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APTIAN TO CENOMANIAN PALYNOMORPHS FROM THE QARUN 2-1 BOREHOLE, WESTERN DESERT, EGYPT

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أبواغ وحبوب لقاح العصر الابتي حتى السنوماني في بئر قارون ٢ ـ ١ بالصحراء الغربية ـ مصر

صلاح يوسف البيلي

قام الباحث بدراسة المحتوى الاحفوري لحبوب اللقاح والأنواع في أربع عينات اسطوانية تم الحصول عليها من عضو خريطة الذي ينتمي إلى تكوين برج العرب في بئر قارون ٢ ـ ١ بشمال الصحراء الغربية بمصر وتم التعرف على تجمعين احفورين أمكن بواسطتهما الاستدلال على الأعمار الجيولوجية لهذا التتابع الذي يتراوح في مداه من العصر الابتي إلى العصر الالبي المبكر/الأوسط في جزئه السفلي بينما ينتمي الجزء العلوي من هذا التتابع للعصر الالبي الاوسط/العلوي حتى باكورة السنوماني . وقد تبين أن سحنه الترسيب كانت قارية وبدراسة التغير اللوني للأنواع فقد ظهر جليا أن هذه الرسوبيات غير ناضجة حرارياً وبالتالي فإنها لا تصلح أن تكون صخراً مصدريا لتكون الهيدروكربون .

Key Words: Albian, Aptian, Cenomanian, Egypt, Hydrocarbons, Qarun, Palynofacies, Palynomorphs, Western Desert.

ABSTRACT

Rich distinctive, miospore assemblages are recovered from four sidewall core samples obtained from the Kharita Member of Burg El Arab Formation in the Qarun 2-1 borehole located in the eastern part of the North Western Desert of Egypt. Palynomorph assemblages with *Reyrea polymorphus* Herngreen, *Elaterosporites klaszi* (Jardiné & Magloire) Jardiné and *Afropollis jardinus* (Brenner) Doyle *et al.*, are typical members of the Mid-Cretaceous African - South American microfloral province ASA. This allows dating the deposits as? Aptian to early / middle Albian and middle / late Albian to early Cenomanian. On the whole the palynomorph / kerogen content suggests a non-marine environment of deposition. These sediments are too immature to have any potential source for hydrocarbons.

INTRODUCTION

Palynological investigations of late Early Cretaceous sediments in the North Western Desert of Egypt began with the work of Saad in 1978. Other publications on the same general area dealing with Mid-Cretaceous palynofloras are those of Sultan (1978, 1987); Sultan and Ali (1986); El Shamma and Arafa (1988); Schrank (1987); Penny (1986, 1988a and b, 1989) and Omran *et al.* (1990).

The intent of this paper is to present the results of palynological analysis of four sidewall cores from the Qarun 2-1 borehole. The well was drilled by Shell Winning N. V. in 1986 in the eastern part of the North Western Desert of Egypt (Lat. 29° 21' 04"N.; Long. 30° 41' 03" E., Fig. 1). This palynological approach was undertaken to throw light on the age of sediments which have not yielded stratigraphically diagnostic fauna. This paper also focuses on the palynofacies, paleoenvironment, organic thermal maturity and the contribution of palynology to exploration in this area which is of considerable economic interest with major oil and gas reserves (Schlumberger, 1984).

STRATIGRAPHY

The Qarun 2-1 borehole reached a total depth of 3102.4 m. The oldest part of the sequence studied forms part of the Kharita Member of the Burg El Arab Formation, a unit of fine to coarse quartzose sandstone interbedded with shales and carbonates. This member rests unconformably over older units from Lower Cretaceous to Basement. It underlies the widely spread Bahariya Formation at the easily recognizable contact provided by the limestone bed which is persistently present at the base of the Bahariya Formation (Fig. 2).

The Kharita Member is Albian according to foraminiferal evidence (Barakat *et al.*, 1980), Aptian / Albian (Penny, 1988b) on palynological criteria and Albian to Cenomanian age is postulated on lithostratigraphical observations (Hanter, 1990).

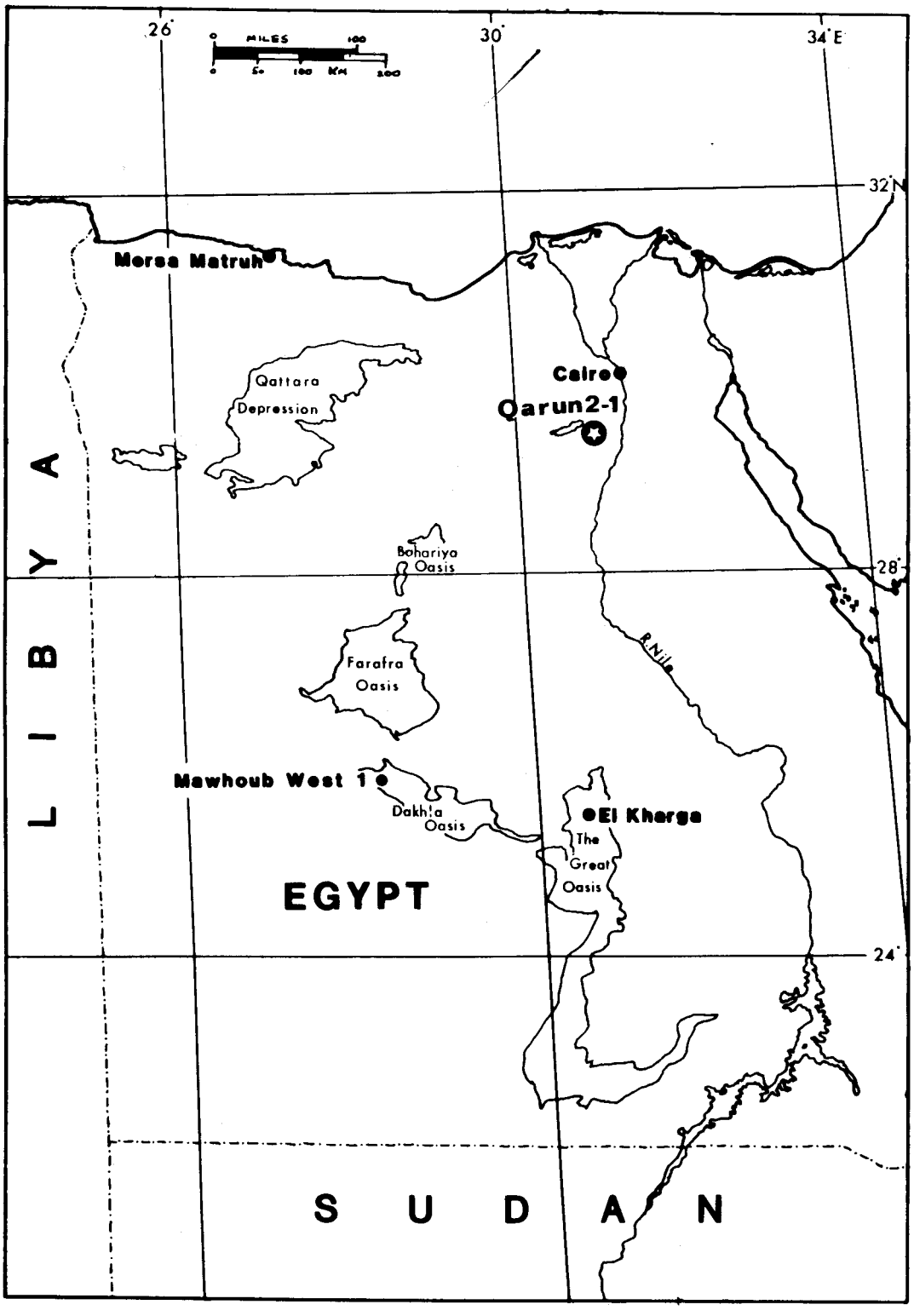


Fig. (1): A sketch map to show the location of the Qarun 2-1 borehole.

The studied part of the Kharita Member was deposited in a high energy shallow marine to near shore environment (Schlumberger, 1984). In the extreme north, the unit seems to have been deposited in deep water, while in the south it was under the influence of continental conditions (Hanter, 1990, p. 309).

MATERIALS AND METHODS

Standard palynological extraction methods were used for sample preparation, involving HCl and HF to remove carbonates and silicates. Acid insoluble organic matter (kerogen) was then mounted in Canada Balsam for examination in transmitted white light. Any remaining residue was subjected to brief ultrasonic vibration and oxidation using 70% HNO3 and then filtered using a sintered glass funnel of porosity 2 to clear some of the finely particulate detritus. The organic fraction between 10 and 125µm was Safranian - stained and prepared as permanent scatter mounts. Few drops of polyvinyl alcohol (PVA) were added to the residue for dispersion and Canada Balsam was the mounting medium. Counts of 200 specimens per sample were made from each sample, the most important of which are discussed in the following section and illustrated on Plates 1 and 2.

All material relating to this study is stored in the Department of Geology, Faculty of Science, Qatar University, Doha, Qatar.

PALYNOLOGICAL RESULTS

A selection of the most important microfloral elements for each sample is briefly discussed. Relative abundances of miospores are as follows, Rare (R), less than 5%, Common (C), 5-25%, Abundant (A), more than 25%.

Sidewall core 1

A sidewall core from depth 2325.5 m of the Qarun 2-1 borehole has yielded rich microfloras which include biostratigraphically important miospores and no dinocysts were recovered. The species list includes the following miospores:

Cyathidities sp. (A), *Perotrilites pannuceus* Brenner (A), *Afropollis jardinus* (C), *E. klaszi* (C), *Foveomonocolpites* sp. (C), *Dictyophyllidites harrisii* Couper (R), *Concavissimisporites* sp. (R), *Schizosporis parvus* Cookson & Dettmann (R), *Todisporites minor* Couper (R), *Cicatricosisporites* sp. (R), *Retitricolpites* sp. (R) and *Ephedripites* sp. (R).

The miospores listed above include biostratigraphically important forms such as *A. jardinus* and *E. klaszi*. *Afropollis* has been observed in strata of early Aptian to early Cenomanian age, the earliest occurrences mainly being in the pre Albian west African - south American WASA microfloral province of Herngreen and Chlonova (1981). While the majority of reports of *Afropollis* are from the WASA, sporadic occurrences have been noted at more northerly locations, the earliest of those also being of early Aptian or possibly latest Barremian (Hasenboehler, 1981). In Egypt *Afropollis* has been observed with comparable detail in strata of Aptian / Albian (Saad, 1978; Schrank, 1982, 1983; Sultan, 1986; Penny, 1986, 1989; Soliman *et al.*, 1989; El Beialy *et al.*, 1990; Omran *et al.*; 1990) to early Cenomanian (Sultan, 1978, 1987; Sultan & Ali, 1986; Penny, 1989; El Beialy *et al.*, 1990; Omran *et al.*, 1990). The elaterate species *E. klaszi* is relatively short-ranging and largely restricted to the middle Albian to Cenomanian interval in North Africa (Urban *et al.*, 1976; Saad, 1978; Sultan, 1978, 1987; Sultan and Ali, 1986; Thusu and Van der Eem, 1985; Batten and Uwins, 1985; Uwins and Batten, 1988; El Beialy *et al.*, 1990; Omran *et al.*, 1990). The recent summary of Herngreen and Duenas Jiminez (1990) indicates that this species has its widest distribution in the late Albian and earliest Cenomanian.

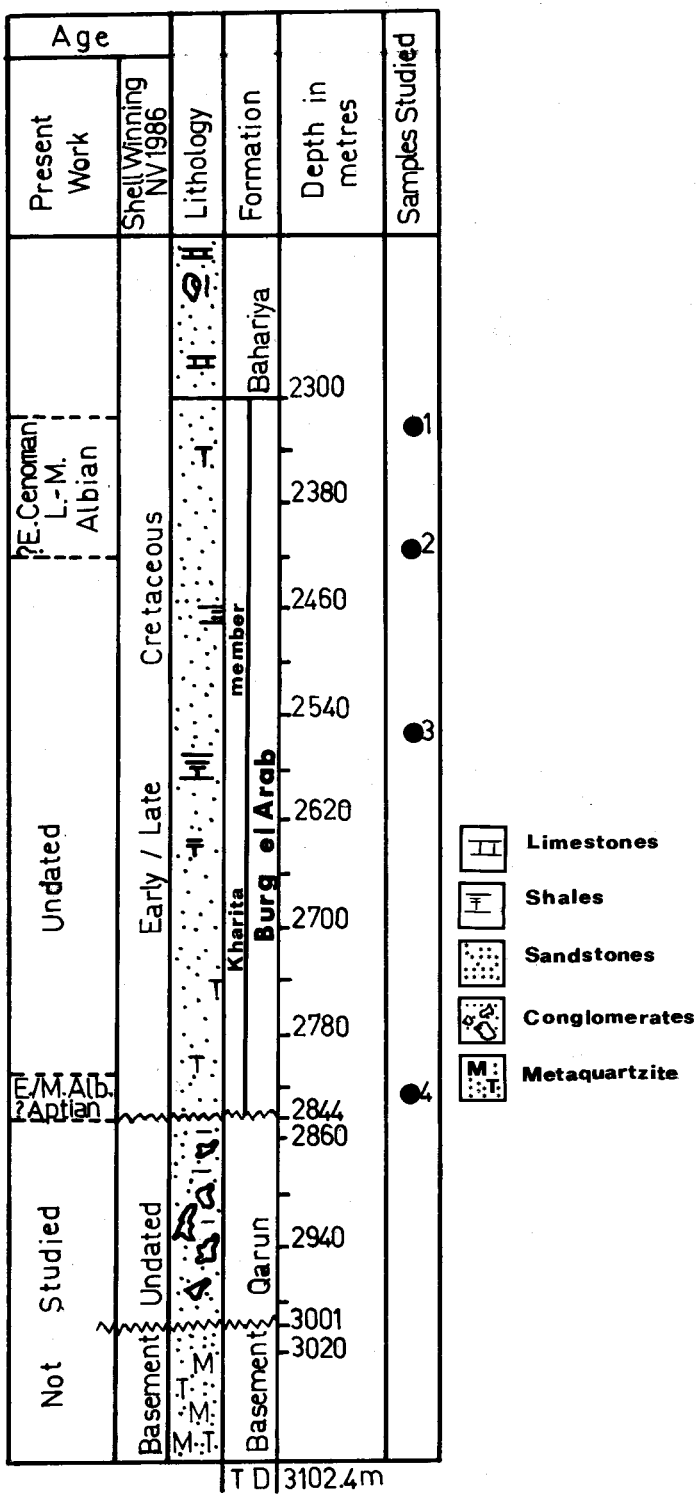
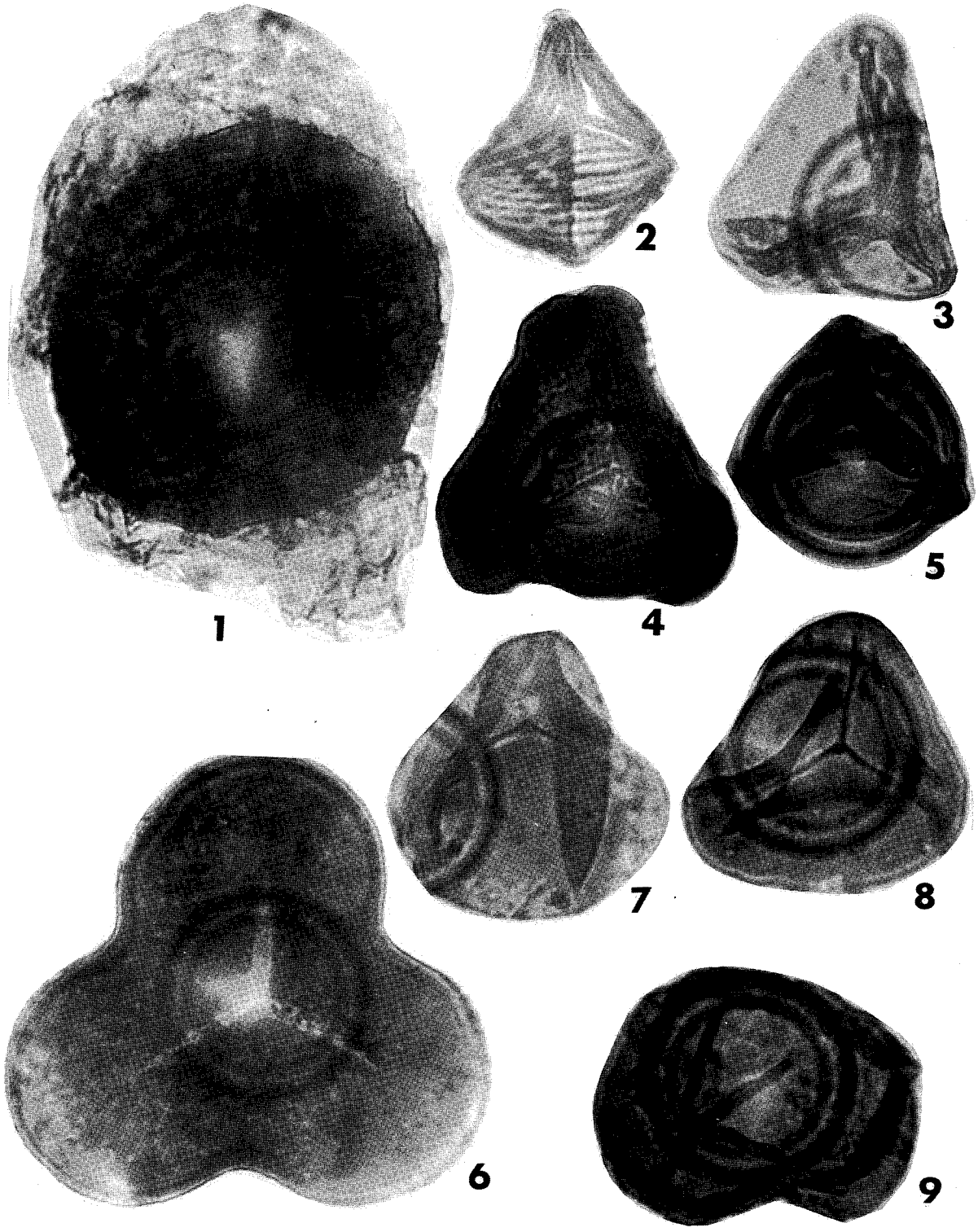


Fig. (2): Subsurface stratigraphy of the Qarun 2-1 borehole in comparison with the stratigraphic classification of Shell Winning NV (1986).



Figs. (3, 4, 5): All figures approximately X 1000, unless otherwise noted, England Finder reference is given for each illustrated specimen.

Fig. 3.

1. *Balmeisporites holodictyus* Cookson & Dettmann 1958, core 4, depth 2827.5 m, G48.
2. *Cicatricosisporites* sp., core 1, depth 2325.5 m, J36.
3. *Biretisporites* sp., core 1, X23.
4. *Matonisporites* sp., core 3, depth 2556 m, X43.
5. *Todisporites? minor* Couper 1958, core 1, P44.
6. *Concavissimisporites* sp., core 3, Q37.
7, 8. *Dictyophyllidites harrisii* Couper 1958, core 1, P46, V30.
9. *Perinopollenites elatoides* Couper 1958, core 4, J49.

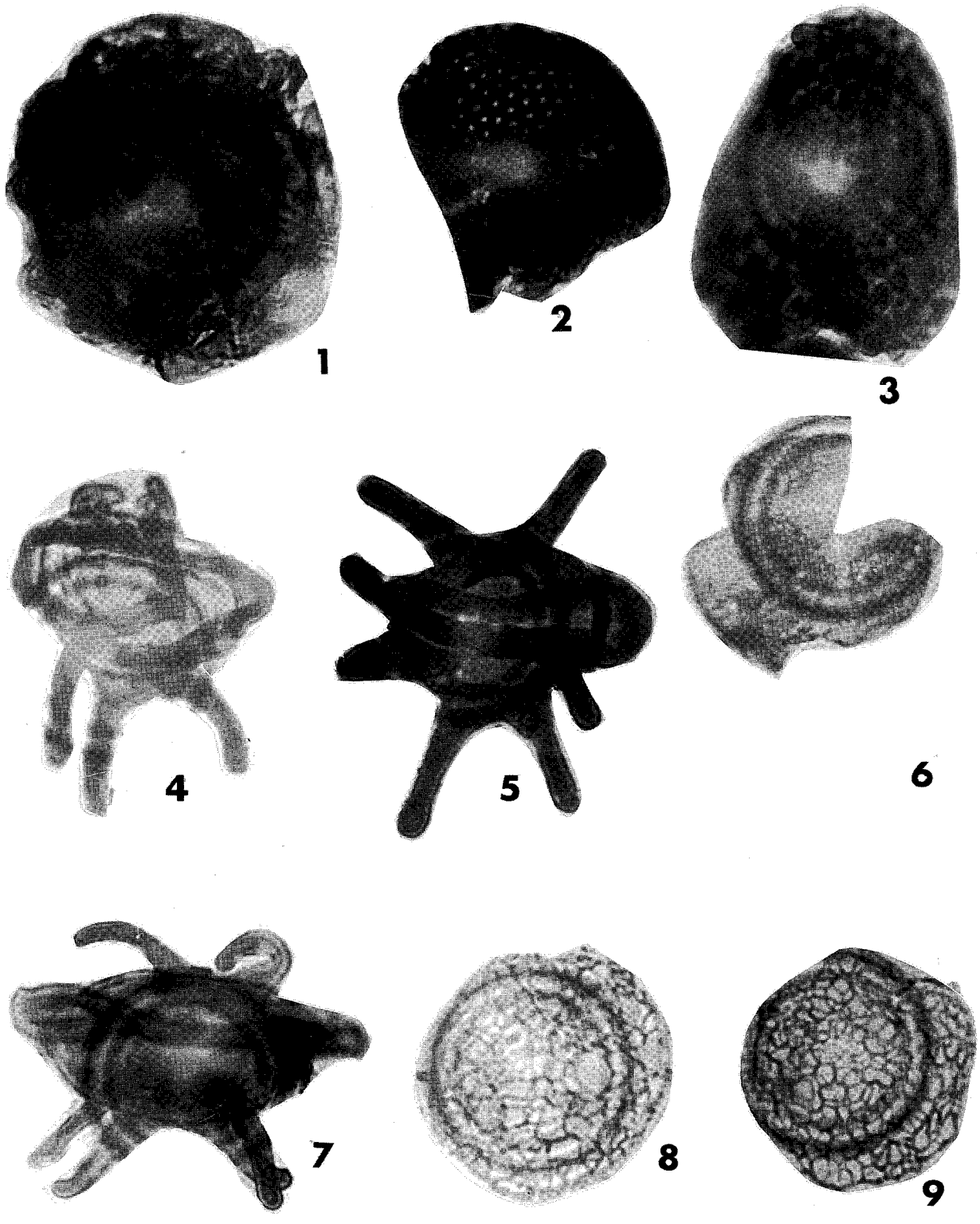


Fig. 4.

1. *Perotrilites pannuceus* Brenner 1963, core 1, J24.
2. *Foraminisporis wonthaggiensis* (Cookson & Dettmann) Dettmann 1963, core 3, W38.
3. *Impardecispora apiverrucata* (Couper) Venkatachala *et al.*, 1969, core 3, U22.
4, 5, 7. *Elaterosporites klaszi* (Jardiné & Magloire) Jardiné 1967, core 1, P50, W32, Q39.
6. *Retitricolpites* sp., core 1, V27.
8, 9. *Afropollis jardinus* (Brenner) Doyle *et al.* 1982. core 1, S19, N33.

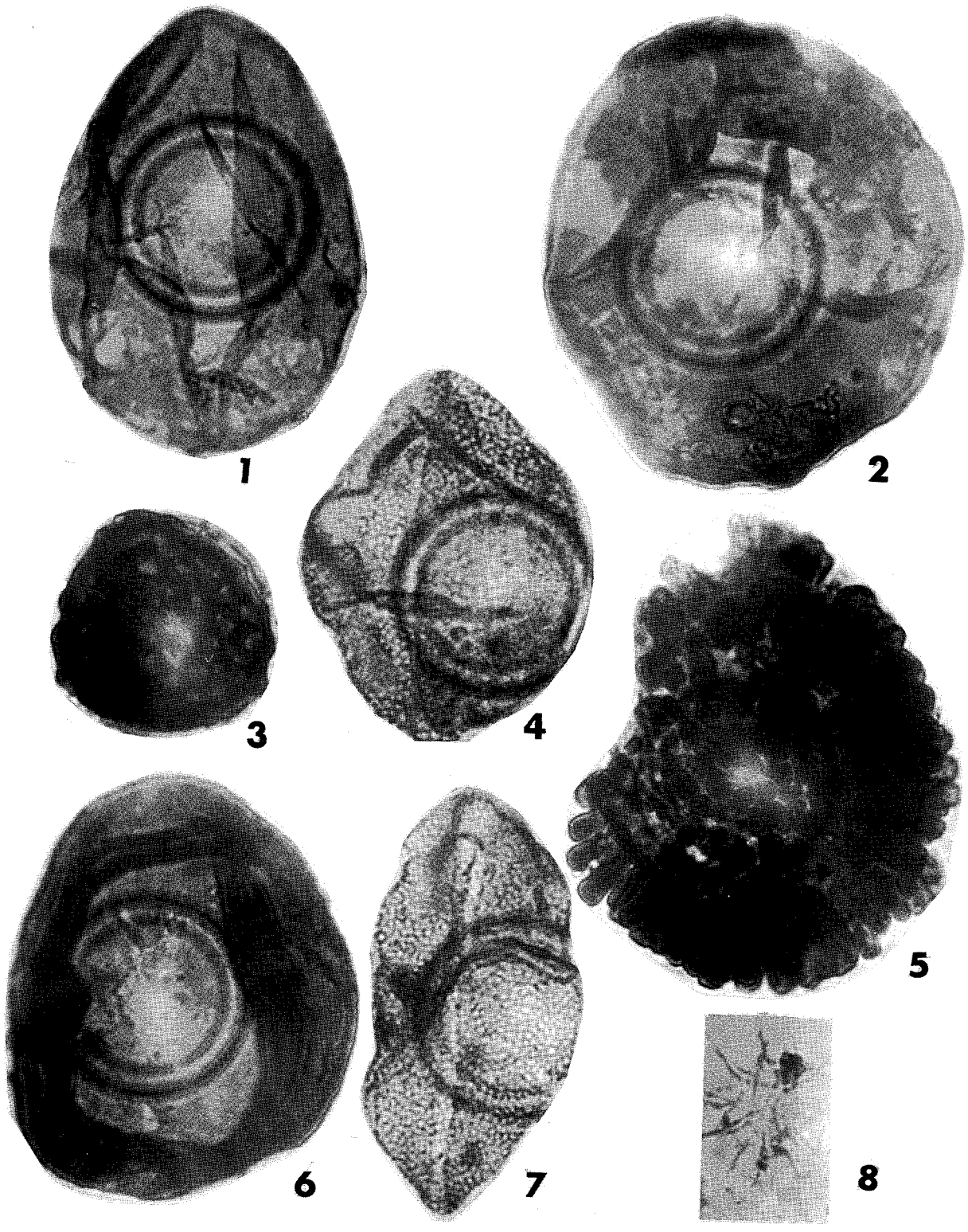


Fig. 5.

1. *Araucariacites australis* Cookson 1947, core 3, H48.
2. *Inaperturopollenites* sp. / *limbatus* Balme 1957, core 3, G47.
3. aff. *Ischyosporites* sp., core 4, V29.
4, 7. *Foveomonocolpites* sp., core 1, U39, W37.
5. *Reyrea polymorphus* Herngreen 1973, core 4, C38.
6. *Cingulatipollenites aegyptiaca* Saad & Ghazaly 1976, core 3, R29.
8. *Micrhystridium* sp., core 1, Q32.

One can conclude that there is very good evidence for a late Albian to earliest Cenomanian age for sidewall core 1 at depth 2325.5 m from the Qarun 2-1 borehole containing the elaterate - *Afropollis* association. This assemblage corresponds to the one described from Zone III in the Umbarka IX borehole (Saad, 1978) and also with that of Sultan (1978) described from the Tahrir - 1 borehole and attributed to the Albian. The Cenomanian assemblage zone described from the Alamein area in the Egyptian Western Desert (Urban *et al.*, 1976) contains the same marker species in the present study which enabled these deposits to be assigned to the middle / late Albian - earliest Cenomanian. This assemblage is also equivalent to those described by Sultan and Ali (1986) and Sultan (1987) from the same area and attributed to the middle Albian / earliest Cenomanian age. The assemblage described from the present sample is also equivalent to that described from zones V, VI established in the Nile Delta (El Beialy *et al.*, 1990) and with the PS2 palynofloral unit of Aptian - Albian - ? Cenomanian reported from the North Western Desert of Egypt (Omran *et al.*, 1990). A similarity also exists between the present one and that described from northeast Libya (Thusu & Van der Eem, 1985; Batten & Uwins, 1985; Uwins & Batten, 1988). It can also be correlated with the palynomorph assemblage described from central and northern Sudan within Zone B of Kaska (1989) and the elaterate - *Afropollis* - *Cretacaeiporites* association of Schrank (1990) which is dated as Albian - Cenomanian. Although ASA guide forms such as *A. jardinus, E. klaszi* have not been found in the late Albian - earliest Cenomanian of the Ammonite - 1 well, Western Desert of Egypt (Schrank, 1987) and within the Omdurman palynoflora in the Khartoum area, Sudan (Schrank and Awad, 1990) there is no doubt that these can be correlated palynologically with the assemblage described from core 1 of the Qarun 2-1 borehole. Also the palynological characteristics of this sample are closely comparable to those illustrated by Lawal and Moullade (1986) described from the *A. jardinus* Assemblage Subzone Ia in Nigeria, of late Albian to earliest Cenomanian age.

Palynofacies and Paleoenvironments:

The palynological residue of core 1 is overwhelmingly dominated by abundant and degraded vitrinite, common exinite / cutinite and rare inertinite.

The assemblage from this unit can be assigned to the Middle Cretaceous African - South American (ASA) microfloristic province of Herngreen & Chlonova (1981).

Sidewall core 2

A sidewall core from depth 2418 m has yielded two miospores, namely *Cyathidites* and an inaperturate pollen. There is therefore insufficient fossil evidence to enable dating of this sample.

Kerogen consists mainly of rare inertinite, exinite / cutinite and amorphous material.

Sidewall core 3

An age cannot be assigned to core 3 of depth 2556 m because of its poor fossil content.

The kerogen content is represented by rare to common inertinite, rare exinite / cutinite and rare? amorphous material.

Sidewall core 4

A sidewall core from depth 2827.5 m contains the following miospores: *Cyathidites* spp. (A), *Araucariacites australis* Cookson (A), *D. harrisii* Couper (C), *Stellatopoilis* spp. (C), *Cicatricosisporites* sp. (R), *Matonisporites* sp. (R), *C. australis Couper* (R), *Callialasporites* sp. (R), *Chomotriletes minor* (Kedves) Pocock (R), *Auritulinaesporites deltaformis*- Burger (R), *C. dampieri* (Balme) Sukh Dev (R), *Inaperturopollenites* spp. (R), *Rouseisporites reticulatus* Pocock (R), *Foraminisporis wonthaggiensis* (Cookson & Dettmann) (R), *Cingulatipollenites aegyptiaca* Saad & Ghazaly (R), *I. limbatus Balme (R), Reyrea polymorphus* Herngreen (R), *Ephedripites* sp. (R), *Impardecispora apiverrucata* (Couper) Venkatachala *et. al* (R), *Cycadopites* sp. (R), *Balmeisporites holodictyus* Cookson & Dettmann (R), *Perinopollenites elatoides* Couper (R), *Todisporites major* Couper (R), *Murospora* cf. *florida* Balme (R).

Biostratigraphical discussion

A middle / early Albian - ? Aptian age is suggested for this sample by the occurrence of *R. polymorphus*. This form was described from the late Aptian to possibly early / middle Albian strata (Herngreen, 1973; Regali *et al.*, 1974; Thusu and Van der Eem, 1985; Uwins and Batten, 1988). Although it occurred in the Aptian, it is most typically encountered in middle / early Albian assemblages (Reyre, 1966; Herngreen, 1981; Lawal and Moullade, 1986; Sultan, 1987; El Shamma and Arafa, 1988). The rich, diverse, nonmarine assemblage recovered from this sample is dominated by *Cyathidites* spp. and *A. australis* and is further characterised by significant numbers of the distinctive form *Stellatopollis* spp. recorded from Barremian and younger deposits.

Kerogen content

The palynological residue of this sample is dominated by abundant / common degraded brown wood (vitrinite), common exinite / cutinite and common black wood (inertinite). The presence of woody material indicates nonmarine deposits. This was confirmed by the presence of common exinite which points to increased terrigenous supply represented only by spores and pollen (Habib, 1982).

Organic thermal maturity

Palynomorph colours favour the presence of immature organic matter which has no source potential for hydrocarbons. This may be close to the immature / mature transition corresponding to approximate vitrinite reflectance (Ro) of 0.3-0.5%.

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