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FORAMINIFERA AND AGE OF THE ARAEJ FORMATION IN THE DUKHAN OIL FIELD, WESTERN QATAR ARABIAN GULF

By

ABD ELGALIL HEWAIDY and HAMAD AL SAAD
Faculty of Science, University of Qatar, Doha, Qatar

محتوى الفورامنيفرا ومناقشة عمر تكوين العريج في حقل بترول دخان ـ غرب قطر

عبد الجليل عبد الحميد هويدى و حمد عبد الرحمن آل سعد

ينقسم تكوين عريج إلى ثلاثة أعضاء هي عضو عريج السفلي وعضو العوينات وعضو عريج العلوى . أسفرت دراسة هذا التكوين عن تعريف ٣٧ نوعاً من الفورامنيفرا من بينها ٢٩ نوعاً تتبع تحت الرتبة الرملية الجدار والمعرفة بـ Textularina . استعملت هذه المجموعة الحفرية في تقسيم تكوين عريج إلى خمس نطاقات حيوية . الثلاثة نطاقات السفلى منها وهي نطاق Ammodiscus Orbis ويقع في النصف السفلي من عضو عريج السفلي ، نطاق Pfenderina Trochoidae ويشمل النصف العلوي من عضو عريج السفلي بالاضافة إلى الجزء السفلي من عضو العوينات ، نطاق Trocholina Intermedia في الجزء العلوي لعضو العوينات . هذه النطاقات الثلاث تتبع الباثوني . بينما يشمل عضو عريج العلوي عضوين ، العضو السفلي منهما ويشمل الجزء السفلي من هذا العضو وهو نطاق خالي من أي فورامنيفرا أما الجزء العلوي فيشمل نطاق Kurnubia Jurassica ولهذا يعتبر عضو العريج العلوي تابعاً للكالوفي . ويبدو أن توزيع جنس Pfenderina في صخور الجوراسي الاوسط في منطقة الشرق الاوسط يحكمه إلى حد كبير نوعية الرواسب المصاحبة له حيث يتطلب وجوده رواسب جيرية نقية ضحلة كما لوحظ أن هذا الجنس لا يتواجد مطلقاً مع عناصر تحت رتبة Lagenina في صخور الجوراسي الاوسط في منطقة الشرق الاوسط .

Key Words: Foraminifera, Age, Jurassic, Araej Formation, Dukhan field, West Qatar.

ABSTRACT

The detailed examination of the three members of the Araej Formation (lower Araej, Uwainat and upper Araej) in four wells, in the Dukhan Field, led to the identification of 36 foraminiferal species. Of these, 29 species belong to the arenaceous Suborder Textulariina. This fauna enable to subdivide the Araej Formation into five zones. The lower three zones are: the *Ammodiscus orbis* Zone in the lower half of the lower Araej member, the *Pfenderina trochoidea* Zone in the upper half of the lower Araej Member and the lower part of the Uwainat Member and the *Trocholina intermedia* Zone in the upper part of the Uwainat Member. These zones are of Bathonian age. The upper Araej Member includes a lower barren interval and an upper *Kurnubia jurassica* Zone. The upper Araej Member is considered to be of Callovian age. The distribution of the genus *Pfenderina* is largely controlled by sedimentary facies. It seems that members of the Suborder Lagenina never occur with *Pfenderina* in Middle Jurassic sediments of the Middle East. A correlation between the established zones and their equivalents in the surrounding regions is attempted.

INTRODUCTION

The Dukhan field is the only major oil field in onshore Qatar which is located on the western side of the Qatar Peninsula (Fig. 1). The Middle Jurassic, in Dukhan Field, is represented by the Izhara and Araej formations. The Araej formation comprises one of the main oil producing horizons in the Dukhan Field. The middle carbonate part, the Uwainat Member, includes the major hydrocarbon accumulations within the Araej Formation.

Publications on the Araej Formation especially on its faunal content are scarce. (Smout & Sugden, 1961) used mainly the foraminifera collected from the boreholes of the Araej Formation of Qatar to introduce their new Family Pfenderinidae and identify the new species *Pfenderina trochoidea*. (Sugden &

Standring, 1975) mentioned a list of fossils of which only nine species of foraminifera were recorded, in addition to a number of simple arenaceous foraminifera, in the Uwainat Member, which had not been determined specifically. They correlated the Araej Formation in Qatar with the middle and upper Dhruma Formation and assigned the Araej Formation to the Bathonian/ Callovian. Based on the studies of (Imlay, 1970), they put the boundary between the Bathonian and Callovian at the boundary between the lower Araej and the Uwainat members. The faunal content and age of the Dhruma Formation of Saudi Arabia, which is partly equivalent to the Araej Formation of Qatar, were studied by Redmond, (1964, 1965), Powers *et al* (1966); and Powers, (1968).

The Araej Formation is characterized by cyclic shallow carbonate deposits which include three members: lower Araej, Uwainat and upper Araej. The lithofacies and depositional setting of these members were studied in detail by Al-Saad *et al.* (in prep).

This paper is the first detailed study of the foraminiferal faunas of the Araej Formation and their biostratigraphic importance. 95 core samples from 4 wells in the Dukhan oil field were selected as representatives of the different lithofacies of the Araej Formation (Fig. 1). A representative of each sample, in addition to thin sections, was prepared for the micropaleontological study.

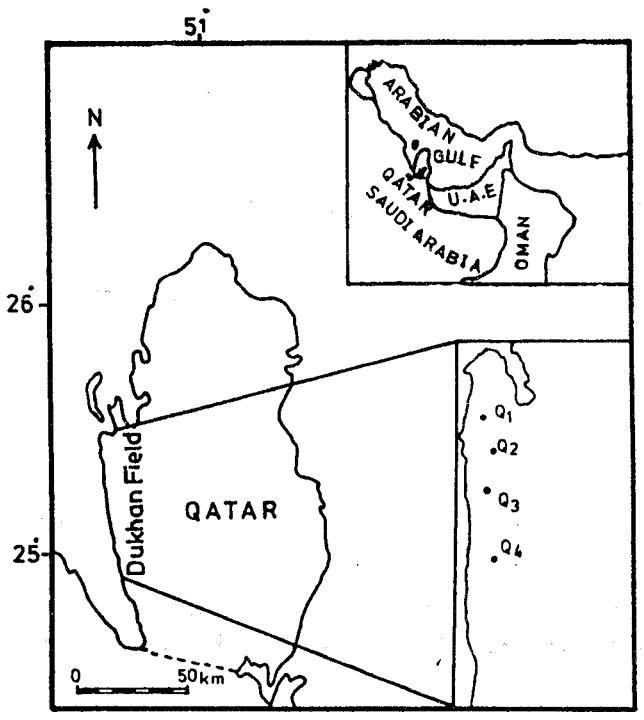

Fig. 1: Location map of Dukhan Oil Field, West Qatar.

Faunal content:

In the study area, thirty-six species of foraminifera were identified in the Araej Formation. These microfaunas are restricted to some horizons of the formation and are always rare except in some samples of the Uwainat Member.

According to the classification of Loeblich and Tappan (1988), 28 species of the identified fauna belong to the Suborder Textulariina (Delage & Herouard, 1896), 4 species to the Suborder Involutinina (Hohenegger & Piller, 1977), 3 species to the Suborder Miliolina (Delage & Herouard, 1896) and one species to the Suborder Robertinina (Loeblich & Tappan, 1984) (Table 1).

The thirty-seven species identified in the Araej Formation are placed into 16 genera (Table 1). A brief description of the more diverse and the stratigraphically important genera is given below:

Genus *Riyadhella* Redmond, 1965:

The genus *Riyadhella* was introduced by Redmond, (1965) from the Bathonian/Callovian middle and upper Dhruma Formation in Saudi Arabia. He identified 8 new species of this genus. These species were distinguished mainly by the size of the test, the number of the chambers per whorl and the general shape of the chamber. The genus *Riyadhella* is recorded out side of Saudi Arabia only in West India (in Loeblich & Tappan, 1988). In Qatar, six species of this genus are recorded in the Uwainat Member (pl. 1) whereas rare occurrences are recorded in the upper and lower Araej members (Fig. 2).

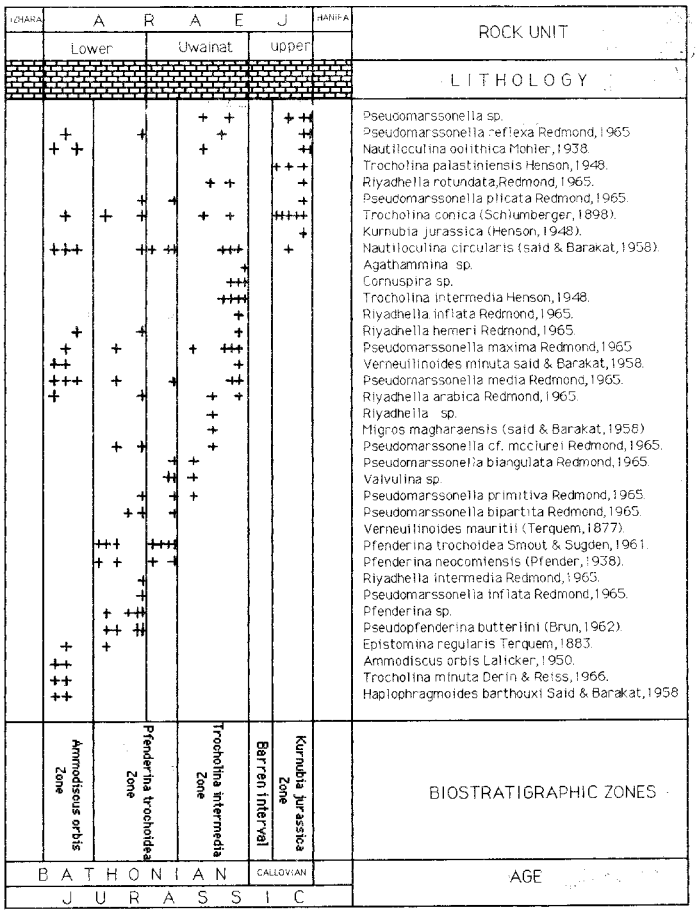

Fig. 2: Distribution chart of the identified foraminifera in the Araej Formation. (Not to scale).

Genus *Pseudomarssonella* Redmond, 1965

The *Pseudomarssonella* was first recorded by Redmond (1965) from the Bathonian/Callovian middle and upper Dhruma Formation in Saudi Arabia. The *Pseudomarssonella* Redmond

(1965) differs from the very similar genus *Marssonalla* Cushman, 1933 in having a cribrate aperture in place of a simple opening along the inner margin of the apertural face. This genus is recorded, in this study, for the first time in Qatar. Sugden & Standring, (1975) list a number of simple arenaceous fossils, in the Uwainat Member, which may include representatives of this genus. The elements of this genus in the Araej Formation are generally poorly preserved, but it was possible to distinguish 10 species of which 9 species were previously named by (Redmond, 1965), whereas one species is different from any described *Pseudomarssonella* species (pl. 3).

The main occurrence of the representatives of this genus is in the Uwainat Member, but it is rarely recorded in the lower and upper members (Fig. 2). In this study, a Bathonian/Callovian age is suggested for the representatives of this genus.

Genus *Pfenderina* Henson, 1948:

The genus *Pfenderina* was first named by Henson, (1948) with *Eorupertia neocomiensis* Pfender as its genotype. This genus is distinguished from any other genus of the subfamily Pfenderininae Smout & Sugden, (1962) by the absence of the subepidermal partitions.

In the beginning, it was classified in the family Trochamminidae. In 1961, Smount and Sugden studied in detail the genus *Pfenderina* and redescribed it based on isolated specimens for the first time. They also added their new species *Pfenderina trochoidea*. They erected the family Prfenderinidae Smount & Sugden, (1961) which includes *Pfenderina* and *Kurnubia*. They denonted that *Pfenderina* is recorded from the Berriasian/Valanginian in Europe, while it is recorded from older horizons, Bathonian, in the Middle East. Loeblich & Tappan, (1964)

Table 1

The foraminiferal species of the Araej Formation arranged according to their systematic position in the classification of the Loeblich & Tappan, (1988).

Suborder	Superfamily	Family	Subfamily	Genus	Species
Textulariina (Delage and Herouard 1896)	*Ammodiscacea* (Resus, 1862)	*Ammodiscidae* (Reuss, 1962)	*Ammodiscinae* (Reuss, 1862)	*Ammodiscus* (Lalicker, 1950)	*A. orbis*
	Lituolacea (de Blainville, 1827)	*Haplohragmoididae* (Maync, 1952)	—	*Haplophragmoides* (Cushman, 1910)	*H. barthouxi* (Said & Barakat, 1958)
		Nautiloculinidae (Loeblich & Tappan, 1985)	—	*Nautiloculina* (Mohler, 1938)	*N. circularis* (Said & Barakat, 1958)
					N. oolithica (Mohler, 1938)
	Verneuilinacea (Cushman, 1911)	*Prolixoplectidae* (Loeblich & Tappan, 1985)	—	*Riyadhella* (Redmond, 1965)	*R. arabica* (Redmond, 1965)
					R. hemeri (Redmond, 1965)
					R. inflata (Redmond, 1965)
					R. intermedia (Redmond, 1965)
					R. rotundata (Redmond, 1965)
					R. sp.
		Verneuilinidae (Cushman, 1911)	*Verneuilinoidinae* (Suleymanov, 1973)	*Verneuilinoides* (Loeblich & Tappan, 1985)	*V. minuta* (Said & Barakat, 1958)
					V. mauritti (Terquem, 1877)
	Ataxophragmiacea (Schwager, 1877)	*Pfenderinidae* (Smout & Sugden, 1962)	*Pfenderininae* (Smount & Sugden, 1962)	*Pfenderina* (Henson, 1948)	*Pf. neocomiensis* (Pfender, 1938)
					Pf. trochoidea (Smount & Sugden, 1961)
					Pf. sp.
				Pseudopfenderina (Hottinger, 1967)	*Ps. butterlini* (Brun, 1962)

Contd. Table 1

The foraminiferal species of the Araej Formation arranged according to their systematic position in the classification of the Loeblich & Tappan, (1988)

Suborder	Superfamily	Family	Subfamily	Genus	Species
Textulariina (Delage & Herouard 1896)	*Ataxophragmiacea* (Schwager, 1877)	*Pfenderinidae* (Smout & Sugden, 1962)	*Kurnubiinae* (Redmond, 1964)	*Kurnubia* (Henson, 1948)	*K. jurassica* (Henson, 1948)
	Textulariacea (Ehrenberg, 1838)	*Eggerellidae* (Cushman, 1937)	*Minouxiinae* (Redmond, 1965)	*Pseudomarssonella* (Redmond, 1965)	*P. biangulata* (Redmond, 1965)
					P. bipartita (Redmond, 1965)
					P. inflata (Redmond, 1965)
					P. maxima (Redmond, 1965)
					P. mcclurei (Redmond, 1965)
					P. media (Redmond, 1965)
					P. plicata (Redmond, 1965)
					P. primitiva (Redmond, 1965)
					P. reflexa (Redmond, 1965)
					P. sp.
		Pseudogaudryinidae (Loeblich & Tappan, 1985)	*Pseudogaudryininae* (Loeblich & Tappan, 1985)	*Migros* (Finlay, 1939)	*M. magharaensis* (Said & Barakat, 1958)
		Valvulinidae (Berthelin, 1880)	—	*Valvulina* (D'orbigny, 1826)	*V. sp.*
Involutinina (Hohenegger & Piller 1977)		*Involutinidae* (Butschli, 1880)	*Involutininae* (Butschli, 1880)	*Trocholina* (Paalzow, 1922)	*T. conica* (Schlumberger, 1898)
				T. intermedia	(Henson, 1948)
Involutinina (Honenegger & Piller 1977)	—	*Involutinidae* (Butschli, 1880)	*Involutininae* (Butschli, 1880)	*Trocholina* (Paalzow, 1922)	*T. minut* (Derin & Reiss, 1966)
				T. palastiniensis	(Henson, 1948)
Miliolina (Delage & Herouard 1896)	*Cornuspiracea* (Schultze, 1854)	*Cornuspiridae* (Schultze, 1854)	*Cornuspirinae* (Schultze, 1854)	*Cornuspira* (Schultze, 1854)	*C. sp.* (Schultze, 1854)
	Hemigordiopsidae	*Hemigordiopsinae* (Nikitina, 1969)	*Agathammina* (Nikitina, 1969)	*Ag. sp.* (Neumayer, 1887)	
Robertinina (Loeblich & Tappan 1984)	*Ceratobuliminacea* (Cushman, 1927)	*Ceratobuliminidae* (Cushman, 1927)	*Epistomininae* (Wedekind, 1937)	*Epistomina* (Terguem, 1883)	*E. regularis* (Terquem, 1883)

considered them as a subfamily, Pfenderininae Smount & Sugden, (1961), belonging to the family Pavonitinidae Loeblich & Tappan, (1961). Redmond, (1964) investigated a well-preserved material from Saudi Arabia and concluded that interior labyrinthic passages in the family Pfenderinidae Smount & Sugden, (1961), are outside rather than inside of the chamber cavities. He identified two new species of which *P. inflata* Redmond is the oldest known occurrence of this genus as it is recorded in Bajocian, lower Dhruma, sediments.

The distribution of the genus *Pfenderina* is largely restricted to clean, shallow marine limestone (Smount & Sugden, 1961). A relationship is also observed between *Pfenderina* and the occurrence of representatives of the Suborder Lagenina (Delage & Herouard, 1896). These relations can be illustrated with a comparison between East Arabia and North Egypt. In East Arabia, the Bathonian fauna are rich in *Pfenderina* while representatives of the Suborder Lagenina are completely absent. In contrast to North Egypt, where the Bathonian faunas are rich in representatives of the Suborder Lagenina as *Nodosaria, Dentalina* and *Lenticulina* while *Pfenderina* is completely absent. The other elements of the faunal assemblages are generally similar in both areas.

Genus *Kurnubia* Henson, 1948:

The genus *Kurnubia* was first identified by Henson, (1947) from the Jurassic limestone in the core of the Kurnub anticline in Palestine from where he also introduced *Kurnubia palastiniensis* at its genotype. *Valvulinella jurassica* Henson, (1948) was included in this genus by Smount & Sugden, (1961; Loeblich and Tappan, (1964). The genus *Kurnubia* ranges from the Oxfordian to the Valanginian (Smount & Sugden, 1961). Redmond, (1964) recorded *Kurnubia variabilis* in Callovian sediments in Arabia which is the oldest known representative of the genus *Kurnubia.*

In Egypt, the *Kurnubia* in general and *Kurnubia jurassica* in particular are recorded in Callovian sediments (Osman & Hassanein, 1961; Hassan *et al* 1978; Abd El Shafy, 1984 & Abd El Shafy *et al.* 1990). In the studied sequence, the genus *Kurnubia* is represented only by the *Kurnubia jurassica* Henson, (1948) which is recorded in the upper part of the upper Araej member of Callovian age (Fig. 2).

Genus *Trocholina* Paalzow, 1922:

The genus *Trocholina* is widely distributed in the Jurassic sediments of the Middle East. Sugden & Standring, (1975) recorded *Trocholina palastiniensis* Henson, (1948) in the Araej Formation of Qatar. In the present study, the genus *Trocholina* is represented by four species (Table 1). These are: *Trocholina palastiniensis* Henson, (1948) restricted to the upper Araej member, *Trocholina intermedia* (Henson, 1948) limited to the upper part of the Uwainat Member, *Trocholina minuta* Derin & Reiss, (1966) recorded in the lower part of lower Araej member while *Trocholina conica* Schlumberger, (1898) occurs in all the Araej members (Fig. 2).

BIOSTRATIGRAPHY

The identified foraminiferal faunas are used to subdivide the Araej Formation in the study area into five biostratigraphic zones. The lower three zones belong to the Bathonian while the uppermost one and the underlying barren interval belong to the Callovian. A brief description of these zones, from base to top, is given below:

1. Ammodiscus orbis Zone

In the studied sections, this zone is represented by nearly the lower half of the lower Araej Member, (Fig. 2). It includes the part of the Araej Formation below the first appearance of the genus *Pfenderina* and is composed of grey to dark pyritic wackestone/packstone facies with foraminifera in some horizons. Thirteen foraminiferal species were recorded in this zone, of which 10 species belong to the Textulariina, 2 species belong to the Involutinina and one species belongs to the Robertinina.

Amodiscus orbis (Lalicker, 1950) is selected as index for this zone since it is also used by many authors in the northern Egypt as a zonal marker (Hassan *et al* 1978; Hassanein, 1970; Abd El Shafy, 1981; Abd El Shafy, 1984). According to these authors, *Ammodiscus orbis* is a guide form for the lower part of the Egyptian Bathonian. Furthermore, this zone is equivalent to the *Pseudomarssonella mcclurei* and *Dhrumella evoluta* zones of early Bathonian age in Saudi Arabia (Powers, 1968, Fig. 3). In the studied area, the *Ammodiscus orbis* Zone is considered to be of early Bathonian age.

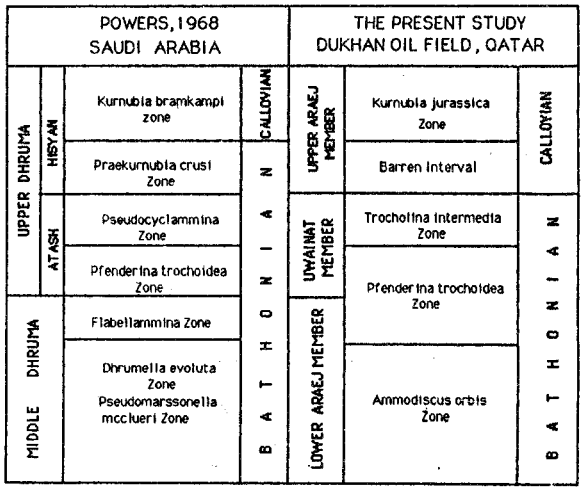

Fig. 3: Correlation between the Bathonian/Callovian foraminiferal zones in the Dukhan Field and its equivalents in Saudi Arabia.

2. Pfenderina trochoidea Zone

This zone represents the upper half of the lower Araej Member and the basal part of the Uwainat member (Fig. 2). It corresponds to the total range of the genus *Pfenderina.* It is composed in its lower part by grey laminated shaly packstone which gradually changes upward to grey olive grainstone with increased faunal content. Twenty foraminiferal species were recorded, of which 18 species belong to the Textulariina, one species belongs to the Involutinina and one species belongs to the Miliolina. The *Pfenderina* Zone is a very characteristic horizon in the Middle East region from where many records of species of the genus *Pfenderina* were reported (Hudson, 1954; Smount & Sugden, 1961; James & Wynd, 1965; Powers *et al,* 1966; Powers, 1968 & Sampo, 1969).

Smount & Sugden, (1961) and Powers, (1968) considered the *Pfenderina trochoidea* Zone to be of Bathonian age. The genus

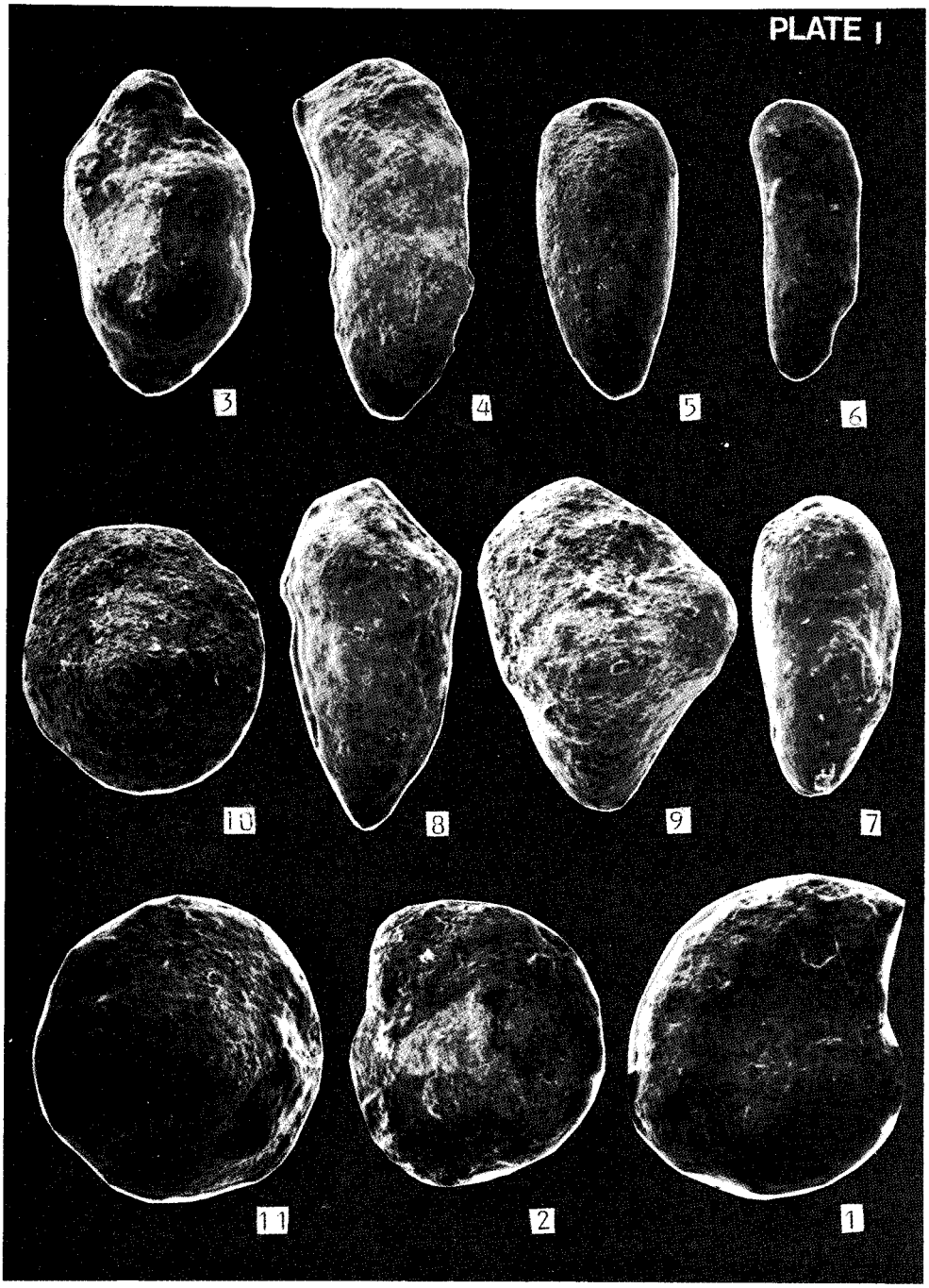

PLATE 1

Fig. 1: *Haplophragmoides barthouxi* Said & Barakat, Lower part of the Lower Araej Member, × 50. Fig. 2: *Nautiloculina circularis* (Said & Barakat), Lower Uwainat Member, × 50. Fig. 3: *Riyadhella inflata* Redmond, Lower Uwainat Member, × 75. Fig. 4: *Riyadhella intermedia* Redmond, Lower Uwainat Member, × 100. Fig. 5: *Riyadhella arabica* Redmond, Upper part of the Lower Araej Member, × 100. Fig. 6: *Riyadhella hemeri* Redmond, Upper part of the Lower Araej Member, × 100. Fig. 7: *Riyadhella sp.*, Middle Uwainat Member, × 100. Fig. 8: *Riyadhella rotundata* Redmond. Upper part of the Upper Araej Member, × 100. Fig. 9: *Verneuilinoides minuta* Said & Barakat, Lower part of the Lower Araej Member, × 100. Fig. 10: *Trocholina intermedia* Henson, Upper Uwainat Member, × 50. Fig. 11: *Trocholina conica* (Schlumberger), Middle part of the Upper Araej Member, × 50.

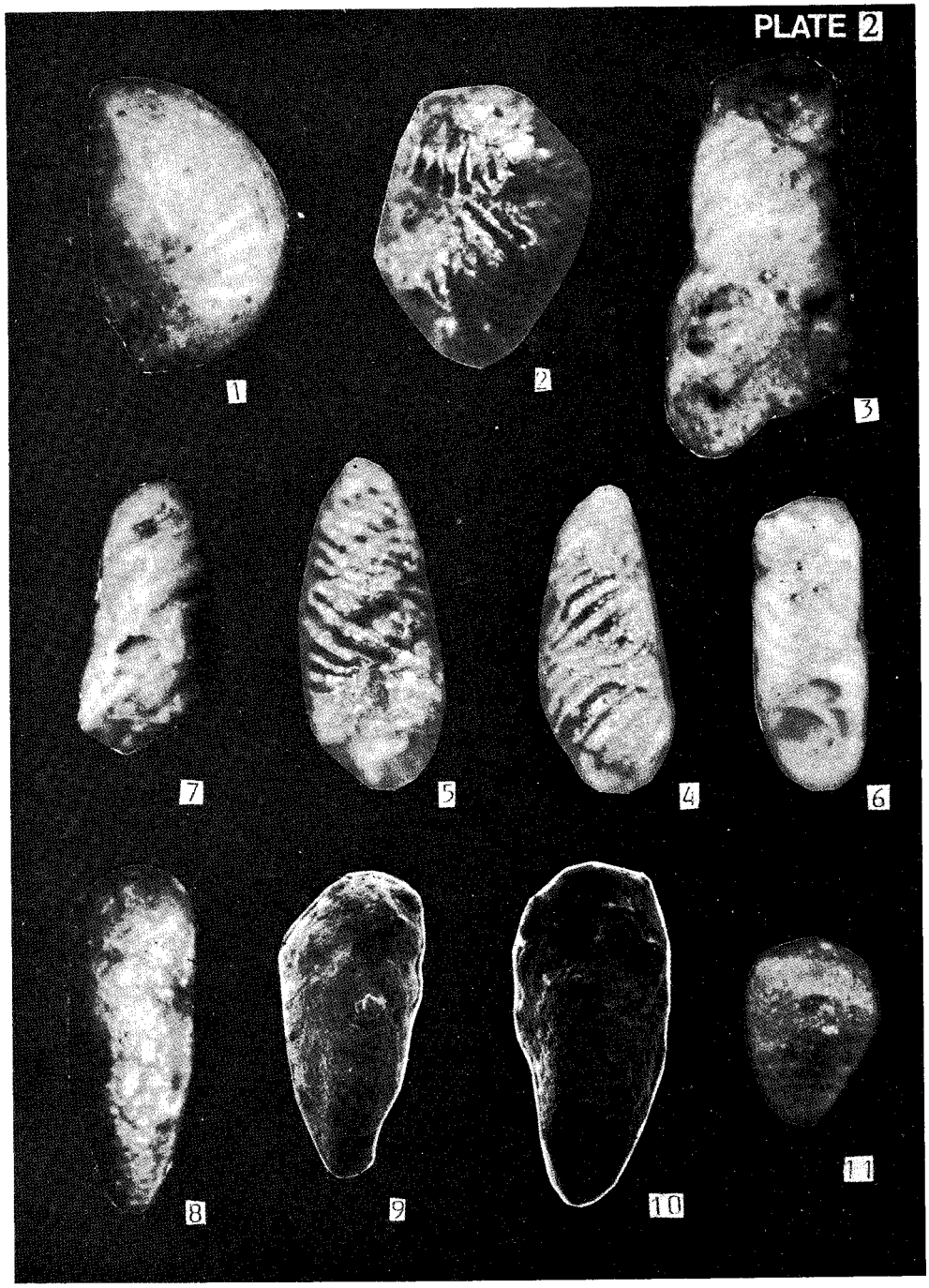

PLATE 2

Fig. 1 & 2: *Pfenderina trochoidea* Smount & Sugden, Lower Uwainat Member, × 40. Fig. 3, 4 & 5: *Pfenderina neocomiensis* (Pfender), Upper part of the Lower Araej Member, 3. × 40; 4 & 5. × 25. Fig. 6: *Pfenderina sp.*, Middle part of the Lower Araej Member, × 40. Fig. 7: *Pseudopfenderina butterlini* Brun, Middle part of the Lower Araej Member, × 40. Fig. 8: *Kurnubia jurassica* (Henson), Upper part of the Upper Araej Member, × 50. Fig. 9: *Migros magharaensis* (Said & Barakat), Upper Uwainat Member, × 75. Fig. 10: *Valvulina sp.*, Middle Uwainat Member, × 75. Fig. 11. *Riyadhella rotundata* Redmond. Upper Uwainat Member, × 40.

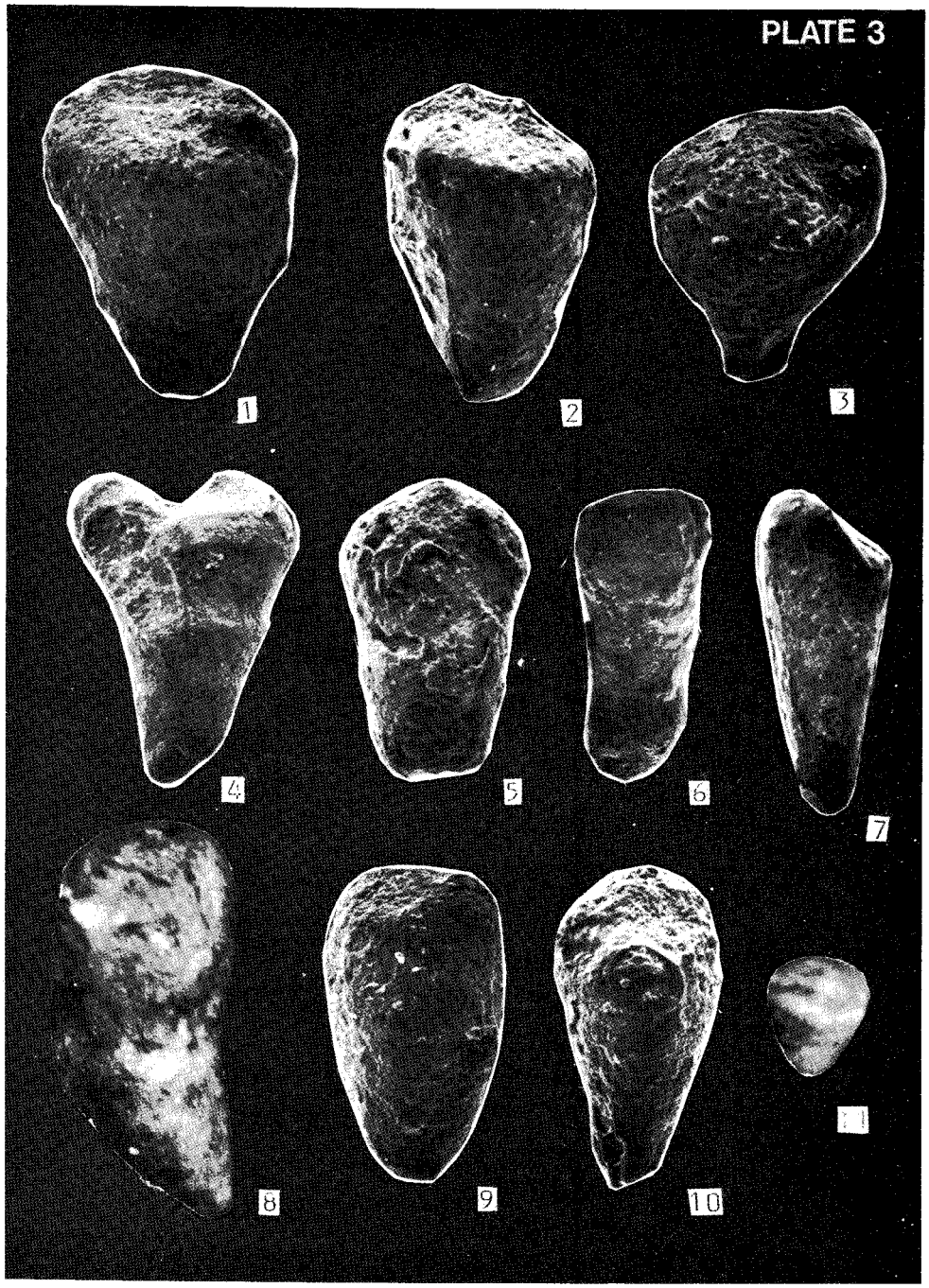

PLATE 3

Fig. 1 & 2: *Pseudomarssonella maxima* Redmond, Middle Uwainat Member, × 75. Fig. 3: *Pseudomarssonella inflata* Redmond, Upper part of the Lower Araej Member, × 75. Fig. 4: *Pseudomarssonella bipartita* Redmond, Middle Uwainat Member, × 75. Fig. 5: *Pseudomarssonella sp.* Upper part of the Upper Araej Member, × 75. Fig. 6: *Pseudomarssonella primitiva* Redmond, Middle Uwainat Member, × 75. Fig. 7: *Pseudomarssonella cf. mcclurei* Redmond, Upper part of the Lower Araej Member, × 75. Fig. 8: *Pseudomarssonella reflexa* Redmond, Upper part of the Upper Araej Member, × 100. Fig. 9: *Pseudomarssonella biangulata* Redmond. Lower Uwainat Member, × 75. Fig. 10: *Pseudomarssonella plicata* Redmond, Middle Uwainat Member, × 75. Fig. 11: *Pseudomarssonella media* Redmond. Lower part of the Lower Araej Member, × 40.

PLATE 4

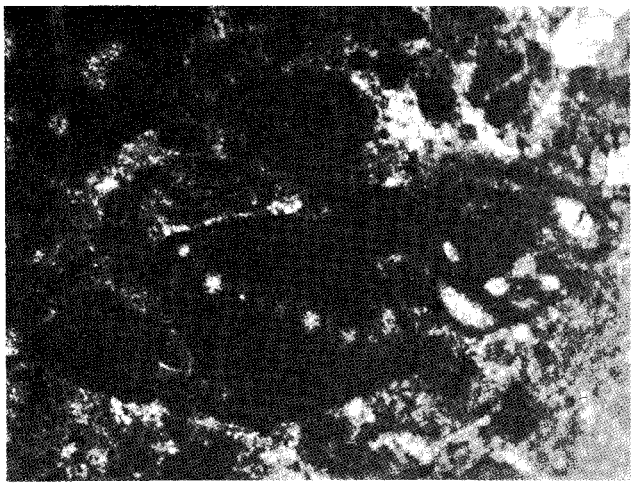

FIG.1

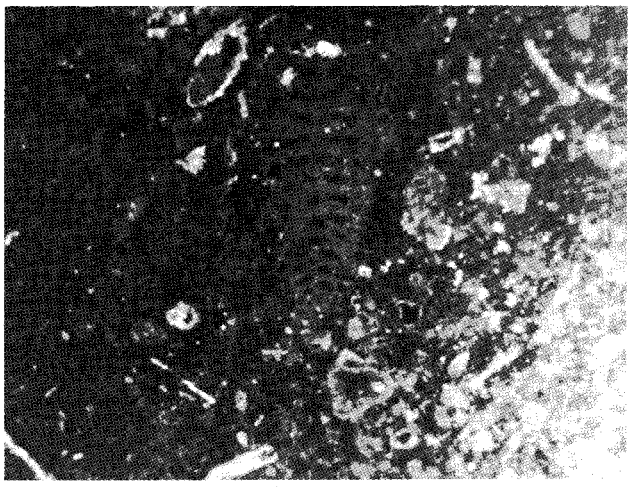

FIG.4

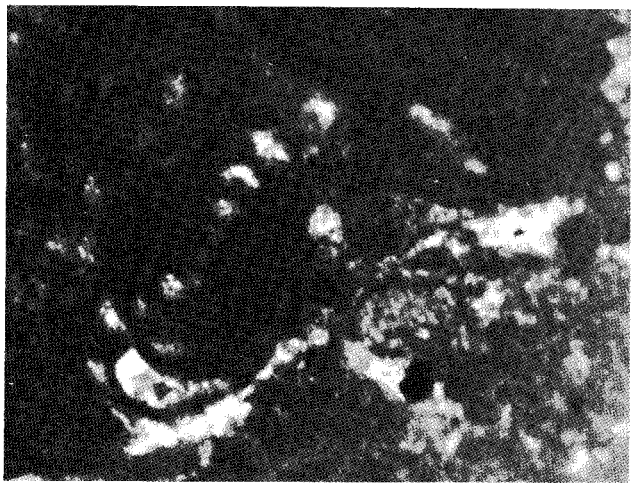

FIG.2

FIG.5

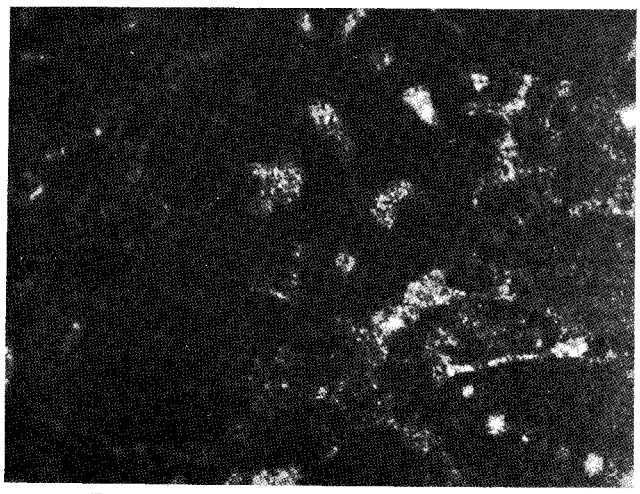

FIG.3

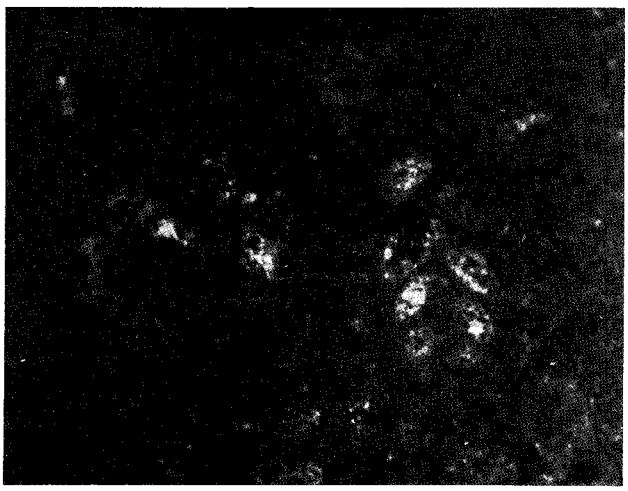

FIG.6

PLATE 4

Fig. 1, 2 & 3: *Nautiloculina oolithica* Mohler, Q1, Upper Araej Member, × 25. Fig. 4: *Riyadhella sp.* Q4, Uwainat Member, × 25. Fig. 5 & 6: *Valvulinidae,* Q4, Uwainat Member, × 25.

PLATE 5

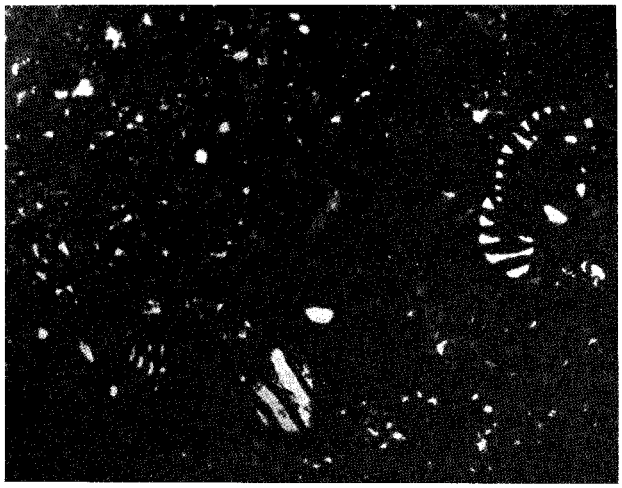

FIG.1

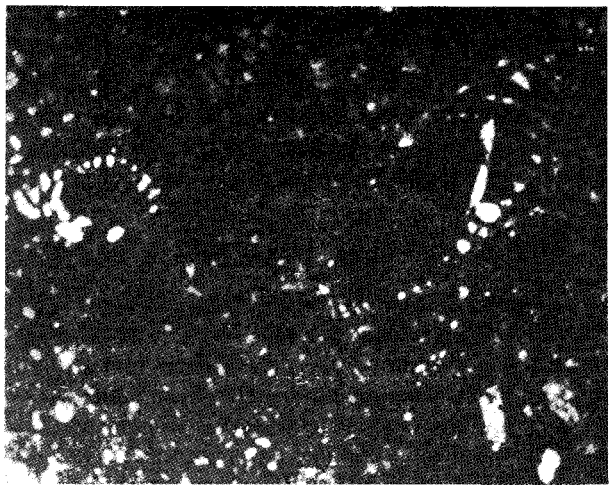

FIG.4

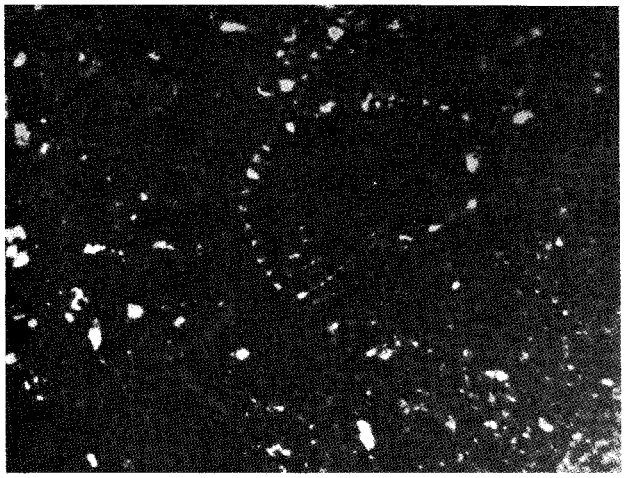

FIG.2

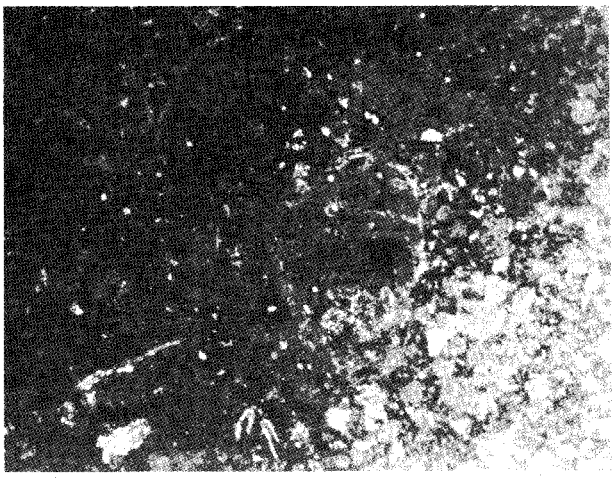

FIG.5

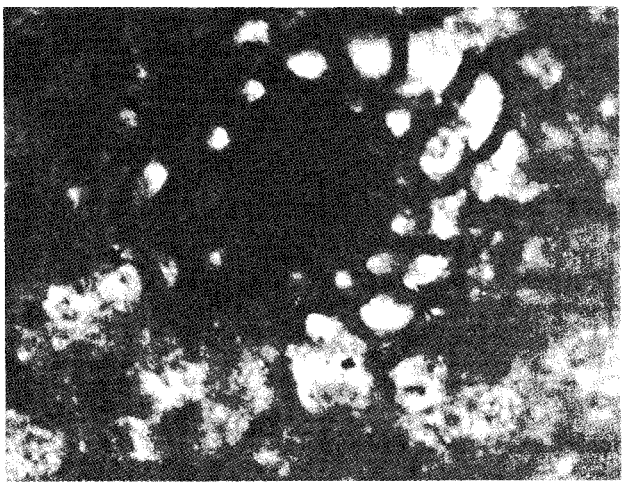

FIG.3

FIG.6

PLATE 5

Fig. 1: *Pseudopfenderina butterlini* Brun., Q1, Upper part of the Lower Araej Member, × 25. Fig. 2 & 3: *Pfenderina trochoidea* Smout & Sugden, Fig.: 2. Q4, Lower part of the Uwainat, × 25; Fig. 3: Q1, Middle part of the Lower Araej Member, × 100. Fig. 4: *Pfenderina neocomiensis* (Pfender), Q3, Lower part of the Uwainat Member, × 25. Fig. 5 & 6: *Pseudomarssonella sp.* Q4, Middle part of the Uwainat Member, × 25.

PLATE 6

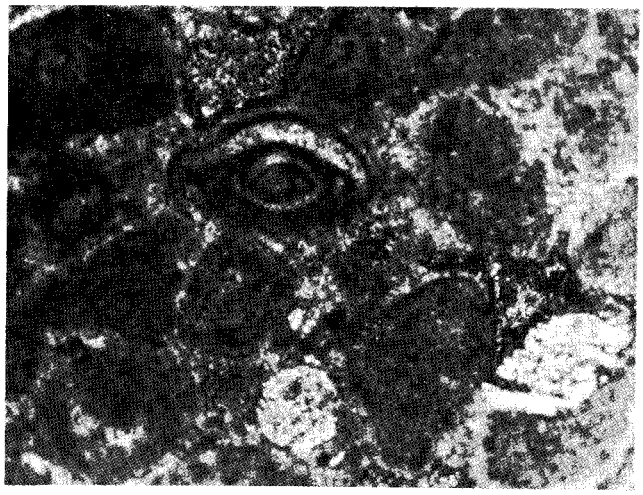

FIG.1

FIG.3

FIG.2

FIG.4

PLATE 6

Fig. 1: *Agathammina sp.* Q4, Uwainat Member, × 25. Fig. 2: *Trocholina conica* (Schlumberger), Q4, Upper Araej Member, × 100. Fig. 3: *Trocholina minuta* Derin & Reiss, Q1, Lower Araej Member, × 25. Fig. 4: *Trocholina palastiniensis* Hensen, Q1, Upper Araej Member, × 25.

Pfenderina was not recorded neither in the surface Middle Jurassic of the Sinai nor in the subsurface in other parts of Egypt. The *Pfenderina trochoidea* zone is equivalent to *Pfenderina trochoidea* and *Flabellammina* Zones of Bathonian age in Saudi Arabia (Powers, 1968). In the study area, this zone is considered to be of middle Bathonian age.

3. Trocholina intermedia Zone

In the study area, this zone characterizes the upper part of the Uwainat Member (Fig. 2). This zone is associated with a light grey wackestone/packstone facies with thin intercalations package of grainstone. It is marked by a rich and diverse foraminiferal fauna represented by 20 species, of which 16 belongs to the Textulariina, 2 to the Involutinina and 2 to the Miliolina. In the study area, the *Trocholina intermedia* Zone is considered to be of late Bathonian age. This zone is equivalent to the late Bathonian *Pseudocyclammina* Zone of Powers, (1968) in Saudi Arabia (Fig. 3).

4. Kurnubia jurassica Zone

This zone coincides with the upper part of the upper Araej Member, and is associated with a dark grey, pyritic, argillaceous wackestone/packstone facies. In the study area, it is represented by the total range of the zonal marker. This interval is generally poor in foraminifera as only 9 species were recorded of which 7 belong to the Suborder Textulariina and 2 to the Suborder Involutinina (Fig. 2; Table 1).

In the study area, *Kurnubia jurassica* Henson, (1948) is the only and rather rare species of the genus *Kurnubia* which is rarely recorded. *Kurnubia jurassica* Henson, (1948) is widely distributed in the Callovian of the Middle East, (Henson, 1948; Powers *et al* 1966; Powers, 1968; Sampo, 1969; Abd El Shafy, 1984 & Abd El Shafy *et al* 1990). It is chosen here as a zonal marker. This zone is equivalent to the *Kurnubia bramkampi* Zone of Powers, (1968) in Saudi Arabia. The *Kurnubia jurassica* Zone is of early Callovian age. It is underlain by a barren interval including the lower part of the upper Araej Member which is probably equivalent to the *Praekurnubia crusi* Zone of Powers, (1968). However, it is attributed here to the early Callovian (Fig. 3).

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