

MIDDLE-UPPER DEVONIAN AND LOWER CARBONIFEROUS MIOSPORE ASSEMBLAGES FROM WESTERN DESERT OF EGYPT

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Key Words: Devonian and Carboniferous Miospores from Egypt, Palynology.

ABSTRACT

Important morphological features of some spore assemblages from Middle-Upper Devonian and Lower Carboniferous of Western Desert of Egypt are described. Comparing the present assemblages with those obtained from other countries, there are differences among Libyan, Algerian, Saudi Arabian and the Egyptian spore assemblages. This might be due to different environmental conditions prevailed in these locations. Close similarities are recorded between South Ireland assemblages and the present one.

INTRODUCTION

Carboniferous miospore assemblages have attracted some attention in Egypt. Saad (1965) has described several species of miospores of Upper Carboniferous from Um Bogma district, south western Sinai. In the same district, Omara & Schultz (1965) reported spore assemblage related to lower Carboniferous. Sultan (1977) also recorded Carboniferous miospores from a black shales unit in the Gulf of Suez, Egypt. However no miospores have previously been reported from the Egyptian Devonian.

The present study deals with spore analysis of assemblages probably related to Devonian and Lower Carboniferous period taken from the Western Desert of Egypt. Another objective of this study is to compare microfossil assemblages recorded from the Egyptian sediments with similar assemblages described from North Africa, Saudi Arabia, Europe and Western Australia.

LOCALITY AND MATERIALS

The miospore assemblages described were obtained from some selected samples of the well Kohla-2, Western Desert of Egypt, located at Lat. 29° 44' 6.06" and Long. 25° 39' 10.84". N. 171.386,23 M.E 569.669, 31 m (Fig. 1).

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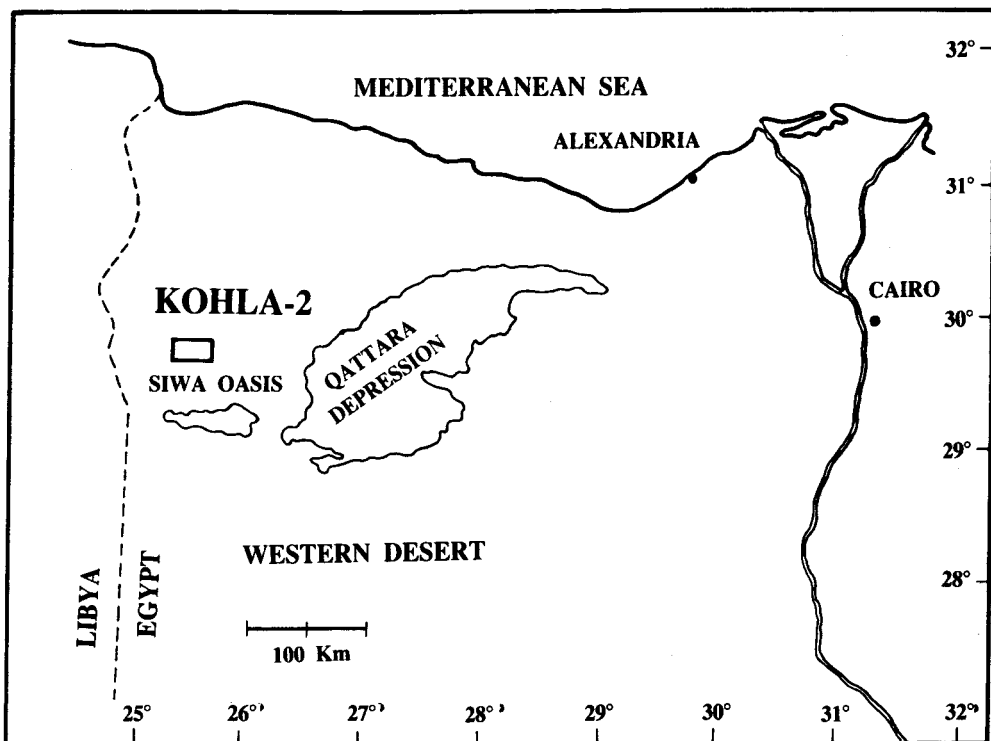


Figure 1. Location map of Kohla - 2 well.

TECHNIQUE

The samples were first treated with 10% HCL to remove carbonate and digested in 50% hydrofluoric acid to remove silicates. The residue was then treated with 10% HCL to dissolve silicon oxide. A few drops of 70% HNO₃ were added to oxidize the organic compounds. Next, 10% KOH was added to the residue. The organic matter was separated from the inorganic residue by floating the material in a heavy liquid solution of zinc chloride with a specific gravity of 2.00. The material was then mounted in glycerine jelly. For each sample, 2 slides were microscopically studied, with a Leitz Dialux 20 microscope.

RESULTS

Morphographic criteria in the present taxonomy are those recognized by Potonie and Kremp (1954).

Terms used in the description of exine structure and ornament are, in the main, taken from the glossaries provided by Potonié and Kremp (1955) or Couper (1958, p. 102).

Abteilung Triletes (Reinsch) Potonié and Kremp 1954.

Genus *Punctatisporites* (Ibrahim) Potonie and Kremp 1954

Punctatisporites planus Hacquebard (Fig. 2, 1).

Trilete spore, amb subcircular. Trilete mark straight distinct and extend to 1/2 to 2/3 radius of spore. Surface of the exine is finely punctate and bears minute granae.

Size range: 45-60 μm , mean 50 μm (10 specimens measured).

Occurrence : All depths).

Punctatisporites Type A (Fig. 2, 2)

Trilete spore, amb subcircular to rounded-triangular. Trilete mark distinct, straight to sinuous, and extend to $\frac{3}{4}$ radius of spore. Surface of the exine is finely punctate and bears minute granae.

Size range : 55-75 μm , mean 66 μm (10 specimens measured).

Occurrence : 3103, 2875 and 2585 m.

Genus *Retusortiletes* (Naumova) Streel 1964

Retusortiletes cf. *triangulatus* (Streel) Streel (Fig. 2, 3)

Description. Trilete spore, amb rounded triangular. Trilete mark straight, extending 2/3 of spore radius, slightly gaping terminating in curvature. Exine laevigate to finely granulate. The exine between the angles of the trilete mark is slightly dark.

Size range: 45-65 μm , mean 60 μm (6 specimens measured)

Occurrence : 2875, 2585 m.

Comment : This species is similar to *R. triangulatus* (Streel) Streel described by Keegan (1977) from the late Devonian of Southwest Ireland.

curvaturae perfectae. Exine \pm laevigate at the margin other-wise coarsely granulate. The borders of contact areas are surrounded by dark thick triangles. Darkness decreases towards the center.

Size range: 66-100 μ m, mean 75 μ m (5 specimens measured)

Occurrence: 3103, 2875, 2585 m.

Comment: This species is \pm similar to *Retusotriletes* sp. 1 described by Hemer & Nygreen (1967) from Devonian rocks of Saudi Arabia.

Genus *Apiculiretusispora* Streel 1964.

Apiculiretusispora Type A (Fig. 2,8)

Description : Trilete spore, amb rounded triangular Trilete mark straight, extending to 3/4 radius of spore. The trilete mark terminate in curvaturae. Exine laevigate and folded at contact areas. Remainder of exine bearing dense minute spinules

Size range: 35-60 μ m, mean 45 (8 specimens measured)

Occurrence: 3103, 2875 m.

Comment: This type is similar to *A. granulata* Owen, described from Middle and Upper Devonian of W. Libya (Massa and Moreau-Benoit 1976).

Genus *Acanthoriletes* (Naumova) Potonie & Kremp 1954.

Acanthotriletes parvus (Fig. 2,9)

Description : Trilete spore, amb rounded-triangular. Trilete mark distinct, extending up to two-thirds of spore radius. Ornament of fine tapering spinae.

Size : 25-40 μ m, mean 35 μ m (7 specimens measured)

Occurrence: All depths except 2103 m.

Acanthotriletes Type A cf. *echinatus* (Knox) Potonié & Kremp (Fig. 2, 10).

Amb. circular, laesurae indistinct. Ornament with close-packed tapering spinae. Exine occasionally folding.

Size range: 25-45 μ m, mean 38 μ m (7 specimens measured)

Occurrence: 3103, 2875, 2585 m.

Comment: Similar specimens were described from Upper Devonian of Western Australia (Balme and Hassell 1962).

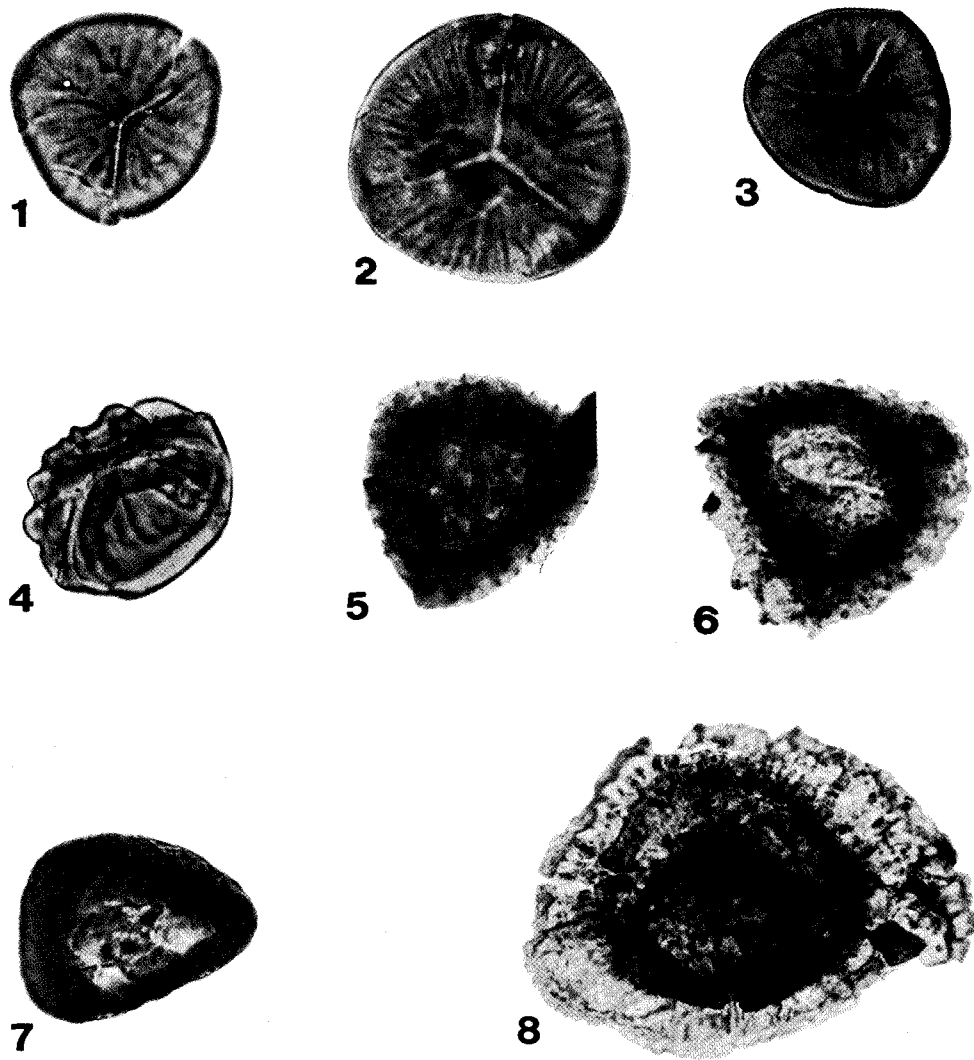


Figure 3.

All Figs. $\times 700$

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| 1. <i>Emphanisporites</i> cf. <i>E. sp. no. 2514</i> Lanzoni and Magloire. | 6. <i>Densosporites</i> Type B |
| 2. <i>Emphanisporites</i> cf. <i>E. radiatus</i> Schultz. | 7. <i>Densosporites</i> Type C |
| 3, 4. <i>Emphanisporites</i> Type A. | 8. <i>Vallatisporites</i> Type A |
| 5. <i>Densosporites</i> Type A | |

Genus *Verrucosisporites* (Ibrahim) Potonié & Kremp, 1954.

Verrucosisporites nitidus (Naumova) Playform (Fig. 2, 11)

Description : Trilete spore, amb subcircular to rounded Margin is underlate to irregular lobate, Trilete mark extend to the border of the spore. Exine predominantly verrucate, folds are absent.

Size range : 35-70 um, mean 50 um (7 specimens measured)

Occurrence: 2103 m.

Comment : This species is recorded in several Lower Carboniferous assemblages such as in Western Algeria (Lanzoni and Magloire 1969) and in Southwest Ireland (Keegan 1977).

Genus *Convolutispora* Hoffmeister, Staplin & Malloy 1955

Convolutispora vermiformis Hughes and Playford (Fig. 2, 12)

Description: Trilete spore, amb rounded. Trilete mark indistinct. Proximal and distal surfaces ornamented with closely spaced regulae and verrucae. Regular partly anastome forming wavy ridges.

Size range: 35-55 um, mean 46 (5 specimens measured)

Occurrence: 3103 m.

Comment: This species was recorded from Upper devonian and Lower Carboniferous of Ireland described by Higgs (1975).

Genus *Emphanisporites* Mc Gregor 1961

Emphanisporites rotatus Mc Gregor (Fig. 2, 13)

Description: Trilete spore, amb subtriangular. Trilete mark straight, extending to 3/4 spore radius. Radial ribs are numerous and fairly thick.

Size range: 40-60 um, mean 50 um (5 specimens measured)

Occurrence: 3255 m.

Comment: Similar to *E. rotatus* described from Devonian of Saudi Arabia (Hemer & Nygreen, 1967), Western Libya (Massa and Moreau-Benoit 1976), and Roumanie (Beju, 1967).

Emphanisporites cf. *E.* sp. no. 2514 Lanzoni and Magloire 1969 (Fi. 3, 1).

Description: Trilete spore, amb subtriangular. Trilete mark straight, extending to 3/4 spore radius. Radial ribs are fairly thick. They are arising from both sides of the trilete mark, and reach the equator.

Size range: 30-50 μm , mean 40 μm (5 specimens measured).

Occurrence: 3255 m.

Comment: Similar specimens were described from Upper Devonian of Algeria.

Emphanisporites cf. *radiatus* Schultz (Fig. 3, 2).

Description: Trilete spore, amb subtriangular. Trilete mark straight, extending to 3/4 spore radius. Radial ribs numerous and fine.

Size range: 35-65 μm , mean 50 μm (7 specimens measured)

Occurrence: 3355 m.

Comment: It is characterized by having many fine ribs similar to *Emphanisporites* sp. from Lower Devonian described by Richardson (1966), and *Emphanisporites* sp. 1 from Devonian of Romania by Beju, (1967).

Emphanisporites Type A (Fig. 3, 3 and 4).

Description: Trilete spore, amb subtriangular. Trilete mark straight, extending to 3/4 spore radius. Radial ribs few and thick.

Size range: 30-45 μm . mean 40 μm (5 specimens measured)

Occurrence: 3255 m.

Comment: This species differs from *E. radiatus* by having fewer and thicker. It is similar to *E. spinaeformis* schultz described from Middle Devonian of Western Libya. (Massa and Moreau-Benoit 1976).

Genus *Densosporites* (Berry) Butterworth, Jansonius, Smith and Staplin 1964.

Densosporites Type A (Fig. 3, 5)

Trilete spore, amb convexly triangular. Trilete mark indistinct. Cingulum thick, opaque, and slightly thin at outer margin. Central body coarsely granulate. Equatorial region with spinae. There is thin layer between the cingulum and the central body.

Size range: 40-75 μm , mean 65 μm (12 specimens measured)

Occurrence: 2103 m

Comment: This type is similar to *D.* sp. No. 3225, described by Lanzoni and Magloire (1969) from Lower Carboniferous of Algeria. It also shows similarity to *D.*

spitsbergensis Playford, described by Higgs (1975) from Lower Carboniferous of Ireland and by Keegan (1977) from Upper Devonian and Lower Carboniferous of Southwest Ireland.

Densosporites Type B (Fig. 3, 6)

Trilete spore, emb convexly triangular. Trilete mark indistinct. Cingulum thick, slightly opaque, translucent and irregular at equator, central body finely granulate. There is no distinct layer between the cingulum and the central body.

Size range: 35-70 μm , mean 60 μm (9 specimens measured)

Occurrence: 2103 m

Densosporites Type C (Fig. 3, 7)

Trilete spore, amb subtriangular with rounded apices. Trilete mark indistinct. Cingulum varies in thickness, smooth. Central body laevigate, occasionally folded.

Size range: 35-55 μm , mean 45 μm (10 specimens measured)

Occurrence: 2103 m.

Genus *Vallatisporites* Hacquebard, 1957.

Vallatisporites Type A (Fig. 3, 8)

Description: Trilete spore, amb triangular, with rounded apices and a serrate margin. Trilete mark extending to spore margin. Exoexine extended equatorially to form a cingulum. The cingulum is internally vacuolate, consisting of chambers separated by thin ribs. The margin of the cingulum bears spinules. The central body of the spore is coarsely granulate.

Size range: 60-80 μm , mean 70 μm (5 specimens measured)

Occurrence: 2103 m.

Comment: Similar to *V.* sp. no. 3324 described from Lower carboniferous of Western Algeria.

Genus *Hymenozonotriletes* (Naumova) Potonié. 1958.

Hymenozonotriletes Type A (Fig. 4, 1).

Description: Trilete spore, amb subcircular to rounded triangular. Trilete mark sinuous, extending to the margin of the spore. The central body is rounded and darker than the zone. Spore ornamented with dense minute conical and rare spines.

Size range: 80-120 μm , mean 100 μm (5 specimens measured)

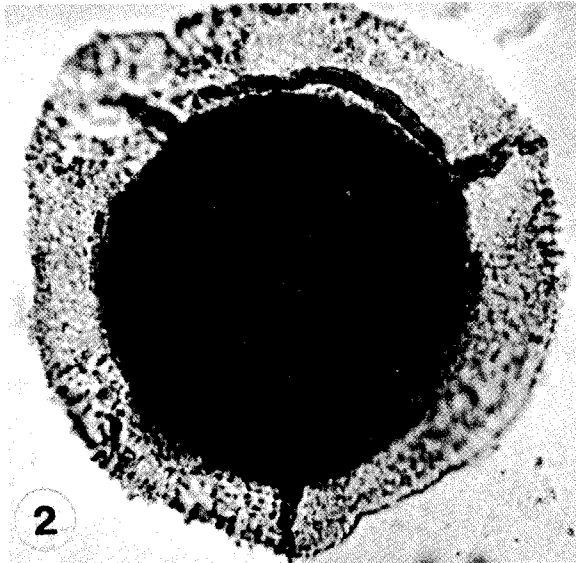


Figure 4. 1. *Hymenozonotriletes* Type A (x 700)
2. *Hymenozonotriletes* Type B (x 500)

Occurrence: 3103, 2875, 2585 and 2103 m.

Comment: Similar to *H. sp. no. 2972*, described from Upper Devonian and Lower Carboniferous of Algeria.

Hymenozonotriletes Type B (Fig. 4, 2)

Description: Trilete spore, amb subrounded. Trilete mark sinuous, extending to the margin of the spore. Central body subrounded, light in color. Spore ornamented with small conic spines.

Size range: 140, 150 & 160 μm , mean 150 μm (3 specimens measured)

Occurrence: 3355 m.

The microfloral assemblages recovered from the successive samples procured from the Kohla-2 well drilled in Western Desert of Egypt, differ in qualities as well as in quantities of the spores. The results of spore analysis of the productive samples are represented graphically in Fig. 5. The results outline three successive zones:

Zone I (Lower Zone)

This Zone comprises samples at the depths 3350 and 3250 meters. The sporomorphs of this zone are dated as Middle Devonian. The characteristic spores of this zone are:

Retusotriletes Type A, *Emphanisporites rotatus* McGregor, *E. radiatus* Schultz, *E. type A* and *Hymenozonotriletes* Type B. *Emphanisporites* species are restricted to this zone. They are encountered in low percentage (ca. 5%).

Zone II (Middle Zone)

This Zone comprises samples at depths 3103, 2875 and 2585 meters. The sporomorphs of this zone are dated as upper Devonian. The characteristic spores of this zone are, *Apiculiretusispora sp.*, *Hymenozonotriletes* species with small pollen, and *Convolutispora*.

Zone III (Upper Zone)

This zone comprises one sample at depth 2100 m. The sporomorphs of this zone are dated as Lower Carboniferous. The characteristic spores are: *Vallatisporites*, *Denesosporites* and *Verrucosporites*.

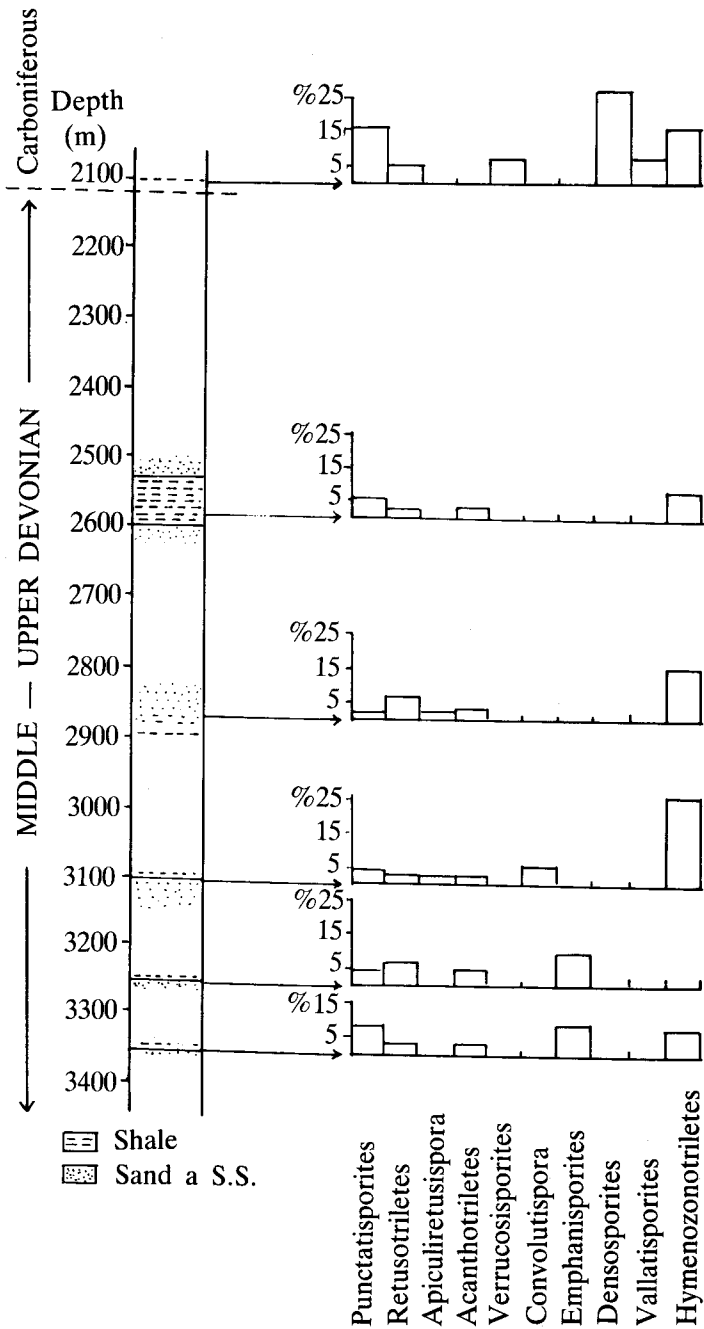


Figure 5. Miospores frequencies in selected samples from Kohla Well - 2, Western Desert, Egypt.

DISCUSSION

The palynological assemblages recovered from this well suggest three distinct successive zones:

Zone I (Lower Zone)

The sporomorphs of this Zone are dated as Middle Devonian. *Emphanisporites* species are recorded only in this zone. The stratigraphic ranges of *Emphanisporites* species in the present study are similar to those recorded from Middle Devonian of other countries. *Emphanisporites rotatus* recorded in the present sediments is also recorded in strata related to the Middle and Upper Devonian of Saudi Arabia (Hemer & Nygreen 1967) and Libya (Massa & Moreau-Benoit 1976). *Emphanisporites* type A is similar to *E. spiniformis* Schultz described from Middle Devonian of Libya. Another similarity to the Middle Devonian of Libya is the presence of *Retusotriletes* Type A that is similar to *R. biarealis* described from the Libyan assemblages. The *Hymenozonotriletes* species described from this zone are larger than those encountered in the other zones. Predominance of large *Hymenozonotriletes* is also recorded from beds dated as Middle Devonian (Naumova 1953, Kedo 1955, Chibrikova 1959, Mc Gregor 1960, Richardson 1962, 1965 and Allen 1965).

Zone II (Middle Zone)

A probable upper Devonian age for this middle zone is based on the disappearance of the *Emphanisporites* and appearance of *Apiculiretusispora* sp, that is similar to *A. granulata* described from Middle and upper Devonian of Western Libya (Massa & Moreau-Benoit 1976). Several *Retusotriletes* species in this zone are similar to others, encountered in upper Devonian of different countries eg. *R. planus* from upper Devonian of Libya (Massa & Moreau-Benoit (1976), and *R. sp. A. Higgs* described by Keegan (1977) from upper Devonian and lower Carboniferous of southwest Ireland.

Palynological correlation with upper Devonian of West Australia described by Balme & Hassel (1962) indicates the presence of similar *Retusotriletes* and *Hymenozonotriletes* species in both sediments.

The *Hymenozonotriletes* species encountered in this zone is smaller in size compared to that found in the lower zone. It is similar to *H. sp. no. 2972* described by Lanzoni & Magloire (1969) from the Algerian Sahara.

The assemblages of this zone exhibit some similarities to those described from southwest Ireland by Keegan (1977). Both include common genera with similar species such as *Apiculiretusispora*, *Hymenozonotriletes*, *Punctatisporites* and *Convolutispora*.

The present assemblages differ from those of the Devonian section encountered in boreholes from North Saudi Arabia, Western Libya and Western Algeria in the absence of forms with bifurcating spines such as species of *Ancyrospora* and *Hystricosporites*. The presence of *Ancyrospora* in the Arabian section may indicate swampy conditions of this area (Humer & Nygreen 1967). Similar *Ancyrospora* species were described by Richardson 1960, 1962 from the Middle Devonian of Scotland. Richardson (1965) postulated a fresh water affinity of the genus *Ancyrospora*.

It seems probable that the present assemblages are deposited under dry conditions because of the absence of *Ancyrosporites* and *Hystrichosporites* that have water affinities.

The differences between the spore assemblages of Libya, Algeria and Arabia and those from the Devonian of the Egyptian Western Desert may be ascribed to differences in the environmental conditions under which these sediments were deposited. Naumova (1953) in his work on Russian sediments suggested considerable floral mobility during the Middle and Upper Devonian. Trends similar to those in Russia are apparent in North Africa, where the Middle-Upper Devonian appears to be a time marked by drastic changes in plant distributions.

Zone III (Upper Zone)

The spore assemblages of this zone are most probably related to Lower Carboniferous rather than Upper Devonian. This assumption is based on the appearance of certain spore indicators such as *Vallatisporites* type A, *Densosporites* types A-C and *Verrucosisporites nitidus*. Other species such as *Apiculiretusispora* sp., and large species of *Hymenozonotriletes* are absent from this zone. The Lower Carboniferous assemblages described by Keegan (1977) from Galley Head-Southwest Ireland are similar to those found in this zone in the present study. Both assemblages contain *Verrucosisporites nitidus*, *Punctatisporites planus*, and similar species of *Densosporites*, *Vallatisporites* and *Retusortiletes*. Both assemblages are lacking distinctive large forms such as *Ancyrospora* spp. and *Hystricosporites* spp. However the present assemblage differs in the absence of *Raistrickia*, *Baculatisporites*, *Dictyotriletes* and *Spelaeotriletes*.

Clayton *et al* (1977) recorded miospore assemblages from the lower part of the Cork beds of southern Ireland, related to upper Devonian and Lower Carboniferous. Their assemblages are similar to those recorded in the present study, in containing the typical zonal indicators and in lacking the distinctive large forms such as *Ancyrospora* spp. and *Hystricosporites*. Miospore assemblages recorded from Lower Carbonifer-

ous of southeast, Ireland, (Higgs, 1975 and Clayton *et al* 1980) show some (resemblance) to the present one, but differ in the presence of distinctive large forms such as *Ancycospora* spp. and *Hystricosporites* spp. which are lacking here.

The sporomorphs of this zone show close relationship to those of the Lower Carboniferous assemblages of Western Algeria. Both contain similar species of the genera *Verrucosisporites*, *Densosporites*, and *Vallatisporites*. However, the present assemblages differ from the Algerian one in the absence of *Diatomozonotriletes* and *Radiizonates*.

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أبواغ من العصر الديفوني (المتوسط والعلوي)
والعصر الكربوبي السفلي بالصحراء الغربية بمصر
جمال الغزالي و شعبان علي

باستخدام الميكروسكوب الضوئي تم وصف بعض الأبواغ الهامة التي استخلصت من عينات تربة مأخوذة على أعماق مختلفة من بئر حفر في الصحراء الغربية المصرية . وتنتمي هذه الأبواغ إلى كل من العصر الديفوني المتوسط والعلوي والعصر الكربوني السفلي .
وقورنت الأبواغ التي درست بمثيلات لها ووصفت في أقطار أخرى مثل ليبيا والجزائر والمملكة العربية السعودية وأيرلنده وروسيا .