DEPARTMENT OF MINES AND ENERGY

Rept.Bk.No. 85/40

PALYNOLOGY AND AGE OF SELECTED SAMPLES FROM BOREHOLES SOUTH-EAST OF LAKE EYRE

GEOLOGICAL SURVEY

by

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BIOSTRATIGRAPHY

JULY, 1985

D.M.E. No. 372/77

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DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK.NO. 85/40
BIOSTRAT NO.2/85
DME. NO. 372/77
DISK NO. 18

PALYNOLOGY AND AGE OF SELECTED SAMPLES FROM BOREHOLES SOUTHEAST OF LAKE EYRE

ABSTRACT

A palynoflora from Palankarinna 1 Well (104.9 m) is assigned to either the uppermost *Phimopollenites pannosus* spore/pollen Zone or the *Appendicisporites distocarinatus* spore/pollen Zone, and is therefore of latest Albian to Cenomanian age. The sedimentary unit sampled is terrestrial, probably Winton Formation.

Palynofloras from Poole Creek 2 Well (27.8-30.9 m) are assigned to the *Crybelosporites striatus* spore/pollen Zone and the *Pseudoceratium turneri* Subzone b microplankton unit of latest Aptian to Early Albian age. The sedimentary unit sampled is marginal marine, probably uppermost Bulldog Shale or Coorikiana Sandstone Member of the Oodnadatta Formation. Deposition occurred during a marine transgressive phase, possibly during the Early Albian.

A few samples proved to be barren of palynomorphs including Poole Creek 2 (24.2 m), Poole Creek 1 (18.2 m) and Lake Hydra (outcrop).

INTRODUCTION

During 1984 a number of fully cored stratigraphic wells were drilled in the southeastern Lake Eyre area (Callen and Plane, 1985). Selected core samples from three of these wells and one grab sample from outcrop were submitted by R.A. Callen (Regional Geology) for palynological dating. Details of the samples are:

TABLE 1

SAMPLE DETAILS

PALYNO-LOGICAL NO.	BOREHOLE NAME	LOCATION LATITUDE/LONGITUDE	DEPTH IN (METRES)	LITHOSTRATIGRAPHIC UNIT
S5917	Palankarinna 1	28°45'56"/138°23'41"	104.9	?Marree Subgroup
S5931	Poole Creek 1	29°07'54"/137°39'06"	18.2	Marree Subgroup
S5932	Poole Creek 2	29°37'45"/137°38'42"	24.2	Marree Subgroup
S5914	Poole Creek 2	as above	27.8	as above
S5915	Poole Creek 2	as above	29.7	as above
S5916	Poole Creek 2	as above	30.9	as above
S5989	Lake Hydra	28°51'36"/137°57'48"	outcrop	?Cainozoic clay

PROCEDURES

The samples were treated with a slightly modified traditional laboratory procedure involving:

- Wash in 10% HCl.
- Heat in water bath with 70% HF for 3 hours.
- Boil in conc. HCl for 30 minutes.
- Add Brij 35 and treat by ultrason for 30 seconds.
- Heavy liquid separation with zinc bromide (S.G.2).
- Treat with Schulze solution ($KClO_3$ and conc. HNO_3) for 5-7 minutes.
- Wash in 10% K_2CO_3 for a few seconds.
- Differential centrifuging up to six cycles.
- Mount in glycerin jelly dyed with Safranin O.

Microscope analyses were undertaken with a Zeiss Photomicroscope III. To allow percentage frequency calculations to be made of dominant pollen and spore types, more than 300 palynomorphs per sample were counted. Following this, each sample was scanned to record the presence of less frequently occurring species. The palynomorphs recorded in each sample along with the relative frequency per cent of the dominant types are listed in Appendix 1. Some commonly occurring palynomorphs along with palynomorphs used for determining zonal boundaries are shown in Appendix 2.

PALYNOLOGY AND AGE

Palankarinna 1

Yield and preservation of palynomorphs from this sample are very good (Appendix 1). The assemblage is dominated by the spores *Cyathidites minor* Couper 1953 (34%), *Gleicheniidites circinidites* (Cookson) Dettmann 1963 (10%), *Laevigatosporites ovatus* Wilson & Webster 1946 (10%), *Cicatricosisporites cuneiformis* Pocock 1965 (6%), and *Osmundacidites wellmanii* Couper 1953 (5%).

A number of recycled palynomorphs occur including the Jurassic to Early Cretaceous species *Anapiculatisporites pristidentatus* Reiser and Williams 1969, *Annulispora folliculosa* (Rogalska) de Jersey 1959, *Laevigatosporites belfordii* Burger 1976, *Polycingulatisporites clavus* (Balme) Burger 1980 and *Rogalskaisporites cicatricosus* (Rogalska) Danze-Corsin & Laveine 1963. One recycled pollen of Permian age, *Protohaploxypinus amplus* (Balme & Hennelly) Hart 1964, was also recorded. The sample contained one specimen of the marine dinoflagellate *Epilidosphaeridia pentagona* Morgan 1980, the upper range of which is within the *Phimopollenites pannosus* spore-pollen Zone (Figure 1) of Late Albian age (Morgan, 1980a). Since the sample contains pollen and spores of a younger age (see below) the dinoflagellate is regarded as a reworked specimen and the sample as nonmarine. Recyling of pollen and spores is common in Eromanga Basin sediments (Morgan, 1980a; Alley, 1984) and thus upper ranges of species are not used in this report for determining spore/pollen zonal boundaries. Recycling of Cretaceous microplankton within the Early Cretaceous sequences is uncommon and last occurrences are still useful in defining zonal boundaries.

The spore/pollen assemblage could be assigned to either the uppermost *Phimopollenites pannosus* Zone or the *Appendicisporites distocarinatus* Zone (Figure 1) on the basis of the evidence presented below. This implies that the sample is of Cenomanian age.

Dettmann and Playford (1969) define the above two zones according to the stratigraphic ranges of the following species:

1. *Phimopollenites pannosus* zone

This zone forms the youngest part of Dettmann's (1963) *Paradoxa* Assemblage characterized by the association of *Coptospora paradoxa* (Cookson & Dettmann) Dettmann 1963 and *Phimopollenites pannosus* (Dettmann & Playford) Dettmann 1973. Other features include the last appearance of *Foraminisporis asymmetricus* (Cookson & Dettmann) Dettmann 1963 and the presence of *Kraeuselisporites jubatus* Dettmann and Playford 1968, *K. majus* (Cookson & Dettmann) Dettmann 1963, *Trilobosporites trioreticulosus* Cookson and Dettmann 1958, *Cicatricosisporites pseudotripartitus* (Bolkhovitina) Dettmann 1963 and *Balmeisporites holodictyus* Cookson and Dettmann 1958.

All of the above species are recorded in the sample from Palankarinna 1 (Appendix 2).

2. *Appendicisporites distocarinatus* Zone

Present in this zone are *Phimopollenites pannosus* and *Appendicisporites distocarinatus* Dettmann and Playford 1968, but absent is *Coptospora paradoxa*, the last occurrence of which defines the base of the zone. Two species, *Australopollis obscurus* (Harris) Krutzsch 1966 and *Balmeisporites glenelgensis* Cookson & Dettmann 1958, make their first appearances in the lower part of the zone, and *Triorites minor* Couper 1953 in the upper part of the zone. The last occurrence of *Appendicisporites distocarinatus* defines the upper boundary of the zone.

Appendicisporites distocarinatus forms 2% of the assemblage from Palankarinna 1 and *Balmeisporites glenelgensis* is common, although forming less than 1% of the assemblage. *Australopollis obscurus* and *Triorites minor* were not observed even though the sample contained abundant palynomorphs.

Thus, the assemblage can only be as old as the uppermost *Phimopollenites pannosus* Zone or as young as the lower part of the *Appendicisporites distocarinatus* Zone. The latter probably applies because of the presence of *Balmeisporites glenelgensis*

and the absence of *Australopollis obscurus* (which makes its first appearance later in the zone than *B. glenelgensis* (Dettmann and Playford, 1969) and *Triorites minor*.

The above determination places the interval sampled in Palankarinna 1 (104.9-104.96 m) in the early Cenomanian, implying that the sedimentary unit sampled is Winton Formation. The Cenomanian aspect of the palynoflora is strengthened by the presence of species which first appear at the base of the Cenomanian (see Dettmann, 1973, and Norvick and Burger, 1975). These species include (Appendix 2):

Cupuliferoidaepollenites parvulus (Groot & Penny) Dettmann 1973

Herkosporites proxistriatus Norvick and Burger 1975

Liliacidites katangataensis Couper 1953

Senectotetradites fistulosus Dettmann 1973

Stoverisporites microverrucatus Norvick and Burger 1975

Other taxa which are also characteristic of Cenomanian palynofloras are the angiosperm pollen *Phimopollenites augathallaensis* (Burger) Dettmann 1973, *Senectotetradites varireticulatus* Dettmann 1973, and *Tricolpites minutus* (Brenner) Dettmann 1973 (Appendix 2).

Rare occurrences of *Clavifera triplex* (Bolkhovitina) Bolkhovitina 1966 (Appendix 2) in the sample confirm the notion that the first appearance of this species is much earlier than the base of the *Clavifera triplex* Zone (Morgan, 1980a).

Poole Creek 2

Yield and preservation of palynomorphs in these samples ranges from fair to poor; the sample from 24.2 m is barren of palynomorphs. Pollen/spore assemblages from the samples 27.8-30.9 m are dominated by *Podocarpidites ellipticus* Cookson 1947 (20-28%), *Cyathidites minor* (12-15%), *Microcachryidites antarcticus* Cookson 1947 (10-15%), *Stereisporites antiquasporites* (Wilson & Webster) Dettmann 1963 (6-8%), *Baculatisporites comaumensis* (Cookson) Potonie 1956 (4-6%), *Alisporites grandis* (Cookson) Dettmann 1963 and *Osmundacidites wellmanii* (Appendix 2). Commonly occurring species that form only a few percent of the assemblage include *Alisporites similis* (Balme) Dettmann 1963,

Araucariacites australis Cookson 1947, *Ceratosporites equalis* Cookson and Dettmann 1958, *Cicatricosisporites australiensis* (Cookson) Potonie 1956, *Cyathidites australis* Couper 1953, *Osmundacidites dubius* Burger 1980, *Podocarpidites multesimus* (Bolkhovitina) Pocock 1962 and *Trisaccites microsaccatus* (Couper) Couper 1960.

Marine microplankton are also common in the samples and at 27.8 m form 5% of the total palynomorph assemblage and at 30.9 m form 11% of the palynomorphs counted. The presence of significant numbers of dinoflagellates and acritarchs indicates that the samples are from marine strata. Only two species, *Chlamydophorella nyei* Cookson and Eisenack and *Spinidinium boydii* Morgan 1975, are frequent enough to form 1% of the palynomorph assemblages. Other commonly occurring species (particularly at 30.9 m) are *Cleistosphaeridium aciculare* Davey 1969, *Cribroperidinium muderongense* (Cookson & Eisenack) Davey 1969, and *Lithodinia helbyi* Morgan 1980 (Appendix 2).

Recycling of palynomorphs has occurred again as shown by the presence of the Jurassic species *Camarozonosporites clivosus* (Williams & McKellar) McKellar 1974, and *Rogalskaisporites cicatricosus*; and the Permian species *Plicatipollenites gondwanensis* (Balme & Hennelly) Lele 1964, and *Protohaploxypinus amplus*.

Evidence presented below indicates that the assemblages are assignable to the *Crybelosporites striatus* spore/pollen Subzone of Dettmann and Playford (1969) or the *Pseudoceratium turneri* Subzone b of Morgan's (1977, 1980) microplankton units (Figure 1). The designation implies that the interval sampled in Poole Creek 2 is of latest Aptian to Early Albian age.

The presence of the spore *Crybelosporites striatus* (Cookson & Dettmann) Dettmann 1963 (Appendix 2) indicates that assemblages are no older than the *Crybelosporites striatus* Zone, whereas the lack of *Coptospora paradoxa* and its zonal associates suggests an age no younger than the base of the succeeding *Coptospora paradoxa* Zone (Figure 1). This conclusion is supported by the microplankton evidence. Morgan (1980) shows that the *Pseudoceratium turneri* Zone is defined at the base by the first occurrence of the above species (present in the assemblages) and at the top by the first occurrence of *Endoceratium ludbrookiae*

(Cookson & Eisenack) Loeblich and Loeblich 1966 emend. (not recorded in the assemblages). The assemblages are not part of *P. turneri* Subzone a in which *Diconodinium davidii* Morgan 1975 is present and has its last appearance at the top of the subzone (Morgan, 1980). However, the youngest occurrences of *Canninginopsis intermedia* Morgan 1980, *Dingodinium cerviculum* Cookson and Eisenack 1958 and *Lithodinia helbyi* Morgan 1980 occur near the top of subzone b and the youngest appearance of *Tenua colligata* Morgan 1980 within the subzone. This is supported by the absence of *Diconodinium cristatum* Cookson and Eisenack emend. Morgan 1977, which has its first appearance near the base of subzone c. The latter species is normally numerous within its range and thus its absence from the samples is strongly suggestive that the assemblages are not from subzone c.

Poole Creek 1

The sample from 18.2 m is barren of palynomorphs.

Lake Hydra

This sample is also barren of palynomorphs.

CONCLUSIONS

The Cenomanian age ascribed to the palynoflora from Palankarinna 1, and the terrestrial character of environment of deposition, indicate that the sedimentary unit sampled is Winton Formation. The excellent preservation (in particular, the preservation of spore/pollen tetrads), diversity and volume of palynomorphs recovered is a further indication that the plants were growing close to the site of deposition.

If the palynofloras from Poole Creek 2 are latest Aptian to Early Albian in age then the sedimentary interval sampled is either the top of the Bulldog Shale or the Coorikiana Sandstone Member of the Oodnadatta Formation (Figure 1). The palynofloras also provide useful information about environments of deposition. In a marine setting, as distance from shore increases the frequency and diversity of microplankton increase and spore/pollen frequency decreases (Morgan, 1980b). Marginal marine environments characteristically have relatively high frequency and diversity of dinoflagellates. The samples from

Poole Creek 2 range from moderate (15-24 species) to very high diversity (35+ species) according to Morgan (1980b), and probably reflect a marginal marine environment. The latter is probably correlative with the transgressive seas early in the Albian (*Pseudoceratium turneri* Subzone b; Morgan 1980b).

ACKNOWLEDGEMENTS

W.K. Harris, J.M. Lindsay and R.A. Callen reviewed and commented on various drafts of the report.

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APPENDIX 1

LIST AND FREQUENCY OF PALYNOMORPHS

Species Name	PALANKARINNA 1 104·9m	POOLE CREEK 2 27·8m	29·7m	30·9m
POLLEN AND SPORES				
Aequitriradites spinulosus (Cookson & Dettmann) Cookson & Dettmann 1961		X		X
Aequitriradites verrucosus (Cookson & Dettmann) Cookson & Dettman 1961	X			X
Alisporites grandis (Cookson) Dettmann 1963	X	5	X	1
Alisporites similis (Balme) Dettmann 1963	X	2	X	2
Anapiculatisporites pristidentatus Reiser & Williams 1969	X			
Annulispora folliculosa (Rogalska) de Jersey 1959	X	X		X
Appendicisporites distocarinatus Dettmann & Playford, 1968	2			
Araucariacites australis Cookson 1947	1	3		X
Asteropollis asteroides Hedland & Norris 1968	X	X		
Baculatisporites comaumensis (Cookson) Potonié 1956	1	6	X	4
Balmeisporites holodictyus Cookson & Dettman 1958	X			
Balmeisporites glenelgensis Cookson & Dettmann 1958	X			
Biretisporites spectabilis Dettmann 1963	X	X	X	X
Callialasporites dampieri (Balme) Sukh Dev 1961		X	X	X
Callialasporites segmentatus (Balme) Srivastava 1963		X		X
Camarozonosporites australiensis Norvick & Burger 1975	X			
Camarozonosporites clivosus (Williams & McKellar) McKellar 1974		X		
Ceratosporites equalis Cookson & Dettmann 1958	X	2	X	2
Cibotiumspora jurienensis (Balme) Filatoff 1975	X			

Cicatricosisporites australiensis (Cookson) Potonié 1956	2	1	X	1
Cicatricosisporites cuneiformis Pocock 1965	6			
Cicatricosisporites hughesii Dettmann 1963	3			
Cicatricosisporites ludbrookiae Dettmann 1963	X	X	X	X
Cicatricosisporites pseudotripartitus (Bolkhovitina) Dettmann 1963	2			
Cicatricosisporites venestus Deak 1963	X			
Classopolis chateaunovi Reyre 1953	1	2	X	X
Classopolis simplex (Danze-Corsin & Laveine) Reiser & Williams 1969	X			
Clavifera triplex (Bolkhovitina) Bolkhovitina 1966	X			
Concavissimisporites sp.	X			
Contignisporites cooksoniae (Balme) Dettmann 1963	X	X		X
Cooksonites variabilis Pocock 1962				X
Coptospora paradoxa (Cookson & Dettmann) Dettmann 1963	X			
?Coptospora sp.				X
Couperisporites tabulatus Dettmann 1963	X			
Crybelosporites berberioides Burger 1976	X	X		
Crybelosporites punctatus Dettmann 1963	X	X		
Crybelosporites striatus (Cookson & Dettmann) Dettmann 1963	X	X	X	1
Crybelosporites stylosus Dettmann 1963		X		X
Cupuliferoidaepollenites parvulus (Groot & Penny) Dettmann 1973	X			
Cyathidites asper (Bolkhovitina) Dettmann 1963	X			
Cyathidites australis Couper 1953	6	3	X	1
Cyathidites concavus (Bolkhovitina) Dettmann 1963		X	X	1
Cyathidites minor Couper 1953	34	12	X	15
Cycadopites nitidus (Balme) de Jersey 1964	2	X	X	1
Cyclosporites hughesii (Cookson & Dettmann) Cookson & Dettmann 1959	X	X		X
Densoisporites velatus Weyland & Krieger emend. Krasnova 1961	X			
Dictyophyllidites crenatus Dettmann 1963		X		X

Dictyophyllidites harrisii Couper 1958	X	X	X	X
Dictyophyllidites sp.	1			
Dictyotosporites complex Cookson & Dettmann 1958	X	X		
Dictyotosporites speciosus Cookson & Dettmann 1958	X	X		X
Foraminisporis asymmetricus Cookson & Dettmann) Dettmann 1963	X	X	X	X
Foraminisporis dailyi (Cookson & Dettmann) Dettmann 1963		X		X
Foraminisporis wonthaggiensis (Cookson & Dettmann) Dettmann 1963	X	X		X
Foveosporites canalis Balme 1957		X		X
Foveotriletes parviretus (Balme) Dettmann 1963				X
Gleicheniidites circinidites (Cookson) Dettmann 1963	10	X	X	X
Gleicheniidites senonicus Ross emend, Skarby 1964	X	X	X	X
Herkosporites proxistriatus Norvick & Burger 1975	X			
Hoegisporis uniforma Cookson 1965	X			
Ischyosporites crateris Balme 1957	X	X		X
Klukisporites scaberis (Cookson & Dettmann) Dettmann 1963	X	X	X	X
Kraeuselisporites jubatus Dettmann & Playford 1968	X			
Kraeuselisporites majus (Cookson & Dettmann) Dettmann 1963	X			
Kuylisporites lunaris Cookson & Dettmann 1958		X		
Laevigatosporites belfordii Burger 1976	X			
Laevigatosporites ovatus Wilson & Webster 1946	10	X		X
Leptolepidites major Couper 1958	X	1	X	X
Leptolepidites verrucatus Couper 1953	X	X		X
Liliacidites cf. intermedius Couper 1953	X			
Liliacidites katangataensis Couper 1953	X			
Lycopodiacidites asperatus Dettmann 1963	X			
Lycopodiacidites dettmannae Burger 1980	X			

Lycopodiumsporites circolumenus Cookson & Dettmann 1958	X	X		X
Matonisporites cooksonae Dettmann 1963				X
Microcachryidites antarcticus Cookson 1947	4	15	X	10
Neoraistrickia truncatus (Cookson) Potonié 1956	X	X	X	X
Nevesisporites vallatus de Jersey & Paten 1964	X			
Obtusisporis canadensis Pocock 1970	X			
Osmundacidites dubius Burger 1980		3	X	1
Osmundacidites wellmanii Couper 1953	5	3	X	4
Phimopollenites augathallaensis (Burger) Dettmann 1973	X			
Phimopollenites pannosus (Dettmann & Playford) Dettmann 1973	X			
Pilosisporites notensis Cookson & Dettmann 1958		X	X	X
Pilosisporites parvispinosus Dettmann 1963		X		
Plicatipollenites gondwanensis (Balme & Hennelly) Lele 1964 (PERMIAN REWORKED)				X
Podocarpidites ellipticus Cookson 1947	1	20	X	28
Podocarpidites multesimus (Bolkhovitina) Pocock 1962		X	X	2
Polycingulatisporites clavus (Balme) Burger 1980	X			
Protohaploxypinus amplus (Balme & Hennelly) Hart 1964 (PERMIAN REWORKED)	X	X		
Punctatosporites scabratus (Couper) Norris 1965	X			
Pyrobolospora reticulata Cookson & Dettmann 1958	X			
Reticulatisporites pudens Balme 1957	X	X		X
Retimonocolpites peroreticulatus (Brenner) Doyle 1975	X			
Retitriletes austroclavatidites (Cookson) Döring *et al.* 1963	X	2	X	2
Retitriletes (al. Lycopodiumsporites) eminulus (Dettmann 1963)				X
Retitriletes nodosus (Dettmann) Srivastava 1977	X	X		X

Retitriletes reticulumsporites (Rouse) Döring *et al.* 1963	X	X		
Retitriletes rosewoodensis (de Jersey) McKellar 1974	X	X	X	1
Retitriletes (al. Lycopodiumsporites) solidus (Burger 1980)	X			
Rogalskaisporites cicatricosus (Rogalska) Danze-Corsin & Laveine 1963	X	X		X
Senectotetradites varireticulatus Dettmann 1973	X			
Senectotetradites fistulosus Dettmann 1963	X			
Sestrosporites pseudoalveolatus (Couper) Dettmann 1963	X			
Staplinisporites caminus (Balme) Pocock 1962		X		
Stereisporites antiquasporites (Wilson & Webster) Dettmann 1963	X	8	X	6
Stereisporites pocockii Burger 1980	X	X	X	X
Stoverisporites microverrucatus Norvick & Burger 1975	X			
Tricolpites minutus (Brenner) Dettmann 1973	X			
Tricolpites variabilis Burger 1970	X			
Trilites tuberculiformis Cookson 1947				X
Trilobosporites purverulentus (Verbitskaya) Dettmann 1963	X			
Trilotosporites tribotrys Dettmann 1963	X			
Trilobosporites trioreticulosus Cookson & Dettmann 1958	X			
Triporoletes laevigatus (Pocock) Playford 1971	X			
Triporoletes radiatus (Dettmann) Playford 1971	X			X
Triporoletes reticulatus (Pocock) Playford 1971	X	X		X
Triporoletes simplex (Cookson & Dettmann) Playford 1971	X			
Trisaccites microsaccatus (Couper) Couper 1960		1	X	2
Velosporites triquetrus (Lanz) Dettmann 1963		X	X	

Vitreisporites pallidus (Reissinger) Nilsson 1958		X		X
DINOFLAGELLATES				
Apteodinium conjunctum Eisenack & Cookson 1960			X	
Apteodinium maculatum Eisenack & Cookson 1960				X
Canningia colliveri Cookson & Eisenack 1960		X		X
Canninginopsis intermedia Morgan 1980		X	X	X
Cannosphaeropsis peridictya Eisenack & Cookson 1960				X
Chlamydophorella nyei Cookson & Eisenack 1958		X	X	1
Cleistophaeridium aciculare Davey 1969		X		X
Cleistosphaeridium polypes (Cookson & Eisenack) Davey 1969				X
Cleistosphaeridium sp.		X		
Coronifera oceanica Cookson & Eisenack 1958		X		
Cribroperidinium muderongense (Cookson & Eisenack) Davey 1969		X	X	X
Cribroperidinium perforante (Cookson & Eisenack) Morgan 1980		X	X	X
Cyclonephelium compactum Deflandre & Cookson 1955				X
Dingodinium cerviculum Cookson & Eisenack 1958		X		X
Endoscrinium luridum (Deflandre) Gocht 1970				X
Epilidosphaeridia pentagona Morgan 1980	X		X	X
Exochosphaeridium phragmites Davey *et al.* 1966				X
Florentinia deanei (Davey & Williams) Davey & Verdier 1973		X		X
Fromea amphora Cookson & Eisenack 1958		X		X
Gonyaulacysta episoma Sarjeant 1966		X	X	X
Heslertonia striata (Eisenack & Cookson) Norvick 1975		X	X	X

Heterosphaeridium heteracanthum (Deflandre & Cookson) Eisenack & Kjellstrom 1971			X
Leptodinium asymmetricum Morgan 1980	X		X
Lithodinia helbyi Morgan 1980	X	X	X
Membranosphaera granulata Norvick 1975	X		
Membranosphaera romaensis Burger 1980			X
Necrobroomea micropoda (Eisenack & Cookson) Wiggins 1975	X	X	X
Nummus monoculatus Morgan 1977			X
Odontochitina operculata (Wetzel) Deflandre & Cookson 1955	X	X	X
Odontochitina singhii Morgan 1980			X
Oligosphaeridium complex (White) Davey & Williams 1966		X	X
Oligosphaeridium pulcherrimum (Deflandre & Cookson) Davey & Williams 1966		X	X
Oodnadattia tuberculata Eisenack & Cookson 1960	X		?
Protoellipsodinium densispinium Morgan 1980	X	X	
Psaligonyaulax deflandrei Sarjeant 1960	?		
Pseudoceratium turneri Cookson & Eisenack 1958		X	X
Schizosporis reticulatus Cookson & Dettmann 1959			X
Spinidinium boydii Morgan 1975	X	X	1
Spinidinium styloniferum Cookson & Eisenack 1962			X
Spiniferites ramosus granomembranaceus (Davey & Williams) Lentin & Williams 1973	X		
Spiniferites ramosus ramosus (Ehrenburg) Loeblich & Loeblich 1966	X		X
Spiniferites wetzeli (Deflandre) Sarjeant 1970	X	X	X
Tanyosphaeridium isocalamum (Deflandre & Cookson) Davey & Williams 1969			X
Tenua colligata Morgan 1980	X		
Veryhachium reductum Deunff) Jekhowsky 1961	X	X	
Veryhachium singulare (Firtion) Burger 1980			X
Unidentified	1		

APPENDIX 2

PHOTOGRAPHIC CATALOGUE OF SELECTED PALYNOMORPHS FROM PALANKARINNA 1 AND POOLE CREEK 2 WELLS.

Species name, palynological slide number and co-ordinates, magnification of objective used and borehole name are given. All photographs were taken with the magnification changer at 1.25X.

SPORES

1. *Appendicisporites distocarinatus* S5917/2; 19.6/97.7; 40X; Palankarinna 1.
2. *Appendicisporites distocarinatus* S5917/1; 15.2/112.3; 40X; Palankarinna 1.
3. *Baculatisporites comaumensis* S5914/1; 16.8/119.2; 63X; Poole Creek 2.
4. *Balmeisporites holodictyus* S5917/2; 2.5/112.5; 16X; Palankarinna 1.
5. *Cicatricosisporites hughesii* S5917/1; 12.0/120.2; 63X; Palankarinna 1.
6. *Cicatricosisporites hughesii* S5917/1; 17.9/118.7; 63X; Palankarinna 1.
7. *Clavifera triplex* S5917/2; 20.1/98.7; 40X; Palankarinna 1.
8. *Contignisporites cooksoniae* S5917/2; 18.4/106.3; 40X; Palankarinna 1.
9. *Coptospora paradoxa* S5917/2; 9.0/96.5; 63X; Palankarinna 1.
10. *Crybelosporites berberioides* S5917/1; 15.7/102.8; 63X; Palankarinna 1.
11. *Crybelosporites striatus* S5917/1; 16.4/97.8; 63X; Palankarinna 1.
12. *Crybelosporites striatus* S5914/2; 14.9/124.9; 63X; Poole Creek 2.
13. *Cyathidites minor* S5916/2; 9.1/93.7; 40X; Poole Creek 2.
14. *Dictyotosporites complex* S5917/1; 13.8/97.2; 63X; Palankarinna 1.
15. *Foraminisporis asymmetricus* S5917/1; 7.0/88.6; 63X; Palankarinna 1.
16. *Foraminisporis wonthaggiensis* S5914/2; 3.2/94.7; 63X; Poole Creek 2.
17. *Gleicheniidites circinidites* S5917/1; 17.9/105.3; 63X; Palankarinna 1.
18. *Obtusisporis canadensis* S5917/2; 9.7/115.3; 63X; Palankarinna 1.
19. *Osmundacidites wellmanii* S5916/2; 17.1/82.0; 40X; Poole Creek 2.
20. *Stereisporites antiquasporites* S5914/1; 18.1/99.8; 40X; Poole Creek 2.
21. *Stoverisporites microverrucatus* S5917/1; 21.0/120.4; 63X; Palankarinna 1.
22. *Trilobosporites trioreticulosus* S5917/1; 3.0/103.7; 63X; Palankarinna 1.
23. *Triporoletes laevigatus* S5917/1; 16.9/89.1; 63X; Palankarinna 1.
24. *Triporoletes radiatus* S5917/2; 1.7/108.9; 63X; Palankarinna 1.
25. *Triporoletes reticulatus* S5917/1; 15.0/105.6; 40X; Palankarinna 1

POLLEN

26. *Alisporites grandis* S5914/2; 18.8/117.6; 40X; Poole Creek 2.
27. *Classopolis simplex* S5917/2; 3.2/115.9; 63X; Palankarinna 1.
28. *Microcachryidites antarcticus* S5914/2; 2.9/113.1; 40X; Poole Creek 2.
29. *Phimopollenites augathallaensis* S5917/1; 3.0/111.8; 63X; Palankarinna 1.
30. *Phimopollenites pannosus* S5917/1; 4.2/103.8; 63X; Palankarinna 1.

31. *Podocarpidites ellipticus* S5914/1; 14.8/96.9; 40X; Poole Creek 2.
32. *Senectotetradites varireticulatus* S5917/2; 7.2/112.1; 63X; Palankarinna 1.
33. *Senectotetradites varireticulatus* S5917/1; 15.8/104.7; 63X; Palankarinna 1.
34. *Trisaccites microsaccatus* S5917/2; 83./119.9; 63X; Palankarinna 1.

DINOFLAGELLATES (all from Poole Creek 2)

35. *Chlamydophorella nyei* S5916/2; 3.1/92.4; 40X.
36. *Cleistosphaeridium polypes* S5916/2; 4.8/109.3; 40X.
37. *Cribroperidinium muderongense* S5914/2; 1.7/89.4; 40X.
38. *Cribroperidinium perforante* S5916/1; 0.8/111.5; 40X.
39. *Dingodinium cerviculum* S5916/2; 10.3/82.6; 40X.
40. *Epelidosphaeridia pentagona* S5916/2; 2.0/114.4; 40X.
41. *Heslertonia striata* S5916/2; 2.5/93.2; 40X.
42. *Lithodinia helbyi* S5916/2; 2.0/105.0; 40X.
43. *Odontochitina operculata* S5914/2; 13.4/89.3; 40X.
44. *Pseudoceratium turneri* S5916/2; 15.9/92.3; 40X.
45. *Spinidinium boydii* S5916/2; 3.9/85.4; 63X.
46. *Spinidinium styloniferum* S5916/2; 17.7/119.4; 40X.

AGE	EARLY NEOCOMIAN	LATE NEOCOMIAN	APTIAN				ALBIAN: Early	ALBIAN: Middle	ALBIAN: Late	ALBIAN: Vraconian	CENOMANIAN	
SPORE-POLLEN UNITS (after Dettmann and Playford, 1969)	*C. stylosus*		*D. speciosus*					*C. paradoxa*		*P. pannosus*	*A. distocarinatus*	
	C. australiensis	*F. wonthaggiensis*	*C. hughesii*				*C. striatus*					
MICROPLANKTON UNITS (after Morgan, 1977, 80)			*O. operculata*			*P. turneri*			*E. ludbrookiae*			
			a	b	c	a	b	c	a	b	c	
STRATIGRAPHY (after Dettman and Playford, 1969)	CADNA-OWIE FORMATION	BULLDOG SHALE					OODNADATTA FM. (COORIKIANA SANDSTONE MEMBER)				WINTON FM.	

Fig. 1

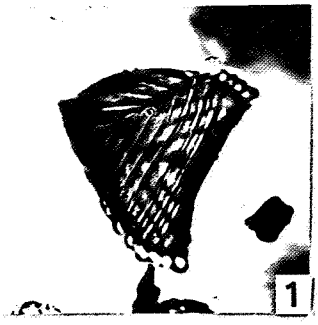
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

EROMANGA BASIN
PALYNOLOGICAL ZONES

COMPILED N.F.A.	C.D.O.	DATE 5.9.85	
DRAWN N.R.S.	SCALE —		
DATE 24-4-85	PLAN NUMBER		
CHECKED	S 18102		

3810

Spores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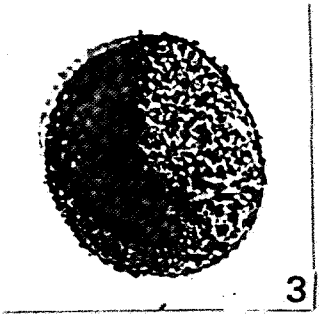
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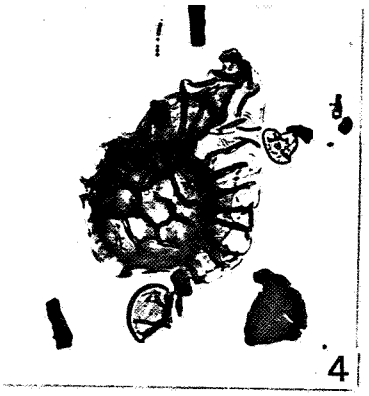
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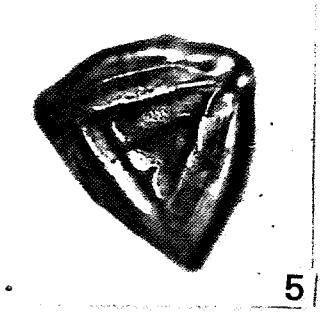
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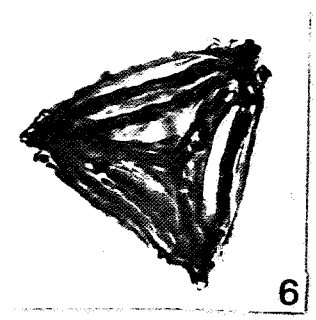
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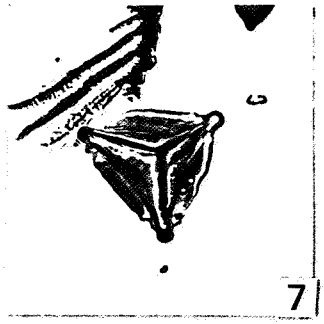
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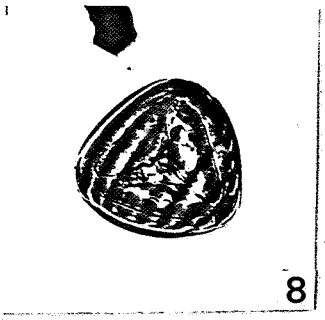
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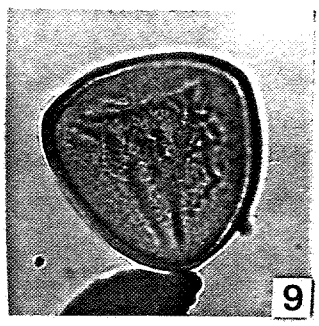
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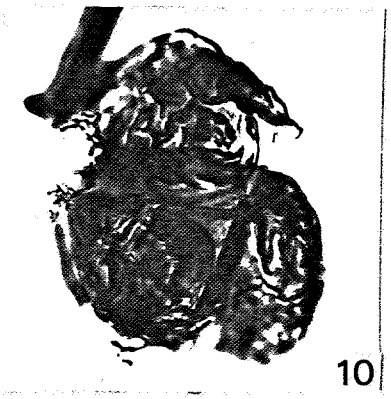
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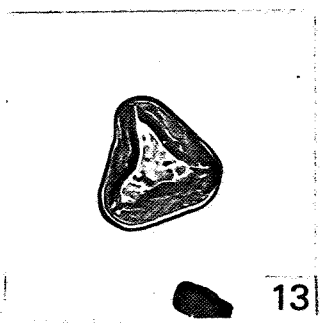
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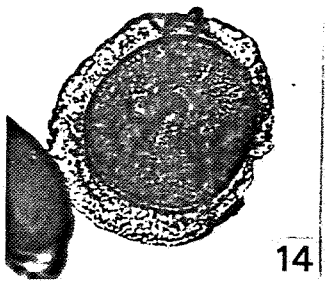
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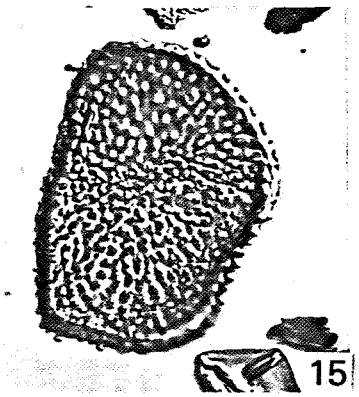
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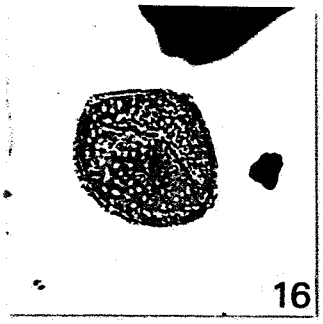
Spores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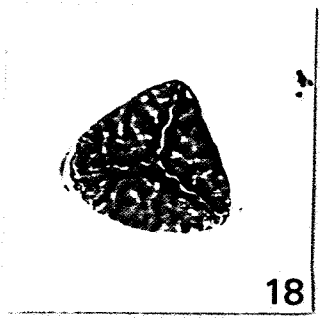
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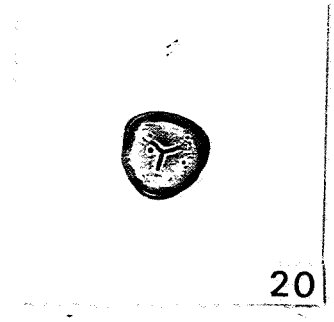
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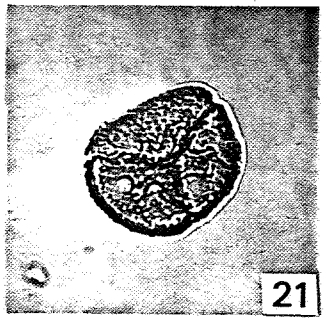
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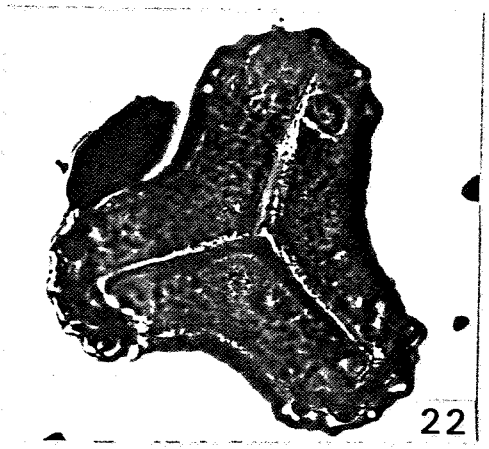
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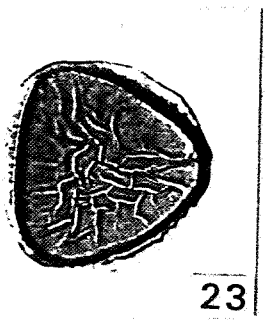
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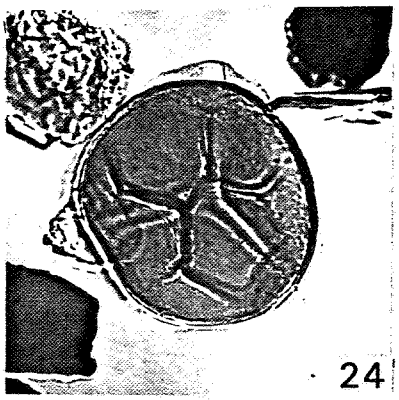
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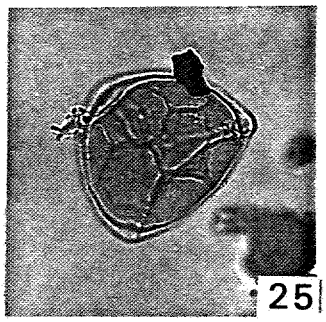
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Pollen


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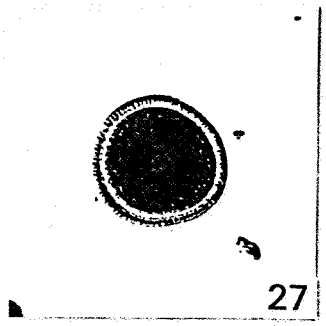
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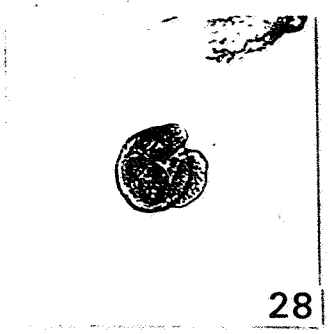
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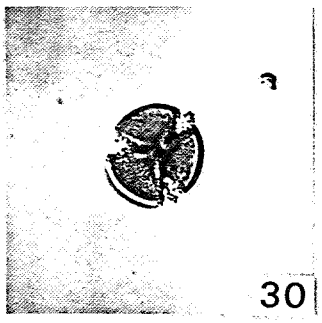
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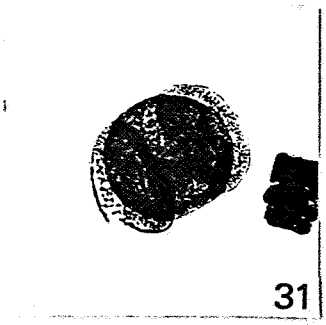
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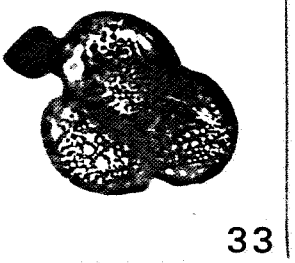
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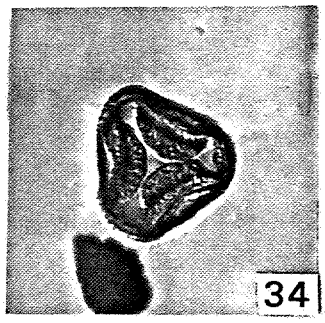
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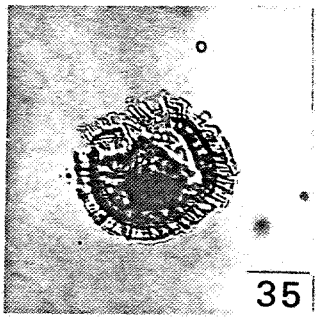
Dinoflagellates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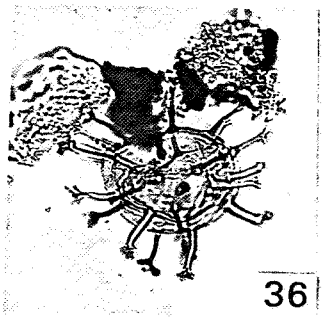
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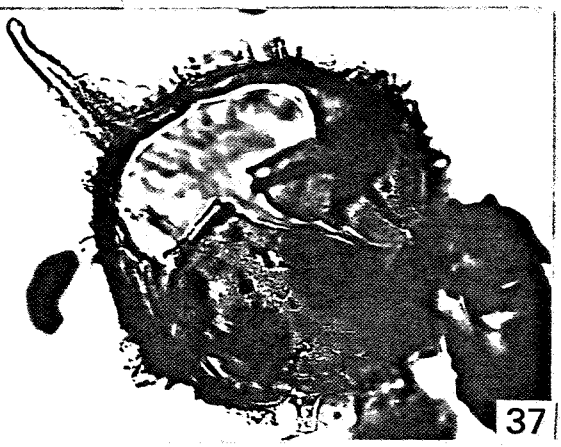
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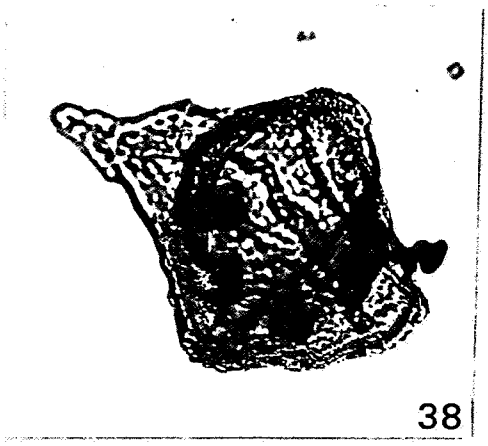
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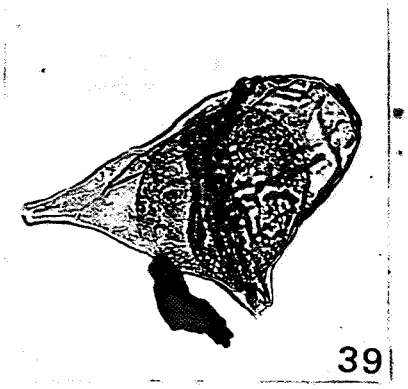
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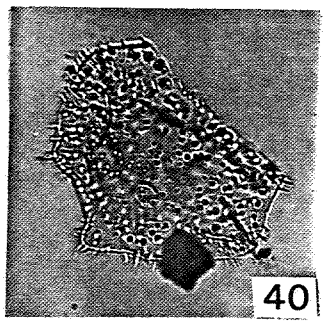
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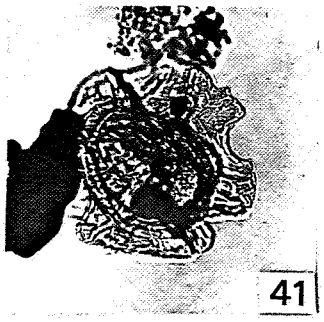
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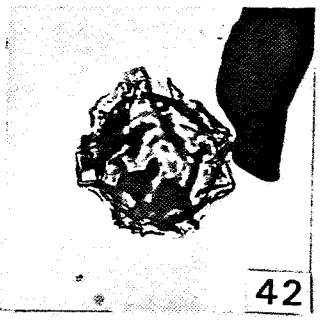
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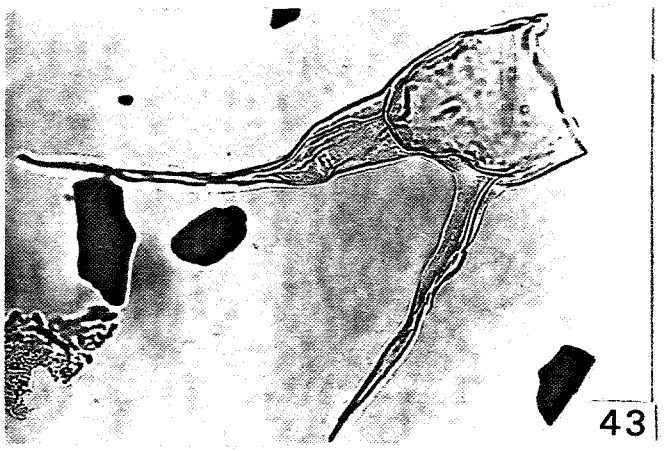
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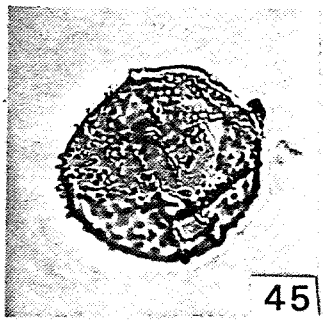
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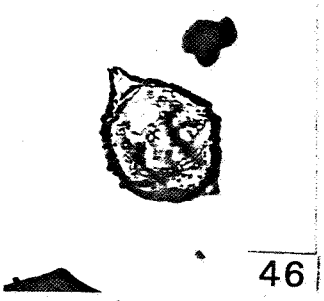
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