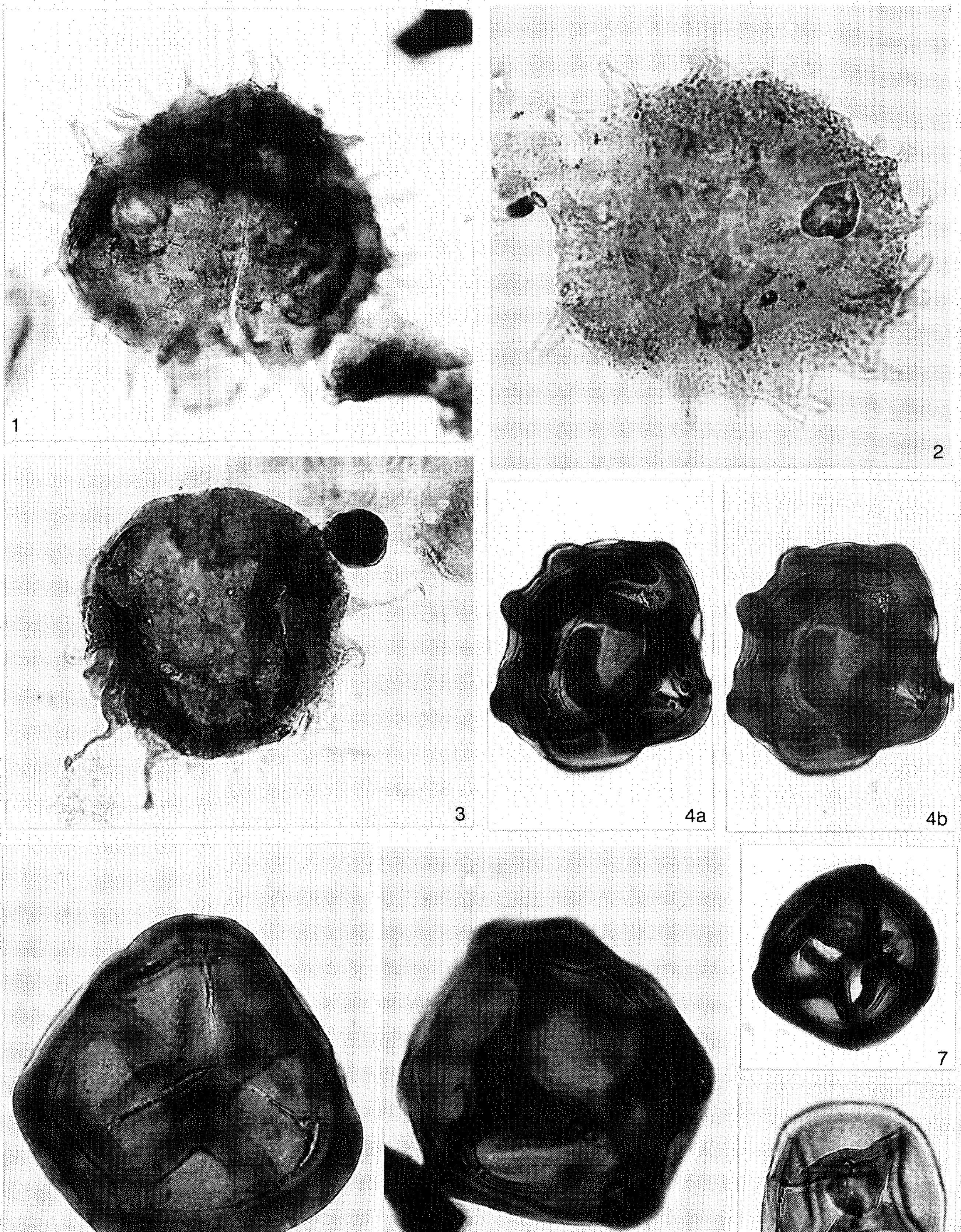
Fig.	5		proximal view (MF)
Fig.	6		proximal view (MF)

Knoxisporites pristinus Sullivan 1968

Fig.	4	a	proximal view (MF)
	4	b	proximal view (HF)
Fig.	7		proximal view (HF)

Knoxisporites sp. indet.

Fig.	8		distal view (MF)



GSWA 25748

Plate 20

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

cf. *Kraeuselisporites ollii*? (Chibrikova 1972) McGregor and Camfield 1982

Fig.	1	a	lateral view (MF)
	1	b	lateral view (HF)
Fig.	2		? view (HF)
Fig.	3		lateral view (MF)

Latosporites sp. indet.

Fig.	4		proximal view (MF)

Leiotriletes liebigensis Hodgson 1968

Fig.	7		distal view (LF)

Leiotriletes pulvereus Balme and Hassell 1962

Fig.	8		? view (MF)

Leiozonotriletes laurelensis Balme and Hassell 1962

Fig.	5		proximal view (MF)
Fig.	6		proximal view (HF), x 300

Lophozonotriletes triangulatus (Ischenko 1956) Hughes and Playford 1961

Fig.	9		distal view (MF)
Fig.	11	a	distal view (HF)
	11	b	distal view (LF)

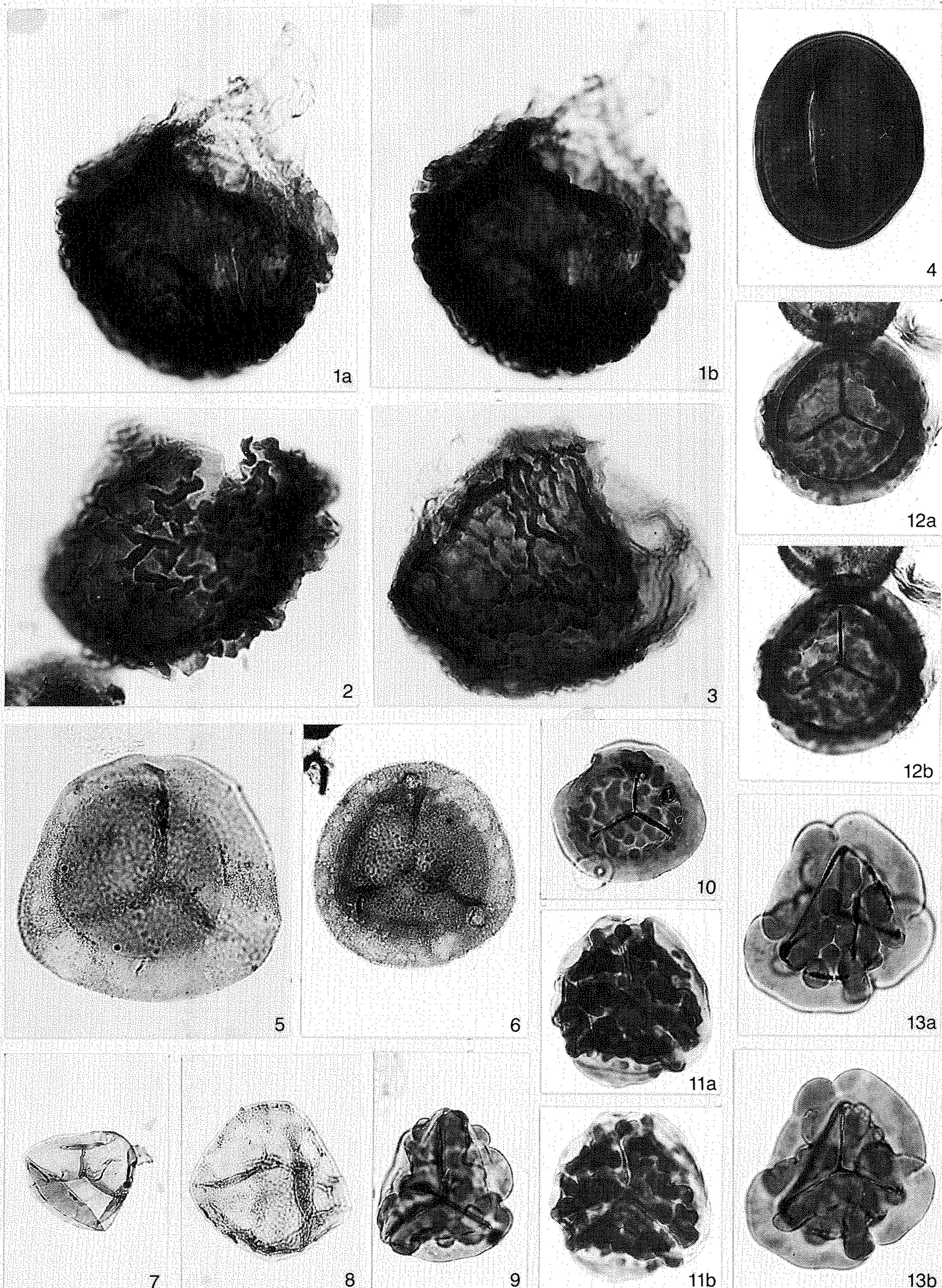
Lophozonotriletes varionodosus Playford 1982

Fig.	10		proximal view (MF)
Fig.	12	a	proximal view (MF)
	12	b	proximal view (HF)

Lophozonotriletes sp. indet.

Fig.	13	a	distal view (HF)
	13	b	distal view (MF)

PLATE 20



GSWA 25749

04531-9

Plate 21

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Medusaspora dringii Balme 1988

Fig.	1	a	proximal view (MF)
	1	b	detail of fibril in 1a
Fig.	2		proximal view (LF)
Fig.	3		proximal view (LF)

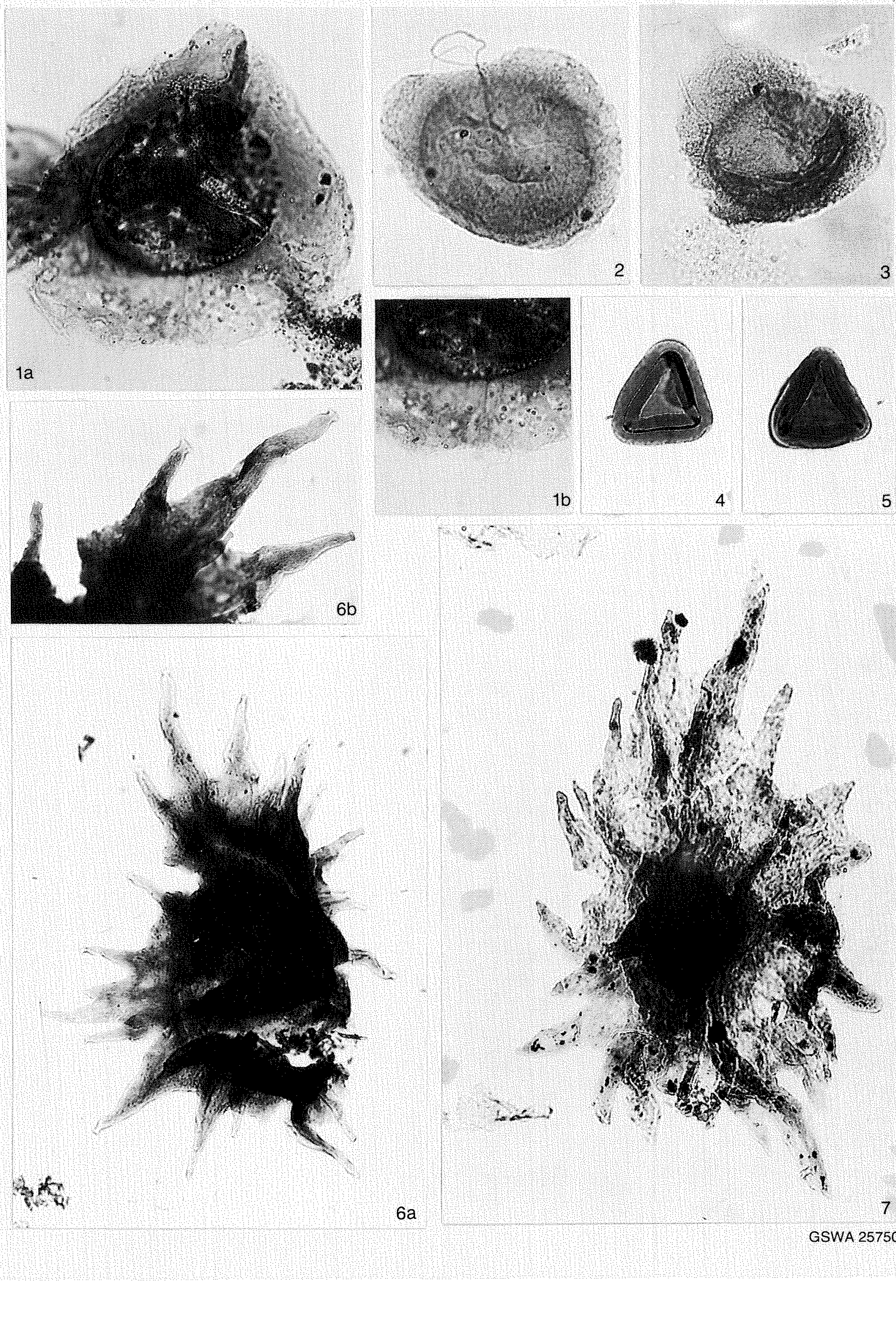
Murospora sp. indet.

Fig.	4	? view (MF)
Fig.	5	? view (MF)

Nikitinisporites spitsbergensis Allen 1965

Fig.	6	a	? view (MF), X 250
	6	b	detail of ornament in 6a, X 400
Fig.	7		? view (MF), X 400

PLATE 21



GSWA 25750

Plate 22

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

cf. *Perotriletes bifurcatus* Richardson 1962

Fig.	1	proximal view (MF)
Fig.	2	proximal view (MF)
Fig.	3	proximal view (MF)
Fig.	4	proximal view (MF)

Planisporites furfuris Balme and Hassell 1962

Fig.	5	? view, (MF)
Fig.	6	? view, (MF)

Punctatisporites etonvalensis de Jersey 1966

Fig.	7	proximal view, (MF)

Punctatisporites iterabilis Balme and Hassell 1962

Fig.	8	proximal view, (MF)

Punctatisporites sp. cf. *P. solidus* Hacquebard 1957 in Balme and Hassell 1962

Fig.	9	proximal view, (MF)

Punctatisporites sp. indet.

Fig.	10	proximal view (MF)

Raistrickia aratra? Allen 1965

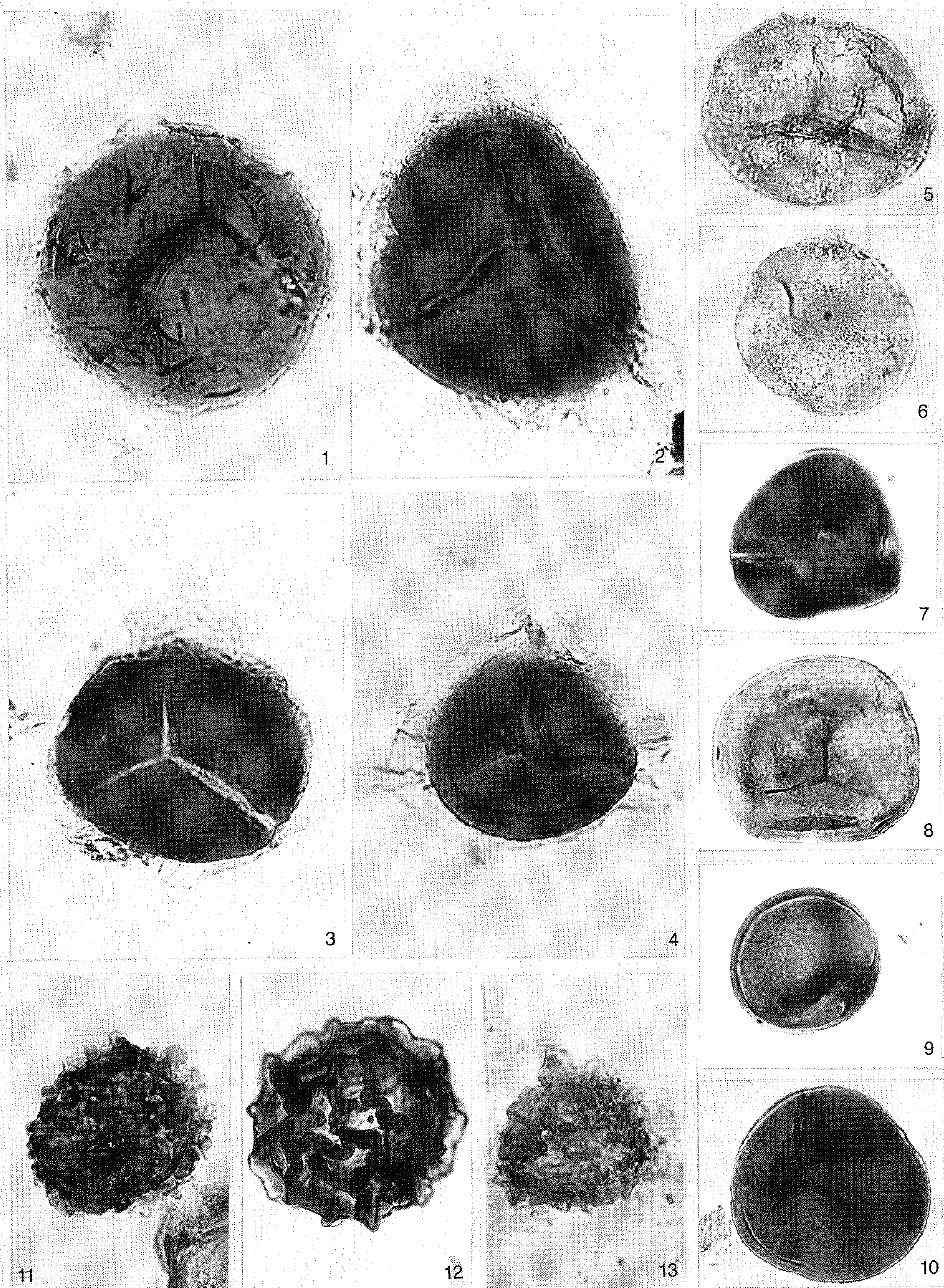
Fig.	11	distal view (MF)

Reticulatisporites ancoralis Balme and Hassell 1962

Fig.	12	distal view (HF)

Reticulatisporites sp. Balme in press

Fig.	13	? view (MF)



GSWA 25751

04531-10

Plate 23

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Retispora archaelepidophyta (Kedo 1955) McGregor and Camfield 1982

Fig.	1	distal view (MF)

Retispora lepidophyta (Kedo 1957) Playford 1976

Fig.	2	distal view (MF)
Fig.	3	proximal view (MF)

Retusotriletes actinomorphus Chibrikova 1962

Fig.	4	proximal view, (MF)
Fig.	5	distal view, (MF)

Retusotriletes biarealis McGregor 1964

Fig.	8	distal view (MF)
Fig.	9	proximal view (MF)

Retusotriletes sp. cf. *R. biarealis* McGregor 1964

Fig.	10	distal view (MF)
Fig.	11	lateral view (MF)

Retusotriletes digressus Playford 1976

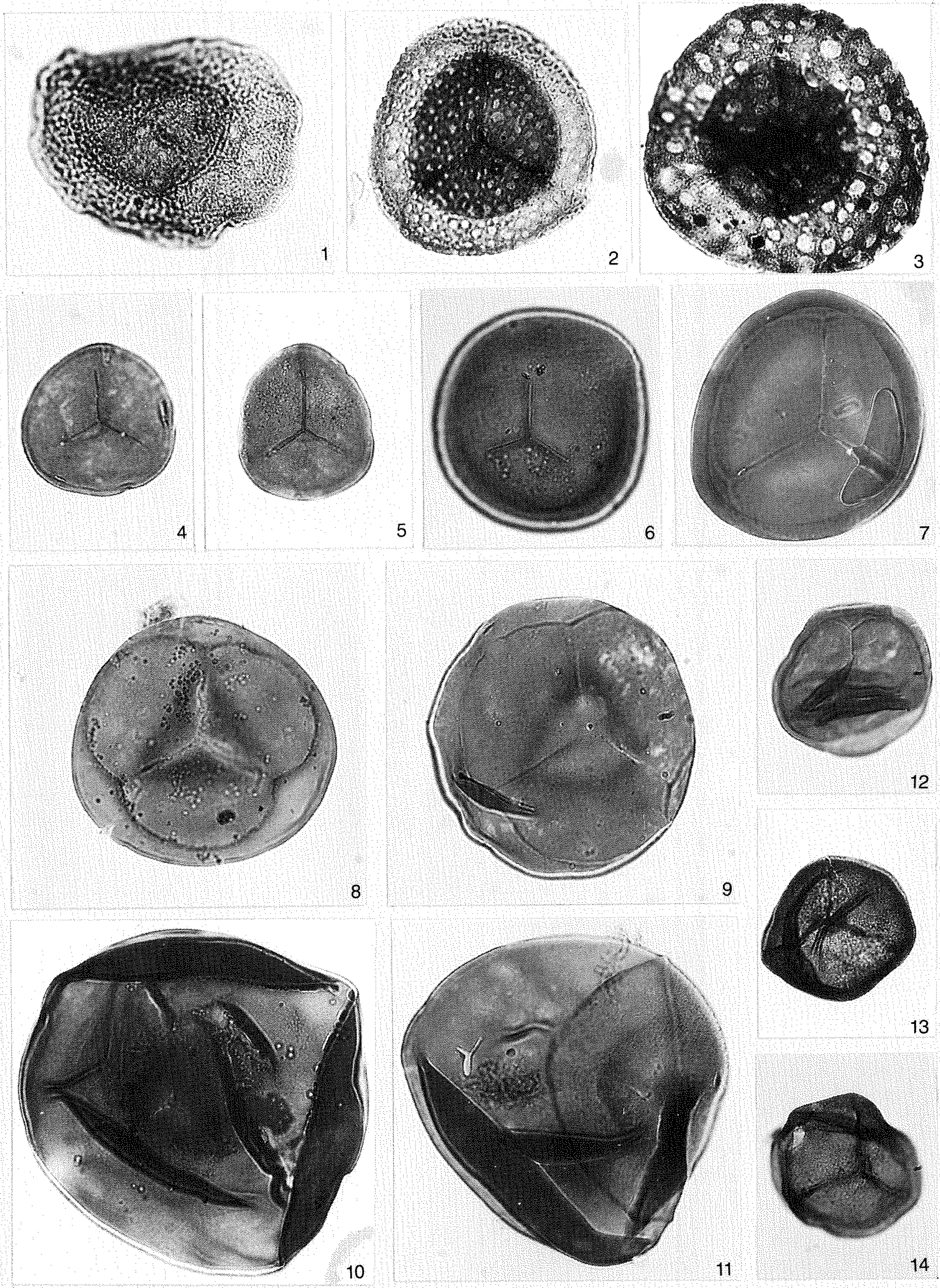
Fig.	6	proximal view (MF)

Retusotriletes distinctus? Richardson 1965

Fig.	7	proximal view (MF)

Retusotriletes punctimedianus Balme 1988

Fig.	12	proximal view (MF)
Fig.	13	proximal view (MF)
Fig.	14	proximal view (MF)



GSWA 25752

Plate 24

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Retusotriletes pychovii Naumova 1953

Fig.	1	proximal view (MF)
Fig.	2	proximal view (MF)

Retusotriletes rotundus (Streel 1964) Streel 1967

Fig.	3	distal view (MF)
Fig.	4	proximal view (MF)
Fig.	5	distal view (MF)

Retusotriletes simplex Naumova 1953

Fig.	6	proximal view (MF)

Retusotriletes sp. indet.

Fig.	7	proximal view (MF)

Rhabdosporites sp. cf. *R. langii* (Eisenack 1944) Richardson 1960

Fig.	9	proximal view (MF)
Fig.	10	? view (MF)

?*Rhabdosporites* sp. indet.

Fig.	8	? view (MF)

Stenozonotriletes clarus Ischenko 1958

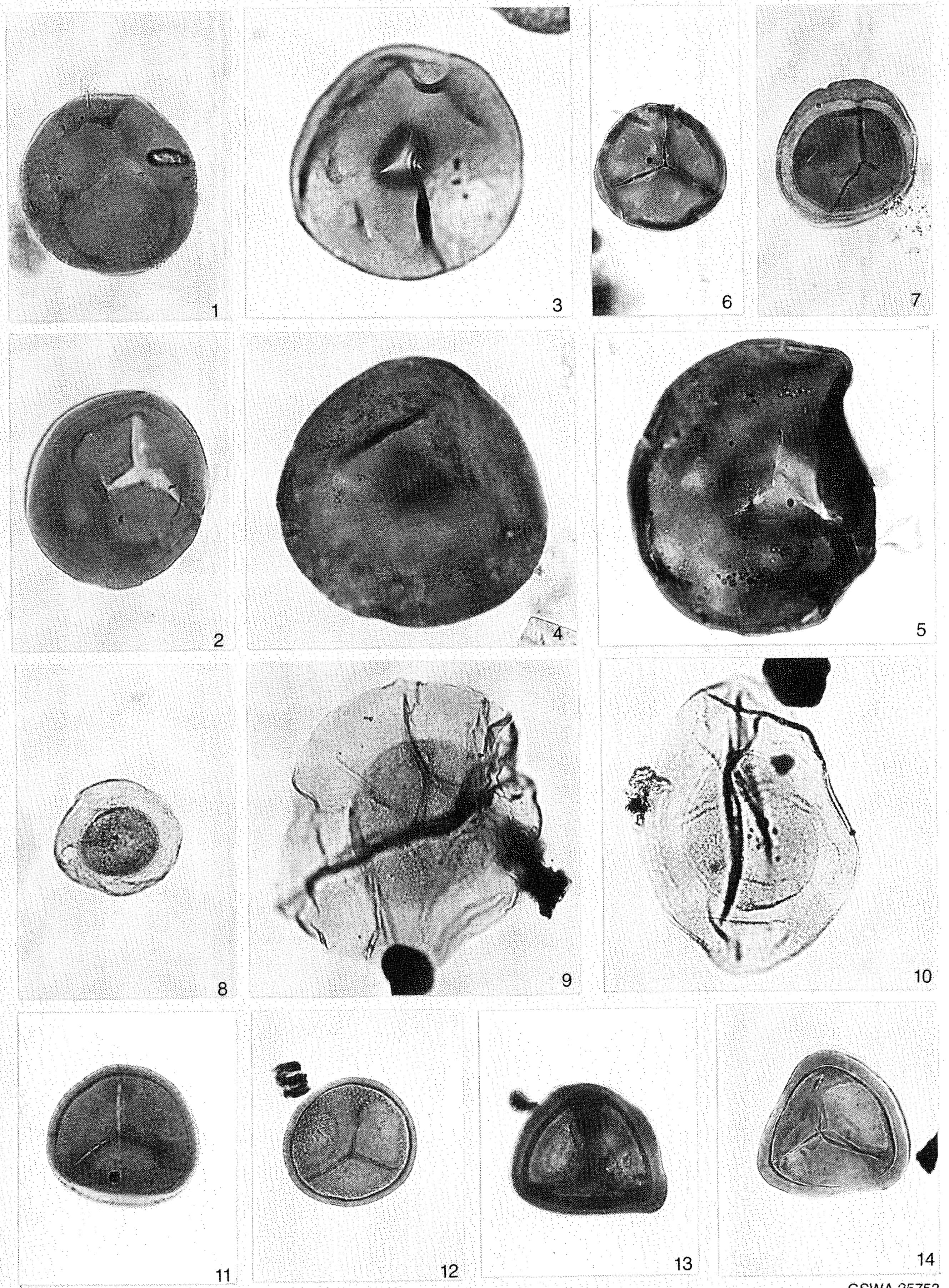
Fig.	11	proximal view (MF)
Fig.	12	distal view (MF)

Stenozonotriletes forticulus Balme and Hassell 1962

Fig.	13	distal view (MF)

Stenozonotriletes simplex Naumova 1953

Fig.	14	proximal view (MF)



GSWA 25753

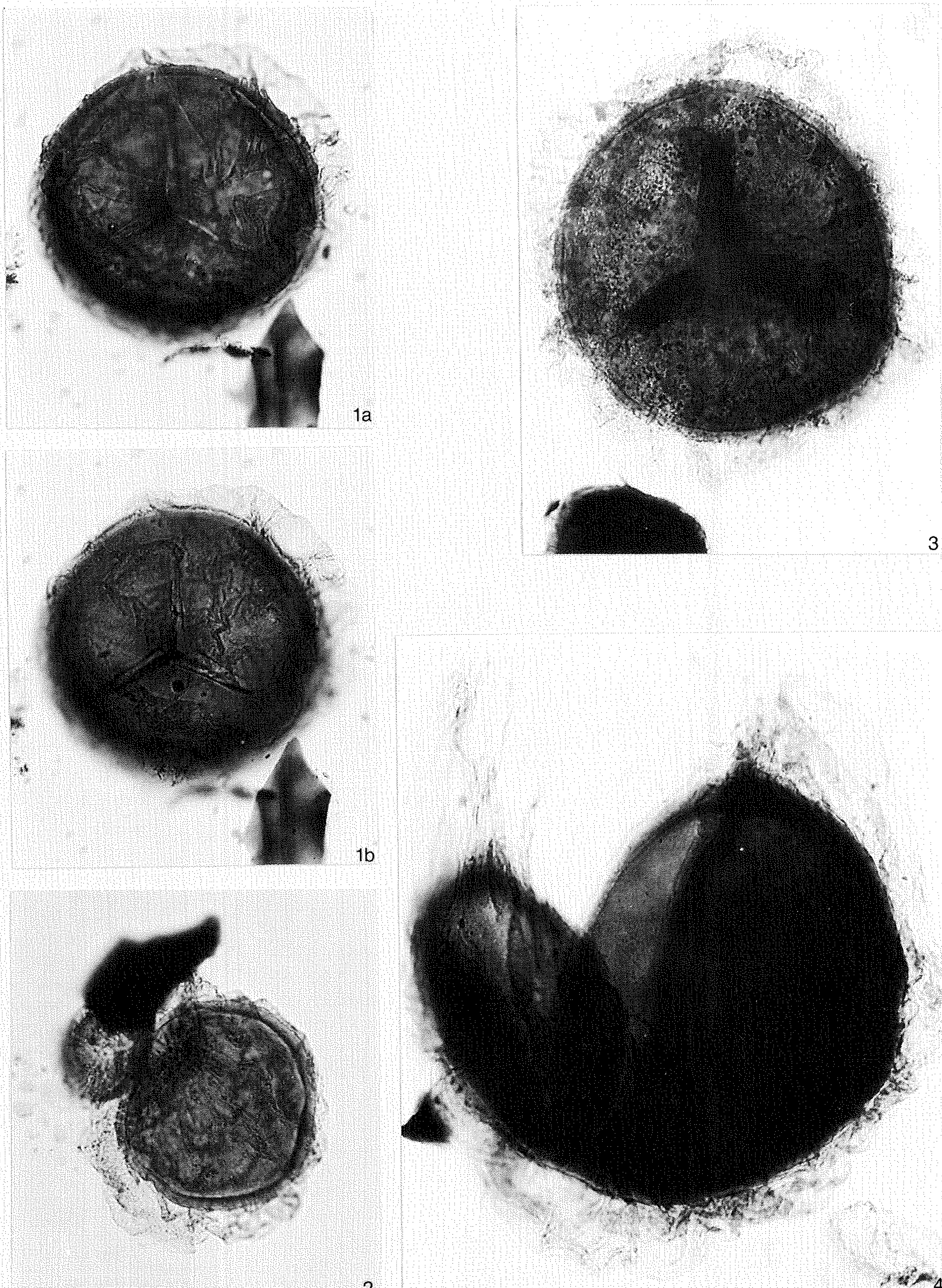
Plate 25

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Velamisporites sp. cf. *V. rugosus* Bharadwaj and Venkatachala 1962 of Playford 1971

Fig.	1	a	proximal view (LF)
	1	b	proximal view (MF)
Fig.	2		proximal view (MF)
Fig.	3		proximal view (MF)
Fig.	5		lateral view of large specimen showing double thickness of exine wall (MF)

PLATE 25



GSWA 25754

Plate 26

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Stenozonotriletes sp. C Playford

Fig.	1		proximal view (MF)
Fig.	2		distal view (MF)

Verrucosisporites confertus Owens 1971

Fig.	3		proximal view (MF)

Verrucosisporites mucronatus Streel 1964

Fig.	4		proximal view (MF)
Fig.	5	a	distal view (MF)
	5	b	distal view (MF)

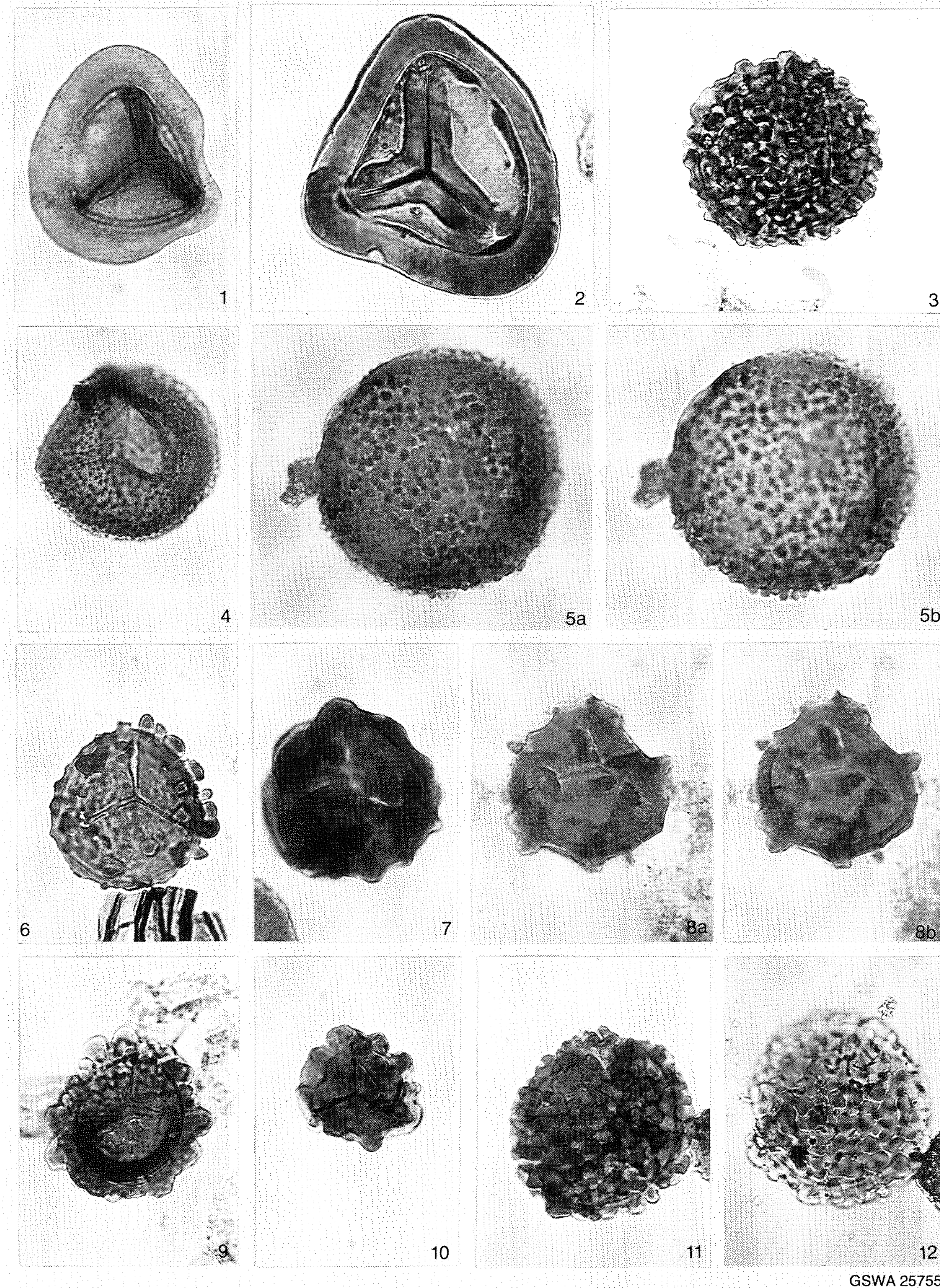
Verrucosisporites premnus Richardson 1965

Fig.	6		proximal view (LF)
Fig.	7		distal view (MF)
Fig.	8	a	distal view (HF)
	8	b	distal view (LF)
Fig.	9		proximal view (MF)
Fig.	10		proximal view (MF)

Verrucosisporites pulvinatus de Jersey 1966

Fig.	11		distal view (HF)
Fig.	12		distal view (MF)

PLATE 26



GSWA 25755

Plate 27

All illustrations x 600 except where specified. HF = high focus, MF = mid focus, LF = low focus.

Verrucosisporites scurrus (Naumova 1953) McGregor and Camfield 1982

Fig.	1		proximal view (HF)
Fig.	2		distal view (MF)
Fig.	3	a	proximal view (LF)
	3	b	proximal view (HF)
Fig.	4		distal view (MF)
Fig.	5	a	distal view (HF)
	5	b	distal view (MF)

Gen. and sp. indet. 1

Fig.	6	proximal view (MF)

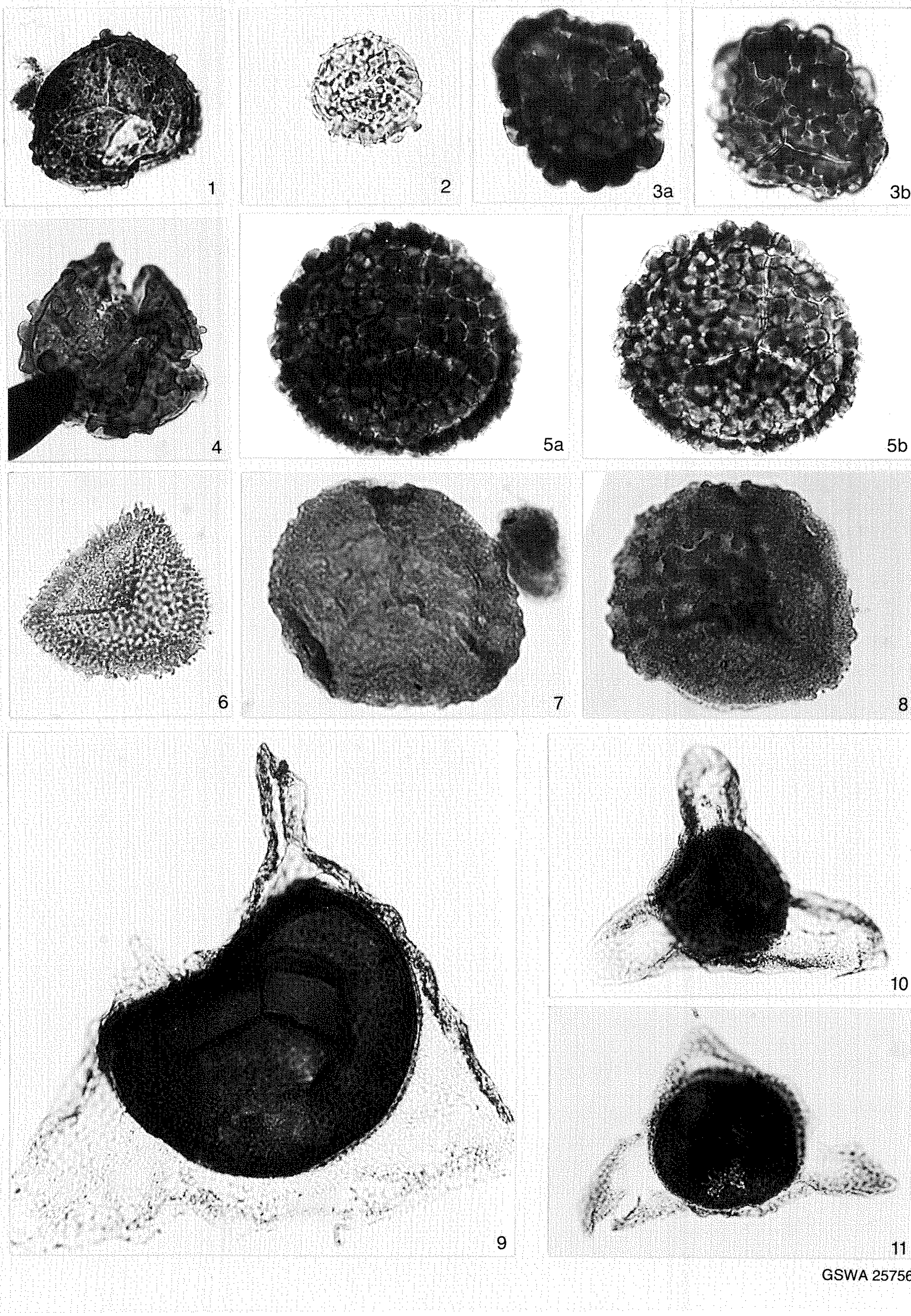
Gen. and sp. indet. 2

Fig.	7	proximal view (MF)
Fig.	8	distal view (MF)

Gen. and sp. indet. 3

Fig.	9	proximal view (MF)
Fig.	10	proximal view (MF)
Fig.	11	distal view (MF)

PLATE 27



GSWA 25756

Systematic index

04531/11/91-500-L/5590

GARRY L. DUFFIELD, Government Printer, Western Australia