AN EARLY CRETACEOUS ANGIOSPERM POLLEN ASSEMBLAGE FROM EGYPT

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ABSTRACT. A new assemblage of angiosperm pollen has been recovered from core samples of the borehole Mersa Matruh-1 in the North West Desert of Egypt. Six new species are described: *Stellatopollis hughesii*, *S. bituberensis*, *Retimonocolpites matruhensis*, *R. muristriatus*, *R. muriundulatus*, and *Liliacidites aegyptiacus*. Comparison with palynofloras from southern England, North America, West Africa, and Israel suggests a late Barremian age for the samples, making this the earliest angiosperm pollen assemblage yet described from Egypt.

THE Cretaceous sediments of Egypt have been the subject of several palynological investigations. Many of these have recognized the presence of diverse assemblages in the Cenomanian to Maastrichtian deposits (e.g. Aboul Ela 1978; Aboul Ela and Mabrouk 1978). Some studies have also included descriptions of earlier deposits (Komorova *et al.* 1973; Soliman 1975) and have noted an apparent absence of angiosperm pollen in the 'Neocomian' to Aptian deposits (Komorova *et al.* 1973; Saad and Ghazaly 1976; Soliman 1977; Saad 1978). The oldest angiosperms recovered were of suspected Albian age (Sultan 1978). Indeed Saad (1979) stated that 'angiosperms have appeared for the first time in North Africa during lower Albian age'. It is possible that the failure to find angiosperms before the Albian was due to the limitations imposed by the lack of the use of scanning electron microscopy (SEM) in the examination of the material. For example, Saad (1978) observed *Reticulatasporites jardinus* Brenner 1968 (now *Afropollis jardinus* (Brenner) Doyle *et al.* 1982) in possible Aptian strata, but without SEM detail interpreted it as having possible algal or fungal affinities. Schrank (1982) gave the first evidence of Aptian angiosperms in Egypt and has since used SEM to confirm the presence of a varied Aptian angiosperm assemblage in the Mawhoub West 2 borehole, Western Desert, Egypt (Schrank 1983).

The aim of this paper is to describe an assemblage of angiosperms recovered from core samples of early Cretaceous age from the Mersa Matruh-1 borehole (MMX-1), situated at 31° 19′ 43·00″ N. and 27° 16′ 07·00″ E. in the North West Desert of Egypt. The sediments form a thick sequence of dark fissile shales with interbedded sandstones and limestones. The early part of the sequence was deposited under stable marine conditions and contains a marine-dominated palynoflora. There is evidence of a possible unconformity or regression at approximately 12 000 ft (3657 m) (middle to late Barremian?). Subsequent deposition occurred rapidly in a synsedimentary graben under shallow marginal marine and occasionally high energy conditions.

The samples studied contain a palynoflora which is typical of the pre-Albian West African-South American (WASA) microfloral province of Herngreen and Chlonova (1981) and have been dated provisionally on the basis of pollen and spores as late Barremian to earliest Aptian.

MATERIAL AND METHODS

The samples studied were all from the Matruh Shale, a unit of dark grey, slightly indurated fissile shales with occasional thin beds of sandstone or limestone. They were processed using a standard palynological extraction method.

Material from the organic residues was spread evenly over the surfaces of stubs equipped with Cambridge Geology SEM grids (Hughes *et al.* 1979). After coating with gold the stubs were searched systematically and

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selected specimens were photographed. Grid coordinates enable relocation of these specimens, but the negatives on 70 mm FP4 film form the effective permanent records.

All material relating to this study is housed in the Sedgwick Museum, Department of Earth Sciences, Cambridge University, Downing Street, Cambridge CB2 3EQ.

SYSTEMATIC PALAEONTOLOGY

In describing the new species below an attempt is made to demonstrate the use of data which has been stored as biorecords for conventional taxonomy. Individual observations were recorded using the system of biorecords (reference observation) and comparison records (additional data) which was described by Hughes (1976). In the text biorecords and comparison records are referred to collectively as 'observation records'. The descriptive data contained in the observation records appears in Table 1.

By pooling all the available data for each pollen type it has been possible to describe species in the conventional way. However, it can be seen that the component observations still remain distinguishable because they have been stored as observation records. This is most important, as it will enable future workers to see exactly what data is contained within the species that have been described. This is considered further in the discussion section.

Measurements, where given, are written as minima and maxima with the means in parenthesis. The term 'microlumina' is used to describe very small perforations of a reticulum that produce lumina which are usually of the order of 0·1 to 0·2 μm and in any case much smaller than the mean luminal diameter in the reticulum. In the text the abbreviation o.r. means observation record. Samples mentioned are all core samples except where they are marked *, which denotes a ditch cuttings sample.

Form Genus STELLATOPOLLIS Doyle, Van Campo and Lugardon 1975

Type species. Stellatopollis barghoornii Doyle, Van Campo and Lugardon 1975, pp. 465, 467, 469; pl. 7, figs. 1–8; pl. 8, figs. 1–9; pl. 9, figs. 1–4.

Stellatopollis hughesii sp. nov.

Plate 21, figs. 1–6

Derivatio nominis. After N. F. Hughes, who first observed specimens of this type (Hughes *et al.* 1979).

Material. Described from data on 10 specimens which are stored in four observation records. Type sample MMX-1 11832 (?late Barremian).

Holotype. Grain no. 137/2 from sample MMX-1 11832 (Pl. 21, figs. 1–3), prep. JP160, stub JPS197, coordinates 829 × 245.

Diagnosis. Monocolpate pollen, subcircular in outline, maximum diameter 21·3 (29·0) 38·0 μm. Exine semitectate, reticulum composed of lumina 1·0 (2·5) 3·8 μm in diameter. Muri low, narrow; height 0·38 (0·43) 0·5 μm, width 0·33 (0·58) 1·0 μm, supported on short columellae 0·08 (0·14) 0·25 μm tall and 0·1 (0·18) 0·25 μm wide. Muri bear expanded supratectal processes, 0·25 (0·44) 0·6 μm tall and 0·5 (0·85) 1·33 μm wide, some of which are triangular and some rectangular in surface view. Apices of triangular processes directed into lumina and sides parallel with those of adjacent processes. Nexine smooth to sparsely verrucate, much thinner than sexine. Total exine thickness 1·6 μm. Colpus long, narrow, margins infolded and poorly defined.

Occurrence. This species has been recovered from samples MMX-1 11832 (o.r. JPR2; 2 specimens) and MMX-1 10825 (o.r. JPR1; 5 specimens), which are of ?late Barremian age. Its last appearance is in sample MMX-1 10617 (o.r. JPR148; 1 specimen) which is of late Barremian to ?early Aptian age. It has also been recovered from cuttings sample MMX-1 11250* (o.r. JPR111; 2 specimens), and from samples of Barremian age from southern England (Hughes *et al.* 1979; BIORECORD : SUPERRET-CROTON (5 specimens) and comparison records

RECORD NUMBER JPR:	NAME AND STATUS	SAMPLE NUMBER MMX-1:	NUMBER OF SPECIMENS	MAXIMUM DIAMETER OR LENGTH	WIDTH OF ELONGATED SPECIMENS	DIAMETER OF LARGE LUMINA	DIAMETER OF SMALL LUMINA	COLUMELLAE HEIGHT	COLUMELLAE WIDTH	MURI HEIGHT	MURI WIDTH	SUPRATECTAL PROCESSES HEIGHT	SUPRATECTAL PROCESSES WIDTH
GENUSBOX SUPERRET	Descriptive Limits: Defined by Hughes et al. 1979												
1	CfA:SUPERRET-CROTON	10825	5	21·3(22·9)24·5		2·3(2·9)3·8	0	0·3	0·1 (0·15)0·2	–	0·33(0·64) 1·0	0·25(0·39)0·6	0·5(0·73)1·33
2	CfA:SUPERRET-CROTON	11832	2	24·5(25·5)26·5		2·3(2·7)3·0	0	0·08	0·25	0·41(0·46)0·5	0·33 (0·62)0·83	0·33 (0·39)0·42	0·83 (1·05) 1·33
111	CfA:SUPERRET-CROTON	11250*	2	21·9		2·31 (2·95) 3·08	0	–	–	–	0·42(0·49) 0·69	–	0·92(0·97) 1·0
148	CfA:SUPERRET-CROTON	10617	1	38·0		1·4 (1·9) 2·5	0	–	–	0·38	0·69 (0·71) 0·77	0·38 (0·42)0·46	0·85 (1·09)1·23
3	CfA:SUPERRET-BILUMP	10825	3	27·1 (29·0)31·0		1·25(2·0)3·13	0	–	–	0·33	0·33(0·68) 1·0	0·75(1·0) 1·41	1·25 (1·81) 2·33
4	BIORECORD:SUPERRET-BILUMP	11832	4	32·3 (36·8)43·2		3·17(4·2) 5·67	0	–	–	0·66(0·71)0·75	0·75 (0·85) 1·0	0·75(0·86)1·0	1·33 (1·9) 2·67
112	CfA:SUPERRET-BILUMP	12250/60*	2	–		3·54 (3·69)3·85	0	–	0·39(0·42)0·46	–	0·54 (0·79) 1·0	–	1·94 (2·11) 2·26
113	CfA:SUPERRET-BILUMP	12490*	1	38·1		3·08	0	–	0·15(0·23)0·31	–	0·54 (0·64) 0·77	–	1·69 (1·89 2·04
GENUSBOX RETICOLL	Descriptive Limits: Monocolpate Pollen Semitectate Reticulate Columellate Lumina Size Distribution Unimodal												
5	BIORECORD: RETICOLL-RIBBER	10825	27	31·3 (38·7)45·9	20·0(23·4)25·2	0·5 (1·2) 1·7	0	0·2(0·3)0·5	0·4 (0·6) 0·8	0·3 (0·35)0·4	0·3 (0·5) 0·7	0·2	0·2
48	CfA : RETICOLL-RIBBER	11832	2	41·6	24 2	0·46 (0·75)1·08	0	–	–	–	0·31 (0·38) 0·46	0·2	0·2
49	CfA : RETICOLL-RIBBER	10617	2	30·7(31·5)32·3	18·1(19·7)21·3	0·62 (0·77)0·85	0	–	–	–	0·39(0·47)0·5	0·2	0·2
6	BIORECORD:RETICOLL-STRIPER	10825	9	19·4(23·2)27·1		0·5 (1·0)2·0	0	0·3(0·5)0·8	0·3 (0·4) 0·5	0·3 (0·5) 0·8	0·4 (0·6) 0·8	0·2	0·2
7	CfB : RETICOLL-STRIPER	11832	2	27·8		0·8 (1·2) 1·9	0	–	–	0·42 (0·46) 0·5	0·42 (0·56) 0·75	0·2	0·2
114	CfB : RETICOLL-STRIPER	11250*	1	28·4		–	0	–	–	–	0·31 (0·41) 0·46	0·2	0·2
8	BIORECORD:RETICOLL-JILLIAN	11832	13	11·0(6·9)21·9		1·0 (1·3) 2·0	0	0·2(0·25)0·3	0·1 (0·2) 0·3	0·2 (0·35) 0·5	0·2 (0·38) 0·8	0	0
9	CfA :RETICOLL - JILLIAN	10825	3	13·8(16·5)20·6		1·0 (1·9) 2·6	0	0·25	0·33(0·38) 0·42	0·33(0·47) 0·66	0·42(0·58) 0·91	0	0
115	CfA:RETICOLL - JILLIAN	11250*	2	18·7(20·3)21·9		0·46(0·76)1·15	0	0·1 (0·18)0·23	0·1 (0·18) 0·31	0·38(0·43)0·46	0·31(0·37)0·54	0	0
GENUSBOX CROCHETRET	Descriptive Limits: Monocolpate Pollen Semitectate Reticulate Columellate Lumina Size Distribution Bimodal												
10	BIORECORD:CROCHETRET-NETTED	10825	5	19·4(22·0)25·8		0·66(1·02)1·42	0·1 (0·16)0·25	0·1 (0·3) 0·4	0·1 (0·2) 0·4	0·4(0·45)0·5	0·3 (0·35) 0·4	0	0
11	CfA:CROCHETRET-NETTED	11832	3	22·0(23·3)25·8		0·7(1·1) 1·5	0·1 (0·2) 0·3	0·1 (0·23)0·4	0·1 (0·18) 0·4	0·4 (0·45) 0·5	0·4	0	0
101	CfB : CROCHETRET-NETTED	9867	1	19·4		0·85(1·09)1·23	0·1 (0·37)0·61	0·38	0·23	–	0·15 (0·28) 0·38	0	0
116	CfA:CROCHETRET-NETTED	10350*	2	20·7(21·3)21·9		0·92(1·07)1·23	0·1 (0·2) 0·61	0·23(0·29)0·38	0·23(0·28)0·31	0·23(0·35)0·48	0·23(0·37)0·46	0	0
GENUSBOX RETIMONO	Descriptive Limits: Monocolpate Pollen Semitectate Reticulate Acolumellate Lumina Size Distribution Unimodal												
12	CfA: RETIMONO-PERORET	10825	3	15·0(17·2)19·4		1·5 (2·0) 3·2	0	0	0	0·5(0·69) 0·83	0·5(0·83) 1·1	0·25(0·3) 0·41	0·08(0·18)0·3
GENUSBOX AFROPOL	Descriptive Limits Grains with the characteristics of Afropollis Doyle et al. 1982												
13	BIORECORD:AFROPOL-COLUMN	10825	7	20·0(24·0)27·7		1 0(2·63)3·9	0	0·3	0·2	0·7	0·3	0	0

TABLE 1. Descriptive data for the observation records mentioned in the text. Measurements take the form minimum (mean) maximum. The Genusboxes are for filing purposes and are not intended to be synonyms for Linnaean Genera. 0 = Feature is absent; — = measurement could not be made; * = cuttings sample.

cfA: WM1333/10, S38(IOW), 11rg(Alford)). The descriptive data for the English specimens falls within the range of that observed for the Egyptian examples. Rare specimens which resemble this species have also been observed during light microscope studies of samples from the Barremian of Gabon and the Albian of Ghana (Laing, pers. comm., March 1985).

Stellatopollis bituberensis sp. nov.

Plate 21, figs. 7–11

Derivatio nominis. From the presence of both triangular and rectangular supratectal processes.

Material. Described from data on 10 specimens which are stored in four observation records. Type sample MMX-1 11832 (?late Barremian).

Holotype. Grain no. 141/09 from sample MMX-1 11832 (Pl. 21, figs. 7–9), prep. JP160, stub JPS198, coordinates 715 × 263.

Diagnosis. Monocolpate pollen, oval to subcircular in outline, maximum diameter 27·1 (33·7) 43·2 μm. Exine semitectate, reticulum composed of lumina 1·25 (3·2) 5·67 μm in diameter. Muri low, narrow, height 0·33 (0·56) 0·75 μm, width 0·33 (0·74) 1·0 μm, supported on low columellae. Muri bear expanded supratectal processes, 0·75 (0·9) 1·41 μm tall and 1·25 (1·85) 2·67 μm wide, some of which are triangular and some rectangular in surface view. Apices of triangular processes directed into lumina and sides parallel to those of adjacent processes. Nexine smooth to sparsely verrucate, much thinner than sexine. Total exine thickness 2·5 μm. Colpus long, narrow, margins inrolled with sculpture of irregular verrucae and granulae.

Occurrence. This species has been recovered from samples MMX-1 11832 (o.r. JPR4; 4 specimens) and MMX-1 10825 (o.r. JPR3; 3 specimens) which are of ?late Barremian age. Outside this range it has only been observed in cuttings samples MMX-1 12250/60* (JPR112; 2 specimens) and MMX-1 12490* (JPR113; 1 specimen).

A similar grain was figured as *Stellatopollis* sp. 1 by Doyle *et al.* (1977, pl. 1, fig. 10) in samples from the Congo which were of possible Barremian age, equivalent to zone C-V1 of the Gabon Cocobeach sequence. In spite of its clear similarities this specimen has not been definitely assigned to *S. bituberensis* because SEM details are not yet available.

Genus RETIMONOCOLPITES Pierce 1961

Type species. Retimonocolpites dividuus Pierce 1961, p. 47, pl. 3, fig. 87.

Retimonocolpites matruhensis sp. nov.

Plate 22, figs. 1–5

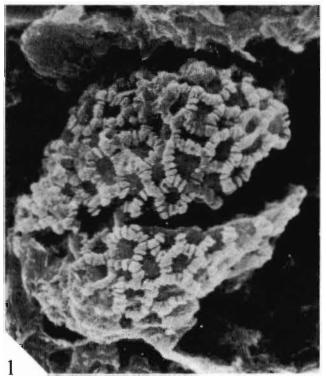
Derivatio nominis. Named after the Mersa Matruh-1 borehole in the North West Desert of Egypt, where it was discovered.

Material. Described from data on 31 specimens which are stored in three observation records. Type sample MMX-1 10825 (?late Barremian).

EXPLANATION OF PLATE 21

Figs. 1–6. *Stellatopollis hughesii.* 1–3, 6, holotype, sample MMX-1 11832, preparation JP160, stub JPS197, coordinates 829 × 245, record number JPR2. 1, negative 137/02, × 1600; 2, 169/16, × 3200; 3, EX5, × 7000; 6, EX6, × 13000. 4 and 5, another specimen, sample MMX-1 10825, prep. JP157, stub JPS112, coordinates 877 × 290, record JPR1. 4. 149/05, × 1600; 5, 169/14, × 7000.

Figs. 7–11. *S. bituberensis.* 7–9, holotype, sample MMX-1 11832, prep. JP160, stub JPS198, coordinates 715 × 263, record JPR4. 7, negative 141/09, × 1600; 8, 141/10, × 7000; 9, 141/11, × 7000. 10 and 11, another specimen, sample MMX-1 10825, prep. JP157, stub JPS111, coordinates 725 × 355, record JPR3. 10, 148/19, × 1600; 11, 148/20, × 7000.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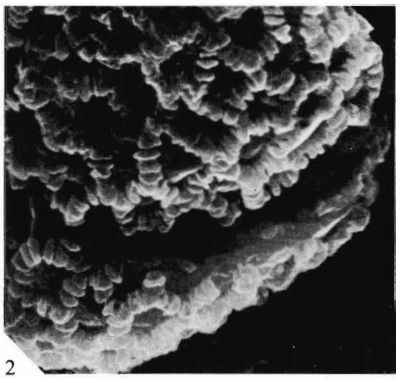
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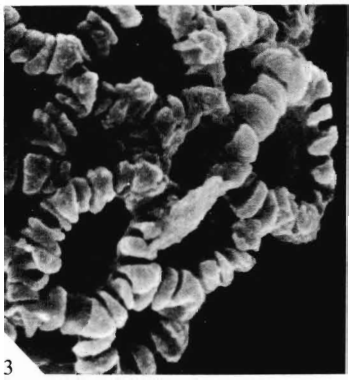
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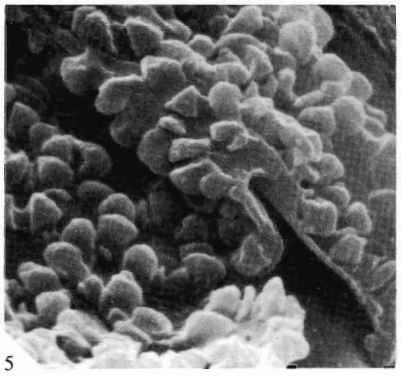
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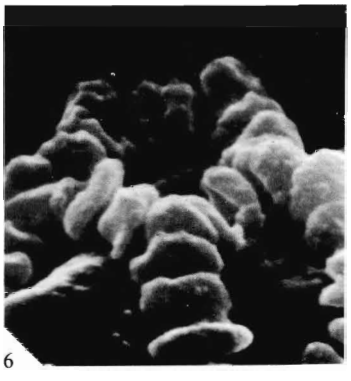
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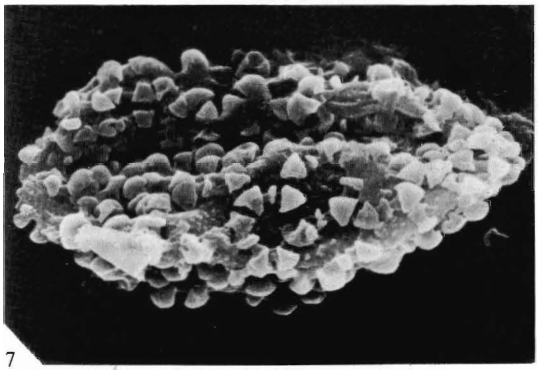
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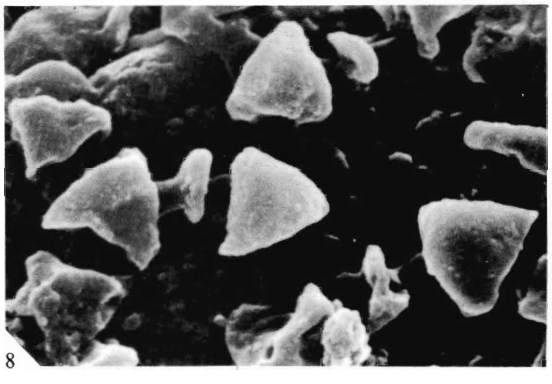
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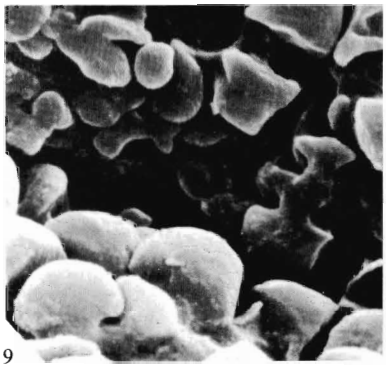
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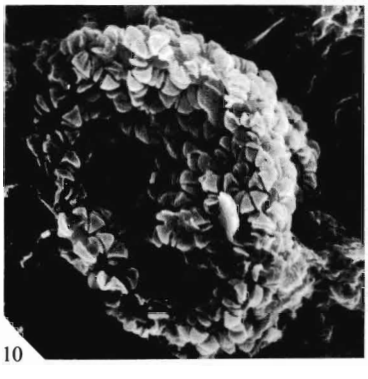
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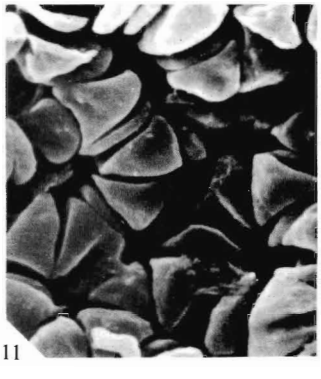
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PENNY, *Stellatopollis*

Holotype. Grain no. 169/26 from sample MMX-1 10825 (Pl. 22, figs. 1 and 2), Prep. JP012, stub JPS65, coordinates 847 × 263.

Diagnosis. Monocolpate pollen, elliptical in equatorial outline, blunt-ended to tapering sharply at the poles. Length 31·3 (37·2) 45·8 μm, width 20·0 (23·0) 25·2 μm. Exine semitectate, reticulate, with rounded to polygonal lumina 0·46 (1·2) 1·7 μm in diameter. Occasional microlumina are present. Muri sinuous, height 0·3 (0·35) 0·4 μm, width 0·3 (0·5) 0·7 μm, sculptured with fine transverse ridges set up to 0·2 μm apart. Columellae short, height 0·2 (0·3) 0·5 μm, width 0·4 (0·6) 0·8 μm. Nexine smooth, attached to sexine over whole grain surface. Total exine thickness up to 1.0 μm. Colpus extending whole length of distal surface, closed or slightly open at poles to gaping. Margins slightly infolded with some disaggregation of sexine near the poles, margins entire in central part of grain.

Occurrence. This species appears first in the ?late Barremian sample MMX-1 11832 (o.r. JPR48; 2 specimens), becomes very common in sample MMX-1 10825 (o.r. JPR5; 27 specimens) and makes its last appearance in sample MMX-1 10617 (o.r. JPR49; 2 specimens), which is late Barremian to ?early Aptian in age.

Retimonocolpites muristriatus sp. nov.

Plate 22, figs. 6–12

Derivatio nominis. From the fine transverse striations which decorate the muri.

Material. Described from data on 12 specimens which are stored in three observation records. Type sample MMX-1 10825 (?late Barremian).

Holotype. Grain no. 151/14 from sample MMX-1 10825 (Pl. 22, figs. 6–8), prep. JP157, stub JPS112, coordinates 817 × 346.

Diagnosis. Monocolpate pollen, rounded in outline. Diameter 19·4 (24·1) 27·1 μm. Exine semitectate, finely reticulate with rounded to polygonal lumina 0·5 (1·1) 2·0 μm in diameter. Muri sinuous, height 0·3 (0·5) 0·8 μm, width 0·4 (0·6) 0·8 μm, sculptured with fine transverse ridges. Columellae 0·3 (0·5) 0·8 μm tall, 0·3 (0·4) 0·5 μm wide. Nexine smooth, attached to sexine over whole grain surface. Total exine thickness up to 1·2 μm. Colpus long, extending whole length of distal surface. Margins entire, aperture membrane granular to verrucate.

Occurrence. This species occurs in samples MMX-1 11832 (o.r. JPR7; 2 specimens) and MMX-1 10825 (o.r. JPR6; 9 specimens) which are of ?late Barremian age. It has also been recovered from cuttings sample MMX-1 11250* (o.r. JPR114; 1 specimen).

Retimonocolpites muriundulatus sp. nov.

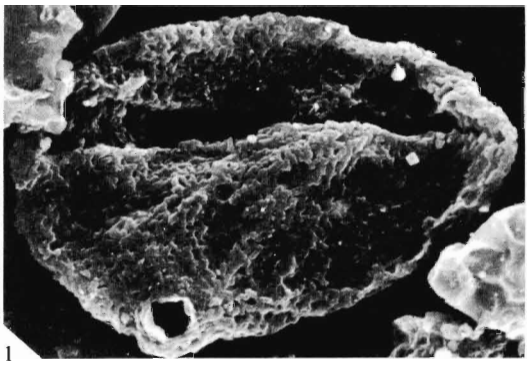
Plate 23, figs. 7–12

Derivatio nominis. From the continual variations in murus width.

EXPLANATION OF PLATE 22

Figs. 1–5. *Retimonocolpites matruhensis.* 1 and 2, holotype, sample MMX-1 10825, preparation JP012, stub JPS65, coordinates 847 × 263, record JPR5. 1, negative 169/26, × 1600; 2, 195/13, × 7000. 3 and 4, another grain, sample MMX-1 10825, prep. JP157, stub JPS204, coordinates 782 × 288, record JPR5. 3, 170/03, × 1600; 4, 170/04, × 7000. 5, another specimen, sample MMX-1 10825, prep. JP157, stub JPR204, coordinates 775 × 285, 170/02, × 7000.

Figs. 6–12. *R. muristriatus.* 6–8, holotype, sample MMX-1 10825, prep. JP157, stub JPS112, coordinates 817 × 346, record JPR6. 6, 151/14, × 1600; 7, EX9, × 7000; 8, EX8, × 7000, tilted to show aperture. 9 and 10, another specimen, sample MMX-1 10825, prep. JP157, stub JPS203, coordinates 885 × 328, record JPR6. 9, 168/32, × 1600; 10, 168/33, × 7000. 11 and 12, another specimen, sample MMX-1 10825, prep. JP157, stub JPS112, coordinates 705 × 316, record JPR6. 11, 153/25, × 1600; 12, 153/26, × 7000.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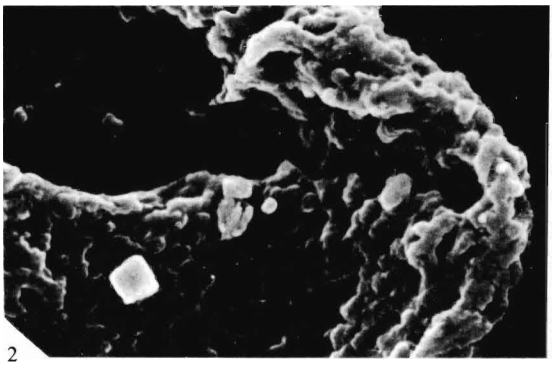
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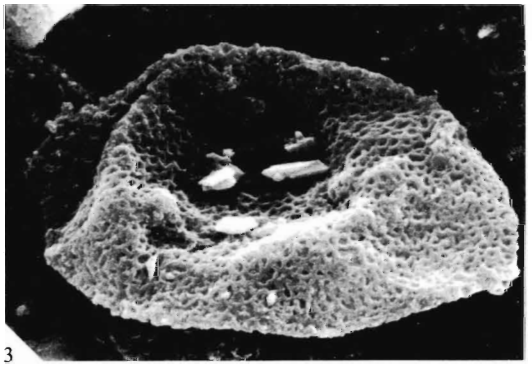
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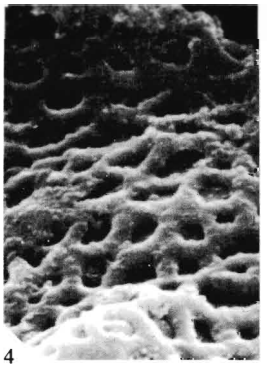
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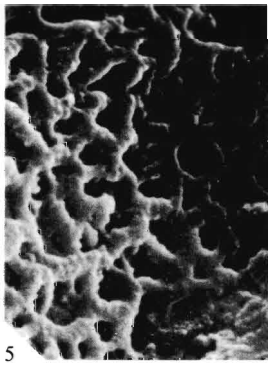
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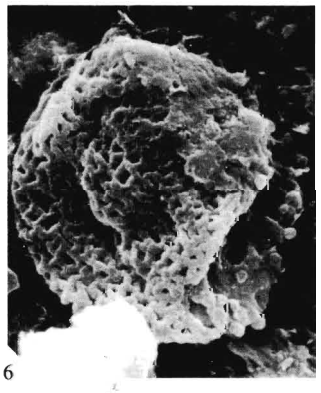
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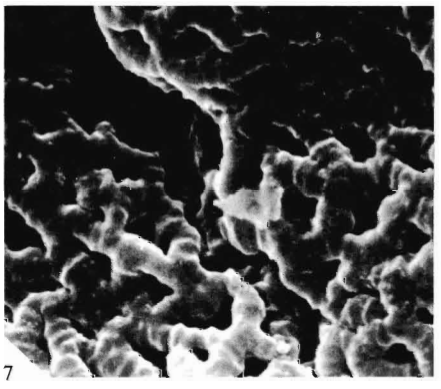
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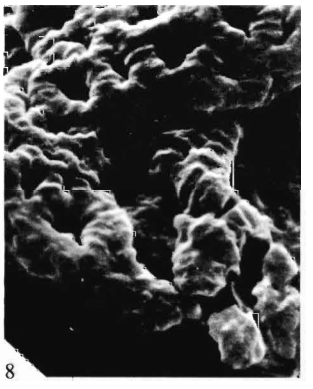
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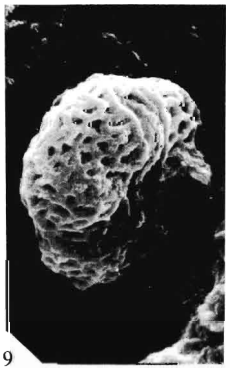
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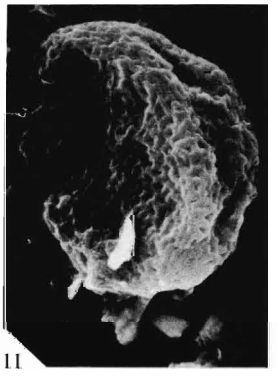
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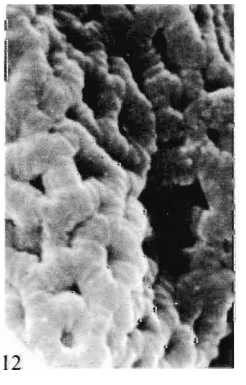
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PENNY, *Retimonocolpites*

Material. Described from data on 18 specimens which are stored in three observation records. Type sample MMX-1 11832 (?late Barremian).

Holotype. Grain no. 141/12 from sample MMX-1 11832 (Pl. 23, figs. 7–9), prep. JP160, stub JPS198, coordinates 706 × 278.

Diagnosis. Monocolpate pollen, rounded to subcircular in outline, diameter 11·0 (17·0) 21·9 μm. Exine semitectate, finely reticulate with small polygonal lumina 0·46 (1·6) 2·6 μm in diameter. There are occasional microlumina. Muri sinuous, smooth or with very fine transverse ribbing, height 0·2 (0·4) 0·66 μm, width 0·2 (0·48) 0·91 μm. Some developments of muri end blindly in lumina. Muri vary continually in thickness. Columellae conspicuous, numerous, height 0·1 (0·25) 0·3 μm, width 0·1 (0·3) 0·42 μm. Nexine smooth, attached to sexine over whole grain surface. Total exine thickness 0·5 μm. Colpus long with entire margins.

Occurrence. This species occurs in samples MMX-1 11832 (o.r. JPR8; 13 specimens) and MMX-1 10825 (o.r. JPR9; 3 specimens), which are of ?late Barremian age. It has also been recovered from cuttings sample MMX-1 11250* (o.r. JPR115; 2 specimens).

Genus LILIACIDITES Couper 1953

Type species. Liliacidites kaitangataensis Couper 1953, pl. 7, fig. 97.

Liliacidites aegyptiacus sp. nov.

Plate 23, figs. 1–6

Derivatio nominis. After Egypt, where this species was discovered.

Material. Described from data on 11 specimens which are stored in four observation records. Type sample MMX-1 11832 (?late Barremian).

Holotype. Grain no. 138/05 from sample MMX-1 11832 (Pl. 23, figs. 1–3), prep. JP16, stub JPS160, coordinates 863 × 267.

Diagnosis. Monocolpate pollen, elongated to subcircular in outline, diameter 19·4 (22·5) 25·8 μm. Exine semitectate, reticulate with a bimodal distribution of lumina size. Small lumina measure 0·1 (0·2) 0·61 μm and the large 0·66 (1·1) 1·5 μm in diameter. Grain ends with solid exine or lumina reduced to puncti. Muri sinuous, smooth, height 0·23 (0·45) 0·5 μm, width 0·3 (0·35) 0·4 μm. Columellae conspicuous, stout, height 0·1 (0·3) 0·4 μm, width 0·1 (0·2) 0·4 μm, individual columellae generally taller than wide. Nexine slightly granular, attached to exine over whole grain surface. Colpus long, slightly twisted, margins entire and slightly inrolled. Lumina adjacent to colpus are in the smaller size range.

Remarks. This species is very similar to *R. muriundulatus*, with which it can easily be confused. It is distinguished by the regular occurrence of small lumina which are especially concentrated towards the ends of the grain and along the aperture margins. The lumina of *R. muriundulatus* are also of a

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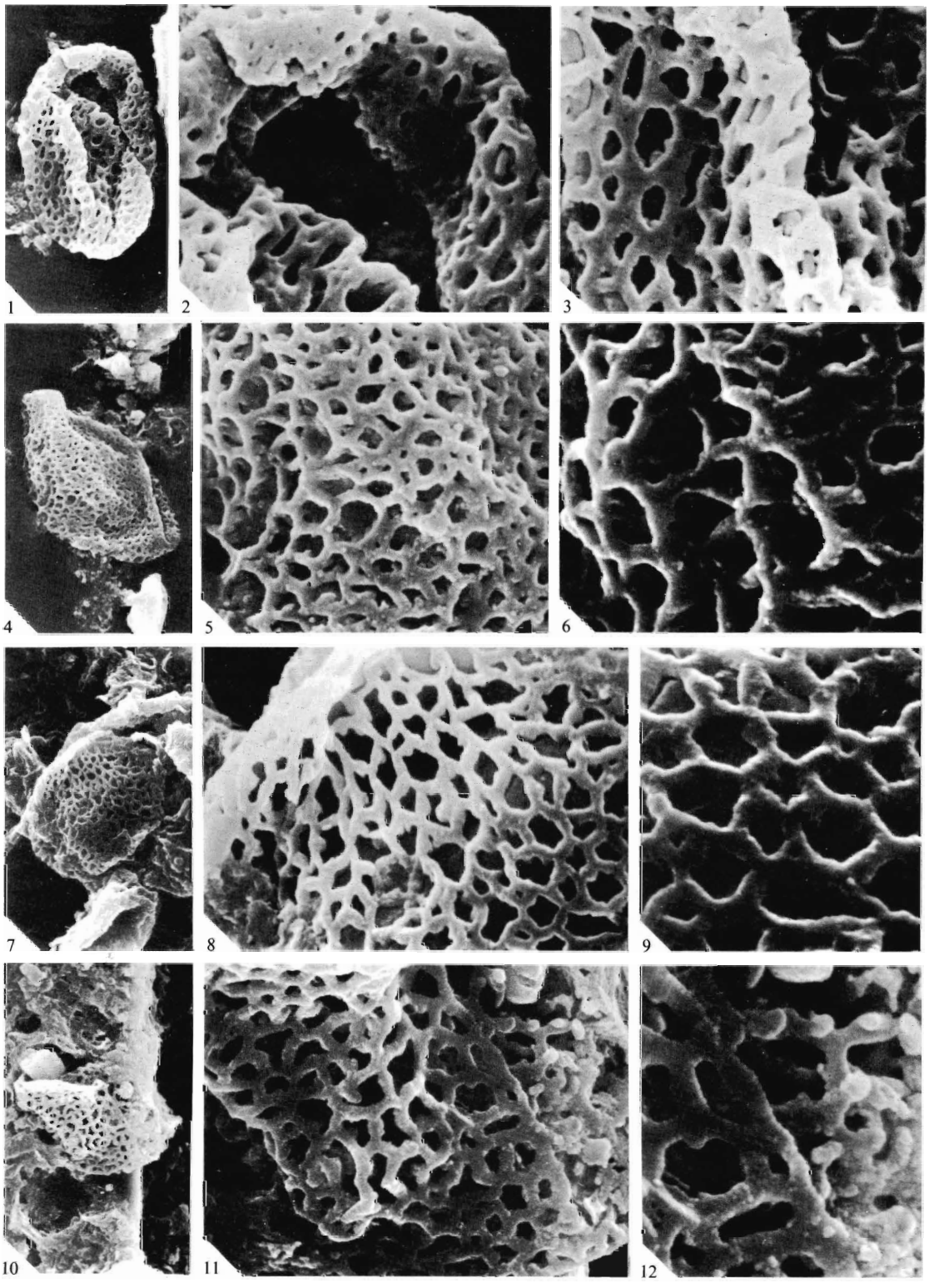
EXPLANATION OF PLATE 23

Figs. 1–6. *Liliacidites aegyptiacus.* 1–3, holotype, sample MMX-1 11832, preparation JP160, stub JPS198, coordinates 863 × 267, record JPR11. 1, negative 138/05, × 1600; 2, 138/07, × 7000; 3, 138/06, × 7000. 4–6, another specimen, sample MMX-1 11832, prep. JP160, stub JPS198, coordinates 815 × 299, record JPR11. 4, 139/06, × 1600; 5, 139/07, × 7000; 6. EX10, × 13000.

Figs. 7–12. *Retimonocolpites muriundulatus.* 7–9, holotype, sample MMX-1 11832, prep. JP160, stub JPS198, coordinates 706 × 278, record JPR8. 7, 141/12, × 1600; 8, 141/13, × 7000; 9, EX14, × 13000. 10–12, another specimen, sample MMX-1 11832, prep. JP160, stub JPS197, coordinates 765 × 296, record JPR8. 10, 135/08, × 1600; 11; EX11, × 7000; 12, EX12, × 13000.



PENNY, *Liliacidites*, *Retimonocolpites*

generally larger size than the larger sized lumina of *L. aegyptiacus*. The muri also differ between the two species, being very variable in thickness in *R. muriundulatus*. Both species have occasional fine transverse striations on the muri.

Occurrence. This species has been recovered from samples MMX-1 11832 (o.r. JPR11; 3 specimens) and MMX-1 10825 (o.r. JPR10; 5 specimens), which are of ?late Barremian age. It makes its final appearance in sample MMX-1 9867 (o.r. JPR101; 1 specimen) which is early Aptian in age. It has also been recovered from cuttings sample MMX-1 10350* (o.r. JPR116; 2 specimens).

DISCUSSION

Species of fossils and the ICBN

The object in describing the six new Egyptian species from data which have been stored using the biorecord system is to demonstrate that this system is indeed compatible with traditional use of the International Code of Botanical Nomenclature (ICBN). As Hughes (1976) stated, 'the two can be complementary'. Having set up the species there are two possible methods of recording future observations.

First, new data could be included in the traditional way; inevitably observations of different quality would expand the species until they eventually become less useful as they grow into the 'balloon taxa' described by Hughes (1970). Alternatively new data could be included using the biorecord system, in which every observation remains individually distinguishable.

For each of the species described above there is a clearly stated record of the individual observations, each of which is stored as a separate biorecord or comparison record. This means that within the pool of data the details of every observation on each species will remain uniquely identifiable. Thus in the future the observations can be assessed individually in their own right. As a result records that are potentially unreliable, such as those based on small numbers of specimens or incomplete observations, could be picked out and if necessary, ignored. In this way species will remain useful both biologically and stratigraphically. It is, after all, the less reliable observations and consequent 'best fit' identifications that are mainly responsible for the ballooning of established taxa.

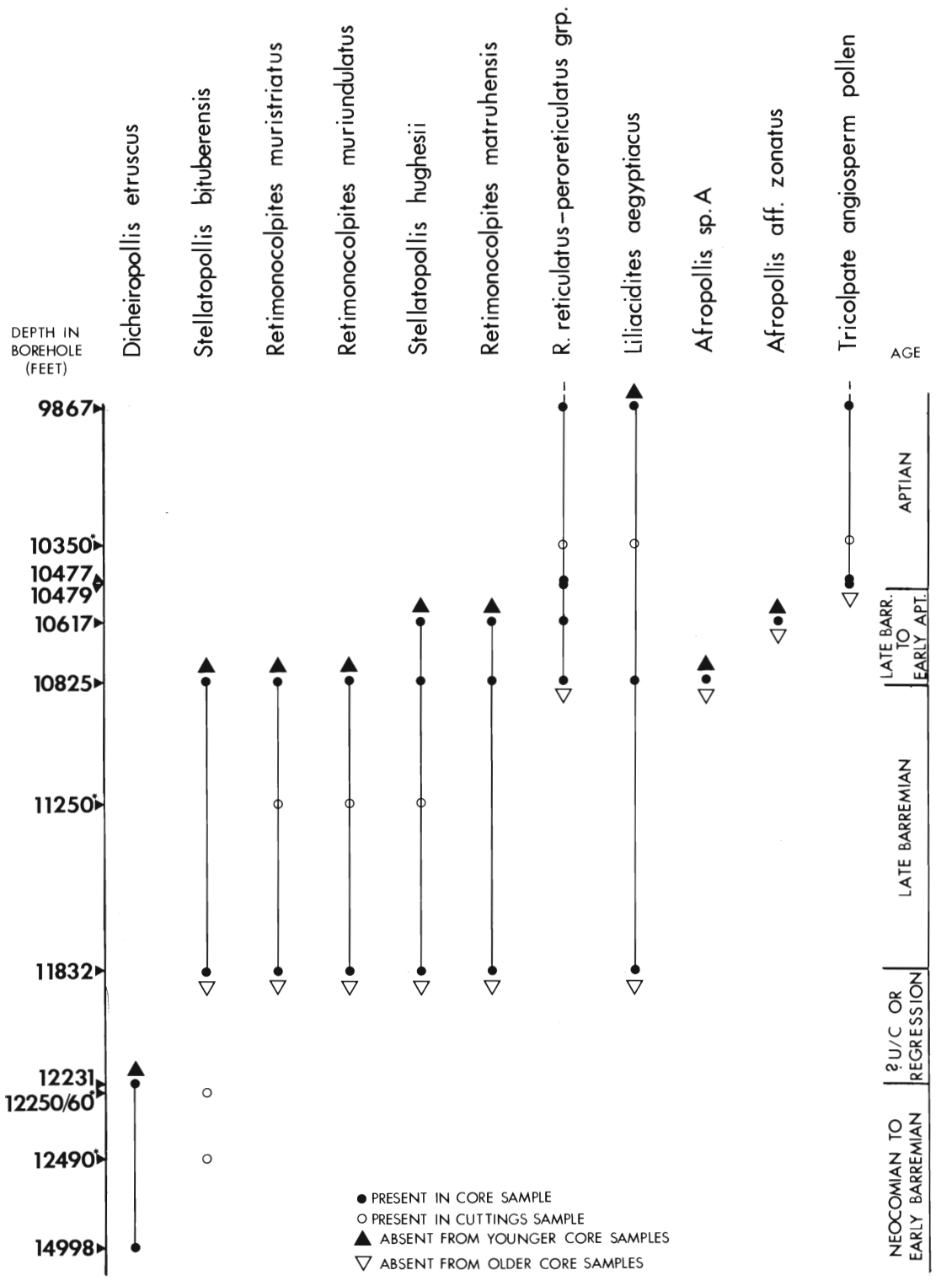
SEM detail and the recognition of species

The species described above are based on characters derived from SEM observations. Although this might seem inappropriate from the point of view of users of routine light microscopy (LM), it must be appreciated that species distinguished by SEM inevitably incorporate information that renders them impossible to recognize using LM. Obviously this necessitates the use of SEM in future work in order to maintain the improved specific and stratigraphic resolution which can be obtained with such observations.

An alternative is to use individually picked grains, as Doyle *et al.* (1982) did in their work on *Afropollis*. However, this method is very time consuming and for very rare species, such as those described above, there is an unacceptable risk of specimen loss. In any case, species erected in this way are still not easily distinguished by LM (Doyle *et al.* 1982).

Angiosperm pollen and the dating of the sequence

The first appearance of angiosperm pollen in Mersa Matruh is in the core sample MMX-1 11832 (text-fig. 1). The preceeding core sample, MMX-1 12231, which is 400 ft (122 m) downhole, contains only poorly preserved dinocysts with non-angiospermous terrestrial palynomorphs including rare *Dicheiropollis etruscus* Trevisan 1971. There is no evidence to suggest that these are reworked and accordingly sample MMX-1 12231 has been dated as Neocomian to early Barremian. A possible unconformity or regression is present between these two samples, suggesting the probability of artificial curtailment of the downhole ranges of the species which appear in sample MMX-1 11832. In this sample, which is dated as ?late Barremian, the angiosperms account for 6·5 % of the land



TEXT-FIG. 1. Scale diagram illustrating the observed stratigraphic ranges of the taxa mentioned in the text.

derived palynoflora and consist entirely of semitectate, reticulate monocolpates of the genera *Stellatopollis* Doyle *et al.* 1975, *Retimonocolpites* Pierce 1961, and *Liliacidites* Couper 1953. Clear similarities exist between this early flora and other described Barremian assemblages.

a. Stellatopollis. S. hughesii was recovered from late Barremian strata in southern England (Hughes *et al.* 1979). Their samples were dated by correlation with the ammonite zones of Rawson *et al.* (1978), although it now appears that these strata might be slightly older (Harding, this vol.).

S. bituberensis is very similar to *Stellatopollis* sp. 1 Doyle *et al.* 1977, which was recovered from samples of possible Barremian–Aptian strata in the Congo, but SEM examination of the Congo specimens would be required before confident correlations could be made. Further grains were illustrated by Doyle *et al.* (1975, pl. 8, figs. 6–8) as *Stellatopollis* sp. and by Hickey and Doyle (1977, fig. 4i, j), both these observations being made on ?Barremian to Aptian material from outcrops of the Potomac group in Virgina. These grains differ in appearing to be zonosulcate, but have the same arrangement of both triangular and rectangular supratectal processes as the West African and Egyptian specimens. This feature is interesting as it seems to occur mainly in *Stellatopollis* of Barremian or earliest Aptian age, and might therefore be useful in recognizing early forms of *Stellatopollis* elsewhere.

b. Retimonocolpites and *Liliacidites*. The three species of *Retimonocolpites* and *L. aegyptiacus*, which occur in association with these *Stellatopollis* species are not clearly comparable with other published species. *R. matruhensis*, however, is superficially similar to *R. mawhoubensis* Schrank 1983 and might be confused using LM, but SEM reveals the completely different mural sculpture and shape. *R. mawhoubensis* also has a zonosulcus instead of the long colpus of *R. matruhensis*.

The last appearances of *R. muristriatus* and the two *Stellatopollis* species in sample MMX-1 10825 are associated with the first appearance of representatives of *Afropollis* Doyle *et al.* 1982 (*Afropollis* sp. A, observation record JPR13) and *Retimonocolpites* cf. *peroreticulatus* (Brenner) Doyle *et al.* 1975 (observation record JPR12). There is also an increase in the angiosperm component of the land-derived palynoflora in this sample (7 %).

c. Afropollis. In West Africa *Afropollis* appears for the first time in sediments of suspected Aptian age, where it is represented by *A.* aff. *zonatus*, *A. operculatus*, and *A. zonatus* (Doyle *et al.* 1982). The Egyptian *Afropollis* (sp. A) could not be positively identified, although it had definite similarities with these West African species. *Afropollis* grains which are clearly recognizable as *A.* aff. *zonatus* Doyle *et al.* 1982 first appear in a younger sample, MMX-1 10617. The implication is that the grains in MMX-1 10825 may represent a very early species, possibly *A.* aff. *zonatus*, and maybe even a new form altogether. It seems quite likely that this species might belong with *A. operculatus* and *A.* aff. *zonatus* in a group which extends from earliest Aptian into the latest Barremian and which might, as suggested by Doyle *et al.* (1982), represent a series of closely related species which is as yet incompletely understood.

d. Retimonocolpites reticulatus–peroreticulatus group. Grains of this group first appear in the Barremian (Kemp 1970). In Mersa Matruh the group is represented by only three grains when it makes its first appearance in sample MMX-1 10825. Although these specimens do exhibit similarities with *R. peroreticulatus* (Brenner) Doyle *et al.* 1975, they were not similar enough to allow confident identification. However, they clearly belong in the *R. peroreticulatus–reticulatus* group of Schrank (1982). Examples of this group become quite common in younger samples, increasing steadily through the Aptian strata to early Albian and beyond, where they can make up more than 50 % of the total angiosperm representation in the palynoflora.

e. Tricolpates. Associated with the increase in the *R. reticulatus–peroreticulatus* group is the first appearance of tricolpate angiosperm pollen in sample MMX-1 10479. The first appearance of

tricolpates in West Africa is considered to be early Aptian (Doyle *et al.* 1977) and in Israel they may appear as early as Barremian (Brenner 1976). If the first appearance is taken to indicate earliest Aptian (cf. Doyle *et al.* 1977) then the samples below MMX-1 10479, from which the species described above were recovered, are almost certainly Berremian in age, a suggestion which is supported by comparison with other floras.

f. Conclusion. Unfortunately there is no independent dating control for these samples. Dinocysts are present at low diversity. They are rather poorly preserved and include morphologically unusual forms, possibly as a consequence of environmental changes such as reduced salinities associated with close proximity to the shoreline (Davey, pers. comm., 1984). As a result the dating is based entirely on observations of the land-derived palynoflora. Although this method does seem to have provided good evidence for the postulated Barremian age, it must be borne in mind that such an approach can lead to circular arguments when making time-based correlations between floral events in different palaeogeographical locations.

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